Final Report

CASCADE GATEWAY RAIL STUDY

BNSF New Westminster, Bellingham and Scenic Subdivisions

International Mobility and Trade Corridor Project (IMTC)

led by the
Whatcom Council of Governments

Whatcom

Prepared by
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in association with
Reebie Associates
BST Associates
Washington Infrastructure Services
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December 20, 2002

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Executive Summary
CASCADE GATEWAY RAIL STUDY

PROJECT OVERVIEW

This study is a conceptual analysis of how congestion on the Cascade Gateway highway corridor might be relieved by diversions of truck and motor vehicle traffic to rail. The highway system consists of U.S. Interstate 5 and B.C. Highway 99. Paralleling these two highways is the main line of the Burlington Northern and Santa Fe Railway (BNSF).

This rail line, known as the Cascade Gateway rail corridor, hosts a moderate amount of cross-border traffic today. Given its direct route, moderate speeds, and connections to other lines to major markets to the south and east, the 156-mile route between Seattle and Vancouver has the potential for attracting more highway traffic, thus the potential for relieving some of the congestion at Blaine.

Accordingly, the purpose of this study has been to identify:

- The truck traffic that could be attracted to the line (and thus diverted from the highway system).
- The passenger traffic that could be attracted to the line (and thus diverted from the highway system).
- The minimum capital investments needed to handle the train traffic increases due to highway diversions.
- The economic and societal benefits that would result from the diversions.

At the same time, the study investigated the potential for a cross-border commuter rail service operating between Bellingham and Vancouver, and an Amtrak station at Scott Road in Surrey. The latter would provide for a transfer to SkyTrain at Scott Road.

HOW THE STUDY WAS DONE

To accomplish these objectives, the study team performed six essential analyses.

- ***Truck diversions and normal rail traffic growth.*** The team forecasted the cross-border truck traffic on the I-5/Highway 99 corridor at Blaine. The team then estimated the diversions that could be expected for the rail corridor, given assumptions of certain capacity and service enhancements. The key service improvement is initiation of truck competitive "high cube double-stack"[1] intermodal services between Vancouver and Southern California. The diversions totaled about 2 trucks per hour in both the northbound and southbound directions in 2012. At the same time, the team forecasted the normal

[1] These terms are defined in Chapter 2.

growth of the line's traditional carload business. This will increase more than 50 percent to 9.33 million tons in 2012 from 6.03 million tons today.

- ***Motor vehicle diversions.*** The team forecasted the passenger trips that could be expected given the assumption of expanded Amtrak *Cascades* service between Seattle and Vancouver. The study assumed that these trips would be made otherwise by motor vehicles. With two additional round trips, total corridor rail passengers should be about 362,000 in 2012, up from about 137,000 today.
- ***Capacity improvements.*** The team analyzed the minimum capacity improvements needed to handle the new freight (the truck diversions and the increase in carload business) and passenger rail traffic. Six specific improvements were identified; these total about $38.6 million. This total included vertical clearance improvements to handle high cube double-stacks on the route. However, there remain other vertical clearance obstructions for this traffic on the BNSF and UP routes to the south. (UP has the right to market rail service in Vancouver; BNSF provides haulage for UP between Vancouver and UP's railhead in Seattle. Both railroads have routes between Seattle and Southern California.)
- ***Diversion benefits.*** The team quantified the accident, congestion, energy, and air pollution savings that would result from diversions of truck and motor vehicle traffic from the highway system to the rail corridor. Annual benefits from these diversions could total as high as $2.7 million in 2012.
- ***Commuter rail service.*** The team assessed the potential of a cross-border commuter rail service operating between Bellingham and Vancouver. The analysis identified a ridership potential of 288 daily passenger trips, a public operating subsidy of $1.1 to $2.4 million per year, and a minimum of about $35.5 million start-up capital.
- ***Scott Road Amtrak station.*** Serving as a terminus for the Amtrak Cascades, this station would obviate the need for any capital improvements for passenger service between New Westminster and Downtown Vancouver. However, it would require Vancouver-bound passengers to transfer to SkyTrain. Preferences of Amtrak riders are unknown. Construction costs would total about $14.1 million.

RECOMMENDATIONS

The findings dictated the following recommendations:

- ***Pursue the extension of the second the Amtrak Cascades train from Bellingham to Vancouver, perhaps as soon as 2004.*** Introduce a third train by perhaps 2008. The ridership potential appears to exist to justify this expansion.
- ***Working with the BNSF and other freight rail operators on the line, identify and construct rail improvements necessary to support the second Amtrak Cascades train to Vancouver.*** These improvements would include the controlled siding at Colebrook and CTC between Blaine and Townsend.
- ***Study the feasibility of eliminating all vertical clearance obstructions for high cube double-stack trains on the BNSF and UP rail lines paralleling I-5 between Seattle and Los Angeles.*** The cost for doing so is reportedly around $20 million.

- ***There is no need of a commuter rail service between Bellingham and Vancouver (either Pacific Central Station or Waterfront Station).*** The ridership likely would be very low. At the same time, the required subsidy and capital improvements likely would be very high.
- ***Survey Amtrak riders to determine their origin and destination patterns in Vancouver, as well as their interest in using a Scott Road station and a SkyTrain transfer.*** The survey would be crafted to test further the feasibility of an Amtrak stop or terminus there.

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Chapter 1
INTRODUCTION

1.1 PURPOSE OF THE STUDY

The principal highway system between Seattle, WA and Vancouver, BC – Interstate 5 and Highway 99 – is experiencing increasing truck and motor vehicle traffic. This traffic is causing recurring delays at the border crossings at Blaine, WA. The highway route has a parallel rail route – the Burlington Northern and Santa Fe Railway (BNSF) main line known as the Cascade Gateway rail corridor. The underlying question behind this study is, how much of the road traffic can possibly be diverted to the railroad main line?

The primary purpose of this study is to identify the freight and passenger rail traffic which could be attracted to the BNSF line over the next 10 years. Once that traffic is identified, the study determines the minimum capacity improvements needed to handle this traffic. As these improvements may require public sector investment participation, the study quantifies the economic and societal benefits of these investments.

There were two secondary purposes of the study. One was to assess the potential of a cross-border commuter rail service running between Bellingham, WA and Downtown Vancouver. The other was to assess the potential of a Scott Road Amtrak station in Surrey. The interest in such a station is driven by two factors. These are 1) previous discussions about expensive capital improvements between New Westminster and Pacific Central Station for more passenger trains, and 2) delays caused by the opening of the New Westminster Bridge over the Fraser River for maritime traffic. Were the station to serve as the Amtrak *Cascades* trains' northern terminus, passengers could transfer to an adjacent SkyTrain station for furtherance to Downtown Vancouver. The study defines how trains might serve the station and the capital improvements required to build it.

1.2 STUDY PROCESS

The study's first effort was to determine the cross-border freight that the BNSF New Westminster, Bellingham and Scenic Subdivisions will handle between 2002 and 2012. This traffic consists of traditional railroad carload business, predominantly oriented southbound. The next step was to determine cross-border truck traffic on the parallel highway system. The third step was to forecast how much of the highway traffic might divert to rail with improvements in rail service. The critical improvement would be implementation of truck competitive double-stack intermodal service to and from Vancouver. Double-stack service and its impacts are defined in ***Chapter 2.***

The second step was to estimate the increase in passengers that would likely happen with the expansion of the popular Amtrak *Cascades* service. The rail corridor today hosts one round trip between Seattle and Vancouver, and another between Seattle and Bellingham. The analysis assumes that the latter would be extended in 2004 and a third round trip added in 2008. The service expansion and the rise in ridership are detailed in ***Chapter 3.***

The study also determined the number of commuters that might ride a cross-border commuter rail service operating between Bellingham and Vancouver. This weekday peak-period service would offer two northbound trains in the morning and two southbound trains in the afternoon. The study quantified the likely ridership, revenue, operating costs and capital costs of this service. Details of this concept appear in ***Chapter 4.***

Given scenarios of more freight and passenger trains (exclusive of the commuter trains), the study then determined the minimum capital improvements needed to operate these trains efficiently on the Cascade Gateway rail corridor. These improvements and their attendant costs appear in ***Chapter 5.***

The pre-feasibility assessment of the Amtrak Scott Road station followed. The analysis looked at the station both as a terminus for the Amtrak *Cascades* as well as an intermediate station stop. Station requirements, capital costs, and impacts on the surrounding area are all elements of the analysis in ***Chapter 6.*** Serving as a terminus, passengers bound for Downtown Vancouver would transfer to SkyTrain. In order to understand the viability of the remote Scott Road Amtrak station, experiences at two potentially peer remote passenger stations were reviewed. These stations were Emeryville, serving San Francisco, and Ottawa.

