TRUCK FREIGHT EXISTING CONDITIONS

Technical Memorandum

May 2007

Columbia River CROSSING

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ACRONYMS

AADT	Annual Average Daily Traffic
BIA	Bridge Influence Area
CRC	Columbia River Crossing
EIS	Environmental Impact Statement
E_T	Passenger Car Equivalent of a Truck
FHWA	Federal Highway Administration
FWG	Freight Working Group
I-5	Interstate 5
I-205	Interstate 205
ODOT	Oregon State Department of Transportation
MP	Milepost
Mph	miles per hour
MVM	Million vehicle miles
SR	State Route
USDOT	United States Department of Transportation
VMT	Vehicle miles traveled
WSDOT	Washington State Department of Transportation

1. Executive Summary

1.1 The Columbia River Crossing Project

The Columbia River Crossing (CRC) project is aimed at improving the mobility, reliability, and accessibility for automobile, freight, transit, bicycle, and pedestrian users of the Bridge Influence Area (BIA) —a five-mile segment of I-5 between State Route (SR) 500 in Washington and Columbia Boulevard in Oregon. Through an inclusive, collaborative process, this project will deliver a financially feasible solution that strengthens the regional economy and strives to enhance community livability. The CRC project involves environmental impact studies of the BIA, selection of a preferred alternative for addressing the problems, and public involvement.

The purpose of this Technical Memorandum is to evaluate existing truck operating conditions and mobility issues in the BIA so that Interstate 5 (I-5) can be designed to meet the important economic need for truck mobility.

1.2 The Role of Interstate 5 and the Economy

I-5 across the Columbia River is critical to national and international freight flow. I-5 serves direct international land connections to Mexico and Canada, and carries over ten million tons of freight to and from California.[1] All freight flow—national, west coast, and regional—is dependent on the daily function of I-5 within the BIA.

The rapid increase in freight, particularly truck volumes, is well recognized by the Oregon and Washington transportation plans. Oregon and Washington combined have a $350 billion economy and an export value of $45 billion per year. The five most freight-intensive industry sectors sensitive to transportation along the Portland-Vancouver highway and rail corridors are wood and paper products, transportation equipment and steel, farm and food products, high technology, and distribution and wholesale trade. These industries account for approximately 70 percent of the commodity tonnage crossing the Columbia River via I-5 and Interstate 205 (I-205) on large trucks. There are 28.2 million tons of freight moving across these bridges, with the five most transportation-sensitive industries contributing 20.6 million tons of that freight[2].

Trucks carry 67 percent of all freight in the region, and this is expected to grow to 73 percent by 2030. The market for commodities is sensitive to transport time and shipping cost. Rail is more

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[1] USDOT, FHWA, Office of Management and Operations, Freight Analysis Framework. http://ops.fhwa.dot.gov/freight/freight_analysis/state_info/state_flow.htm

[2] *Regional Economic Effects of the I-5 Corridor/Columbia River Crossing Transportation Choke Points,* prepared for Oregon Department of Transportation by Cambridge Systematics, Inc. in association with David Evans and Associates, Inc., April 2003.

cost effective for large tonnage, but it cannot meet delivery schedule requirements for many commodities. The majority of the region's freight movement is by truck.

1.3 Characteristics of Truck Movement

The operating characteristics of heavy trucks consume approximately twice the highway capacity of a passenger car. In addition, oversize loads occur regularly in the BIA. Data and analysis of truck volumes for the CRC use truck classifications grouped as volumes of medium and heavy trucks. Medium and heavy trucks have multiple axles and a tractor-trailer configuration. Trucks are bigger and heavier than passenger vehicles and, therefore, are slower to accelerate, require longer stopping distances, and have larger turning radii than a passenger vehicle. Ramp grades, length of grade, and super-elevation are key concerns for truck drivers.

1.4 Existing Truck Traffic

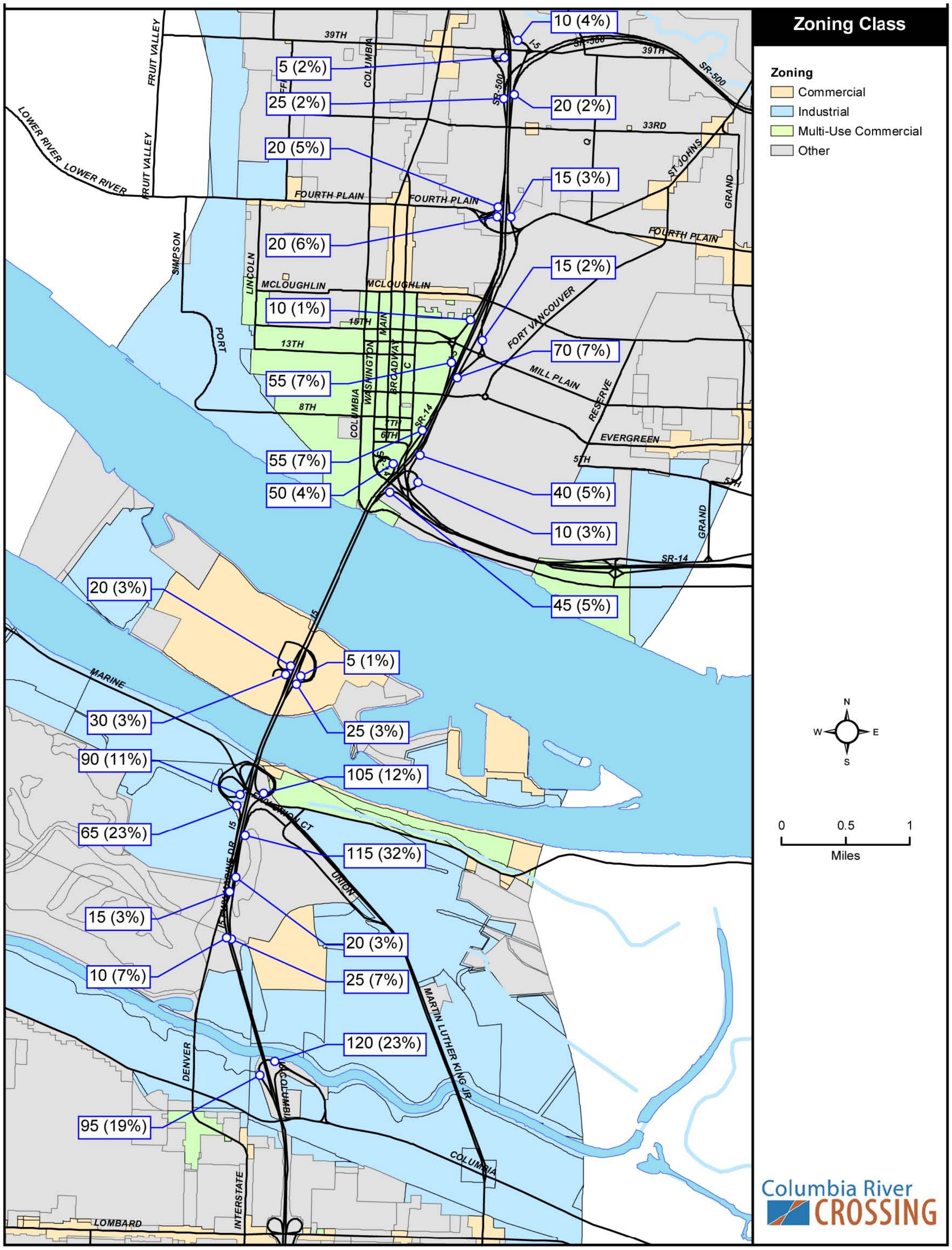
In the Portland-Vancouver region, I-5 carries long-distance freight from Mexico and California to Canada. Approximately 52 percent of the long-distance trips that pass through (and do not originate in) the Portland-Vancouver urban area are without a destination in the BIA.[3] The remaining 48 percent begin or have a destination within the Portland-Vancouver region.

Truck trips are produced and attracted by certain industry types. Manufacturing industries tend to produce and attract long-haul truck trips that originate over 250 miles from their destination. Manufacturers also attract and generate short-haul trips to and from the Ports of Portland and Vancouver and other local manufacturers. Wholesale industries, which distribute goods throughout the region, attract long-haul and short-haul truck trips and generate the majority of the local truck trips (fewer than 50 miles long). Retail industries are the primary attraction for local distribution truck trips generated by the wholesale industries.

The main sources of regional truck traffic are the Port of Vancouver, the Columbia Industrial Park in Washington, the Port of Portland, and adjacent industrial areas in Oregon. Industrial and commercial land uses are shown in **Figure 1-1** along with the midday truck volumes. Truck volumes are highest midday, as discussed in Section 4.0. **Figure 1-1** provides a corridor view of the relationship between truck trips and land uses that generate truck trips. The highest truck volume occurs in the vicinity of Columbia Boulevard and Marine Drive. In Washington, the important regional truck movements occur east-west from SR 14 to Mill Plain Boulevard via I-5. Key findings from the truck data follow **Figure 1-1.**

[3] *Portland Freight Data Collection Phase II, Draft Report,* Cambridge Systematics, Inc., July 18, 2006

Figure 1-1. Land Use and Truck Trips



Analysis by M. Rohden; Analysis Date: 6-Dec-2006; Plot Date: 6-Dec-2006: File Name: PBR_Fig11_2_LMU.mxd

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Key Findings

- Trucks carry 67 percent of all freight in the region, and this is expected to grow to 73 percent by 2030.
- Approximately 52 percent of trucks that originate outside the Portland-Vancouver urban area are trucks that pass through the region. Approximately 48 percent are going to or coming from a location within the Portland-Vancouver region.
- The Interstate Bridge over I-5 carries approximately 3,240 (42 percent) more trucks than I-205. More truck trips are generated by industrial and commercial land use within the BIA than along I-205 and the through trip on I-5 is shorter during uncongested conditions.
- The highest daily truck volumes on I-5 in the BIA are north of I-405 and in the vicinity of Lombard Street and Columbia Boulevard. Daily truck volumes in this area are 12 percent of all traffic. Over the I-5 bridge, daily truck volumes are 8 percent of all traffic.
- The highest hourly truck volumes occur midday from 12:00 to 1:00 P.M. More trucks move midday in order to meet delivery schedules and avoid travel during congested conditions.
- Most truck movement occurs from 9:00 A.M. to 3:00 P.M. From 35 to 45 percent of the daily truck volumes occur in these hours, depending on the segment. Truck drivers prefer to travel during uncongested conditions to minimize travel time and increase reliability.
- The highest truck volume on-ramps are: southbound at Marine Drive on-ramp and Columbia Boulevard on-ramp; and northbound at the Columbia Boulevard off-ramp and the Marine Drive on-ramp.
- The large tractor-trailer trucks, on average, travel at 29 miles per hour (mph) when merging on to the highway (for a typical 1,000-foot ramp at a three percent grade with the truck starting from a complete stop). The slow merge speed consumes highway capacity for all traffic.
- Oversize loads occur on a daily basis throughout the BIA. Oversize loads are linked to important economic activities, such as heavy equipment transport from Portland industrial areas, manufacturing in the Columbia Industrial Park, and wind turbines from the Port of Vancouver to eastern Oregon and Washington.
- Of all peak-period peak-direction traffic crossing the I-5 Bridge, 68 to 75 percent of that traffic entered I-5 within the BIA, exited I-5 within the BIA, or entered and exited I-5 within the BIA. These data demonstrate the importance of I-5 within the BIA to local/regional mobility for industry and commuters alike.

1.5 Truck Safety

Passenger vehicle drivers and truck drivers are concerned about truck safety. In the BIA, collisions involving trucks are more concentrated where the existing I-5 has deficient geometrics. At these locations, collisions involving trucks increase as truck volumes increase. On average, throughout the corridor, truck collisions occur at approximately the same rate as collisions of general purpose traffic.

- The collision rate on I-5 within the Oregon section of the BIA is 1.34 collisions per million vehicle miles (MVM) compared to the Oregon state average of 0.6 collisions per MVM on urban interstates. Narrow shoulders and short diverge and merge lengths contribute to collisions on the Oregon section, especially in the vicinity of Hayden Island.
- The collision rate on I-5 within the Washington section of the BIA is 1.23 collisions per MVM compared the Washington average of 1.38 collisions per MVM on urban interstates. The higher average urban Interstate rates on the Washington side reflects different reporting criteria and comparisons from the larger Puget Sound urban area. Also, the Washington side rates are slightly lower than the Oregon side because I-5 is a newer facility and north of SR 14 Interchange better meets design standards than the Oregon side. Weaving volumes and weave conditions contribute to collisions on the Washington section.
- Truck collisions are approximately ten percent of all collisions reported in the BIA, approximately eight percent of the traffic volume over the bridge, and 12 percent of the traffic volume in the Lombard to Columbia Boulevard vicinity.
- Additional locations with higher numbers of truck-related collisions are at the Columbia Boulevard ramps, the Victory Boulevard ramps, the Hayden Island interchange, and the northbound exit to Marine Drive.
- The SR 14 eastbound to I-5 southbound on-ramp, with its short turning radius, steep super-elevation, and uphill grade, likely contributes to the higher number of truck-related collisions at the bridge approach. Between 2000 and 2004, there were 10 collisions between mile post 0.39 and 0.30, immediately south of the SR 14 on-ramp.
- The number of truck collisions increases proportionally with the truck traffic volume and during the hours of peak congestion in each commute direction.
- The proportion of truck collisions to all collisions is greater than the proportion of truck volume to all traffic during the peak hours of both truck and commuter traffic.

1.6 Truck Mobility Issues Identified by Users

Users identified three categories of issues: physical and geometric constraints, truck trips from truck-intensive land uses, and highway access. The physical and geometric constraints are short weave distances, lack of capacity, and narrow lanes. The intensive land uses are primarily the Port of Vancouver, the Port of Portland, and adjacent industrial areas. The impediments to highway access are delays, ramp backups, closely spaced interchanges, and steep grades and super-elevations on-ramps. A detailed presentation of truck mobility issues as identified by the users is presented in Section 7.0.

1.7 Potential Actions for Improving Truck Mobility

Trucks moving freight rely on capacity and uncongested conditions to reduce travel time, improve reliability, minimize collisions, and reduce cost. The most obvious solution to increasing capacity is to increase the number of lanes on I-5 and over the Columbia River. However, given the policy and funding decisions required for this project, it is recognized that there will always be A.M. and P.M. peak periods of congestion.

The findings in this Technical Memorandum indicate that truck mobility can be improved by:

- Increasing the number of through lanes to minimize congested highway conditions.
- Improving the design of the eight interchanges in the BIA.
- Creating more efficient access to I-5 using truck bypass lanes and truck ramps.
- Improving the highway geometry to increase capacity and reduce the collision rate (e.g., lengthening ramps, reducing grades, ramp curves and super-elevation, and merge and weave distances).
- Reducing or eliminating the number of bridge lifts.
- Applying Transportation System Management to improve operational efficiency.

Trucks benefit whenever general-purpose traffic moves faster — and general-purpose traffic benefits whenever the slower speeds and operational differences of trucks and general-purpose traffic are minimized. Ramps with heavy truck traffic should be designed, where possible, to minimize grade and super-elevation. Ramps with heavy truck volumes could be designed to allow trucks to merge at speeds closer to the general-purpose traffic. Design alternatives that incorporate "truck-friendly" design will add capacity to the system, preserve the investment in mainline capacity, and improve the safety and comfort of all drivers.

2. The Columbia River Crossing Project and the Role of the Freight Community

2.1 What is the Columbia River Crossing project?

The CRC project is aimed at improving the mobility, reliability, and accessibility for automobile, freight, transit, bicycle, and pedestrian users of the five-mile segment on I-5 between SR 500 in the BIA. Through an inclusive, collaborative process, this project will deliver a financially feasible solution that strengthens the regional economy and strives to enhance community livability. The CRC project involves environmental impact studies of the BIA, selection of a preferred alternative for addressing the problems, and public involvement.

The 39-member Task Force advises the project team. The Task Force is composed of leaders from a broad cross section of the Washington and Oregon communities interested in the project, including public agencies, businesses, civic organizations, neighborhoods, freight, commuter, and environmental groups. Working Groups have been formed to address specific project issues as they arise. Groups include specialists from agency and consultant staff as well as other organizations.

2.2 What is the purpose of this memorandum?

The purpose of this *Truck Freight Existing Conditions Technical Memorandum* is to document existing truck operation conditions and mobility issues within the BIA in order to define how I-5 can be designed to meet the important economic need for truck mobility. Existing conditions data for trucks are presented in this technical memorandum in a format that supports alternatives development and evaluates the benefits to truck mobility for each alternative. This memorandum examines the characteristics of truck movement, documents existing truck traffic and truck safety, identifies truck mobility issues, and describes potential actions to improve truck mobility.

2.3 What work occurred prior to the Columbia River Crossing project?

In 1998, the Washington and Oregon Departments of Transportation formed a bi-state partnership to study transportation problems and possible solutions for the I-5 corridor from the Portland metropolitan area through southern Clark County. While this study included the CRC project area, it also encompassed a much broader stretch of the I-5 corridor.

The I-5 Transportation and Trade Partnership Task Force, a 28-member bi-state committee, began its study in January 2000. The Task Force, which included elected, business, neighborhood, and community representatives, spent January through June of 2001 working with the public and one another to determine what improvements should be studied. Evaluation results were reviewed in autumn 2001, and draft recommendations completed in January 2002. These recommendations were subsequently handed over to the CRC project for more review and implementation.

2.4 How is the freight community involved in the Columbia River Crossing project?

The CRC project team recognized the importance of bringing together freight interests in an advisory role to the Task Force. A list of Freight Working Group (FWG) members is provided in **Appendix A**. The FWG has provided guidance to the preparation of this *Truck Freight Existing Conditions Technical Memorandum*.

2.5 What is the federal freight policy?

The United States Department of Transportation (USDOT) has proposed a *Framework for a National Freight Policy,* Draft, April 10, 2006. This policy document begins by recognizing that the United State's freight system underpins the nation's continued economic growth. It recognizes that a successful freight system must bring together public and private stakeholders. Improvements to truck freight mobility on I-5 for the Columbia River Crossing project can meet all federal objectives presented in the *Framework for a National Freight Policy.* The seven objectives are:

1. Improve the operations of the existing freight transportation system.
2. Add physical capacity to the freight transportation system in places where the investment makes economic sense.
3. Use pricing to better align all costs and benefits between users and owners of the freight system.
4. Reduce or remove statutory, regulatory, and institutional barriers to improved freight transportation performance.
5. Proactively identify and address emerging transportation needs.
6. Maximize the safety and security of the freight transportation system.
7. Mitigate and better manage the environmental, health, energy, and community impacts of freight transportation.

Objective five of the *Framework for a National Freight Policy* includes three strategies addressed very well by the CRC project. They are:

- Develop data and analytical capacity for making future investment decisions.
- Conduct freight-related research and development.
- Maintain dialogue between and among public and private sector freight stakeholders.

2.6 What are the state freight policies?

2.6.1 Oregon Transportation Plan

The Oregon Transportation Plan [4] recognizes three freight trends causing the rapid growth in freight volume moving through Oregon's transportation systems. The three freight trends are:

- Deregulation
- Globalization of commercial activities
- New and emerging technologies in freight movement

The 1999 Oregon Highway Plan established a State Highway Freight System to further recognize the importance of freight transportation in the state. These designated routes account for 28 percent of the state highway system and includes I-5 and all interstate routes in Oregon.

2.6.2 Washington Transportation Plan

The Washington Transportation Plan[5] recognizes three components of Washington State's freight system:

- Global Gateways – international and national trade flows through Washington
- Made in Washington – regional economies rely on the freight system
- Delivering Goods to You – the retail and wholesale distribution system

The Washington State Freight and Goods Transportation System is used to classify Washington State roadways by average annual gross truck tonnage. I-5 is at the highest classification, T-1, with more than 10 million tons per year. Globalization, competitive industry trends, and new technologies are pushing freight volumes up twice a fast as Washington's overall population and traffic growth. From 1980 to 2003, truck trips increased by 94 percent on the I-5 corridor[6]. The Washington and Oregon transportation plans recognize the very important role of I-5 to respond to economic trends that increase the need to efficiently move truck freight.