Chapter *7* assesses the economic and societal impacts of truck and motor vehicle diversions to the Cascade Gateway rail corridor. The accident, congestion, energy, and air pollution savings are the subject of this chapter and are quantified in dollars. Lastly, the key findings of this study and the recommendations that flow from them appear in ***Chapter 8.***

1.3 AGENCIES AND OTHER ENTITIES CONSULTED

Throughout the course of this study, the consultant team contacted numerous agencies and private entities for input relevant to the current and future operation on the Cascade Gateway rail corridor. These agencies and private entities were:

- Representatives for the freight operators on the Cascade Gateway rail corridor. These included representatives of the Burlington Northern and Santa Fe Railway, BC Rail, Southern Railway of British Columbia, Canadian Pacific Railway, and Canadian National Railway. Each of these entities provided insight on their future freight train volumes on the corridor. These insights were helpful in developing the freight train volume forecasts for 2002-2012.

- Representatives of passenger operators on the corridor. These included Amtrak and VIA. These operators provided insight on their future passenger train volumes on the corridor. These insights were helpful in developing the passenger train volume forecasts for 2002-2012. The Seattle-area Sounder commuter rail service was also contacted, as this service will operate trains on the corridor in the near term.

- The Greater Vancouver Transportation Authority (GVTA), which provided home-to-work trip data in the Vancouver area. These data were essential in estimating the ridership potential for a commuter rail service Bellingham-White Rock-Surrey-Vancouver. The GVTA was also helpful in providing insight on the potential development of a Scott Road Amtrak station, and SkyTrain interchange, in Surrey.
- The Vancouver-area *West Coast Express* commuter rail service, which provided insight on how a Bellingham-Vancouver commuter rail service might access the Vancouver Waterfront Station.
- Members of the International Mobility and Trade Corridor (IMTC) Rail Subgroup provided feedback on the various work products developed through the course of this study. The study team met with the Rail Subgroup in April to discuss the study approach and in June to discuss the preliminary freight and passenger forecasts. Members of the Subgroup are noted in Appendices.

Amtrak provided the study team with a ride in the rear cab of an Amtrak *Cascades* train set on its run between Seattle and Vancouver. A BNSF operating officer attended with the study team members. This trip was invaluable in confirming details of the existing rail traffic, track configuration, signalization, and other detail essential in developing an assessment of the minimum capacity improvements needed to handle forecasted volume of freight and passenger trains.

Chapter 2
RAIL FREIGHT FORECASTS

2.1 INTRODUCTION

This chapter summarizes forecasts for rail freight movements through the Cascade Gateway over the period between 2002 and 2012. The forecasts were developed and discussed in two documents prepared during the course of the study: "Cascade Gateway Freight Demand Analysis" and "Cascade Corridor Port-related Rail Traffic Analysis", which appear in the Appendices. The forecasts are used in Chapter 4 as a basis for determining minimum capacity improvements needed and in Chapter 5 for determining the economic and societal benefits diverting truck traffic. The rail capacity investments potentially would lead to diversion of freight movements from highway to rail, with a consequent decrease of traffic on the often-congested parallel highway system.

2.1.1 Study Area

The study area for this project is Seattle to Vancouver, British Columbia. The particular area of emphasis for the analysis is on the portion of rail corridor between Everett and Pacific Central Station in Vancouver, as this is where the major constraints for expanded rail activity are. Planned track improvements south of Everett should be sufficient to handle the increases in rail activity there.

2.1.2 Methodology

The focus of the freight rail forecasts is on traffic carried on BNSF across the U.S./Canadian border at Blaine, Washington. This is because these BNSF through train operations parallel the existing highway system – Highway 99 and Interstate 5 – and offer the potential for diversions of truck movements on those highways.

The first step in the forecasts was to quantify existing rail and truck international through traffic crossing the border. Base year data were estimates of 2002 rail and truck through traffic measured in tons. Year 2012 rail tonnages were then estimated, given the likely growth trends in existing rail-borne commodities and assumptions about truck-competitive rail services, i.e. intermodal "double-stack" trains[1]. Tonnages were then translated into estimates of trains per day in 2012. These train counts are used in Chapter 4 to determine the rail capacity improvements required to support them.

Future port-related rail movements were also investigated to determine their likely impact on corridor capacity in the area of emphasis, i.e. Everett to Vancouver. Also, other freight operators

[1] Double-stack trains are unit trains of articulate cars (five units to a car) that have the ability to carry containers one on top of another, ergo the name "double-stack". Double-stack service has proven itself competitive with truck service in terms of travel time, reliability, and price, especially in corridors greater than about 500 miles. Double-stack trains have operated in such long-haul corridors as between Seattle and Chicago and between Los Angeles and Chicago, and have succeeded in attracting truck traffic off parallel highways. Double-stack trains are further defined on page 4.

on the line were contacted to learn of their operations, their future traffic volumes, and the likely impacts to corridor capacity.

2.1.3 Forecast Summary

The BNSF is the only freight operator through the entire length of the study area. At present in the area of emphasis, Everett to Vancouver, there are about six through freight trains a day running on the BNSF line and crossing the U.S./Canadian Border at Blaine. At the north end of the line, most of these trains originate and terminate in the Canadian National Railway's Thornton Yard in Surrey, east of the Fraser River Bridge. The remaining trains originate and terminate in BNSF's New Westminster Yard (also known as Sapperton), just north of the bridge.

By 2012, trains could total between 8 and 10 per day, assuming implementation of intermodal double-stack container trains and the improvements to support them. Also in that year, there likely will be at least six Amtrak *Cascades* intercity passenger trains operating through the study area. Amtrak's Empire Builder and Sounder commuter trains will operate on the corridor, but only south of Everett. Sounder service will start in 2003.

In addition to BNSF and Amtrak, there are several operators on the line. These include the Southern Railway of British Columbia, Canadian Pacific Railway, Canadian National Railway, BC Rail, VIA Rail Canada, and Rocky Mountain Rail Tours. However, none of these carriers crosses the U.S./Canadian border, provides alternatives for attracting international through traffic, or offers the potential for helping to relieve truck and motor vehicle congestion on Highway 99 and Interstate 5 or at the land-border ports-of-entry where they join. All of these carriers run on various portions of the BNSF line north of Colebrook (Mud Bay).

2.2 RAIL FREIGHT FORECAST

2.2.1 Freight History and Background

The Cascade Gateway rail corridor runs between Seattle, WA on the south and Vancouver, BC on the north. The line is about 156 miles long and belongs to the Burlington Northern and Santa Fe Railway. The line appears in Figure 2-1.

The particular emphasis of the Cascade Gateway Rail Study is the 122-mile segment of the rail line between Everett (PA Junction) and Vancouver (Pacific Central Station). This is because improvements planned for additional passenger service (commuter and intercity services) between Everett and Seattle will restore double track in that segment, and double track there will ensure sufficient capacity for new rail freight business. The chief concern of the study, given forecasts of increasing freight and passenger volumes, is the capacity of the rail line north between Everett and Vancouver, where the track configuration will continue to be single track with occasional sidings.