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[4] *Oregon Transportation Plan*, Adopted September 20, 2006, *Freight Issues*, Background Paper

[5] *Washington Transportation Plan, Moving Freight, Executive Summary of Freight Report*, Draft, January 2005

[6] *Strategic Freight Transportation Analysis (SFTA) Origin- Destination Freight Data* 1993/1994 – 2002,Washington State University

3. The Regional Economy and Freight Movement on Interstate 5

The I-5 corridor is the major north-south freight route along the entire West Coast, providing a direct international land connection to Canada and Mexico. I-5 links the major and minor West Coast ports and cities. I-5 carries more freight than any other National Highway System facility in Oregon and Washington. In 1998, more than 10 million tons of freight was moved between the states of Oregon, and Washington, and California.[7] Truck freight flows for each state are shown in **Figure 3-1**, **Figure 3-2**, and **Figure 3-3**. West Coast regional trade is robust—Oregon sells $10 billion per year to California and Washington sells $15 billion a year, equaling that state's exports to Canada, China, and Japan. Northwest goods are transported to California via I-5.[8]

I-5 crossing at the Columbia River is critical to national freight flow, as shown in these three national and international freight flow figures. These figures show that that the West Coast gateways are the "Port of Chicago" serving America's heartland. All freight flow—national, West Coast, and regional—is dependent on the daily function of I-5 within the BIA.

[7] USDOT, FHA, Office of Management and Operations, Freight Analysis Framework. http://ops.fhwa.dot.gov/freight/freight_analysis/state_info/state_flow.htm

[8] West Coast Corridor Coalition, 2003 Overview Presentation, http://www.bettertransport.info/cascadia/WCCCoverview.pdf

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Figure 3-1 Oregon Truck Flows

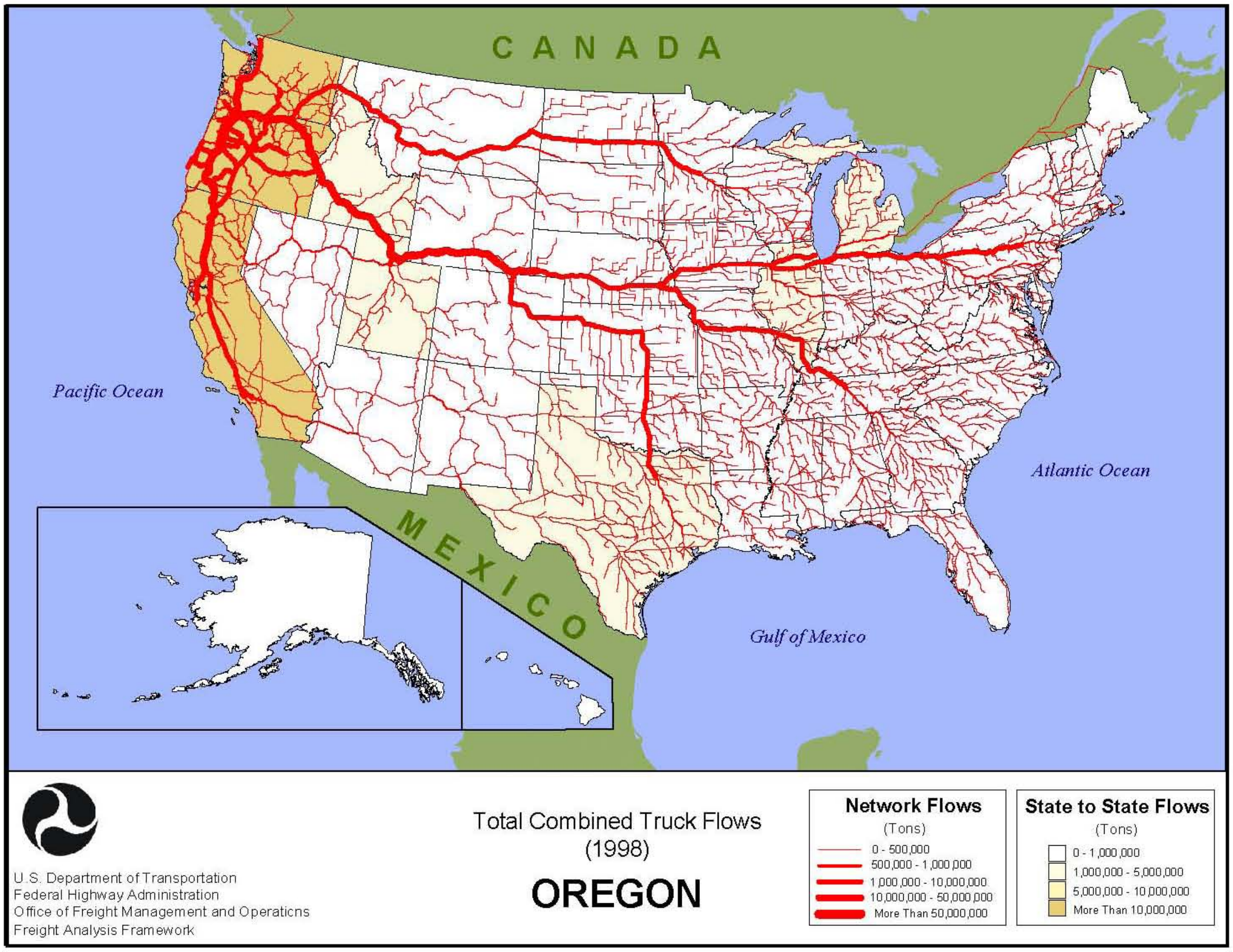

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Figure 3-2 Washington Truck Flows

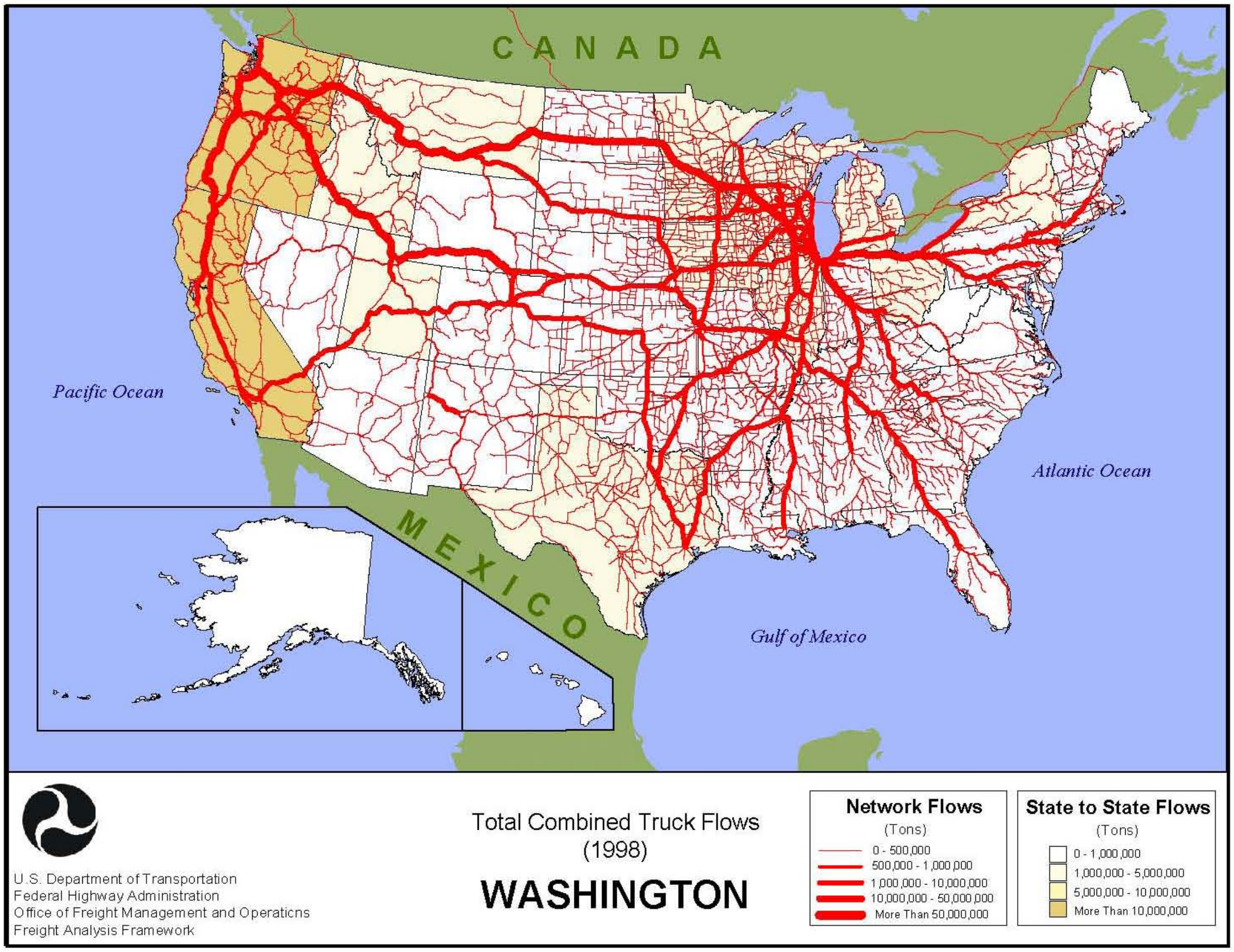

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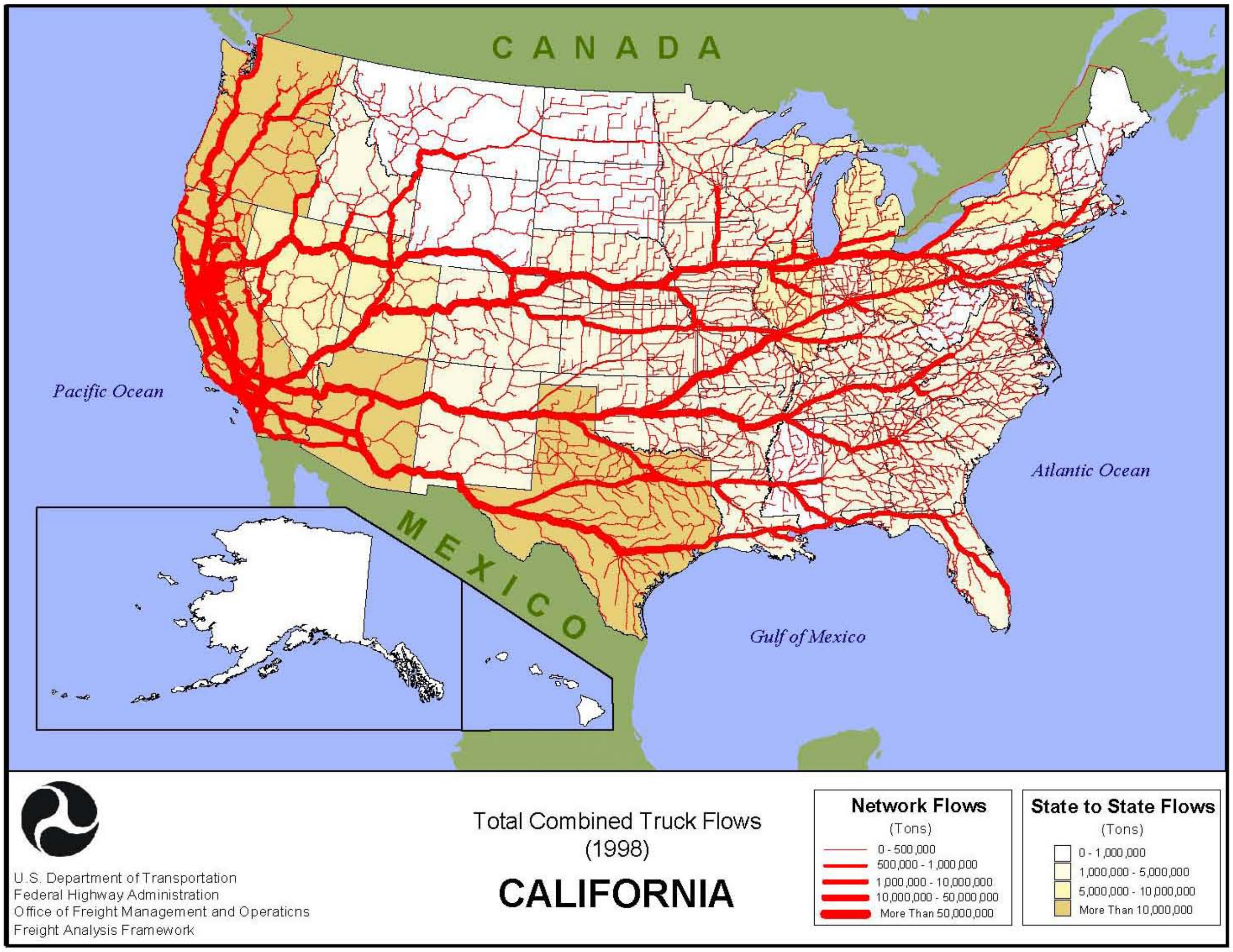
Figure 3-3 California Truck Flows



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3.1 How much of the region's economy depends on I-5?

3.1.1 Commodity Flows on I-5

In April 2003, ODOT completed a milestone report: *Regional Economic Effects of the I-5 Corridor/Columbia River Crossing Transportation Choke Points,* Cambridge Systematics, Inc., in association with David Evans and Associates, Inc. The study examined the impact of congestion at the I-5 Columbia River crossing and the cost of congestion to the economy. In this report it was recognized that the region's economy is built on transportation-intensive industries.

Oregon and Washington combined have a $350 billion economy and the value of exports are $45 billion per year. The five most freight-intensive industry sectors are especially sensitive to transportation along the Portland-Vancouver highway and rail corridors. These industries are:

- Lumber, wood, and paper products;
- Transportation equipment manufacturing and steel;
- Farm and food products;
- High-technology (electronics and scientific instruments); and
- Distribution and wholesale trade.

These five industries account for approximately 70 percent of the commodity tonnage crossing the Columbia River via I-5 and I-205 in large trucks. There is 28.2 million tons of freight moving across the Columbia River via the I-5 and I-205 bridges, and the five most transportation-sensitive industries contribute 20.6 million tons of that freight[9].

3.1.2 Freight Volume by Truck

Trucks carry more freight than the other five modes (rail, ocean, barge, pipeline, and air) used to move freight in the Portland-Vancouver region as shown in **Table 3-1**. Trucks carry 67 percent of all freight in the region, and this is expected to grow to 73 percent by 2030. Previous analysis of freight commodities and the mode choice to move those commodities demonstrated that opportunities to divert freight from trucks to rail are limited, and so the future of the region's economic well-being is linked to the transportation system used to ship freight by truck[10].

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[9] *Regional Economic Effects of the I-5 Corridor/Columbia River Crossing Transportation Choke Points,* prepared for ODOT by Cambridge Systematics, Inc. in association with David Evans and Associates, Inc., April 2003

[10] *Technical Memorandum, Feasibility of Diverting Truck Freight to Rail in the Columbia River Corridor, Draft,* Prepared by: CRC Project, April 2006

Table 3-1. Portland-Vancouver Region Freight Tonnage by Mode

	Year 2000 Volume	
Mode	**Tons (millions)**	**Percent**
Truck	197.2	67 percent
Rail	32.9	11 percent
Ocean	28.4	10 percent
Barge	15.1	5 percent
Pipeline	22.2	7 percent
Air	0.4	<1 percent
TOTAL	**296.2**	**100 percent**

Source: Feasibility of Diverting Truck Freight to Rail in the Columbia River Corridor, Draft, Prepared by: Columbia River Crossing Project, April 2006

The market for commodities is sensitive to transport time and shipping cost. Rail is more cost effective for large tonnages, but it cannot meet the delivery schedule requirements for many commodities. Therefore the majority of freight within the Portland-Vancouver region moves by truck.

4. Characteristics of Truck Movement

Trucks are bigger and heavier than passenger vehicles, and therefore, are slower to accelerate, require longer stopping distances, and have larger turning radii than a passenger vehicle. Traffic counts and vehicle classification data are used to quantify the number of medium and heavy trucks in the traffic stream with operating characteristics much different than a passenger vehicle. An analysis of existing truck data shows the effect of truck volume on highway operations, safety, and capacity. Understanding truck operating characteristics and truck volume provides a basis for designing safe facilities.

4.1 How are trucks classified?

Data and analysis of truck volumes for the CRC use truck classifications grouped as volumes of medium and heavy trucks. **Table 4-1** compares the CRC classifications to those used in transportation planning and traffic forecasting and to those used in other study documents. The 13 WSDOT vehicle classification types, shown in the first column, are distinguished by the number of axles. The class number in the last column presents the weight classification of trucks, primarily used in pavement and structural design. For planning purposes, car-trailer and light trucks that are conducting commercial activities were evaluated separately. Throughout this technical memorandum, the terms "medium" and "heavy" refer to the CRC classification shown in the **Table 4-1**.

Table 4-1. Truck Classifications

Traffic Count Tube[1]		Columbia River Crossing[2]	Transportation Planning[3]	Size
Class Number	Name			
1	Bikes			
2	Cars and Trailers		Light = Non-personal Use	<16,000 lb
3	2-Axle Long		Light	<16,000 lb
4	Buses			
5	2-Axle 6 Tire		Light	<16,000 lb
6	3-Axle Single	Medium	Medium	Single Unit 16 – 52,000 lb
7	4-Axle Single	Medium	Medium	Single Unit 16 – 52,000 lb
8	<5-Axle Double	Heavy	Heavy	Tractor Trailer– one trailer >52,000 lb
9	5-Axle Double	Heavy	Heavy	Tractor Trailer– one trailer >52,000 lb
10	>6-Axle Double	Heavy	Heavy	Tractor Trailer– one trailer >52,000 lb
11	<6-Axle Multi	Heavy	Heavy	Tractor Trailer– two trailers >52,000 lb
12	6-Axle Multi	Heavy	Heavy	Tractor Trailer– two trailers >52,000 lb
13	>6-Axle Multi	Heavy	Heavy	Tractor Trailer– two trailers >52,000 lb

1-ODOT and WSDOT Machine (tube) traffic Counters used for CRC Project
2-CRC Project office, Data and Charts, July 2006
3-Congestion Relief Analysis, PSRC Travel Model Documentation Final Report, Chapter 10.0 Truck Model, August 24, 2006, Cambridge Systematics, Inc.

Light trucks are a single unit, have two axles and up to six tires. This size truck performs light commercial activity. On highways and arterials the operating characteristics are equivalent to a passenger car. This is the Class 5 example in **Figure 4-1**.

Medium-sized trucks have three or four axles and a "tractor-trailer" configuration. The tractor is the vehicle, and the trailer is connected to the tractor to haul freight. The medium trucks carry heavier loads, require a wider turning radius, and use more capacity on highways and arterials than a passenger car.

Heavy trucks have five or more axles and a "tractor-trailer" configuration. Containers, also used for rail or marine shipments, are loaded onto a truck trailer. The operating characteristics differ substantially from a passenger car, with slower acceleration speeds, longer stopping distances, different sight lines, and a large turning radius. Their operating characteristics consume approximately double the highway capacity as compared to a passenger car. These are the Class 8, 9, 10, and 13 examples in **Figure 4-1**.

4.2 How do truck operating characteristics differ from passenger vehicles?

Trucks are bigger and heavier than passenger vehicles, and therefore, are slower to accelerate, require longer stopping distances, and have larger turning radii than a passenger vehicle. Trucks are more adversely impacted by uphill grades. Truck operating speed on a highway is determined by the truck speed at the beginning of the grade, the grade of slope, and the grade length. On long uphill grades, trucks eventually reach a crawl speed, the lowest speed attained while traveling up a grade. The maximum recommended grade on a highway facility is five percent.

Ramp grades, length of grade, and super-elevation are key concerns of truck drivers. The slope and length of grade affects truck operating speed at the merge point, as well as downstream of the merge, until the truck can accelerate to the highway speed limit. Tight loop ramps with steep super-elevation further limit the ability for a truck to accelerate. Trucks consume highway capacity at a greater proportion when they are merging or traveling below the speed of traffic on the highway.