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Figure 2-1
CASCADE GATEWAY RAIL CORRIDOR

BNSF currently operates about 6 through trains a day between Everett and Seattle, and 12 local freight trains. The locals serve industries along the line and on branch lines off the main line. The through trains in 2002 will carry a total of 6 million tons of freight, predominantly in the southbound direction. Union Pacific Railroad (UP) has an agreement with BNSF that allows it to market its services to shippers along this line to and from points in several western states[2]. Under the terms of this agreement, BNSF handles cars from points on this line to an interchange with UP in Seattle; no UP trains *per se* operate on the corridor. BNSF/UP interchange tonnage is included in the 6 million ton figure for 2002.

2.2.2 Forecast of BNSF Through Trains between Everett and Vancouver, BC

Study team member Reebie Associates performed the forecast of cross-border rail freight volumes on the corridor. Reebie's effort, "Cascade Gateway Freight Demand Analysis", appears as Appendix A. This analysis studied both truck and rail volumes in tons over the Cascade Gateway, and forecasted shipments by origin, destination and commodity through Year 2012. A description of the forecasting methodology appears in the document. The rail volumes forecast by Reebie are summarized in Table 2-1 below.

Table 2-1. Rail Freight Traffic Forecast

Year	Southbound Tons	Northbound Tons	Total Tons
2002 base year	5.62 million	.41 million	6.03 million
2012 standard	8.72 million	.61 million	9.33 million
2012 likely	8.91 million	.76 million	9.67 million
2012 optimistic	9.01 million	.83 million	9.84 million

Source: Reebie Associates

The table uses 2002 as the base year. This 2002 estimate is based on actual tons shipped for 2000 increased by a normal growth factor per individual commodities. Netted out of the 2000 total were one-time northbound shipments of rip-rap to Roberts Bank for expansion of the port facility there[3]. The rail freight travels in "carload service", which means conventional boxcars, flat cars, tank cars, gondolas, etc. It differs from intermodal service, which handles containers and trailers on flat cars or in double-stack cars.

The "standard" forecast assumes normal growth per commodity northbound and southbound through Year 2012. As previously noted, the current volumes are handled by three round trips (or six through trains) per day. The 9.33 million tons forecast for 2012 could be handled by four round trips (or eight through trains) per day.

[2] UP/SP Proportional Rate Agreement, signed between UP and BNSF in May of 1997. This agreement was concluded as part of the BNSF and UP/SP settlement, by which BNSF supported the 1996 UP/SP merger. The agreement specifies that UP can quote rates to shippers along the Cascade Gateway rail line to/from points in Oregon, California, Nevada, Utah, Colorado, Arizona, and New Mexico, and western Texas. BNSF will haul cars between these shippers and UP. For the haulage, BNSF gets part of the rate.

[3] This is Deltaport, a coal and marine container intermodal facility belonging to the Port of Vancouver. It is referred to as Roberts Bank throughout this document.

The 2012 "likely" and "optimistic" forecasts assume the implementation of double-stack intermodal train service on the corridor[4]. Intermodal transportation would be a new rail service product offering on the corridor. It would be in addition to carload service, whose growth is reflected in the standard forecast. The service will require new equipment (cars and car loading devices) and new configurations at yards whereby intermodal containers can be loaded on and off double-stack cars. This would most likely happen at New Westminster.

Typical Double-Stack Train

Double-stack trains consist of a string of a single car type, i.e. multi-unit articulated cars, in which container boxes are stacked one on top of another. Double-stack trains carry "marine" containers between ports and inland destinations, as well as "domestic" containers between load centers that are not connected specifically with any port. Double-stack trains have succeeded in attracting freight which had previously traveled by truck, due to cost and even transit time savings, in various markets throughout North America. The likely and the optimistic scenarios assume double-stack service on the corridor because such service presents the best opportunity for growth in Cascade Gateway rail tonnage above normal carload growth. While containers can be handled on flat cars or single level, multi-unit articulated cars (called "spine" cars), double-stack services offer greater cost advantages for shippers and, therefore, have had better success in attracting shipments from trucks on highways.

Implementation of double-stack trains on the corridor also assumes two key prerequisites. One is that the double-stacks operate beyond Seattle to other markets on the West Coast, including Southern California. The other is that vertical clearances in tunnels are improved to permit these movements. The latter is because double-stack trains carrying containers 9'6" high (known as high cube containers) require higher clearances than typical carload trains. Currently, there are vertical clearance obstructions for high cube double-stack trains in the Chuckanut tunnels on the Cascade Gateway rail line, as well as on BNSF and UP in southern Oregon and northern California.

Assuming the implementation of double-stack trains, Reebie forecast that 9.67 million and 9.81 million total tons (including carload and intermodal double-stack tons) could be handled on the corridor. This calculation required the quantification of truck movements by commodity through 2012 and the diversion potential for double-stack service. This was done on a commodity-by-commodity basis. Overall, the diversions (either "likely" or "optimistic") result in a comparatively small increase in total tons. Likely diversions were 10 percent of total divertible

[4] The likely and optimistic forecasts comprise the enhanced rail forecasts specified in the scope of work. The new and improved facilities forecast, which was also specified in the scope, would be driven by improvements at corridor area ports. The resulting traffic growth is captured in the port-related traffic forecasts, which are discussed in a subsequent section of this document.

tons, and optimistic diversions were 15 percent of total divertible tons. These could be handled with two round trips (four double-stack trains) per week. Thus, on a given day in 2012, there may be as many as 8 to 10 through trains on the corridor, assuming a double-stack round trip occurs on a single day. This is a 40 percent increase in corridor through trains from today. The additional trains that could run on the corridor in 2012 appear in Table 2-2.

Table 2-2. Train Volume Forecast

Type of Train Service	2002	2012
Carload Trains	6 trains per day	8 trains per day
Double-stack Trains		4 trains per week

Source: Reebie Associates and WSA

Overall, the majority of the increase in trains will be a result of the normal growth of carload traffic. Annual carload trains in 2012 will total about 2,900, and annual double-stack trains will total about 200, or less than a tenth of carload trains.

In addition to these through trains, BNSF operates 12 local freight trains on this segment of the line. This volume likely will remain the same over the 10-year study period. These local operations have lesser priority than through freights and passenger trains. Also, most through freight trains tend to operate at night and locals during the day. Many of these locals work branch lines and yards, as opposed to the main line, for most of their shifts. So they are not likely to have much effect on corridor capacity for the through freight and passenger trains. Approximately on a monthly basis, BNSF delivers unit trains of coal to Roberts Bank for export. BNSF has access to the BC Rail line that enters Roberts Bank coal export facility (see BC Rail discussion below).

2.2.3 Other Freight Rail Operators between Colebrook and Vancouver

Other operators on the corridor, a brief sketch of their operations, and likely volumes over the study period are as follows. None of these operations is likely to have a significant impact on capacity on the corridor between Everett and Vancouver. They pertain to various portions of the corridor only north of Mud Bay. The notable capacity constraint is the single track Fraser River Rail Bridge, which is used by all of these carriers and BNSF.

- ***Southern Railway of British Columbia (SRY)***. BNSF runs a switcher into the SRY Trap Yard in New Westminster daily. To do this, BNSF runs from its New Westminster Yard onto the Canadian Pacific Railway's (CP) track running under the Fraser River Bridge to Trap Yard west of the bridge. SRY interchanges 10 to 20 cars daily there. SRY uses the New Westminster rail bridge to reach its track on the Surrey side. SRY has an approach to the bridge from Trap Yard. SRY has 8 movements across the bridge Monday through Friday, four movements on Saturday, and 6 movements on Sunday. SRY traffic is carload traffic. SRY estimates growth at about 2 percent per year. SRY trackage can be seen in Figure 2-2.