Figure 4-1. Example Truck Classifications

Class 5: **Single-Unit Delivery Truck**

Light Truck

Class 8: **Four-Axle Tractor Trailer**

Heavy Truck

Class 9: **Five-Axle Tractor Trailer**

Heavy Truck

Class 10: **Six-Axle Truck**

Heavy Truck

Class 13: **Eight-Axle Tractor Trailer**

Heavy Truck

Source: http://training.ce.washington.edu/WSDOT/Modules/04_design_parameters/trucks_buses.htm

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Highway facilities are designed to meet the requirements of truck turning radii for all legal-sized trucks; however, the combination of grade and the curvature on a ramp has a unique impact on truck mobility. A tight curve with super-elevation, such as those at interchange ramps, limits a truck's ability to achieve normal acceleration. **Table 4-2** presents select speed-distance relationships for trucks accelerating on an uphill grade from a stop condition. Trucks must accelerate from a stop condition at ramp terminals and ramp meters. For a typical ramp design with a three percent uphill grade and 1,000 feet of ramp length, heavy trucks are entering the highway at 29 mph.

Table 4-2. Speed-Distance for Acceleration of a Typical Heavy Truck

3 percent Grade		5 percent Grade	
Distance (feet)[1]	Speed (mph)	Distance	Speed
500	27	500	22
1,000	29	1,000	24
1,500	31	1,500	25

[a] *Source: AASHTO, A Policy on Geometric Design of Highways and Streets, 2004, Exhibit 3-56*

1. Distance from a stop condition

The affect of reduced truck speed is to increase the passenger car equivalent (E_T) of a truck, which impacts the amount of highway capacity consumed by the truck. A medium or heavy truck traveling at speed on a flat highway has an E_T of 1.5. In other words, trucks consume the same space and capacity as one-and-a-half passenger cars. Where grade has the affect of decreasing truck speed the E_T increases. Note that as the percentage of trucks increases, the E_T decreases, because as trucks form a platoon, the effect is to reduce the passenger car equivalent of each truck.

Table 4-3. Passenger Car Equivalents for Trucks for Grade Lengths of ¼ to ½ mile

	Percentage of Trucks						
Upgrade	2 percent	4 percent	5 percent	6 percent	8 percent	10 percent	15 percent
<2 percent	1.5	1.5	1.5	1.5	1.5	1.5	1.5
≥2-3 percent	1.5	1.5	1.5	1.5	1.5	1.5	1.5
>3-4 percent	2.0	2.0	2.0	2.0	2.0	2.0	1.5
>4-5 percent	3.0	2.5	2.5	2.5	2.0	2.0	2.0

Source: Highway Capacity Manual 2000. Transportation Research Board, Exhibit 23-9

Trucks that can maintain the speed of mainline traffic will affect highway capacity at the equivalent of 1.5 passenger cars per hour. As the speed differential increases, trucks begin to consume more capacity.

4.3 What are oversize loads and where do they access I-5?

Oversize loads occur regularly in the Portland-Vancouver area. Oversize loads are trucks that are over-length, over-height, over-width, and/or over-weight. The definitions of oversized and overweight loads for Oregon and Washington are presented in **Appendix B**. Oversized loads require a permit in both Oregon and Washington. Like other truck traffic, oversized loads can have multiple origins or destinations.

Within the BIA there are some unique and strategically important oversize load transport routes. The Port of Vancouver generates over-length and over-height loads of wind turbines and wind turbine parts to eastern Washington and Oregon wind energy farms. These shipments leave the Port of Vancouver on Mill Plain Boulevard, enter I-5 southbound, and exit to SR 14 eastbound. The Columbia Industrial Park generates oversize loads to the Port of Vancouver and to the north and south on I-5. These loads use SR 14 westbound to I-5, access I-5 (northbound or southbound), and exit onto Mill Plain Boulevard. In Oregon, the high volume oversize load activity occurs on I-5 and exiting I-5 southbound via Marine Drive to Martin Luther King Jr. Boulevard, and to Columbia Boulevard to access industrial land and the Port of Portland.

On highway facilities, or crossing highways, the primary limiting factor for oversize load route choice is vertical clearance. The standard clearance for an arterial crossing is 16 feet (16.5 feet for a new bridge).

5. Existing Truck Traffic Volumes

This section presents current truck information for I-5 from south of I-405 to north of I-205 and provides a basis for comparison of design alternatives. The information includes mainline truck volumes, ramp volumes, and volumes by time of day, travel speeds, and collision data. It summarizes truck volumes relative to all traffic volumes, the time of day that trucks travel, and unique truck travel patterns in the Portland-Vancouver area.

A comprehensive traffic data collection program was conducted by the CRC project in October 2005. The months of May and October reflect average conditions for all traffic and truck traffic, so data collection efforts concentrated on the month of October for consistency and to provide the most current data for the project activities.

Volume data was collected for all ramps within the study area and compiled for three time periods, which will reveal the highest demand ramp locations for local truck access and show the effect of truck volumes on the mainline and ramp merge locations. Traffic and truck data were collected from Tuesday through Thursday because these are the more typical days of the week compared to Monday and Friday when travel patterns are inconsistent due to holidays and long weekends.

5.1 How does the I-5 truck volume compare to the I-205 volume?

The I-5 bridge carries approximately 3,240 more trucks per day than I-205, or 42 percent more. This differential is explained by a number of factors. During uncongested periods, through truck trips will typically remain on I-5 because it is shorter and faster than I-205. The travel distance on I-5 from the south I-205 junction to the north I-205 junction is 19.3 miles. The travel distance between the two junctions on I-205 is 25.5 miles. Distance is a cost factor for a truck trip and includes the cost of truck operations, fuel, and travel time for the driver. During congested conditions most trucks will avoid the corridor (this will be shown with subsequent data) and some trucks will divert to I-205. Trucks attempt to avoid traveling during the congested periods, as will be shown later with the truck volume charts by time of day.

5.2 What are the truck volumes on the I-5 mainline?

Truck volumes on the I-5 mainline are a mix of truck trips generated by industrial and commercial land uses that access I-5 within the BIA and through truck trips. Approximately 48 percent of trucks that originate outside the Portland-Vancouver urban area (at external cordon locations) are going to or from a location within the Portland-Vancouver region[11]. The remaining 52 percent of the truck trips from outside the Portland-Vancouver urban area are through trips. Local truck trips generated by the land uses near the I-5 corridor will remain on I-5. (Truck ramp volumes in the BIA were shown in **Figure 1-1**.)

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[11] *Portland Freight Data Collection Phase II, Draft Report,* Cambridge Systematics, Inc., July 18, 2006

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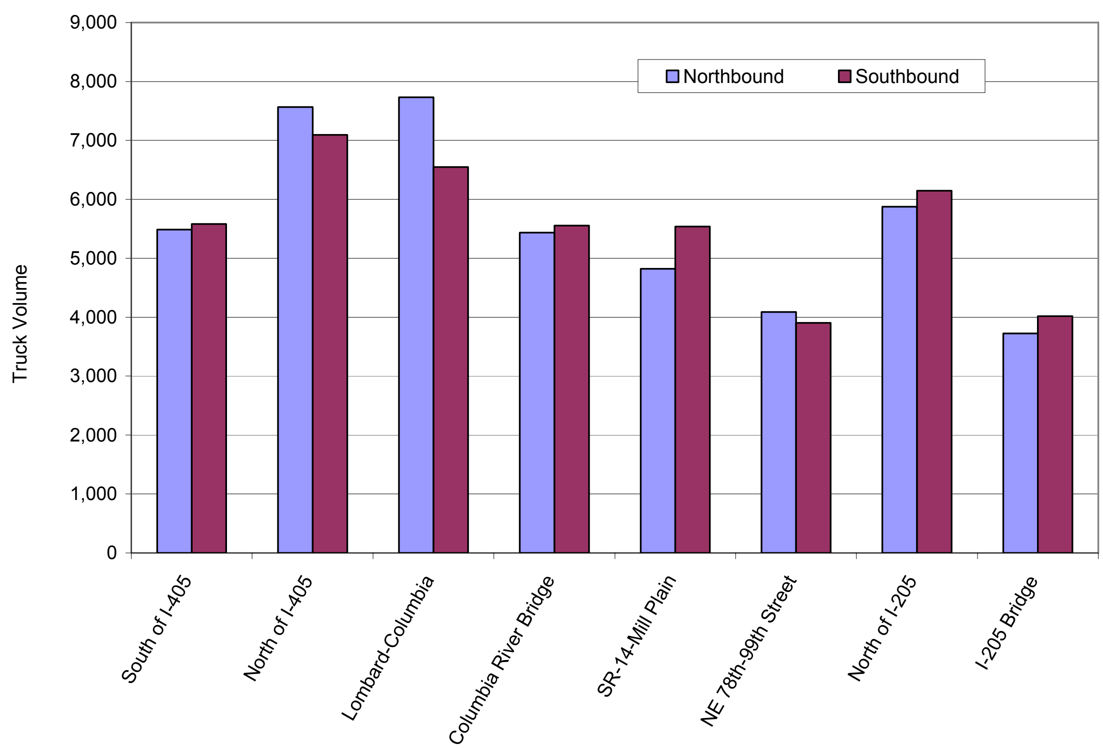
Figure 5-1 presents the daily northbound and southbound volume of medium and heavy trucks on I-5 by segment. The last pair of columns on the right shows I-205 between I-84 and Columbia Boulevard for comparison.

Figure 5-1. Medium and Heavy Truck Volume by Segment, Daily Trips



Source: CRC Project, October 2005 Traffic Data, November 2006 on I-205

Figure 5-1 shows that truck volumes in the segments north of I-405 and between Lombard Street and Columbia Boulevard are the highest within the study area. Northbound volumes in these segments are higher than the southbound volumes. The daily truck volume between Lombard Street and Columbia Boulevard is 12 percent of all daily traffic, and over the I-5 bridge truck traffic is 8 percent of all traffic.

Figure 5-2, Figure 5-3 and **Figure 5-4** present the truck volume data, along the I-5 corridor, for the A.M. peak hour (8:00 a.m. to 9:00 p.m.), midday peak hour (12:00 to 1:00 p.m.), and P.M. peak hour (4:00 to 5:00 p.m.). These figures clearly show that truck volumes are highest during the midday. The midday volume over the bridge is 46 percent higher (890 trucks) than the A.M. peak hour (610 trucks) and 65 percent higher than the P.M. peak hour (540 trucks). This occurs because truck drivers prefer to travel during uncongested conditions. The segments north and south of the bridge show an imbalance in the northbound versus southbound truck volumes, showing differences in truck trip patterns. However, over the bridge the northbound and southbound truck trips are approximately equal.

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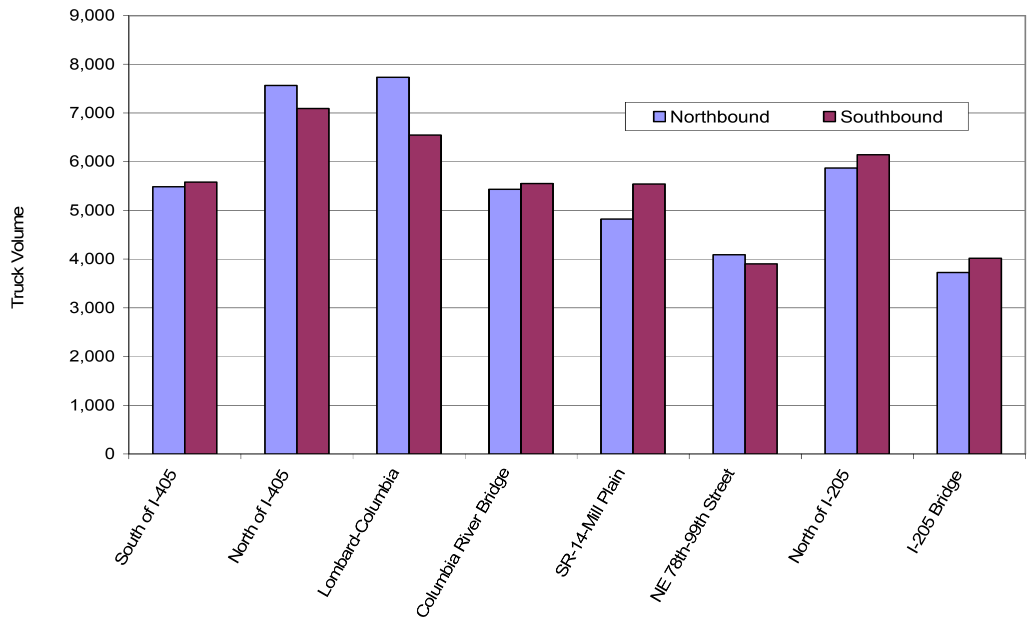
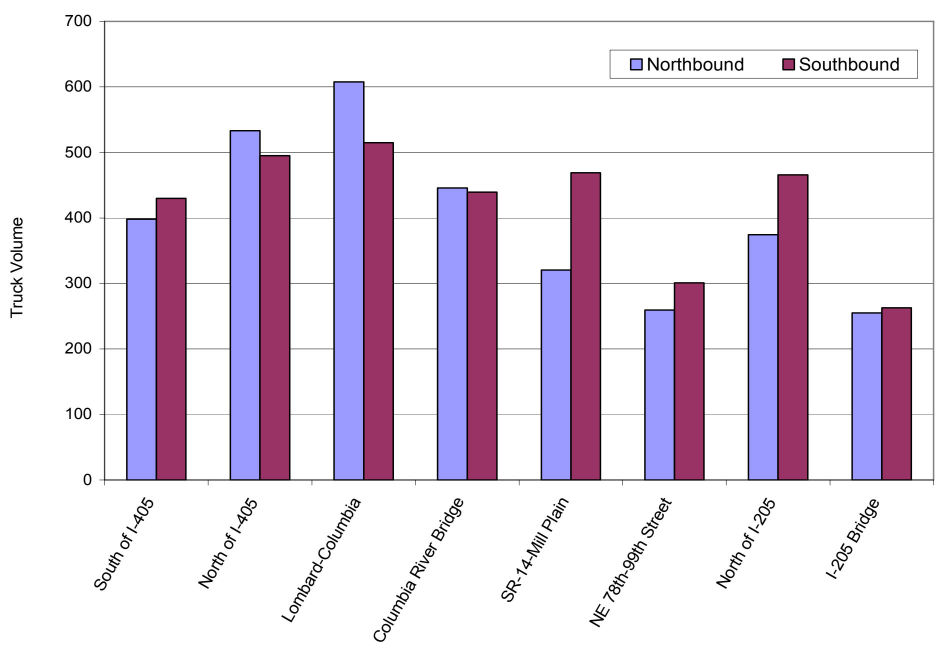
Figure 5-2. Medium and Heavy Truck Volume by Location, 8:00 to 9:00 A.M.



Source: CRC Project, October 2005 Traffic Data, November 2006 on I-205

Figure 5-3. Medium and Heavy Truck Volume by Location, 12:00 to 1:00 P.M.



Source: CRC Project, October 2005 Traffic Data, November 2006 on I-205

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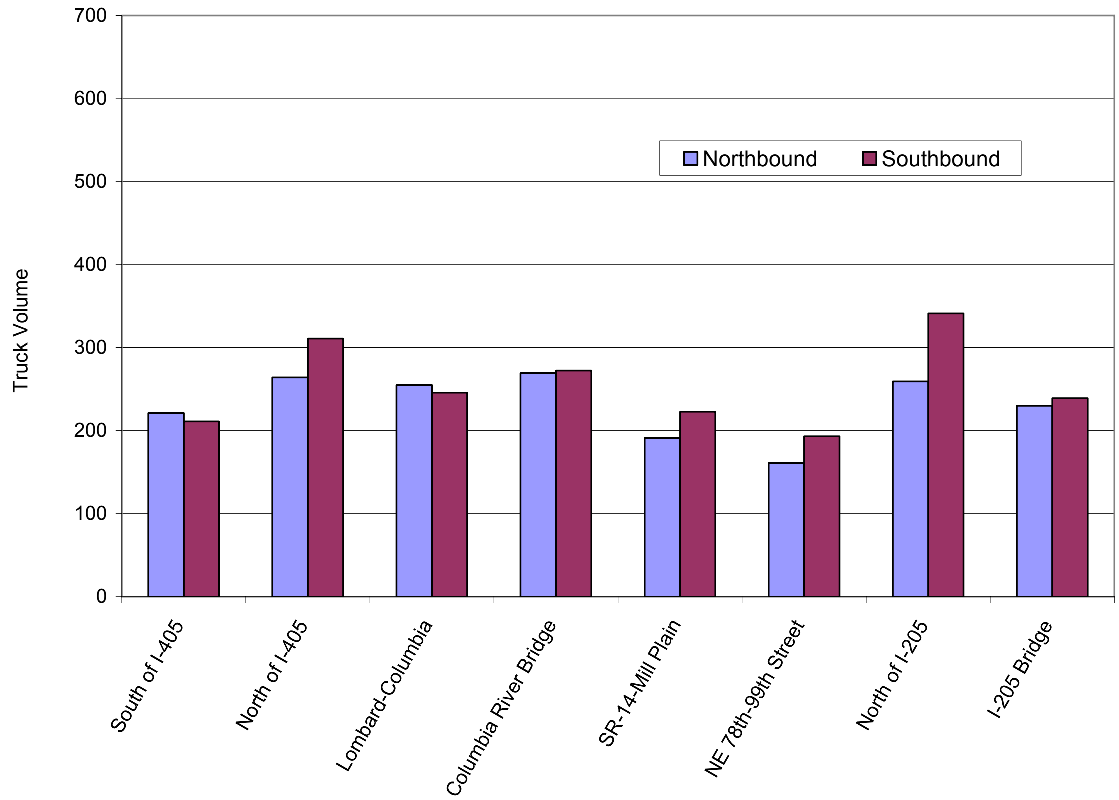
Figure 5-4. Medium and Heavy Truck Volume by Location, 4:00 to 5:00 P.M.



Source: CRC Project, October 2005 Traffic Data, November 2006 on I-205

Figure 5-5 through distinguishes truck volume from other vehicles by segment. Each segment has three figures: northbound volumes for all vehicles by hour, southbound volumes for all vehicles by hour, and truck volumes only from 7:00 a.m. to 7:00 p.m. The set of three figures in each segment show that truck volumes are highest between 9:00 a.m. and 3:00 p.m. (between the A.M. and P.M. peak hours), ranging between 35 percent and 45 percent of daily truck traffic.

5.2.1 North of I-405 Segment

On the north of I-405 segment, there is a substantial increase in traffic volume at 7:00 A.M. The northbound volumes are relatively high throughout the day. The volume during the P.M. peak hour commute is relatively high, but lower than northbound volumes at segments to the north.

Figure 5-6 shows that the southbound volumes are higher than the northbound volumes during most hours.