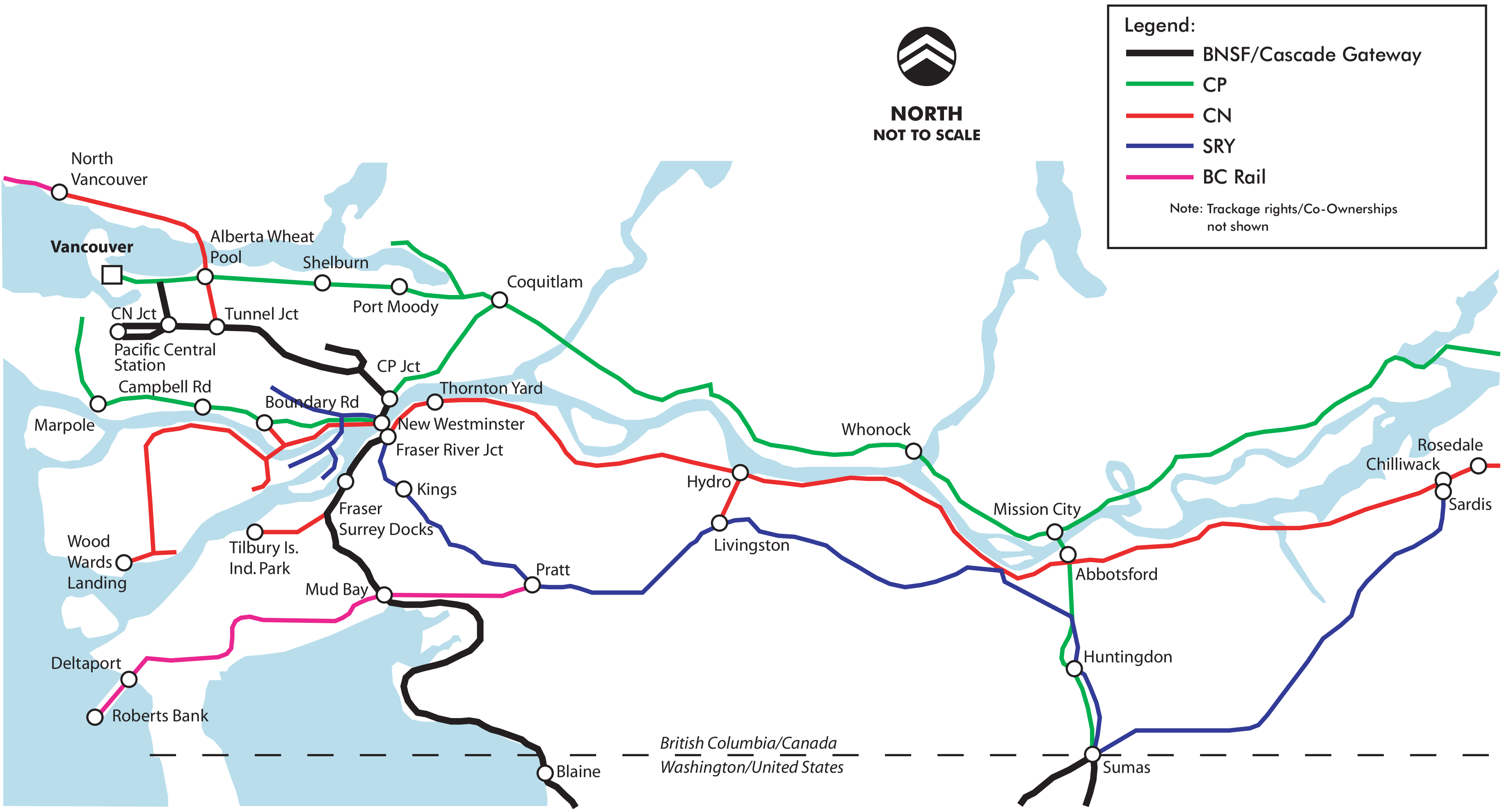

Figure 2-2
RAIL LINES IN SOUTHERN BRITISH COLUMBIA
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Vancouver. The first is from its interchange with BNSF at CP Junction (northeast of New Westminster) to Tunnel Junction (Willingdon). CP has trackage rights on this line. However, Canadian National (CN) hauls the CP traffic. From Tunnel Junction, the traffic travels on CN to North Vancouver industries and an interchange with BC Rail. CP traffic handled on this segment of the BNSF corridor totals 2 trains per day in each direction. The traffic is carload traffic.

The second flow is from CP Junction, across the New Westminster Rail Bridge to Fraser/Surrey docks (Fraser Port Authority) and Tilbury industrial park. CP calls its operations on this segment of track the New Westminster Subdivision. CP has trackage rights from CP Junction to Tilbury Island Industrial Park. From the bridge to Townsend, the line is all BNSF. The branch line from Townsend west to Tilbury, the line is owned jointly by BNSF and CN. CP runs its locomotives and crews to and from CP Junction. Traffic is carload traffic to Tilbury, and intermodal traffic (spine and double-stack cars) to Fraser/Surrey docks. There are 2 trains a day in each direction: 1 round trip New Westminster to Tilbury, and 1 round trip New Westminster to Fraser/Surrey docks. CP expects traffic in the next 10 years to be similar in type and volume as to what it is today.

The third flow is across the eight-tenths of a mile of the BNSF rail line at Colebrook to access the Roberts Bank via trackage rights owned by BC Rail (see below). CP hauls both intermodal container and coal unit trains to Roberts Bank. CP comes on to BC Rail to the east at Pratt. (CP and the Canadian National Railway have trackage rights on the SRY to/from Pratt.) Volumes of CP trains in and out of Roberts Bank were not available from CP at the time of this writing. However, it is reasonable to assume that they are similar to Canadian National Railway traffic patterns there. These are noted below.

- ***Canadian National Railway (CN)***. There are two main flows of CN trains that touch the corridor. The first is from Thornton Yard to Tunnel Junction (Willingdon) in Vancouver. CN operates its own trains, and hauls CP traffic between CP Junction (near New Westminster) and Tunnel Junction. Traffic includes both intermodal containers and general carload traffic. Intermodal traffic is to/from Burrard Inlet port facilities, and carload traffic is interchanged with BC Rail at North Vancouver and with CP along Burrard Inlet. Including haulage of CP and BC Rail carload traffic, CN operates a total of 24 trains (or 12 round trips) per day on this segment, the majority of which are carload trains. Carload traffic should grow at about 2.5 percent per year, while intermodal shipments out of Burrard Inlet may remain somewhat flat due to constrained capacity there.

  CN also hauls coal and intermodal unit trains to Roberts Bank. Like CP, CN comes on to BC Rail to the east at Pratt, and runs for eight-tenths of a mile on BNSF at Colebrook. CN hauls about 4 coal trains (or 4 round trips) per week into Roberts Bank. CN typically has 1 round trip intermodal train per day at Roberts Bank. Coal volumes appear to be diminishing. However, intermodal volumes are expected to grow at Roberts Bank at about 3-5 percent per year.

- ***BC Rail.*** BC Rail, a Crown Corporation, owns the Port Subdivision line running 23 miles from Pratt to Roberts Bank. The subdivision runs on the BNSF main line for eight-tenths of a mile at Colebrook. BC Rail runs none of its own traffic on the subdivision, and CN and CP have operating rights. BNSF also has operating rights on the subdivision to

Roberts Bank. BC Rail maintains and dispatches the subdivision, and it controls dispatching on the eight-tenths of a mile of the BNSF main line at Colebrook. There is a BC Rail siding that parallels the BNSF line at Colebrook, which CN and CP can use when the BNSF line is occupied. The siding is east (or north) of the BNSF main line, and crosses the BNSF main line at its north end. BNSF has its own 2,400 siding on the west side of the main line at Colebrook. BC Rail provides CN, CP, and BNSF access to the Port Subdivision on an equal or impartial basis.