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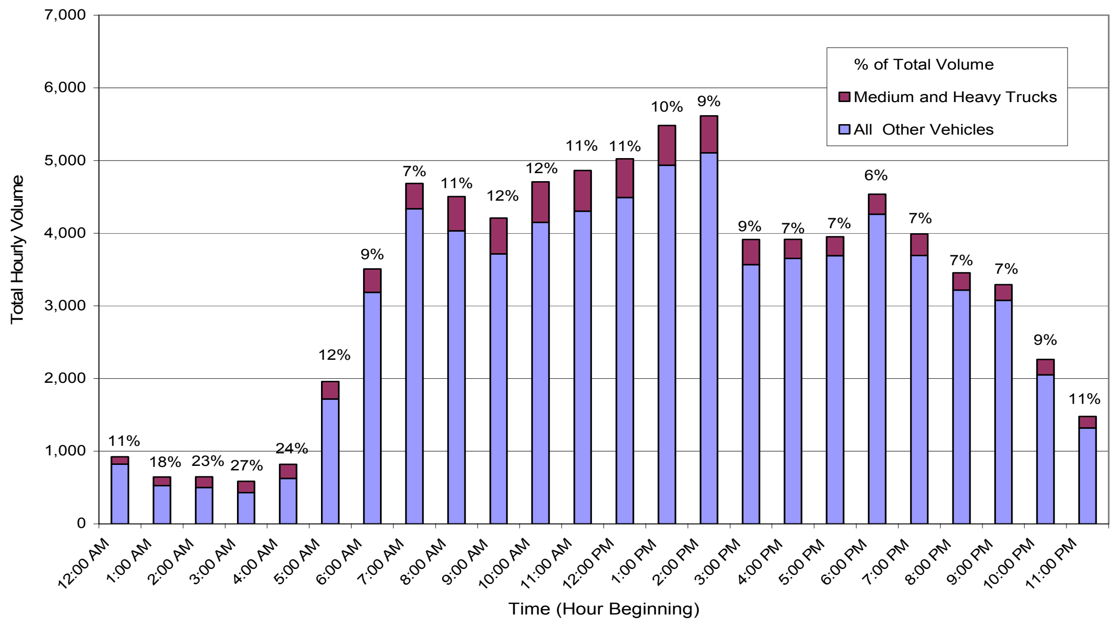
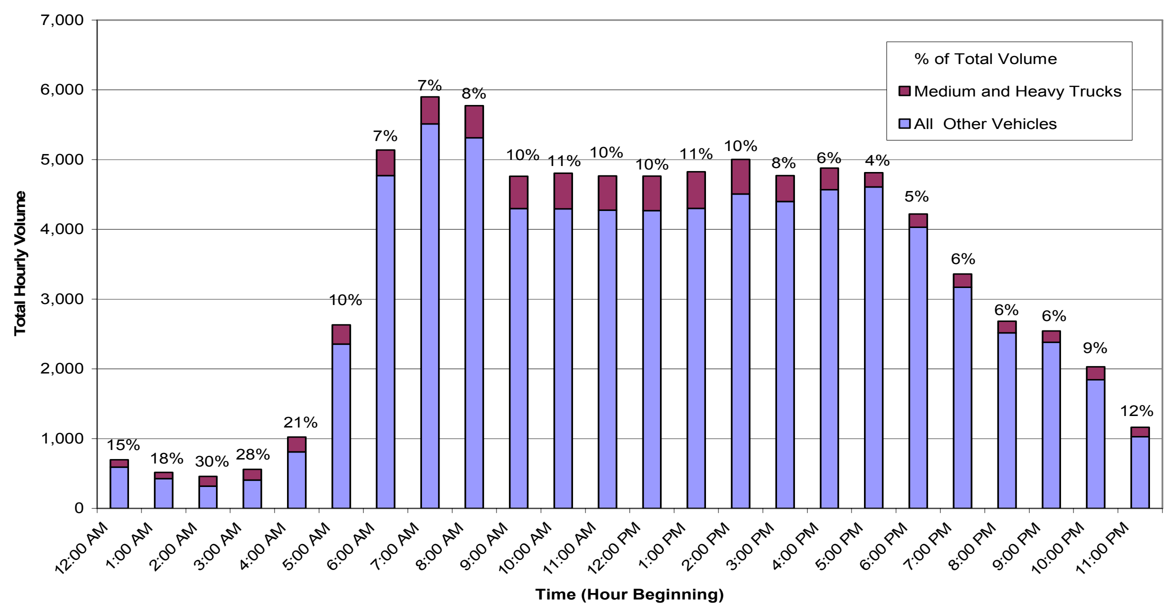
Figure 5-5. Northbound Traffic and Truck Volumes, I-5 North of I-405



Source: CRC Project, October 2005 Traffic Data

Figure 5-6. Southbound Traffic and Truck Volumes, I-5 North of I-405



Source: CRC Project, October 2005 Traffic Data

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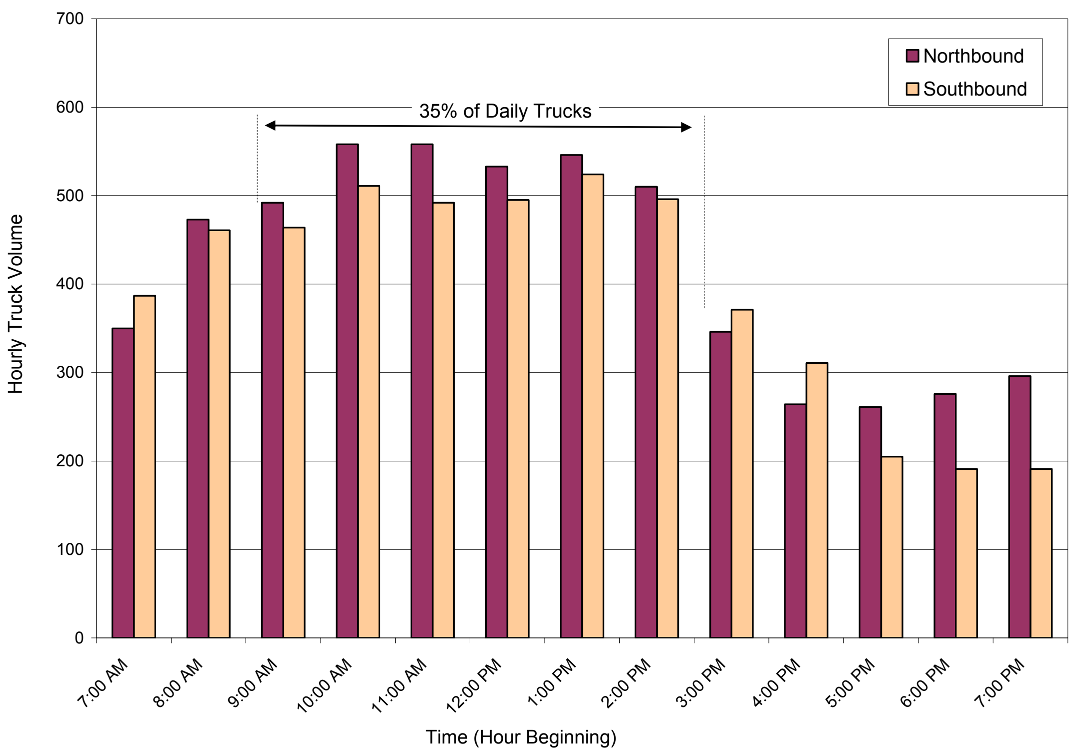
These figures show that truck volume increases at 9:00 A.M. when congestion decreases. At 3:00 P.M. the truck volumes drop substantially. This is the hour when general-purpose traffic volumes begin to increase and congestion increases. The P.M. peak hour traffic volume increase occurs in most of the other segments, however at this location the northbound afternoon volumes show a decrease because of congestion near the beginning of the HOV lane designation.

Figure 5-7. Medium and Heavy Truck Volumes, I-5 North of I-405



Source: CRC Project, October 2004 Traffic Data

5.2.2 Lombard to Columbia Segment

In the Lombard Street to Columbia Boulevard segment, traffic and truck volumes peak from 2:00 to 3:00 P.M. in the northbound direction due to the HOV lane and remain relatively high during the P.M. peak commute period (**Figure 5-8, Figure 5-9,** and **Figure 5-10)**. In the southbound direction, volumes are very consistent from 7:00 A.M. to 6:00 P.M. Northbound truck percentages reach 18 and 19 percent during the 9:00 and 10:00 A.M. hours.

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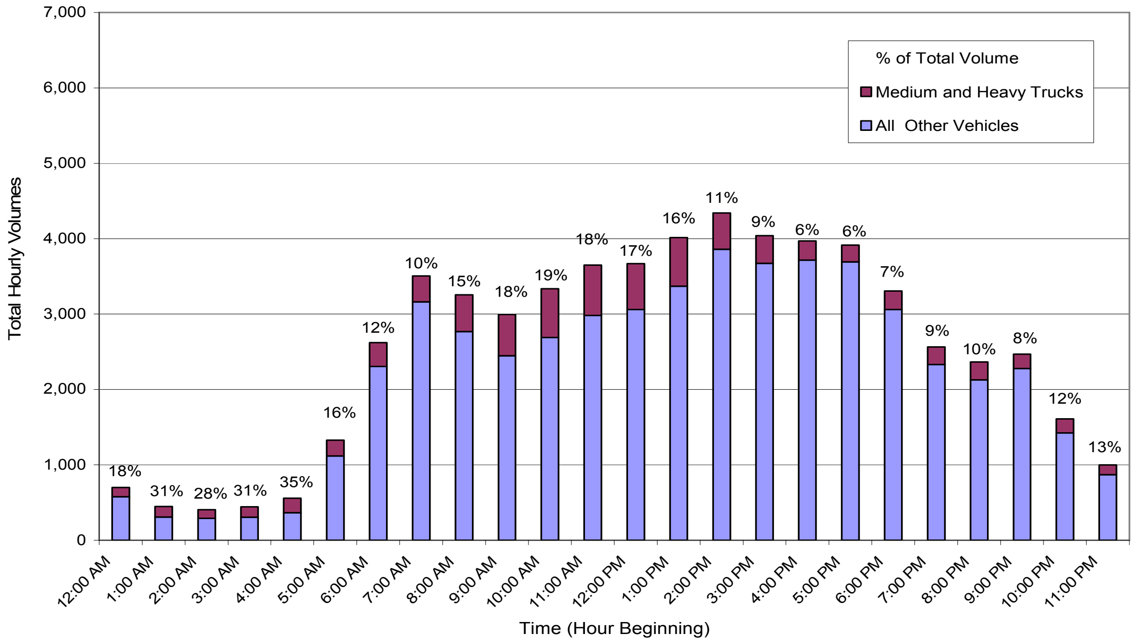
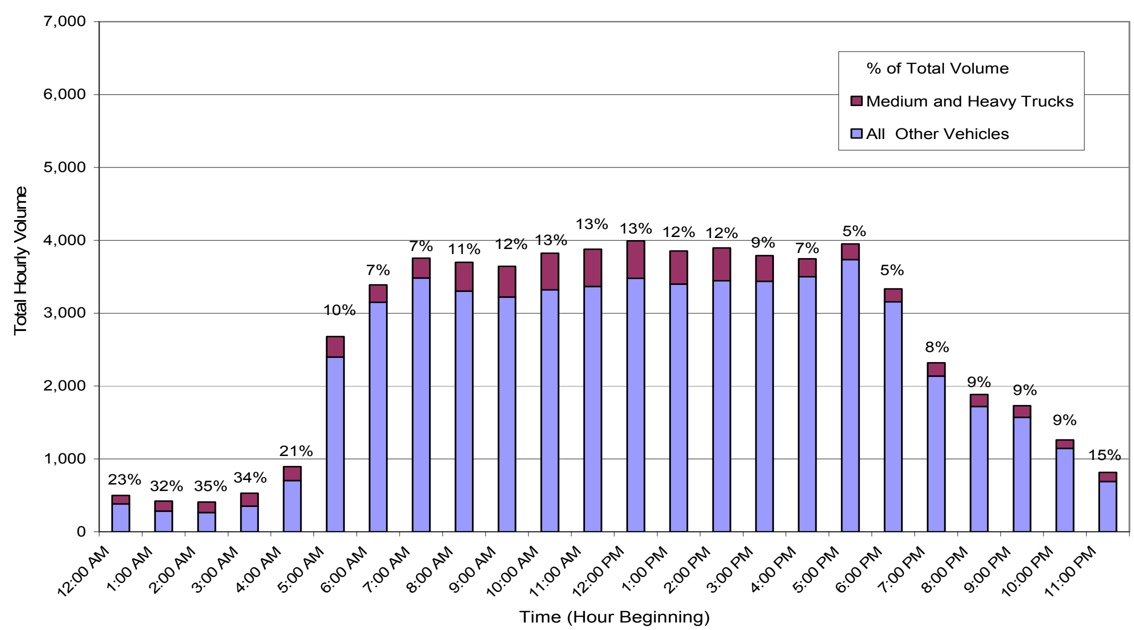
Figure 5-8. Northbound Traffic and Truck Volumes between Lombard Street and Columbia Boulevard



Source: CRC, October 2005 Traffic Data

Figure 5-9. Southbound Traffic and Truck Volumes between Lombard Street and Columbia Boulevard



Source: CRC Project, October 2005 Traffic Data

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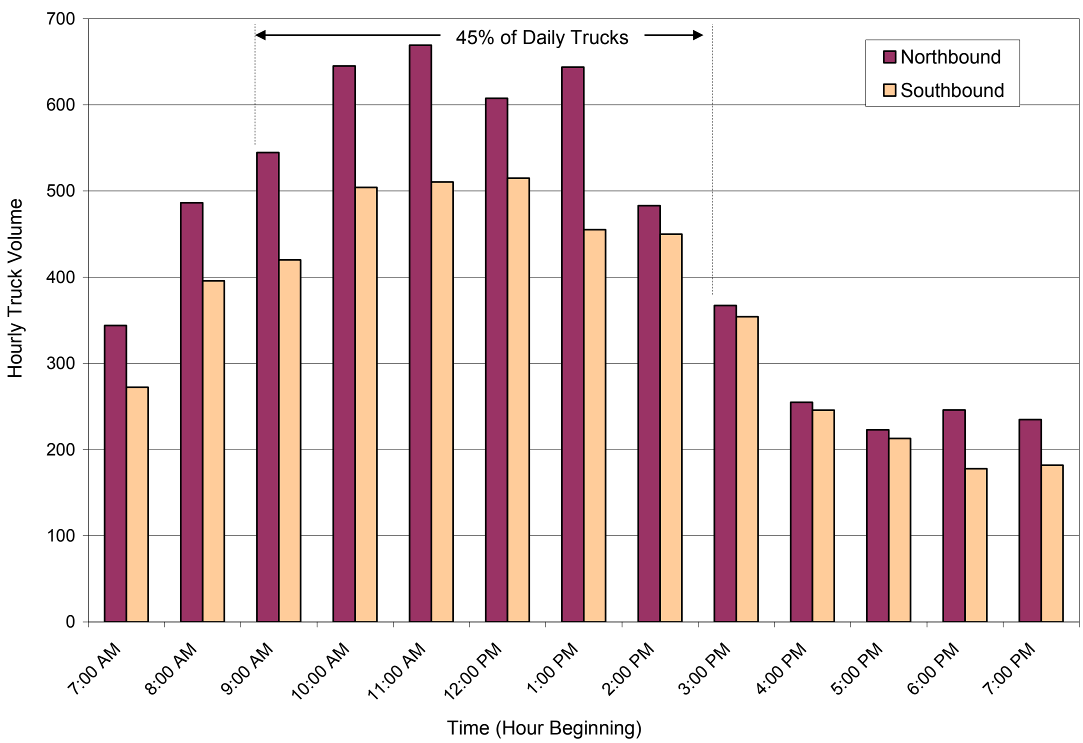
This segment has high truck volumes and higher southbound truck volumes than northbound (**Figure 5-10**). The volume of trucks between 9:00 A.M. and 3:00 P.M. is 45 percent of daily truck traffic. The intense trucking activity in this segment likely is due to truckers' desire to deliver the northbound freight before congestion begins across the I-5 bridge.

Figure 5-10. Medium and Heavy Truck Volumes between Lombard St. and Columbia Blvd.



Source: CRC Project, October 2005 Traffic Data

5.2.3 Columbia River Bridge Segment

Figure 5-11 clearly shows the daily pattern for the northbound P.M. peak hour. Traffic volumes increase steadily up to 6:00 P.M. The southbound volumes show a narrower peak during the morning and no peak during the afternoon even though the P.M. volumes are relatively high. This pattern is consistent with typical commute patterns where the A.M. peak period is more concentrated and reflects a relatively high volume of home-to-work trips. The P.M. peak hour reflects the work-to-home trip as well as school trips, shopping trips, and other afternoon activities. Truck volumes between 9:00 A.M. and 3:00 P.M. are 42 percent of daily truck volumes (**Figure 5-13**).

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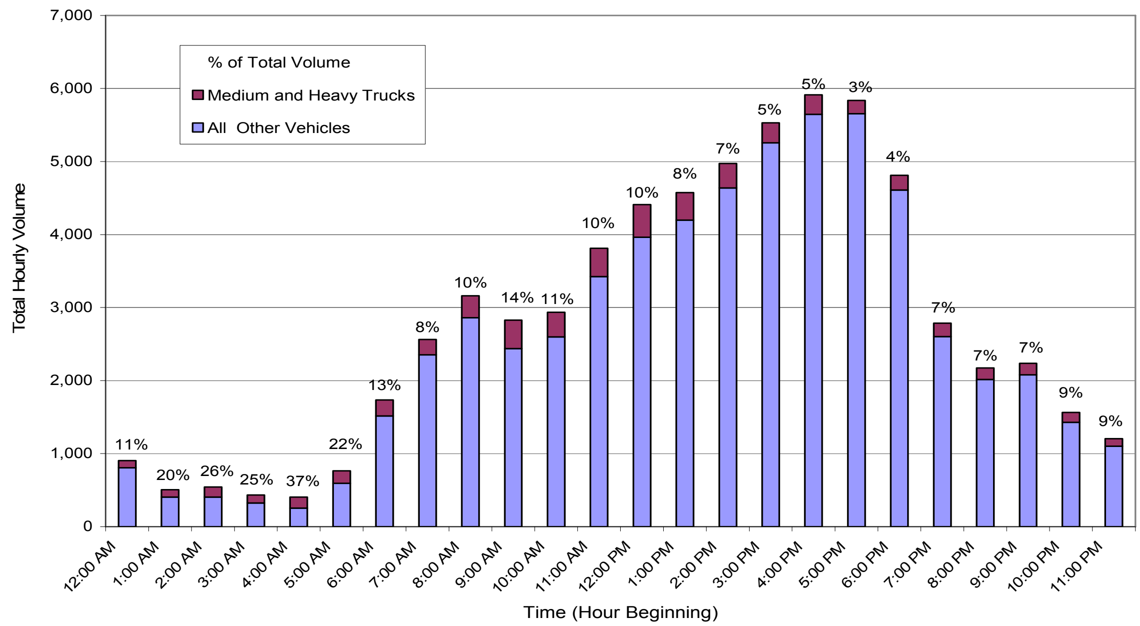
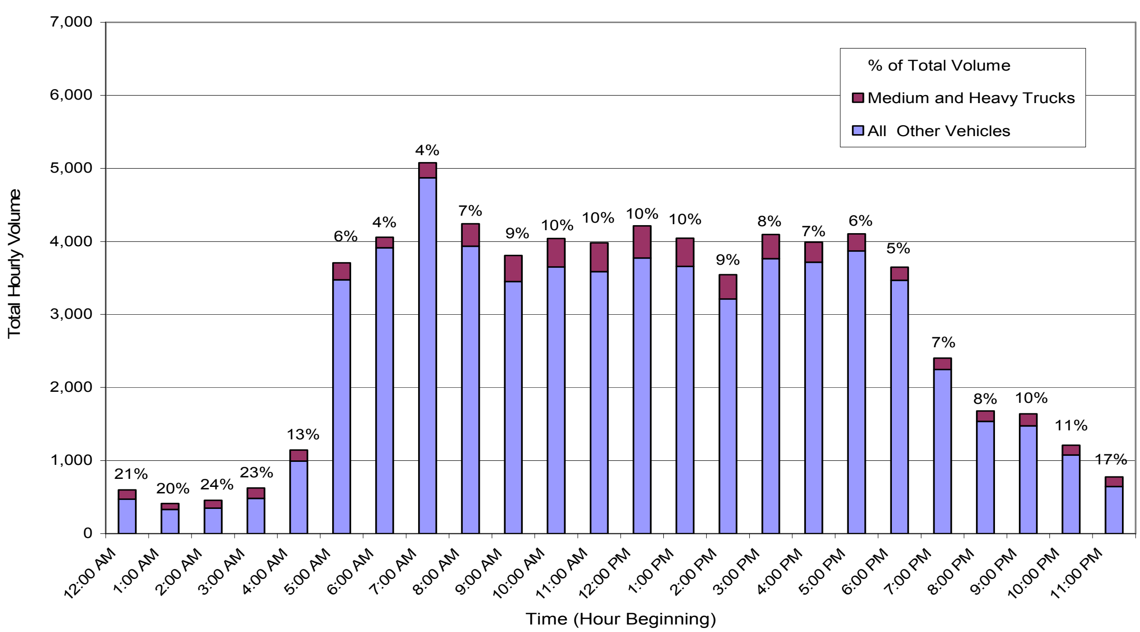
Figure 5-11. Northbound Traffic and Truck Volumes on I-5 Bridge



Source: CRC Project, October 2005 Traffic Data

Figure 5-12. Southbound Traffic and Truck Volumes on I-5 Bridge



Source: CRC Project, October 2005 Traffic Data

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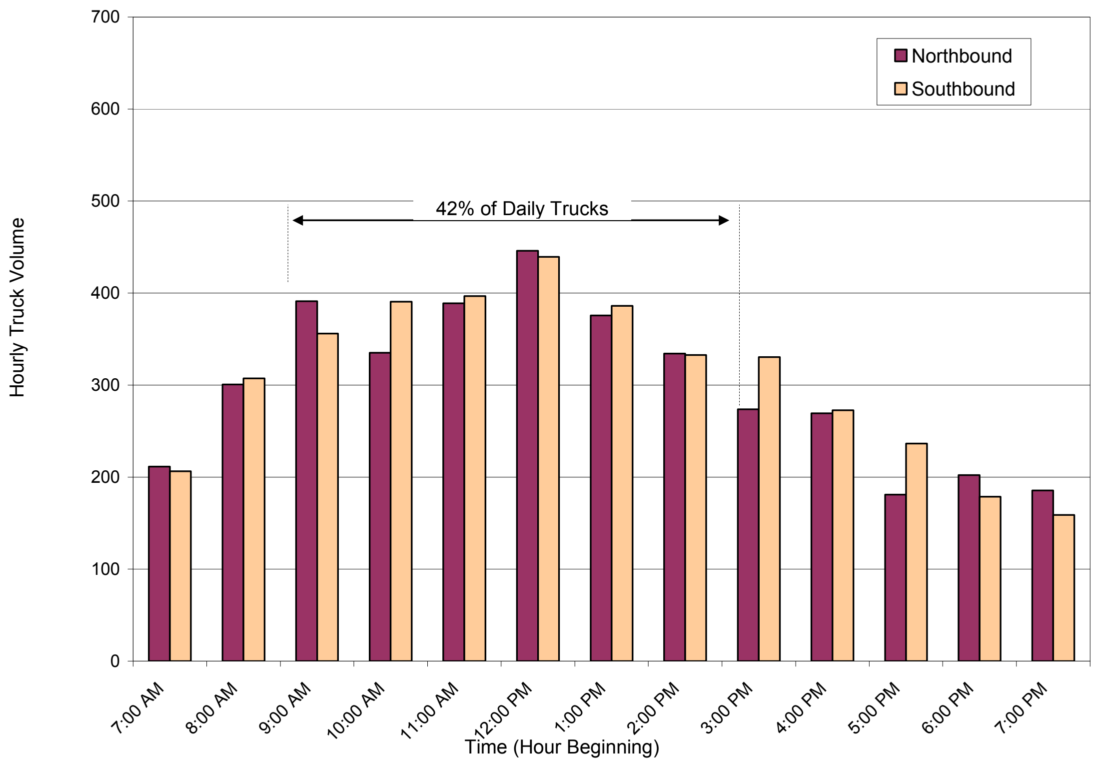
Figure 5-13. Medium and Heavy Truck Volumes on I-5 Bridge



Source: CRC Project, October 2005 Traffic Data

5.2.4 SR-14 to Mill Plain Segment

Figure 5-14 shows the typical northbound P.M. peak period commute. Southbound volumes also show a P.M. peak period commute (**Figure 5-15)**.

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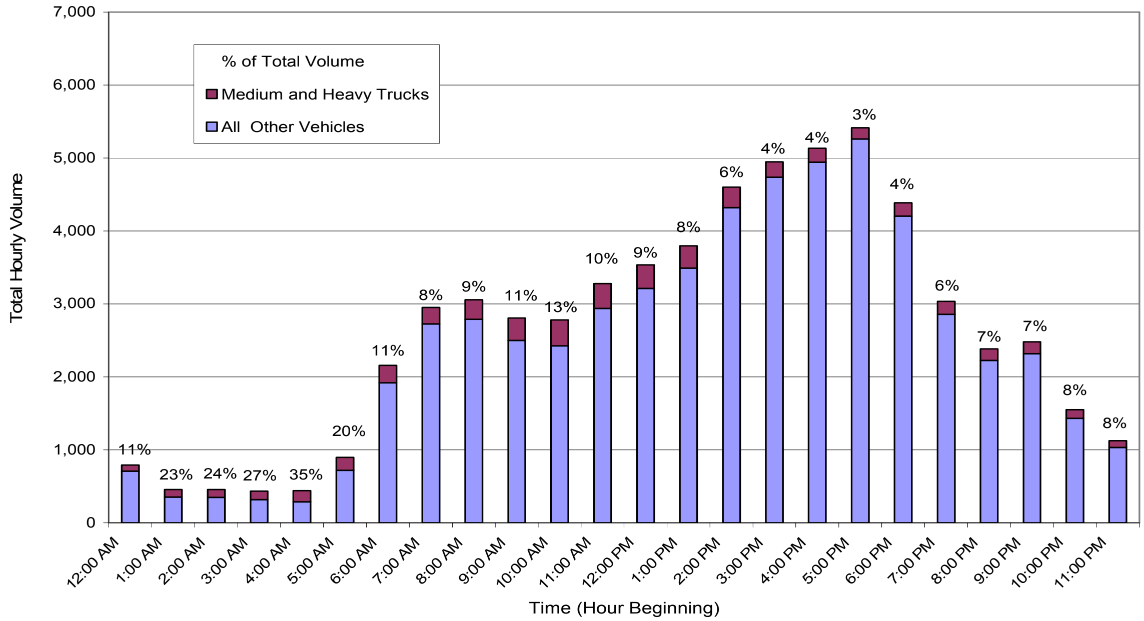
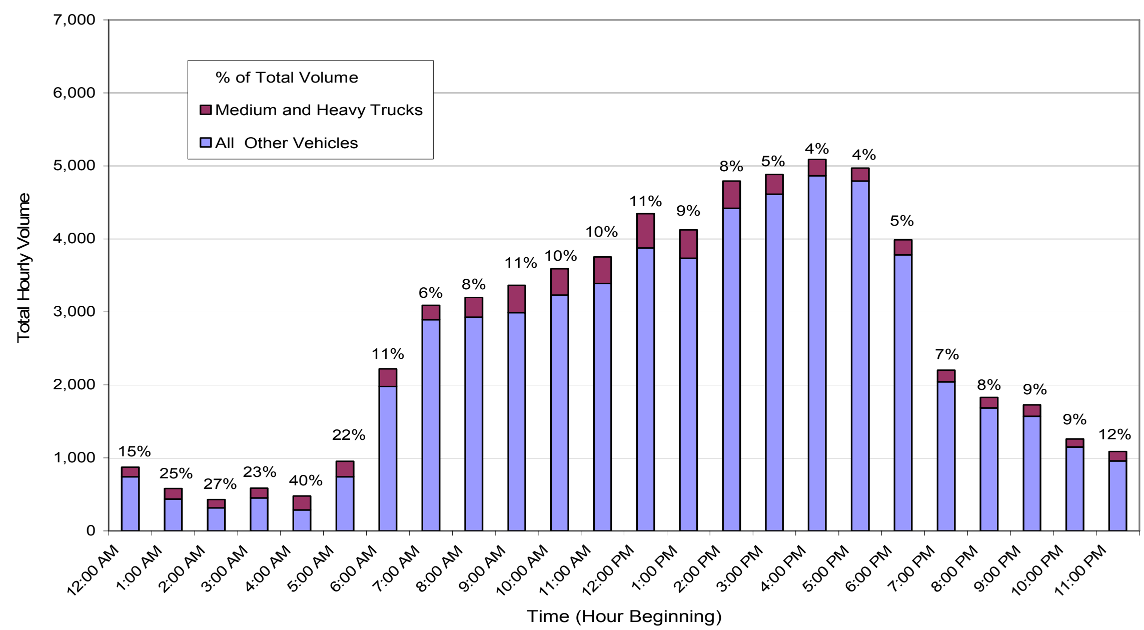
Figure 5-14. Northbound Traffic and Truck Volumes between SR 14 and Mill Plain Boulevard



Source: CRC Project, October 2005 Traffic Data

Figure 5-15. Southbound Traffic and Truck Volumes between SR 14 and Mill Plain Boulevard



Source: CRC Project, October 2005 Traffic Data

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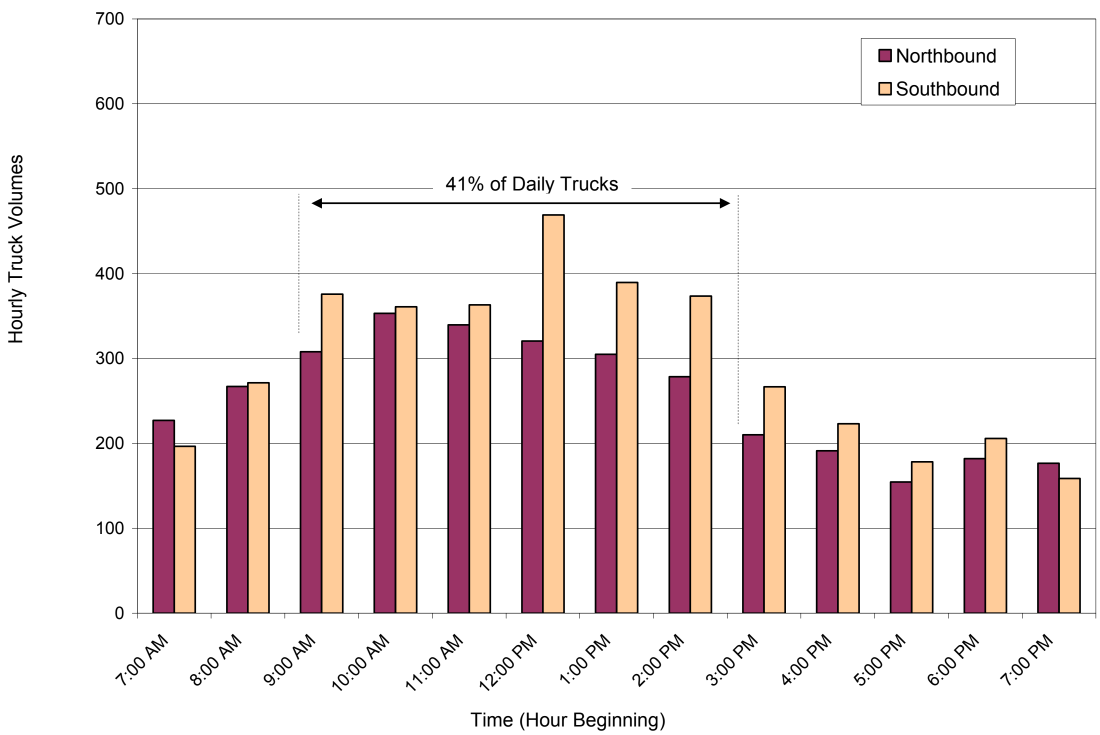
Figure 5-16 shows that 41 percent of daily truck trips occur between 9:00 A.M. and 3:00 P.M. At this location there is consistently a higher volume of southbound truck trips between the hours of 9:00 A.M. and 7:00 P.M. This can be explained by the larger area of industrial activity south of the I-5 bridge. Trucking companies have explained that the peak from 12:00 to 1:00 P.M. is due to their trucks traveling north to the Puget Sound region in the evening, loading trucks and leaving Seattle between 8:00 and 9:00 A.M., and arriving to the Vancouver/Portland region at noon. In addition, trucks that have some other base load within the Puget Sound region and travel south leaving in the morning, and passing through Vancouver/Portland region at noon on their trip south.

Figure 5-16. Medium and Heavy Truck Volumes between SR 14 and Mill Plain Boulevard



Source: CRC Project, October 2005 Traffic Data

5.2.5 78th to 99th Street Segment

Figure 5-17, **Figure 5-18**, and show overall traffic and truck volumes lower than in the segments to the south. The daily northbound and southbound volume pattern reflects classic commute patterns. The truck volume between 9:00 A.M. and 3:00 P.M. is 37 percent of daily truck traffic.

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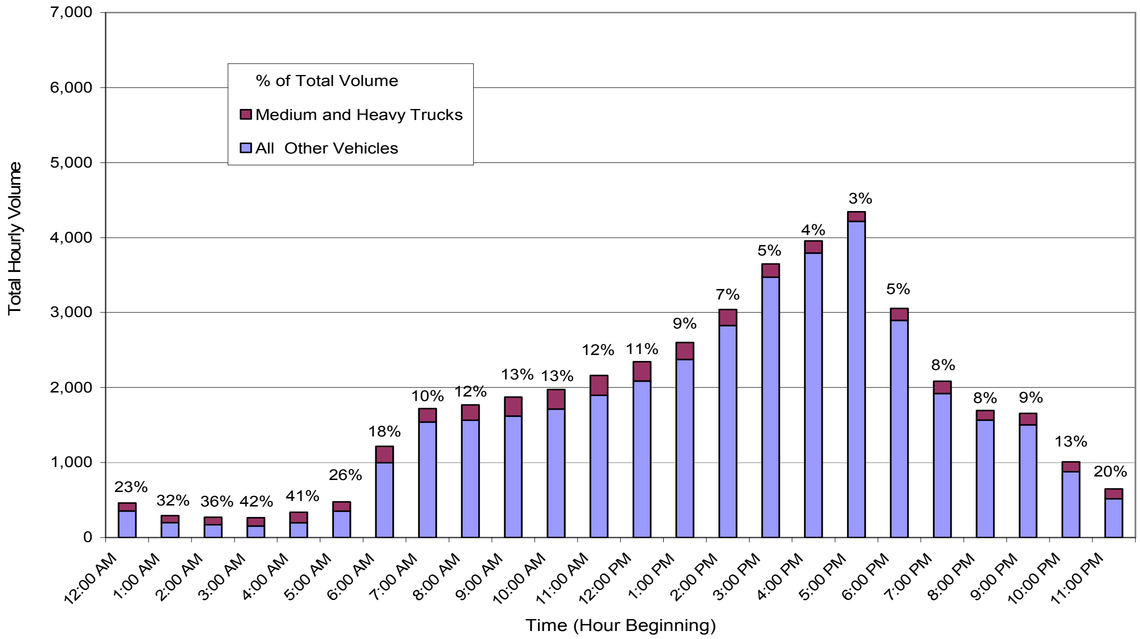
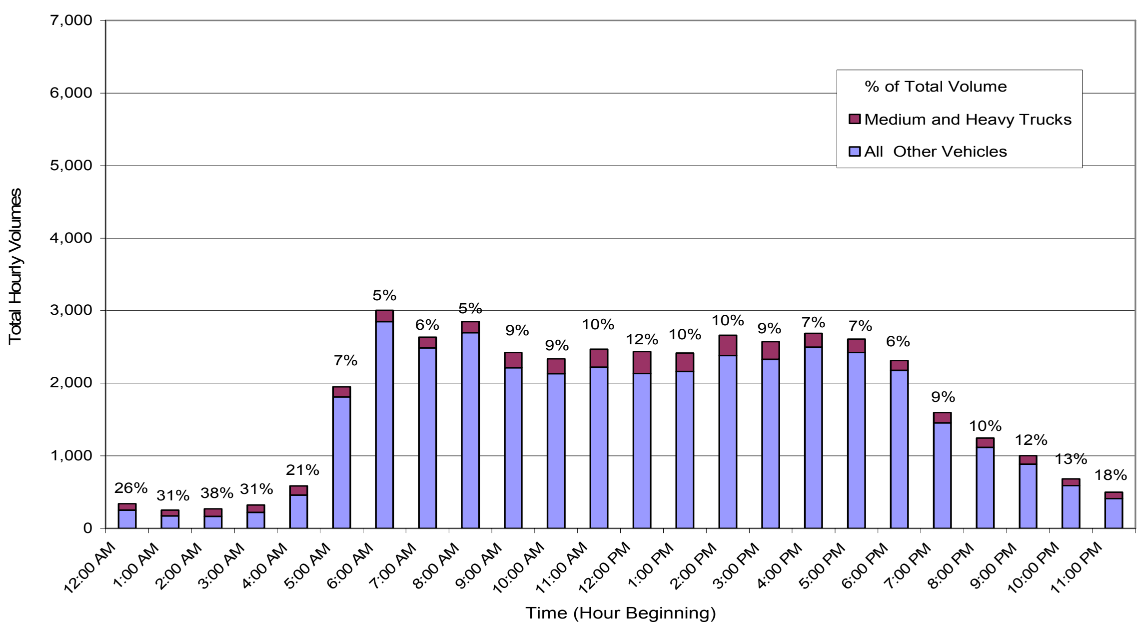
Figure 5-17. Northbound Traffic and Truck Volumes between 78th Street and 99th Street



Source: CRC Project, October 2005 Traffic Data

Figure 5-18. Southbound Traffic and Truck Volumes between 78th Street and 99th Street



Source: CRC Project, October 2005 Traffic Data

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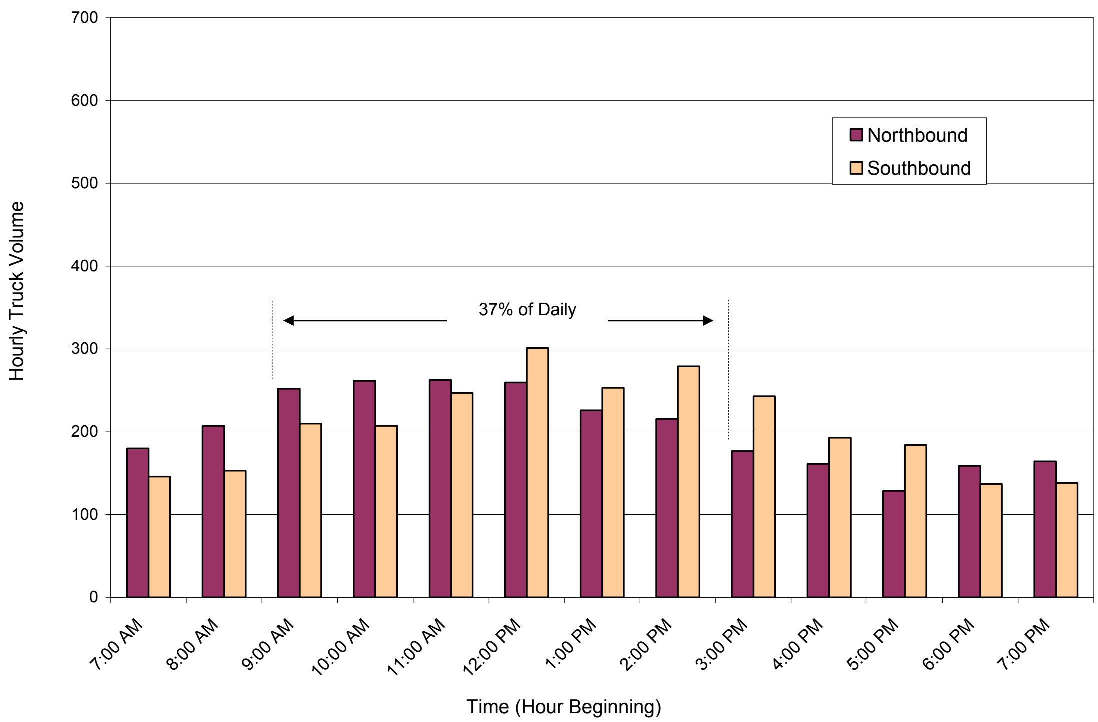
Figure 5-19. Medium and Heavy Truck Volumes between 78th Street and 99th Street



Source: CRC Project, October 2005 Traffic Data

5.2.6 What can be learned from the truck volumes on the I-5 mainline?

- Truck drivers prefer to transport freight during the midday hours when I-5 is free of congestion. Between 35 percent and 45 percent of the daily trucks travel between 9:00 A.M. and 3:00 P.M. on all I-5 segments through the BIA.
- The highest truck volumes are on I-5 north of I-405 and between North Lombard Street and North Columbia Boulevard. On this segment of I-5, volumes are higher in the northbound direction during both the A.M. and midday peak hours.

5.3 What are the truck volumes on I-5 ramps?

The CRC project traffic data collection included truck volumes at ramps throughout the I-5 study corridor and BIA. **Figure 5-20** through **Figure 5-22** present medium and heavy truck volumes on-ramps and on mainline segments for the A.M. peak hour, midday peak hour, and P.M. peak hour. Both the percent of trucks and actual value are shown in order to disclose the difference between low-volume ramps with a relatively high percent trucks (but still a low volume of trucks) from high-volume ramps with a relatively high percent of trucks. The truck volumes represent only heavy trucks.