2.2.4 BNSF Through Trains between Everett and Seattle

Because of the capacity improvements that have either been made or are planned to host commuter and intercity passenger services, this 34-mile segment of the rail corridor between Everett (PA Junction) and Seattle (King Street Station) is not the emphasis of this study. The improvements are aimed at restoring the route's former double track configuration, allowing for large numbers of freight and passenger trains. The route today hosts 15 intermodal trains on a typical day. Intermodal volumes will be tied in large part to the growth in Seattle and Tacoma port traffic. As intermodal train volumes in Seattle and Tacoma are related for the most part to international maritime traffic, it is reasonable to expect that intermodal trains will increase at similar rates. A mid-range growth rate estimated for the ports for their loaded and empty container traffic is about 43 percent over the 10-year period. Accordingly, there might be as many as 21 intermodal trains per day on this segment in 2012, or 7,600 for the year. Port-related rail traffic is the subject of the following section.

There also are 8 carload trains on this corridor on a typical day. These can be expected to grow at rates similar to those forecast for Everett-Vancouver carload traffic. The growth would translate into about 12 trains per day or 4,300 trains per year on this segment.

BNSF also operates 2 garbage trains along with nine local trains, work trains, and road switchers on this segment of the corridor on a typical day. Logically, the former would correlate with the growth in population. As for the other trains, their volume likely will remain the same over the forecast period.

2.2.5 Port-related Rail Traffic Forecast

Port-related traffic is a major component of rail shipments on the corridor between Seattle and Everett, but it is a minor component of rail shipments on the corridor north of Everett. The Cascade Gateway Rail Study investigated port-related rail traffic in an effort to understand the likely impacts of this traffic on corridor capacity over study's 10-year planning horizon. Study team member BST Associates prepared forecasts for the specific ports and assessed their impact on capacity in the corridor. BST identified three types of port-related rail traffic: containerized freight, non-containerized freight, and in-transit freight. Forecasts for each of these freight types and the implications for capacity are discussed below.

Containerized Freight Forecast

BST developed forecasts for the four container handling ports on or near the Cascade Gateway rail corridor. These are Seattle, Tacoma, Vancouver and Fraser Port – the first three being the major container ports. The methodology and assumptions driving these forecasts are discussed in BST's analysis, "Cascade Corridor Port-related Rail Traffic Analysis", which appears as Appendix B. The forecasts appear in Table 2-3 below.

Table 2-3. Forecast of Container Movements (Loaded and Empty TEU[5])

Forecast	Year	Seattle	Tacoma	Vancouver	Fraser
Low	2002	1,593,693	1,473,552	1,245,848	71,463
Low	2007	1,874,545	1,733,513	1,505,989	86,113
Low	2012	2,187,052	2,022,409	1,868,187	106,623
Medium	2002	1,596,577	1,476,436	1,268,630	72,889
Medium	2007	1,904,332	1,761,125	1,609,153	92,559
Medium	2012	2,282,674	2,110,569	2,103,551	121,163
High	2002	1,643,421	1,519,400	1,279,447	73,586
High	2007	2,063,977	1,908,297	1,672,709	96,257
High	2012	2,532,204	2,341,128	2,286,269	131,593

Source: BST Associates

The table includes low, medium and high estimates for each of the ports. All ports will have expanding container trade through the forecast period. To determine the relation of these container movements to the Cascade Gateway, BST estimated the share of these containers that move by truck and rail. These shares, defined in terms of imports and exports by port, appear in Table 2-4.

Table 2-4. Share of Container Movements by Mode Loaded and Empty Containers

	Imports		Exports	
Commodity	**Truck**	**Rail**	**Truck**	**Rail**
Vancouver (BC)	34.8%	65.2%	63.0%	37.0%
Fraser Port	90.0%	10.0%	90.0%	10.0%
Seattle	35.0%	65.0%	80.0%	20.0%
Tacoma	35.0%	65.0%	80.0%	20.0%

Source: Individual Ports

While clearly the majority of import containers leave the three major container ports by rail, the effects of this rail traffic on corridor capacity are felt primarily between Seattle and Everett. Only the traffic which travels on BNSF will find its way to the corridor. UP serves only the Ports of Seattle and Tacoma, and its port-related traffic would not impact the rail operations in the study area. Large portions of containers traveling on BNSF to and from Seattle and Tacoma ports do travel in the study area. The Port of Seattle estimates that currently about 65 percent of rail-borne containers travel on BNSF, and 35 percent on UP[6]. The breakout for Tacoma

[5] The standard unit for reporting shipping container movements is the 20-foot equivalent unit, or TEU. Containers are available in a number of sizes, such as 20-foot, 40-foot, 43-foot, and 45-foot, but are all converted into TEU for reporting purposes.

[6] Per conversation with Larry St. Clair, General Manager of Intermodal Services, Port of Seattle, August 2002.

presumably would be similar. That noted, these BNSF-hauled containers will only travel on the corridor between Seattle and Everett, and thence via the Stevens Pass route across the Cascade Mountains to and from the East.

Rail-borne port-related containers have no effect on corridor capacity north of Everett, which is the area of emphasis for this study. BNSF handles no port-related containers north of Everett. It is speculative that BNSF will handle port-related container traffic in the future. An example of such a move is between Roberts Bank and Chicago, as BNSF does have (as noted) trackage rights to haul containers to and from Roberts Bank. However, CN and CP could perform this same haul, and presumably would compete aggressively for it. Furthermore, the Ports of Seattle and Tacoma logically would compete for the move as the preferred port-of-call. As a result, port-related container rail movements are not included in the forecasts of rail traffic between Everett and Vancouver.

Non-containerized Rail Traffic

Relatively little port-related non-containerized cargo travels on the Cascade Gateway rail corridor north of Seattle, so this type of cargo generates little impact on track capacity between Seattle and Vancouver. While a large volume of non-containerized cargoes is shipped to and from the ports by rail, the routes used tend to avoid the corridor. For example, although most of the grain exported through Seattle and Tacoma originates in the Midwest, these trains travel through the Columbia River Gorge, then up the I-5 Corridor, rather than crossing the mountains via Stevens Pass.

Two exceptions are coal exports and alumina imports. The Roberts Bank coal export facility handles approximately 1 train of U.S. coal per month. These coal trains travel via the Cascade Gateway rail corridor north of Everett. The other major exception is alumina imported to Tacoma, half of which is used in Tacoma and the other half of which moves via the corridor to Everett, thence via Stevens Pass to the Spokane area. This Spokane-bound alumina movement thus avoids the corridor north of Everett. These movements are likely to continue at more or less the same frequency and volume as today. The forecast of Gateway traffic, cited above, is inclusive of the coal shipments to Roberts Bank. The coal shipments are discussed further in the following section.

In-transit Rail Traffic

In-transit cargoes are those goods that are imported or exported through one country, but whose ultimate destination or origin is in a different country. Historically, the Ports of Seattle and Tacoma have both handled a substantial volume of containerized cargo that originates in or is destined for Canada. Bigger, more efficient facilities in Seattle and Tacoma, combined with better labor conditions in those ports, tended to push Canadian containerized cargoes to use the U.S. ports.

Since the mid 1990s, however, the volume of cargo moving in-transit has decreased substantially. One reason for this change was the development of the container facilities at Roberts Bank. This terminal is a state-of-the-art rail-served container yard with on-dock rail located away from the congestion of Vancouver's Inner Harbor. With this facility, the Port of Vancouver has been able to attract shipping lines that did not previously call in Vancouver.

Another reason that Vancouver has been able to recapture former in-transit cargoes is that labor relations have improved substantially from the confrontational situation of the early 1990s. Finally, the transportation industry in Vancouver has cooperated to offer financial incentives to ocean carriers to call in Vancouver, especially if they make Vancouver the first port-of-call inbound or the last port-of-call outbound, or if they provide large numbers of containers.

Few in-transit containers move via rail. Currently most of these moves are handled by truck, although in the past there has been waterborne service moving containers between Seattle/Tacoma and Lower Mainland BC.