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In addition, these figures present the existing speed data on the I-5 mainline for all vehicles. Speed data were collected in October 2005 with techniques including the floating car, machine tube counts, and loop detector data. The speed data presented throughout the corridor disclose congestion and the distance of congestion. The relative impact of trucks merging at slower speeds is reviewed using these speed data.

5.3.1 A.M. Peak Hour Conditions

Figure 5-20 shows the A.M. peak hour medium and heavy truck ramp volumes. This shows that there are five locations where the truck volume exceeds ten percent of the ramp traffic. Southbound, the Marine Drive on-ramp serves 100 trucks per hour and 37 percent of all ramp traffic. The Columbia Boulevard on-ramp serves 105 trucks or 22 percent of all ramp traffic. This volume relates to one truck merging into the mainline traffic at an average of 36-second intervals. **Figure 5-20** also presents the average speed on the mainline during this hour. At the Marine Drive on-ramp, the mainline speed is between zero and ten mph, so trucks are merging with the flow of traffic. At the Columbia Boulevard on-ramp, mainline speed is greater than 50 mph and heavy trucks are merging at speeds slower than the speed of traffic.

In the northbound direction, the highest percent of ramp truck volume occurs at the Columbia Boulevard off-ramp, the Marine Drive off-ramp, and the Marine Drive on-ramp. The volumes are 65, 55, and 85 medium and heavy trucks per hour, respectively. At the Marine Drive on-ramp, slightly more than one truck per minute would be merging into the mainstream. At this location the average mainline speed is free flow at over 50 mph, and trucks are merging into this flow at well below speed. Off-ramps can also create a speed differential on the mainline. If an off-ramp is too short, truck drivers (and other motorists) can start decelerating before leaving the mainline to ensure that they can stop at the end of the ramp.

The Mill Plan/Fourth Plain off-ramp has a ramp truck volume of 60 trucks per hour, approximately the same hourly volume as the Columbia Boulevard and Marine Drive off-ramps. The proportion of trucks is small (5 percent) due to the high volume of other vehicles at that off-ramp.

5.3.2 Midday Peak Hour Conditions

Figure 5-21 shows the midday peak hour ramp medium and heavy truck volumes. In the southbound direction, the Marine Drive off-ramp and the Columbia Boulevard on-ramp have 11 percent and 19 percent trucks with 95 trucks merging at Columbia Boulevard. The mainline is at free flow speed, over 50 mph and so approximately one truck every 38 seconds is merging at a slow speed relative to mainline speeds.

In the northbound direction, Columbia Boulevard and Marine Drive off-ramps are at 23 percent and 32 percent trucks with 120 and 115 trucks per hour, respectively. The Marine Drive on-ramp is at 12 percent trucks with 105 trucks per hour merging at a slow speed. The mainline is at free flow speed, over 50 mph midday. And at the Mill Plain/Fourth Plain off-ramp the volume of trucks is 70, and seven percent of total traffic due to the high volume of all off-ramp traffic.

5.3.3 P.M. Peak Hour Conditions

Figure 5-22 shows the P.M. peak hour ramp medium and heavy truck volumes. In the southbound direction, only the Marine Drive off-ramp and on-ramp are over 10 percent trucks. The volume is 75 trucks per hour at the off-ramp and 45 trucks per hour at the on-ramp. All other southbound ramp truck volumes are 30 per hour or fewer.

In the northbound direction, the highest truck volumes are at the Columbia Boulevard off-ramp and the Marine Drive off-ramp with 16 percent and 24 percent trucks, respectively. The volumes are 45 and 55 trucks per hour. The total ramp volume is low as well as the truck volume. All other ramps have 40 or fewer trucks per hour. The on-ramp volume at Interstate Avenue/Victory Boulevard and Marine Drive is notable at over 1,000 vehicles per hour. These volumes show that the truck activity is less and the work-to-home trip is high. Similarly, the northbound on- and off-ramps at SR 14 and Mill Plan/Fourth Plain are over 1,000 vehicles per hour, but the truck volumes are low.

Figure 5-20.CRC I-5 Bridge Influence Area – A.M. Peak Hour Ramp Volumes

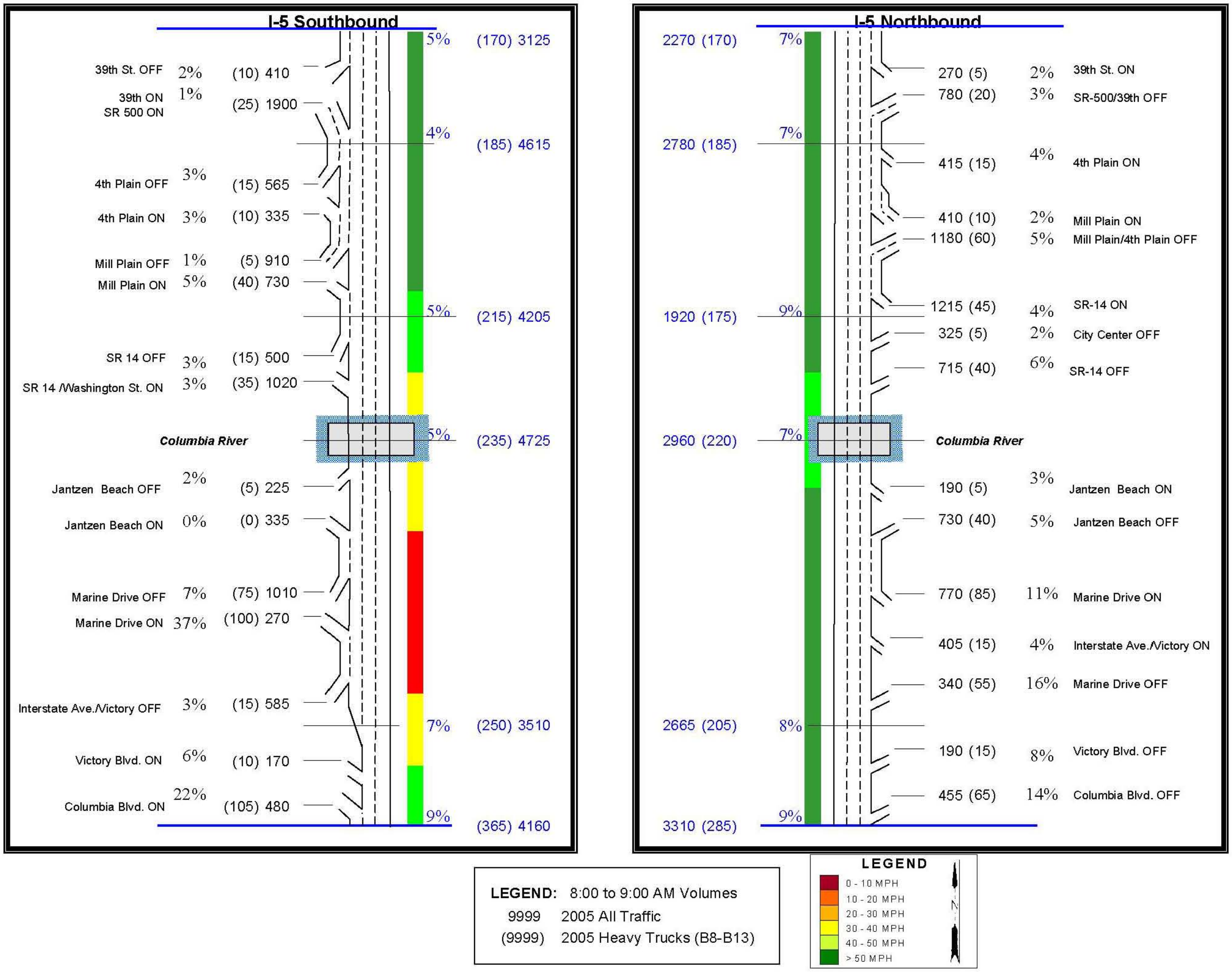

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Figure 5-21. CRC I-5 Bridge Influence Area – Midday Peak Hour Ramp Volumes

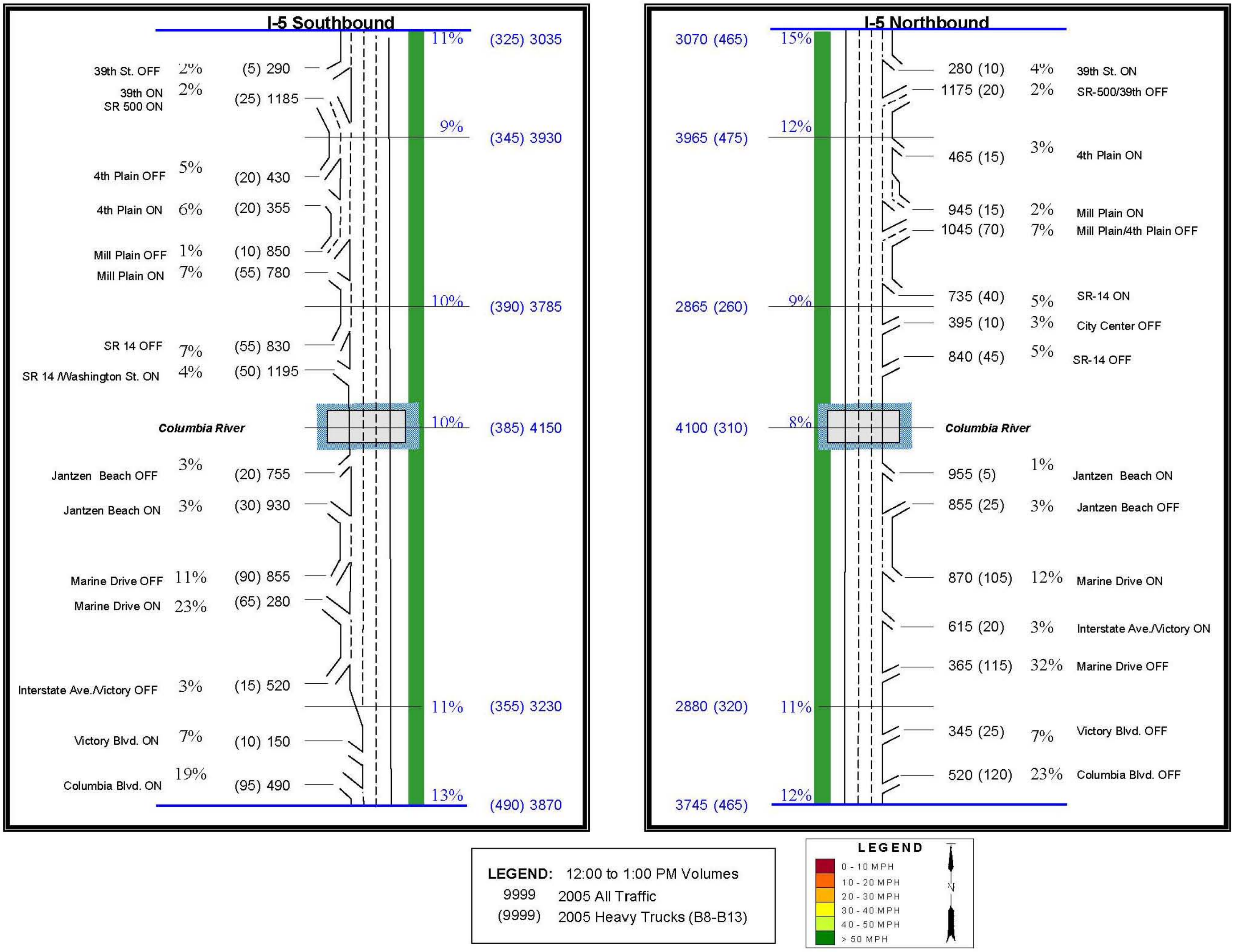

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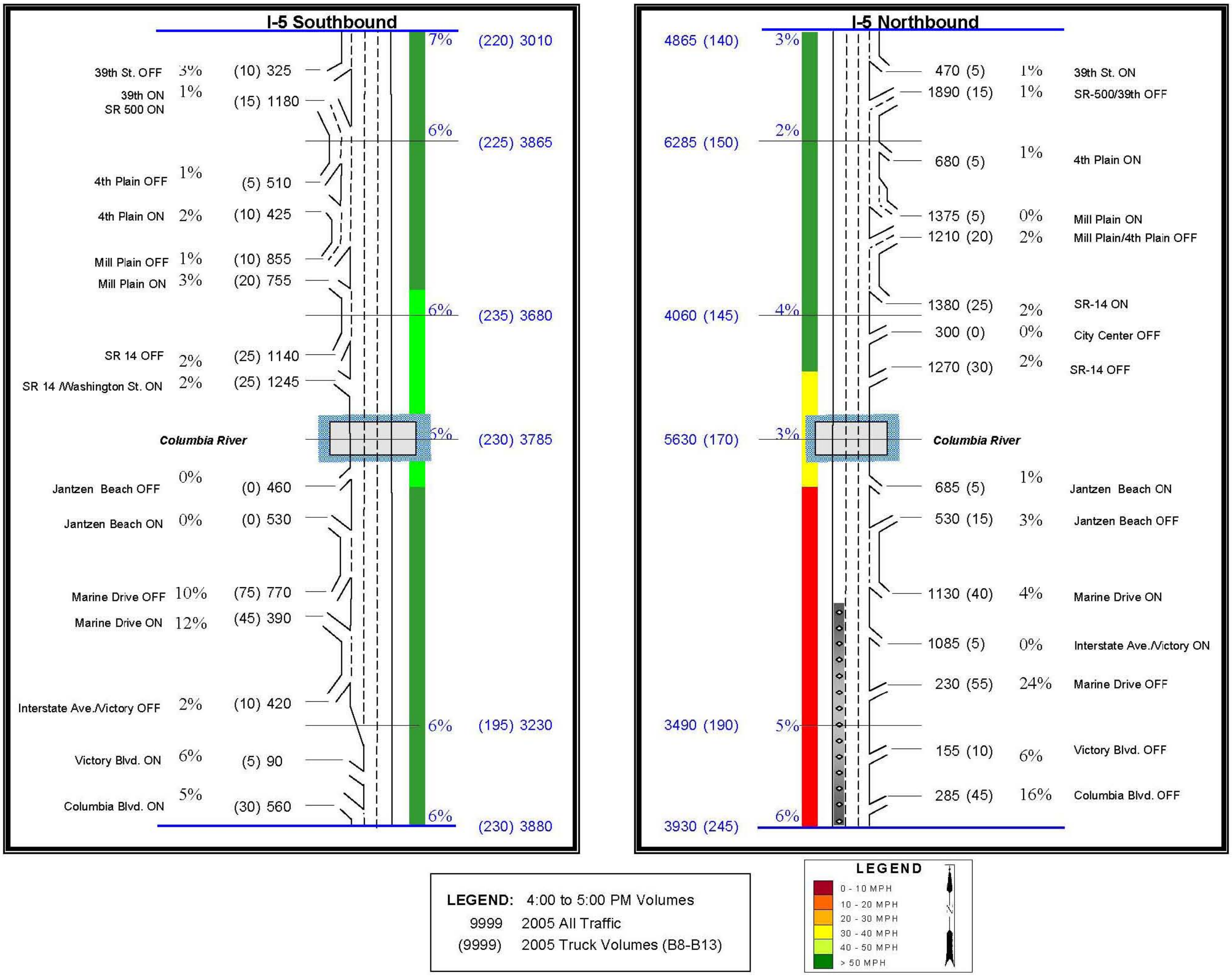
Figure 5-22. CRC I-5 Bridge Influence Area – P.M. Peak Hour Ramp Volumes



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5.3.4 What can be learned from the ramp truck volumes?

- The highest truck volumes occur at the Columbia Boulevard and Marine Drive on- and off-ramps. The truck volumes at these ramps range from 45 per hour during the P.M. peak hour to a high of 105 during the midday peak hour.
- The highest truck on-ramp volumes in Washington occur at Mill Plain Boulevard and SR 14. The SR 14 southbound on-ramp volume is 50 trucks per hour. Trucks enter at “crawl speed” due to the uphill grade, ramp curvature, and super-elevation. In addition, trucks approach the southbound mainline on an uphill grade.
- During the A.M. peak hour, there are five locations where the truck volume exceeds 10 percent of the ramp traffic, even though truck drivers prefer to travel during the midday uncongested conditions.
- Medium and heavy trucks generally merge into mainline traffic well below highway speed. For example, on a typical 1,000-foot long on-ramp with a 3 percent uphill grade, a truck that starts from a stop (e.g., from a traffic signal or stop sign) can accelerate to 29 mph before reaching the merge point. Slow-moving trucks consume much more capacity when the speed differential is the greatest. If ramp meters are used and trucks are required to stop for them, then the acceleration distance needed should account for the location of the ramp meter.

6. Truck Safety

6.1 Is the collision rate higher within the Bridge Influence Area compared to other urban highways?

The ODOT Collision Analysis and Reporting Unit in Salem and the WSDOT Collision Data and Analysis Branch in Olympia provided collision data to the CRC project office. Collision data were provided for I-5 from mile post (MP) 305.22 at the southern end of the N Lombard Street interchange in Oregon to MP 3.28 at the northern end of the Main Street/SR 99 interchange in Washington. The most recent five years of collision data is from January 1, 2000 to December 31, 2004.

Annual collision rates were compared to statewide averages for similar urban interstate highways. **Table 6-1** presents the annual collision rates within the Oregon segment from N Lombard Street in Oregon to the state line. The collision rate is reported as collisions per million vehicle miles (MVM) traveled, and calculated using the Annual Average Daily Traffic (AADT) as a weighted average between points along the corridor.

Table 6-1. Oregon Collision Rate Summary, 2000-2004

Year	Mainline Collisions[1]	Weighted Average AADT[2], Lombard Street interchange to I-5 Bridge	Average Collision Rate per MVM[3]
2000	184	107,000	1.47
2001	192	107,000	1.49
2002	190	110,000	1.49
2003	171	113,000	1.23
2004	137	112,000	1.03
Total:	**874**		**1.34**

1. *ODOT Collision Analysis and Reporting Unit, Salem*
2. *2004 Traffic Volumes on State Highways, ODOT, 2005*
3. *2004 State Highway Crash Rate Tables, ODOT, August, 2000*

Table 6-2 presents the annual collision rates within the Washington segment from the state line to Main Street/SR 99.

Table 6-2. Washington Collision Rate Summary, 2000-2004

Year	Mainline Collisions[1]	Weighted Average AADT[2], I-5 Bridge to Main Street/SR 99 interchange	Average Collision Rate per MVM
2000	173	109,000	1.32
2001	156	108,000	1.21
2002	169	110,000	1.28
2003	147	113,000	1.09
2004	168	113,000	1.24
Total:	**813**		**1.23**

1. WSDOT Collision Data and Analysis Branch in Olympia
2. *2004 Annual Traffic Report*, WSDOT, 2005

Source: *Crash Analysis Study Summary Working Paper* Final Draft 3, 2005,CRC Project

Washington and Oregon have different reporting laws for traffic collisions. From year 2000 through 2004 the minimum threshold for collision reporting in Oregon was $1,000. On January 1, 2004 this mandatory minimum threshold was increased to $1,500. In Washington, the threshold is $700, beginning January 1, 2001. The number of collisions reported in Oregon could be lower than in Washington because at the higher threshold, fewer collisions would be reported.

The average collision rate for 2000-2004 between Lombard Street and the state line was 1.34 collisions per MVM. The average for comparable urban interstates in the state of Oregon for the period of study (2000-2004) was 0.60 collisions per MVM. The BIA on the Oregon side had an average collision rate 2.26 times more than the Oregon state average for urban interstates.

The average collision rate for 2000-2004 between the state line and Main Street/SR 99 was 1.23 collisions per MVM. In Washington the 2004 average collision rate for urban interstates was 1.38 collisions per MVM. (2000-2003 was not available.) The average collision rate on the Washington segment is lower than the average urban interstate. The Washington statewide average is higher due to the influence of collision rates on Seattle area urban highways.