The other type of in-transit move, imports and exports of U.S. cargo through Canadian ports, account for a relatively minor share of BC port traffic. Fraser Port reports little in-transit U.S. export or import traffic, and of this small amount only a small fraction moves by rail. Vancouver does hope to eventually capture a share of the U.S. container cargo moving to and from the Midwest, and does appear to have the intermodal system in place to be competitive with Seattle and Tacoma for these cargoes. However, as noted above, a forecast including in-transit container rail shipments between Vancouver area ports and U.S. origins and destinations would be speculative. Currently, though, only 5 percent of Vancouver's container volume is U.S. origin/destination traffic, and none of this is shipped by rail on the Cascade Gateway.

Overall, the Cascade Gateway rail corridor likely will see very few port-related in-transit rail shipments, with the possible exception of U.S. coal exported through Roberts Bank. The future of these shipments is uncertain, however, as increased demand for coal overseas has led to increased competition from Indonesian, African, and Australian sources as well as from U.S. exports through Southern California.

Chapter 3
RAIL PASSENGER FORECASTS

3.1 INTRODUCTION

This chapter reviews the development of rail passenger service in the study area and presents forecasts for passenger movements through the Cascade Gateway over the period between 2002 and 2012. The forecasts are used in Chapter 4 as a basis for determining minimum capacity improvements needed and in Chapter 5 for determining the economic and societal benefits diverting motor vehicle trips by initiation of additional passenger service on the Cascade Gateway rail corridor.

3.2 RAIL PASSENGER FORECAST

Amtrak provides the only through service (Amtrak *Cascades*) between Seattle and Vancouver. Amtrak also operates a daily long distance train (the Chicago-Seattle *Empire Builder*) between Seattle and Everett. *Sounder* commuter service, which now operates between Tacoma and Seattle, will be extended to Everett in 2004. Within Canada, VIA Rail Canada operates a tri-weekly long distance train (the *Canadian*) which uses the same route as the *Cascades* from Fraser River Junction into Vancouver's Pacific Central Station. Rocky Mountain Rail Tours also operates a tri-weekly service over the same route into Pacific Central Station.

The *Cascades* service area extends from Eugene, Oregon, through Portland and Seattle to Vancouver, BC. Projections of Amtrak *Cascades* service increases through the Cascade Gateway were based on conversations with Amtrak and Washington State Department of Transportation (WSDOT) officials. The trains are operated by Amtrak, with financial support from the states of Washington and Oregon.

Based on these service expectations, WSA forecasted *Cascades* ridership through 2012 over the 156 miles between Seattle King Street Station and Vancouver Pacific Central Station. The forecasts were based on previous ridership studies, the recent history of *Cascades* ridership, and recent ridership trends for similar services. WSA also evaluated potential service increases by the other passenger operators in the study area, i.e. Amtrak, VIA, Sounder, and Rocky Mountain Rail Tours.

3.2.1 Amtrak Ridership History and Background

Passenger service historically operated between Seattle and Vancouver, BC until it was discontinued by Amtrak in 1981. Service was restored in May of 1995 when the State of Washington agreed to cover a portion of the operating losses of the service. In addition, the State purchased some of the new Talgo train sets used in the restored service. The single round trip initiated in 1995 ran north from Seattle in the morning, and returned south to Seattle in the evening, permitting a one-day round trip with a full afternoon in Vancouver.

A second round trip (currently limited to Seattle-Bellingham), also funded by Washington and using the Talgo equipment, began service in September of 1999. The service currently runs south from Bellingham in the morning, and returns in the evening, complementing the original schedule. This second round trip makes connections in Seattle to Amtrak *Cascades* service between Seattle, Tacoma, and Portland. The service was intended to operate through to Vancouver, but operation into Canada has been delayed pending completion of track and signal improvements on the Canadian side of the border.

The Seattle-Vancouver service is an integral part of the long term service planned in the Pacific Northwest Corridor by Oregon, Washington, British Columbia, and Amtrak. The "Pacific Northwest Rail Corridor Operating Plan", completed in 1997, provides a blueprint for the development of rail passenger service in the corridor over 20 years. The plan envisions gradually increasing service levels (increasing frequency of service and reduced running times) that will attract increasing numbers of passengers.

Ridership forecasts for the corridor operating plan were conducted by the Volpe National Transportation Systems Center of the U.S. Department of Transportation, and utilized a model that optimized ridership, revenue, and train set occupancy. The ridership modeling produced sufficient ridership to warrant 4 round trips per day by 2018. Projected service levels and ridership are shown in Table 3-1.

Table 3-1. PNW Corridor Service Forecast

Route Segment	1997	2003	2018
Daily Round Trips			
Vancouver-Seattle	1	3	4
Seattle-Portland	3	8	13
Portland-Eugene	2	3	4
Annual Riders			
Vancouver-Seattle	78,400	117,500	249,000
Seattle-Portland	237,200	970,600	1,683,200
Portland-Eugene	45,200	80,900	161,800

The Volpe modeling used a model based on travel between major metropolitan regions, and was not intended to develop ridership forecasts for each discrete pair of stations on the route. The technique is applicable to long range forecasting in major corridors, but is less specific when considering individual markets.

Since the restoration of service in 1995, the trains have used modern Talgo equipment. The trains provide both regular coach and custom coach service, and offer food and beverage service onboard. Reservations are required for all travel. The current (November 2002) schedule of the Vancouver BC-Seattle service is shown in Table 3-2.

Table 3-2. Vancouver, BC-Seattle Schedule				
READ DOWN				*READ UP*
# 513	**# 517**	**Station**	**# 510**	**# 516**
*	6:00 pm	Vancouver	11:40 am	*
10:20 am	7:30 pm	Bellingham	9:52 am	8:00 pm
10:46 am	7:56 pm	Mount Vernon	9:21 am	6:56 pm
11:31 am	8:41 pm	Everett	8:37 am	6:22 pm
11:55 am	9:05 pm	Edmonds	8:13 am	5:58 pm
12:45 pm	9:55 pm	Seattle	7:45 am	5:30 pm

* A bus connection was initially operated between Vancouver and Bellingham, but was discontinued in June 2001 due to low ridership and budget constraints.

Ridership between Vancouver and Seattle has increased steadily since the restoration of service in 1995. 2002 ridership (through September) increased by 10 percent over the same period in 2001, despite the economic downturn and reduced demand for intercity travel. Overall, the route's growth has averaged about 12 percent per year. Ridership growth has been strong despite any reduction of running times between Seattle and Vancouver. The addition of the second round trip resulted in a one-year ridership gain of about 50 percent. Annual ridership for the route is shown in Table 3-3.

Table 3-3. Vancouver-Seattle Ridership		
Year	**Ridership**	**Service Level**
1995	60,700	One Round Trip (a)
1996	78,700	One Round Trip
1997	82,800	One Round Trip
1998	96,200	One Round Trip
1999	109,500	Two Round Trips (b)
2000	149,900	Two Round Trips
2001	137,100	Two Round Trips
2002	31,200	Two Round Trips (c)

Notes:
(a) 1st round trip Vancouver-Seattle began in May.
(b) 2nd round trip Bellingham-Seattle began in Sept.
(c) Ridership for 3 months.
Source: Amtrak

Monthly ridership patterns show the impact of vacation travel during the summer months, with peaks occurring in July and August of each year. These peak months experience ridership about twice the levels that occur in January and February. Amtrak and WSDOT utilize yield management pricing to encourage travel during the off-peak months, and to capture the highest possible fare return during peak demand months. Ridership profiles developed from surveys in 2000 identified leisure trips (visiting family or friends, or making vacation trips) as the purpose of more than 80 percent of all trips. Day trip ridership (round trips within a single day) was 36 percent on the Bellingham train, with virtually all of the trips destined to Seattle. Only 9 percent of the ridership on the Vancouver train was day trip ridership to and from Vancouver. Figure 3-1 shows the monthly ridership patterns during the past three years. A route closure during August of 2001 held ridership below normal in that year.