6.2 What types of collisions occur on I-5 in the CRC Area?

Table 6-3 reports the number of collisions by direction, fatality and injury, and collision type for I-5 from mile post (MP) 305.22 at the southern end of the N Lombard Street interchange in Oregon to MP 3.28 at the northern end of the Main Street/SR 99 interchange in Washington. The major collision types are rear-end, sideswipe, fixed object, and other. There were substantial differences in reporting of mainline and ramp collisions between the states, making a comparison of mainline and ramp collisions impossible. **Table 6-3** shows combined mainline and ramp data.

Table 6-3. I-5 Mainline & Ramp Collision Summary, Lombard St. to Main St./SR 99 (Jan. 1, 2000-Dec. 31, 2004)

			Collision Type				
Segment, Direction	**Number Fatalities**	**Number Injuries**	**Rear-end**	**Side-swipe**	**Fixed Object**	**Other**	**Number Collisions**
Oregon Northbound	1	231	468	83	14	19	584
Oregon Southbound	1	94	196	49	19	26	290
Washington Northbound	0	75	130	51	46	21	248
Washington Southbound	2	223	387	99	58	21	565
TOTAL	**4**	**623**	**1,181**	**282**	**137**	**87**	**1,687**
			70 percent	17 percent	8 percent	5 percent	100 percent

Source: Collision Analysis Study Summary Working Paper, Final Draft, 2005 CRC Project

In Oregon, the northbound collision rate is twice that of southbound collisions. Approximately 80 percent of northbound collisions in Oregon were rear-end collisions, which are indicative of heavy congestion and short acceleration and deceleration segments. Approximately 14 percent were sideswipe collisions that can be caused by short weaving and merge distances.

In Washington, there are more than twice as many southbound collisions as northbound collisions. Approximately 68 percent of southbound collisions were rear-end, indicative of heavy congestion. Approximately 18 percent were sideswipe collisions.

The three locations where both truck and other vehicle traffic collisions occurred most often within the Oregon BIA were the Hayden Island interchange, the Victory Boulevard interchange, and the northbound Lombard Street exit ramps.

The three locations where collisions occur most often in the Washington BIA (including truck collisions) were the SR 14 interchange, the weaving area from the SR 500 westbound connector ramp to I-5 southbound, and the weaving area between the southbound Mill Plain Boulevard on-ramp and the eastbound SR 14 off-ramp.

Washington southbound collisions are much more evenly distributed along the segment of highway due to the fact that weaving sections and queues backing up from the I-5 bridge bottleneck are more of an issue than in Oregon where interchange ramp acceleration and deceleration lane lengths primarily contribute to the majority of collisions

6.3 Are trucks involved in more collisions than other vehicles?

Table 6-4 shows truck-related collisions. There were differences in nomenclature for trucks in Oregon and Washington. Vehicles described as “semi tow, truck, or bobtail” in the ODOT database were counted as truck collisions. Vehicles described as “Truck Tractor, Truck Tractor & Semi-Trailer, Truck (Flatbed, Van, etc), Truck – Double Trailer Combinations, or Truck & Trailer” in the WSDOT database were counted as truck collisions.

Table 6-4. Truck Collision Summary on I-5 from Lombard St. to Main St./SR 99 (Jan. 1, 2000-Dec. 31, 2004)

			COLLISION TYPE				
Direction	**Number Fatalities**	**Number Injuries**	**Rear-end**	**Sideswipe**	**Fixed Object/ Turning**	**Other**	**Number Collisions**
Northbound	0	23	24	29	9	10	72
Southbound	1	26	47	45	4	10	106
TOTAL	**1**	**49**	**71**	**74**	**13**	**20**	**178**
			40 percent	42 percent	7 percent	11 percent	100 percent

Source: Crash Analysis Study Summary Working Paper, Final Draft, 2005 CRC Project

Notes: If two trucks are involved in one collision, this was reported as two truck collisions.

Four Oregon collisions involved more than one truck

Truck collisions are approximately 11 percent of all collisions reported on I-5 from Lombard Street to Main Street/SR 99, and are approximately equal to the proportion of truck volume to all traffic. The truck volume as a percent of total volume varies by segment, from approximately 8 percent of the traffic volume over the bridge and 12 percent of the traffic north of I-405 in Oregon. The Oregon segment has a three-year average (2002-2004) truck collision rate of 1.50 collisions per million vehicle miles traveled (VMT), slightly higher than the collision rate for all vehicles. (Source: ODOT 2004 Motor Carrier Crash Rate Tables.) Of the total truck collisions in the three-year period, 75 (42 percent) were northbound and 103 (58 percent) were southbound.

The percentage of sideswipe collisions is higher than any other type (42 percent). This could be attributed to the trucks attempting to change lanes in congested traffic as well as short acceleration/deceleration lanes and weaving sections in the BIA.

Table 6-5 and **Table 6-6** list truck collisions in the northbound and southbound directions on I-5. The truck collisions are listed for each tenth of a mile segment. This format provides a closer view of truck collisions, as well as some indication of ramp-related collisions. Note that the tables are presented in the direction of travel; so that MPs decrease in **Table 6-4** (southbound). Also, tenth of a mile segments with no collisions reported are not included in the table.

Appendix B contains two figures with collision history by collision type for the I-5 mainline through the BIA. These figures show the collision type and geometric deficiency at collision locations on an aerial photograph for all vehicles.

Table 6-5. I-5 Northbound Truck Collisions from N Lombard St. to Main St., 2000-2004

Oregon (south to north)				Washington (south to north)			
Begin MP	**End MP**	**Nearest Cross Street**	**Truck-related Collisions**	**Begin MP**	**End MP**	**Nearest Cross Street**	**Truck-related Collisions**
305.22	305.29	Exit 305A to N Lombard Street EB	1	0.00	0.09	I-5 Bridge	2
305.40	305.49	N Lombard Street and Exit 305B to N Lombard St westbound	1	0.10	0.19		1
305.70	305.79		1	0.20	0.29	SR 14 Exit 1A	1
305.90	305.99	Exit 306A to N Columbia Blvd	2	0.30	0.39	SR 14 Exit 1A	2
306.00	306.09		5	0.40	0.49	SR 14 and SR 14 Exit 1B	2
306.10	306.19		1	0.70	0.79		1
306.40	306.49	Exit 306B to N Victory Blvd	4	1.80	1.89	E 29th Street	1
306.50	306.59		1	2.40	2.49	On-ramp/aux lane from E 39th Street	1
306.60	306.69	N Victory Blvd	1	2.70	2.79	Pedestrian and Exit 3 to Main Street/SR 99	1
306.70	306.79	Exit 307 to N Marine Drive	6	2.80	2.89		1
306.90	306.99	On-ramp from N Denver Ave/N Victory Blvd	1			**Washington Northbound Total**	**13**
307.00	307.09		5				
307.40	307.49	On-ramp/auxiliary lane from N Marine Drive	4				
307.50	307.59	Oregon Slough Bridge	1				
307.70	307.79	Exit 308 to Hayden Island	3				
307.90	307.99	On-ramp from Hayden Island	11				
308.00	308.09	I-5 Bridge	8				
308.10	308.19		2				
308.20	308.29		3				
308.30	308.38		1				
		Oregon Northbound Total	**62**				

Source: ODOT Collision Analysis and Reporting Unit in Salem
WSDOT Collision Data and Analysis Branch in Olympia
Notes: If two trucks are involved in one collision, this was reported as two truck collisions.
Four Oregon collisions involved more than one truck

Table 6-6. I-5 Southbound Truck Collisions from N Lombard St. to Main St., 2000-2004

Washington (north to south)				Oregon (north to south)			
Begin MP	**End MP**	**Nearest Cross Street**	**Truck-related Collisions**	**Begin MP**	**End MP**	**Nearest Cross Street**	**Truck-related Collisions**
3.19	3.10	Main Street/SR 99	1	308.09	308.00	I-5 Bridge	1
3.09	3.00		3	307.99	307.90	Exit 308 to Hayden Island	2
2.89	2.80		2	307.79	307.70	On-ramp/auxiliary lane from Hayden Island	2
2.79	2.70		1	307.69	307.60	Oregon Slough Bridge	1
2.59	2.50		1	307.59	307.50		1
2.09	2.00	On-ramp from SR 500 at E 33rd Street	1	307.49	307.40		2
1.99	1.90		4	307.09	307.00		4
1.89	1.80	E Fourth Plain Blvd - Exit 1D	2	306.79	306.70		5
1.79	1.70		1	306.59	306.50	On-ramp from N Victory Blvd	2
1.59	1.50		3	306.49	306.40		3
1.29	1.20		1	306.39	306.30		3
1.09	1.00	E Mill Plain Blvd	4	306.19	306.10		1
0.99	0.90	On-ramp/auxiliary lane from E Mill Plain Blvd	1	306.09	306.00		2
0.79	0.70	Exit 1A to SR 14	1	305.99	305.90	On-ramp/auxiliary lane from N Columbia Blvd	4
0.69	0.60		1	305.79	305.70		2
0.49	0.40	On-ramp from SR 14 & SR 14 connector ramp	2	305.49	305.40	On-ramp from N Lombard Street	1
0.39	0.30		10	305.29	305.22	On-ramp from N Lombard Street	2
0.29	0.20	I-5 Bridge	12			**Oregon Southbound Total**	**38**
0.19	0.10		9				
0.09	0.00		6				
		Washington Southbound Total	**66**				

Source: ODOT Collision Analysis and Reporting Unit in Salem
WSDOT Collision Data and Analysis Branch in Olympia
Notes: If two trucks are involved in one collision, this was reported as two truck collisions. Four Oregon collisions involved more than one truck

Table 6-5 and **Table 6-6** identify locations with higher numbers of collisions. Northbound in Oregon at the on-ramp from Hayden Island and at the approach to the I-5 bridge, there were 11 and 8 truck collisions, respectively, higher than other locations. This also occurs southbound, immediately downstream of the SR 14 on-ramp and at the bridge approach where there were 10 and 12 collisions, respectively. These collisions included sideswipe collisions due to narrow lanes and rear-end collisions due to congestion. The bridge approach and vertical curve on the structure also present hazards for trucks due to short merge lengths and poor stopping sight distance on the bridge.

Additional locations that are notable with higher truck-related collisions are at the Columbia Boulevard ramps, the Victory Boulevard ramps, the northbound on-ramp from the Hayden Island interchange, and northbound Exit 307 to Marine Drive. The figures in **Appendix B** show the short acceleration and deceleration lanes at entrance and exit ramps, and short weaving distances.

Additional areas of concern are the SR 14 ramps (both directions) and southbound between the Oregon Slough Bridge and the on-ramp from Victory Boulevard. The SR 14 eastbound to I-5 southbound on-ramp, with its short turning radius, steep super-elevation, and uphill grade, likely contributes to the higher number of truck-related collisions at the bridge approach. There were ten collisions between mile post 0.39 and 0.30, immediately south of the SR 14 on-ramp.

6.4 When do truck collisions occur?

The number of truck collisions and all other traffic collisions are presented in **Figure 6-1** through **Figure 6-4** in four aggregated segments; northbound in Oregon, southbound in Oregon, northbound in Washington, and southbound in Washington. The notable truck collisions, in absolute number and percent are shown. Also annotated is the volume of trucks relative to all traffic (in percent) within the segment. This information is to assist with the interpretation of truck collision data specifically during the highest volume of truck traffic (midday) and during the peak direction, peak hours of traffic.

Figure 6-1 presents northbound collisions in Oregon by hour of the day to show the effects of traffic and/or truck volume. Truck collisions are higher when the volume of trucks is higher (midday) and during the northbound pear hours of congestion. However, it should be noted that the absolute volume is a small number, and so the variation in truck collisions by time of day should be reviewed with caution.

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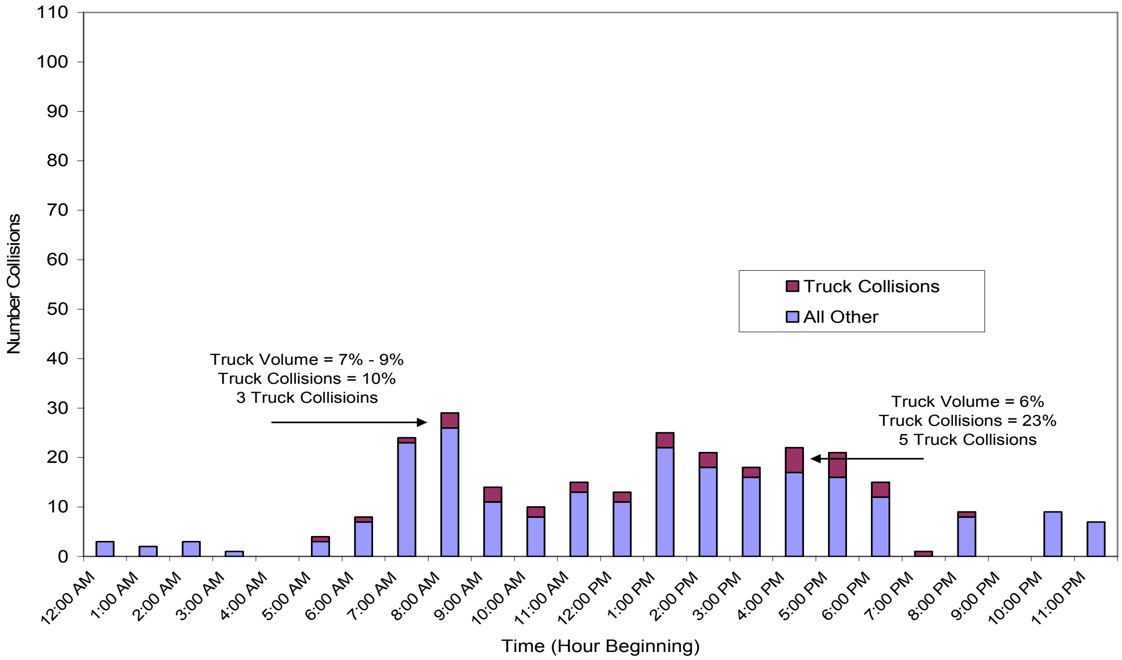
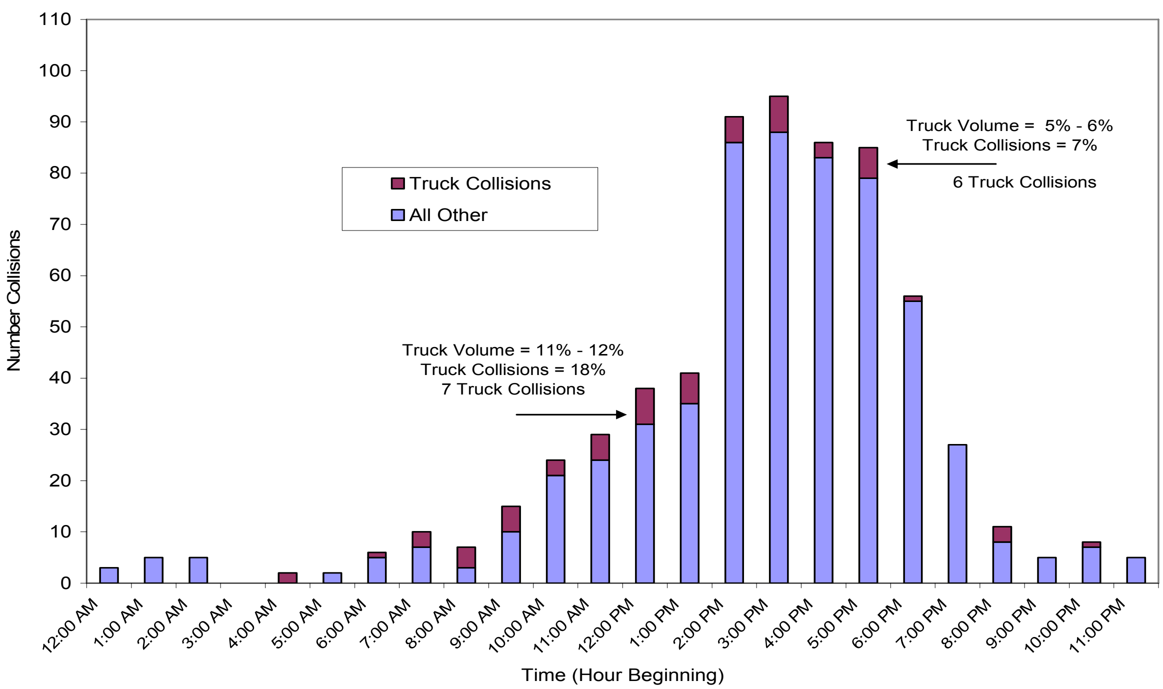
Figure 6-1. I-5 Northbound Truck and Other Traffic Collisions by Time of Day – Oregon



Source: ODOT Collision Analysis and Reporting Unit in Salem, CRC Project
Compiled by: Heffron Transportation, Inc., October 2006

Figure 6-2 shows southbound collisions within the Oregon section of I-5. Southbound volumes and truck traffic are more dispersed throughout the day (see **Figure 5-12**), as are collisions. The number of collisions is clearly lower with less congestion in the southbound direction.

Figure 6-2. I-5 Southbound Truck and Other Traffic Collisions by Time of Day – Oregon



Source: ODOT Collision Analysis and Reporting Unit in Salem, CRC Project
Compiled by: Heffron Transportation, Inc., October 2006

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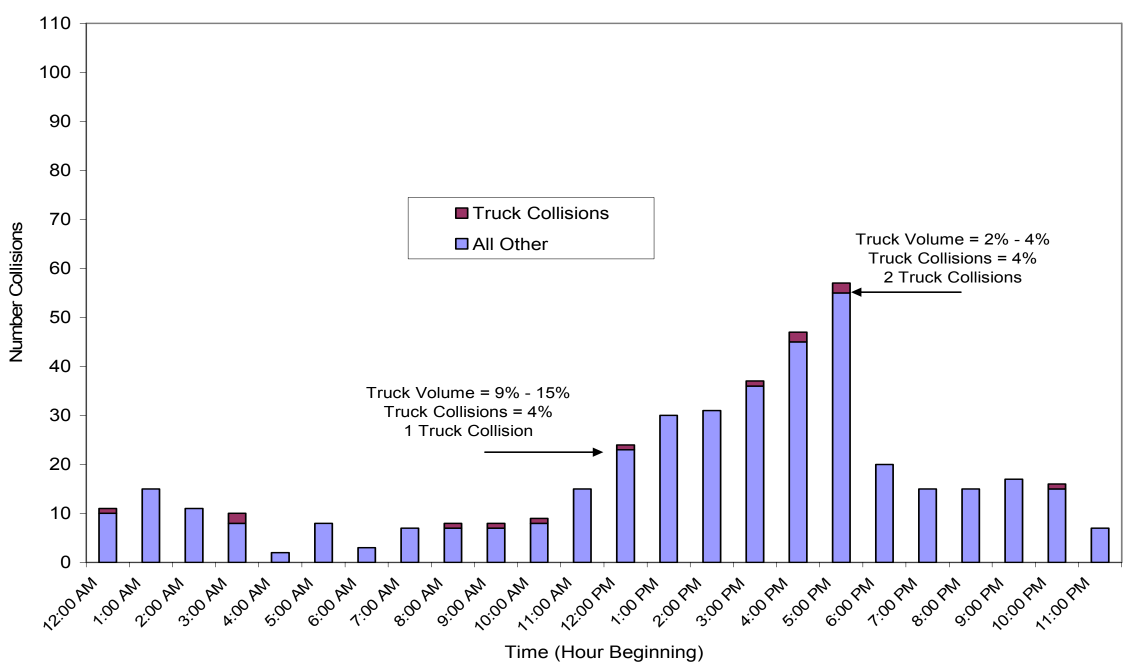
Figure 6-3 shows northbound truck and all other collisions within the Washington segment of I-5. The number of all collisions increases with increasing traffic volume during the P.M. peak period, but overall is lower than in the Oregon segment. Traffic volumes from 4:00 to 5:00 P.M. are approximately the same or slightly higher on mainline segments than mainline segments in Oregon. The lower collision volume can be explained by the greater capacity, less congestion, and a highway segment at a higher design standard. There are very few truck collisions in this segment.