Figure 3-1

Station-to-station ridership for a one-year period (June 2001 through May 2002) was examined to identify the major travel markets along the route. Not surprisingly, the major metropolitan areas of Vancouver and Seattle are responsible for most travel. Over 41 percent of the ridership is between Vancouver and Seattle, and another 22 percent travels between Bellingham and Seattle.

Total ridership across the international border was 90,849, representing 90 percent of the Vancouver train ridership and 61 percent of the total route ridership.

Table 3-4 shows the current rail ridership between stations on the route.

Table 3-4. Ridership by Station Pair (June 2001 to May 2002)

Station Pair	Annual Riders Vancouver Trains #510-517	Annual Riders Bellingham Trains #513-516	Total Riders Cascade Gateway Route
Vancouver-Seattle	61,095	-----	61,095
Bellingham-Seattle	5,329	27,313	32,642
Vancouver-Edmonds	11,266	-----	11,266
Mount Vernon-Seattle	1,632	9,534	11,166
Vancouver-Everett	9,147	-----	9,147
Vancouver-Bellingham	5,030	-----	5,030
Vancouver-Mount Vernon	4,311	-----	4,311
Bellingham-Edmonds	1,665	2,310	3,975
Everett-Seattle	134	3,735	3,869
Edmonds-Seattle	71	2,596	2,667
Bellingham-Everett	686	508	1,194
Mount Vernon-Edmonds	237	260	497
Mount Vernon-Everett	124	357	481
Bellingham-Mount Vernon	227	230	457
Everett-Edmonds	13	96	109
TOTAL	**100,967**	**46,939**	**147,906**
Source: Amtrak West			

3.2.2 Amtrak Ridership Forecast

Continued ridership growth in the corridor will depend upon several causative factors:

- Continuing population growth and economic development in the corridor.
- Increases in vacation and leisure travel in the Vancouver-Seattle corridor.
- Continued provision of a marketable travel experience (new equipment, reduced running time, additional frequencies, and more connections to service south of Seattle).
- Convenience of station facilities in Vancouver and Seattle (the two major origin and destination stations on the route).
- Competitive travel mode factors, principally auto driving time and cost.

Experience in the major Western rail corridors underscores the links between service improvements (particularly new equipment and added frequencies) and ridership growth. The data are shown in Table 3-5.

Table 3-5 Western Rail Corridor Ridership			
Route	**Year**	**Ridership**	**Round Trips/Day**
Los Angeles-San Diego	1973-74	381,800	3
	1978-79	967,300	6
	1983-84	1,221,200	7
	1988-89	1,717,500	8
	2000-01	1,661,700 (a)	11
Bay Area-Bakersfield	1974-75	67,000	1
	1981-82	189,500	2
	1991-92	483,600	3
	1996-97	652,500	4
	2000-01	710,800	5
Bay Area-Sacramento	1992-93	238,800	3
	1996-97	496,600	4
	2000-01	1,030,800	7
Vancouver BC-Eugene	1992-93	92,927	1
	1996-97	335,398	2
	2000-01	564,827	3
Note: (a) Substantial ridership shifted to expanded commuter service operating in the same corridor. Source: Amtrak			

The Volpe forecasts anticipated an annual average growth rate of about 7 percent between 1997 and 2003, declining to about 5 percent per year to 2018. The actual ridership increase, at least in the initial years, has been greater despite fewer round trips being operated than assumed by Volpe.

Following the resumption of Vancouver service in 1995, the route experienced an average ridership growth of about 15 percent annually for the first few years. This is normal for a new service with new equipment. Ridership spiked considerably with the introduction of the second train (Seattle-Bellingham) in 1999. In its first year, ridership on the second train reached about 35,000. Eventual extension of the second train to serve Vancouver (the route's major market) should attract a greater increment, bringing route ridership to about twice the level of the original Seattle-Vancouver train. When a third round trip is added, it will probably be a mid-day schedule[1] that will attract a somewhat lower level of initial new ridership than the first 2 trains, but nevertheless will be an important factor in the overall growth of ridership on the route.

While ridership dropped between 2000 and 2001, use of the trains resumed a "growth mode" in 2002. One possible explanation is that more intercity travelers are taking the train as a way to avoid long roadway delays at the international border. Annual growth increments of about 5

[1] Amtrak experience in other corridors with multiple frequencies is that travel demand on mid-day schedules is lower than morning and late afternoon options. However, the mid-day service provides additional new travel options and contributes positively to the overall growth of the corridor. Mid-day service between Seattle and Vancouver will also increase the potential for connections to corridor services south of Seattle.

percent over the long term, generally consistent with the Volpe forecasts, are a reasonable expectation.

Table 3-6 shows projected ridership in the Vancouver-Seattle corridor over the next 10 years. The projection is based on a 5 percent long term growth rate, and significant one-time increases resulting from extension of the second round trip to Vancouver in 2004, and introduction of a third round trip (also serving Vancouver) in 2008.

Table 3-6. Corridor Rail Ridership Forecasts

Year	Annual Ridership	Round Trips	Ridership Per RT	Annual Growth	Growth Increment	One-time Increases
2002	137,000	2	68,500	5%	6,500	0
2003	143,500	2	71,500	5%	7,000	0
2004	150,500	2	75,000	5%	7,500	50,000
2005	208,000	2	104,000	5%	10,500	0
2006	218,500	2	109,000	5%	11,000	0
2007	229,500	2	114,500	5%	11,500	0
2008	240,000	2	120,000	5%	12,000	60,000
2009	312,000	3	104,000	5%	16,000	0
2010	328,000	3	109,000	5%	16,500	0
2011	344,500	3	115,000	5%	17,500	0
2012	362,000	3	120,500			

Source: WSA

The forecasted ridership of about 362,000 annual passengers in 2012 is significantly higher than the Volpe forecasts prepared in 1997. Experience to date has shown the Volpe projections to be low. The year 2000 ridership with only 2 trains (and only one of these serving Vancouver) was nearly 150,000, while Volpe forecast only 117,500 riders by 2003 with 3 round trips to Vancouver. Clearly, there is an attraction to the rail mode that was not sufficiently represented in the Volpe modeling.

With 362,000 passengers in 2012, if the current ratio of rail passenger border crossings to total ridership holds, there will be about 326,000 annual train riders crossing the international border at Blaine.

The projected 2012 ridership averages to about 165 riders per train departure. The current Talgo configuration provides about 260 seats per train set. During summer and holiday peak travel times, most trains will be at or close to capacity, and yield management (variable pricing) will be required to encourage travelers to use schedules with more available seating.

3.3 OTHER PASSENGER SERVICES

In addition to the Amtrak *Cascades*, several other passenger services operate in the Seattle-Vancouver corridor.

3.3.1 Other Amtrak Service

Amtrak's long distance *Empire Builder* is a daily train operating between Chicago and Seattle. This train gains access to Seattle via Stevens Pass, and the route joins the Cascade Gateway at Everett. The train serves Everett, Edmonds, and Seattle. The *Empire Builder* is excluded from the foregoing ridership forecast for the corridor service because it carries virtually no local ridership within the Cascade Gateway rail corridor. No changes in frequency or new trains are anticipated.

3.3.2 Sounder Commuter Service

Sounder commuter service has operated between Seattle and Tacoma for about two years. Extension of the service north to Everett is planned. Environmental studies and station design are underway now. When these are complete, BNSF will make various track revisions and additions to facilitate installation of station platforms. Commuter service has been delayed by both environmental and funding issues, and likely to commence in 2004. The Seattle-Everett service is expected to carry 3,000 passengers per day by 2010.

Sounder service will not have any direct impacts on Cascade Gateway passenger volumes across the international boundary. While the intercity service may marginally benefit from some additional double track segments south of Everett planned for the commuter operation, the primary growth potential of the intercity service will depend on capacity improvements north of Everett, and particularly in British Columbia.

Sounder will share stations with the intercity trains in Seattle, Edmonds, and Everett. Station improvements, largely financed by local communities, will improve the attractiveness and utility of the intercity service in those communities.