Figure 6-3. I-5 Northbound Truck & Other Traffic Collisions by Time of Day – Washington



Source: WSDOT Collision Data and Analysis Branch in Olympia CRC Project
Compiled by: Heffron Transportation, Inc., October 2006

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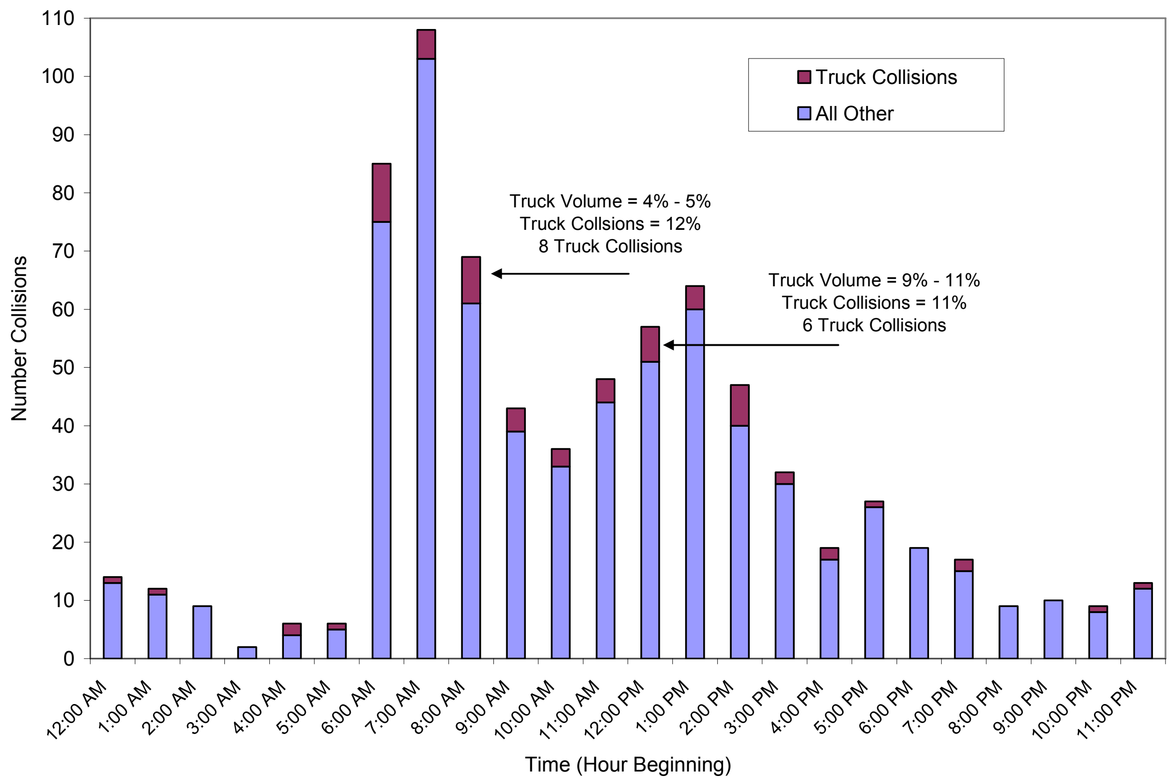
Figure 6-4 shows southbound truck and all other collisions within the Washington section of I-5. The southbound collisions are highest during the A.M. peak-period commute, similar to the northbound Oregon collision volume during the P.M. peak-period commute. Midday collisions remain relatively high. Truck collisions are highest during the A.M. peak period when the highest volumes exist and during the midday peak period when truck traffic is at its peak.

Figure 6-4. I-5 Southbound Truck and Other Traffic Collisions by Time of Day – Washington



Source: WSDOT Collision Data and Analysis Branch in Olympia CRC Project
Compiled by: Heffron Transportation, Inc., October 2006

The collision analysis shows that congestion, substandard geometrics, and the truck-passenger vehicle speed differential influence the number of truck collisions.

6.5 Do collisions increase during a bridge lift?

Bridge lifts occur for navigation and scheduled maintenance work and the average lift is approximately 26 minutes. All traffic is stopped and a queue forms, resulting in conditions of severe congestion. Bridge lifts are not allowed during the peak hours of 6:30 A.M. to 9:00 A.M. and from 2:30 P.M. to 6:00 P.M. weekdays except legal holidays. Between 2001 and 2005 there was an average of 401 lifts per year or approximately 1.1 lifts per day.

Collisions occurring weekdays, between 9:00 A.M. and 2:30 P.M., during bridge lifts and in the direction of travel towards the lift span, were compared to collisions during the same periods that were not during bridge lifts. Collisions substantially increase during a bridge lift. In the northbound direction, there were 410 percent more collisions that occurred during a bridge lift than not during a bridge lift. In the southbound direction there were 510 percent more collisions.

Rear-end collisions increased to approximately 80 percent of all collisions with a bridge lift compared to 70 percent for no lift. Rear-end collisions occur more frequently with congestion, and at the back of queues with congestion that reaches a stop condition compared to higher speeds during off-peak time periods. Sideswipe collisions comprised a smaller proportion—approximately 12 percent of total collisions during a bridge lift-compared to 15 percent without a bridge lift. It is expected that truck-related collisions would increase during a bridge lift, because truck collisions increase with increased congestion.

7. Truck Mobility Issues Identified by Users

The CRC project staff has involved the FWG with this project over the past year. The FWG has provided valuable input to the design and operation issues that trucks face when moving freight through, to, and from the region using I-5. This section presents a summary of freight mobility issues from the user's point of view—the truck drivers, trucking companies, and businesses moving freight by truck. This information is provided to educate others who have not been involved with the FWG about the issues that are of most concern to this group. The issues are summarized within three segments: south of the bridge, the bridge, and north of the bridge.

7.1 South of the Bridge

Physical and Geometric Constraints

- There are multiple short weave distances that are a challenge. One important example is Marine Drive to southbound I-5, where the on-ramp from Marine Drive to Denver Avenue is an auxiliary lane and the highway transitions from four lanes to two lanes through this segment.
- In the northbound direction, truck drivers refer to the "vehicle trap" at Jantzen Beach. Trucks enter the highway northbound from Marine Drive into a short auxiliary lane. Trucks must then change lanes quickly while traffic exiting to Jantzen Beach is using the lane to exit I-5.

Truck Trips from Truck Intensive Land Uses

- The Marine Drive interchange is very strategic for trucking due to the access to the industrial area on Martin Luther King Jr. Boulevard and Columbia Boulevard.
- The Jubitz Truck Stop and Yellow Freight terminal on Vancouver Way (with access at the Marine Drive interchange) generate large volumes of truck traffic. Northbound truck drivers prefer using Vancouver Way and southbound truck drivers prefer using Marine Drive.
- The private container yard south of Victory Drive and west of I-5 generates a lot of truck trips eastbound under I-5 and then to the southbound on-ramp at Victory Drive.

Highway Access

- Access improvements are needed to Hayden Island.
- The high volume of merging traffic at the southbound on-ramps from Hayden Island cause backups on I-5 in the morning. Merging traffic from the northbound on-ramps from Hayden Island cause a backup on I-5 in the afternoon. All of the arterials are also backed up in the afternoon. Higher capacity on-ramps are needed.
- There are back-ups at the Victory Drive southbound on-ramp to I-5.

7.2 The Bridge

Physical and Geometric Constraints

- The existing bridges are 38 feet wide and lack the option to add capacity or improve safety.
- Narrow lanes and lack of shoulders cause numerous safety concerns for truck drivers.
- Additional through lanes are needed to maintain existing capacity into the future.
- Labor and fuel costs severely restrict the option of traveling during peak period congestion. At the same time, the peak period of congestion is getting longer.
- The delays during bridge lifts increase fuel and labor costs and cause an unexpected delay or loss in daily deliveries.

Truck Trips from Truck Intensive Land Uses

- There are substantial regional industrial activities on either side of the bridge generating truck traffic.

Highway Access

- Ramps spaced too close to the bridge and to each other impact operations on I-5 and its ramps. They also cause backups on the bridge.

7.3 North of the Bridge

Physical and Geometric Constraints

- Closely spaced interchanges with short weaving distances are difficult for trucks.
- Direct ramps to and from multiple locations is a positive feature at some interchanges to maneuver (e.g., access to Fourth Plain is provided at the northbound Mill Plain interchange) that should be considered in the development of alternatives.
- The SR 14 interchange is particularly problematic for truck operations. There is a high volume of traffic from SR 14 westbound that merges with I-5 traffic. The I-5 southbound traffic is already slowed from congestion at the I-5 bridge, resulting from the high volume of traffic on I-5 southbound.
- Traffic signals and long traffic queues from SR 14 westbound and downtown Vancouver streets (Washington Street and Fifth Street) slowly meter entry to I-5 southbound. Queues on arterial streets would be shorter if the capacity to enter I-5 were improved.
- Weaving from I-5 northbound to the SR 14/City Center interchange is problematic and complicated by the weave on the exit ramp to Sixth Street, and by the traffic queue that extends from the signal at Sixth Street and Broadway-Main Street.
- The closely spaced interchanges north of the I-5 bridge cause weaving, merge and diverge problems. The Mill Plain interchange is the most compliant with standards, but even the Mill Plain spacing causes merging and weaving problems.

Truck Trips from Truck Intensive Land Uses

- The Port of Vancouver generates the majority of the region's oversized load trucks. In particular, there are frequent truck trips with oversized loads (overweight, over-width, and over-length) carrying wind turbine components to eastern Oregon and Washington. Each turbine generates nine truckloads of parts. Design alternatives must consider routes to accommodate oversized loads.
- Oversize loads (over-height and over-width) traveling through the BIA must use I-205. Design alternatives should consider accommodating oversized loads on I-5 through the BIA.
- Primary access to the Port of Vancouver is currently along Mill Plain Boulevard and this is the preferred route for trucks. Although Fourth Plain is also an option that has been considered, the current street dimensions do not accommodate oversized loads and much of Fourth Plain is residential.

Highway Access

- While there are issues with close interchange spacing, it is important to maintain all existing access to and from I-5.
- Access design is complicated by the BNSF railway mainline, the Pearson Airfield, the navigation channel, and downtown redevelopment efforts in Vancouver.
- The loop ramps from westbound SR 14 to southbound I-5 are very difficult to negotiate. The truck trailers migrate down the super-elevation as the tractor pulls forward. A four percent super-elevation that is within design standards is dangerous on tight curves. The SR 14 ramp cannot be any tighter or increase its super-elevation.
- Some ramps are up to an eight percent super-elevation, which is much too steep for trucks.

8. Potential Actions for Improving Truck Mobility

Understanding the current mobility issues for trucks provides direction to the CRC team of designers, planners, working groups, and the Task Force to develop improvements that will benefit truck mobility. Truck mobility needs are compatible with overall I-5 mobility goals. The next step is to define project alternatives, followed by evaluation of alternatives. Throughout this process, the team of designers is incorporating new information to enhance the design for truck mobility.

8.1 How will the project alternatives be defined?

In defining the full range of alternatives to be studied, the project team has drawn on recommendations from a previous related study, *Portland/Vancouver I-5 Transportation and Trade Partnership* (2002, ODOT/WSDOT), as well as new ideas that were provided by the public and affected agencies during the National Environmental Policy Act "scoping" process in October 2005. The team has developed concept-level design components for highway, transit, river crossing, bicycle, and pedestrian facilities. Freight components will be integrated to improve truck freight mobility. In addition to increasing mainline capacity, the FWG recommended the following freight strategies be considered:

- Truck by-pass lanes
- Access ramps for trucks
- Enhanced design for truck mobility

All strategies will be measured against the *Evaluation Framework*[12] to select the most effective set of strategies in each category. For example, transit components might include express bus, bus rapid transit, streetcar, and light rail systems. The best strategies from each category will then be "packaged" into different alternatives for evaluation. Each alternative will contain highway, transit, river crossing, freight, bicycle, pedestrian, and system efficiency components.

The public and affected agencies will provide input on which alternatives should be carried forward for further study. In the autumn of 2006, the public reviewed preliminary alternatives and provided input on the ones that should be considered in more detail. Engineers will refine the design of these alternatives to increase benefits and to avoid or minimize adverse impacts. The CRC project team will refine and select a limited number of alternatives for further evaluation in the draft Environmental Impact Statement (EIS). The Task Force will recommend the alternatives for consideration in the draft EIS in 2007.

[12] http://www.columbiarivercrossing.org/materials/meetingmaterials/TaskForce_031406_EvaluationFramework.pdf

8.2 What types of improvements could be considered to benefit freight?

Trucks moving freight rely on capacity and uncongested conditions to reduce travel time, improve reliability, minimize collisions, and reduce cost. The most obvious solution to increasing capacity is to increase the number of lanes on I-5 and over the Columbia River. However, given the policy and funding decisions required for this project, it is recognized that there will always be A.M. and P.M. peak periods of congestion.

The findings in this Technical Memorandum indicate that truck mobility can be improved by:

- Increasing the number of through lanes to at least preserve the existing hours of uncongested highway conditions.
- Improving the design of the eight interchanges in the BIA.
- Creating more efficient access to I-5 using truck bypass lanes and truck ramps.
- Improving the highway geometry to increase capacity and reduce the collision rate (e.g., reducing grades, ramp curves and super-elevation, and merge and weave distances).
- Reducing or eliminating the number of bridge lifts.
- Applying Transportation System Management to improve operational efficiency.

Trucks benefit whenever general-purpose traffic moves faster and general-purpose traffic benefits whenever the operational impact of a truck mixed with general-purpose traffic is minimized. Design alternatives should bring as many non-standard features as possible into compliance with standards in order to increase capacity in the corridor. Ramps with heavy truck traffic should be designed, where possible, to minimize grade and super-elevation and to maximize the speed that trucks could attain as they merge into the mainline.

8.3 How will the benefits and impacts of the alternatives be viewed by the freight community?

Key stakeholders, including the trucking and freight community, will consider the following questions when reviewing the benefit of project alternatives' transportation facilities for freight mobility.

- **Truck-Friendly Design and Geometric Features –** Would the design meet current design guidelines? Are high volume truck ramps or highway segments designed to facilitate truck movement? (For example, some ramps may be designed longer or flatter to increase the speed of trucks at the merge.)
- **Reliability –** Would the alternative preserve midday uncongested conditions? Would interruptions in traffic flow be reduced?
- **Cost of Truck-Freight Movement –** Would travel time be improved compared to No Action alternatives?

- **Capacity –** Would the alternative increase capacity? Capacity increases can be achieved by increasing the number of through lanes, improved geometry, truck-friendly design, and improved access.
- **Safety –**Would the alternative reduce the cause of existing collisions? Would the alternative design minimize the potential for truck-related collisions?
- **Access –** Would access meet the needs of truck-generating land uses and the origins and destinations of truck movement? Would the alternative meet the needs of future land use and truck activity?

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APPENDIX A - Freight Working Group

Member	Organization
Grant Armbruster	Columbia Sportswear
Steve Bates	Redmond Heavy Hauling
Bryan Bergman	Georgia Pacific
Mark Cash	G&M Trucking
Corky Collier	Columbia Corridor Association
Ken Emmons	United Road Service
Jerry Gaukroger	Boise Building Supply
Lee Johnson	Jet Delivery Systems
John Leber	Swanson Bark
Tracy Whelan	Esco Corporation

APPENDIX B – Oversize Load Permit Requirements

Oregon and Washington Permitting Requirements

	Oregon State	Washington State
Agency Issuing Permits	Oregon Department of Transportation's Motor Carrier Transportation Division. Participates in Western Regional Permit System.	Washington State Department of Transportation Motor Carrier Services Office. Participates in Western Regional Permit System
Affected Movements	All movements on state highways and the interstate system	All movements on state highways and the interstate system. (RCW 46.44.091)
Permit Application Timeframe	Over size/weight permits must be obtained prior to entering the state (except at specified entry points and under certain conditions). Users may self-issue over size/weight permits depending on their level of authorization. Requests for a Super Load permit can take up to 10 days.	Carriers may apply for selected permits online through eSNOOPI; overweight permits cannot be obtained online. Vehicles within the maximum permitted limits without special review may obtain a permit upon entering Washington State. Permits for super loads over 200,000 pounds or exceeding other permit standards require 30 days advance application. (RCW 46.44.091)
Legal Height	14 feet (ORS 818.080)	14 feet (RCW 46.44.020)
Legal Width	8 ½ feet (ORS 818.080)	8 ½ feet (RCW 46.44.010)
Legal Length	Single unit, 40 ft.; combination including load, 60 ft.; combination including a stinger-steered pole trailer, 65 ft.; truck and two trailers, 75 ft.; front overhang, 4 ft.; rear overhang, 1/3 of wheelbase for a combination. (ORS 818.080)	Single unit, 40 ft.; single trailer, 53 ft.; truck and trailer, 75 ft.; log truck and pole trailer, 75 ft overall. Two trailers, 61 ft measured from the front of the 1st trailer. Front overhang, 3 ft.; rear overhang, 15 ft. from center of last axle. (RCW 46.44.030)
Weight Allowed without Permit for Single Axle	20,000 pounds (ORS 818.010)	20,000 pounds (RCW 46.44.041)
Weight Allowed without Permit for Tandem Axles	34,000 pounds (ORS 818.010)	34,000 pounds (RCW 46.44.041)
Weight Allowed without Permit per Inch of Tire	600 pounds (ORS 818.010)	500 pounds for two-tire axles; 600 pounds for fixed steer axles (RCW 46.44.042)
Maximum Weight per Single Axle with a Regular Permit	21,500 pounds (ORS 818.010)	22,000 pounds (RCW 46.44.091)
Maximum Weight for Tandem Axles With a Regular Permit	43,000 pounds (ORS 818.010)	43,000 pounds (RCW 46.44.091)
Maximum Weight per Inch of Tire Width With a Regular Permit	600 pounds (ORS 818.010)	600 pounds (RCW 46.44.091)
Exceptions to Maximum Weight Limits	Equipment with four or more tandem axles can be allowed to have "bonus weight" exceeding 43,000 pounds, based on Oregon's weight tables. This is applied for through the same process as a regular permit, and is reviewed by the Bridge Department as necessary.	Equipment operating on single pneumatic tires with widths over 20 inches; movements on roadways constructed for such weight; necessary military movements; necessary power facility movements; and as determined necessary by WSDOT. (RCW 46.44.091)

Source: Oregon Department of Transportation, Motor Carrier Transportation Division, Over-Dimension Permit Unit:http://www.oregon.gov/ODOT/MCT/OD.shtml; and Washington State Department of Transportation, Motor Carrier Division, http://www.wsdot.wa.gov/commercialvehicle/.

APPENDIX C – Crash History by Crash Type with Geometric Deficiencies

(2 maps, one Oregon section, one Washington. 11 x 17 color)

Crash History by Crash Type for Mainline Highway
January 2000 - December 2004 with Geometric Deficiencies Delineated
Oregon

Columbia River CROSSING

Date: January 13, 2006

N

0 500 1,000 1,500 2,000
Feet

Deficiency Legend

0.0% - 33.3% 33.4% - 66.6% 66.7% - 100.0%	of standard speed change lane length (acceleration/deceleration lanes)
0.0% - 33.3% 33.4% - 66.6% 66.7% - 100.0%	of standard weaving or turning road merge lengths
0.0% - 33.3% 33.4% - 66.6% 66.7% - 100.0%	of standard horizontal or vertical stopping sight distance
0.0% - 33.3% 33.4% - 66.6% 66.7% - 100.0%	of standard shoulder width

Legend

- Rear End
- Side Swipe
- Fixed Object (OR mainline)
- Other

Crash History by Crash Type for Mainline Highway
January 2000 - December 2004 with Geometric Deficiencies Delineated
Washington

Columbia River CROSSING

Date: January 13, 2006

N

0 500 1,000 1,500 2,000

Feet

Deficiency Legend

0.0% - 33.3% 33.4% - 66.6% 66.7% - 100.0%	}	of standard speed change lane length (acceleration/deceleration lanes)
0.0% - 33.3% 33.4% - 66.6% 66.7% - 100.0%	}	of standard weaving or turning road merge lengths
0.0% - 33.3% 33.4% - 66.6% 66.7% - 100.0%	}	of standard horizontal or vertical stopping sight distance
0.0% - 33.3% 33.4% - 66.6% 66.7% - 100.0%	}	of standard shoulder width

Legend

- Rear End
- Side Swipe
- Fixed Object
- Other