3.3.3 VIA Service

VIA is the national passenger rail service of Canada. VIA operates on the corridor between the Fraser River Junction and Pacific Central Station. VIA's *Canadian* transcontinental train makes 3 round trips per week on this segment of the line. Within the 10-year planning horizon of this study, VIA intends to run 1 round trip of the Canadian daily.

3.3.4 Rocky Mountain Rail Tours

Rocky Mountain Rail Tours operates a private tour train out of Pacific Central Station. The train, known as the *Rocky Mountaineer*, operates 3 round trips per week between April and October. In addition, the company operates several special trains during the winter months. The train uses the same route out of Vancouver as VIA's Canadian. Train volumes are not expected to change in the 10-year horizon.

Chapter 4
COMMUTER OPERATIONS

4.1 INTRODUCTION

The purpose of this chapter is to evaluate the potential for commuter rail service between downtown Vancouver and Bellingham, Washington. A commuter service, known as *West Coast Express*, is currently operated between downtown Vancouver (Waterfront Station) and Mission City on the Canadian Pacific Railway. The study's work scope called for a sketch-level feasibility analysis that looks broadly at potential ridership, revenue, operating and capital costs, and capacity concerns for operation of similar service on the BNSF route between Downtown Vancouver and Bellingham.

4.2 COMMUTER OPERATIONS

The analysis assumed operation of 2 commute trains into Vancouver during the morning peak, with counterpart outbound trains in the afternoon. A potential schedule is shown in Table 4-1. Amtrak service is shown with trains 513 and 516 extended to Vancouver on schedules comparable with current service. Commuter schedules (C1 through C4) use similar running times, adjusted for the intermediate station stops. The schedules include a 20-minute allowance for border crossing inspections between White Rock and Blaine, and result in a travel time of about two hours between Pacific Central Station and Bellingham. Travel time between Pacific Central and White Rock would be just over one hour. If the service were operated to the Waterfront Station in lieu of Pacific Central, travel time would be about 10 minutes greater[1]. If operated to a Scott Road station, the commuter train time would be reduced by about 30 minutes, but the SkyTrain ride to downtown would require a similar time, so overall travel times would be comparable to the schedules in Table 4-1.

Table 4-1. Illustrative Amtrak and Commuter Train Times
Vancouver to Bellingham

A513	C1	C3	A517	Station	C2	C4	A510	A516
8:50	17:15	17:45	18:00	Pacific Central	7:45	8:15	11:40	21:50
---	17:41	18:11	---	New Westminster	7:22	7:52	---	---
---	17:52	18:22	---	North Surrey	7:11	7:41	---	---
---	18:03	18:33	---	South Surrey	7:00	7:30	---	---
---	18:14	18:44	---	Crescent Beach	6:49	7:19	---	---
---	18:23	18:53	---	White Rock	6:40	7:10	---	---
---	18:49	19:19	---	Blaine	6:14	6:44	---	---
10:20	19:16	19:46	19:30	Bellingham	5:44	6:14	9:52	20:00

[1] The additional 10 minutes should be considered a minimum and subject to negotiation with BNSF, CP, and CN as the commuter service would have to cross Healty Diamond, a BNSF crossing of CP just east of Waterfront Station. Commuter trains operating from Bellingham or White Rock to Waterfront Station would use the BNSF to CN Junction, thence on BNSF again to Heatly Diamond (just south of Burrard Inlet), and thence onto the CP to Waterfront Station. CN has trackage rights on the BNSF line between CN Junction and Burrard Inlet.

As can be seen from the schedules, both northbound commuter runs could arrive in Vancouver before the departure of the southbound morning Amtrak train. The second southbound commuter run potentially would conflict with the evening northbound Amtrak train at Bellingham, and it also would be overtaken by the southbound evening Amtrak train that follows it out of Vancouver. Schedule adjustments to either the commuter or Amtrak service might be needed during the evening peak period. The commuter service would introduce 4 additional trains into the mix between the Fraser River and Pacific Central Station (Vancouver Junction), creating additional capacity concerns that would have to be resolved to avoid conflicts with BNSF or CN freight trains operating over that segment of track.

4.2.1 Commuter Ridership, Revenue, and Cost

Ridership

The ridership forecast was derived by applying a capture rate[2] derived from other comparable rail commute services to the number of morning peak period work trips between communities along the commuter route. Northbound peak period work trips were derived from travel zone data provided by the Greater Vancouver Transportation Authority for travel between potential stations from Vancouver south to White Rock. Morning work trips across the international border from Bellingham and Blaine were estimated as a function of total northbound Peace Arch and Pacific Highway crossings, and added to the travel within Canada. WSA forecast just over 8,000 work trips that might be divertible to commuter rail. At capture rates comparable to other systems, the service would attract 173 to 288 northbound morning riders on the two trains. An equal number would be expected outbound in the afternoon.

The ridership analysis found that only 24 to 37 riders would use the service from Bellingham or Blaine. Most of the ridership would be generated from stations serving Crescent Beach and the southernmost portions of Surrey. If the commuter service operated only between Vancouver and White Rock, total daily northbound ridership would range from 149 to 251 trips. Potential morning one-way ridership by station is shown in Table 4-2.

Table 4-2. Northbound High Ridership Forecast Commuter Service with Two Frequencies

Station	On	Off
Bellingham	25	0
Blaine	12	0
White Rock	61	0
Crescent Beach	131	11
South Surrey	60	11
North Surrey	0	29
New Westminster	0	27
Vancouver	0	211
TOTAL	**288**	**288**

[2] The capture rate, or mode split, represents the share of all work trips that could be attracted to, or captured by, the commuter train service. For services offering only minimal frequencies, the rate typically ranges from about one percent for short distances to about ten percent for longer trips.

Revenue

The Vancouver-Bellingham commuter service could be expected to generate annual fare revenue[3] of $513,000 to $842,000 for the low and high forecasts. This estimate assumes that per-mile fares charged are similar to the current fare structure of *West Coast Express*, with average fares ranging from over $0.30 per mile for short trips (e.g. Waterfront to Coquitlam) to as low as $0.14 per mile for long trips (e.g. Waterfront to Mission City). For a service operating only north of White Rock, the annual revenue would range from $428,000 to $710,000.

Fare Box Recovery

Typical annual operating costs of commuter rail systems in the U.S. range from about $40 to $60 per train-mile. Applying a mid-range cost of $50 per train-mile, the annual operating costs of Vancouver-Bellingham service with 2 weekday round trips would be $2,950,000. The shorter system operating north of White Rock would have an annual cost of about $1,800,000. At the higher ridership levels, the fare box return (the ratio of revenues to costs) would be about 29 percent for the Bellingham service, and about 39 percent for the White Rock option. These levels are comparable to many U.S. commuter rail systems, but the total ridership served would be small with relatively high start-up capital costs.

Projected annual operating costs and revenues are shown in Table 4-3.

Table 4-3. Annual Operating Costs and Revenues
Vancouver-White Rock-Bellingham Commuter Service

	Vancouver-Bellingham		Vancouver-White Rock	
	Low Ridership	High Ridership	Low Ridership	High Ridership
Daily Northbound Riders	173	288	149	251
Annual Riders	86,500	144,000	74,500	125,500
Annual Fare Revenue	$ 513,000	$842,000	$428,000	$710,000
Annual Operating Cost	$2,950,000	$2,950,000	$1,800,000	$1,800,000
Fare Box Ratio	.17	.29	.24	.39

(This space intentionally left blank.)

3 All costs and revenues cited in this chapter are U.S. currency.

Capital Costs

The service would experience one-time start-up and capital costs for stations, train sets, storage and service facilities, and track capacity improvements to accommodate the four added daily trains. Using costs comparable to recent U.S. commuter services, the order-of-magnitude cost that would be incurred could be as high as $35.5 million, excluding potential capital costs to create sufficient capacity. The projected capital costs are shown in Table 4-4. Table 2-4 shows equipment costs comparable to the locomotives and commuter cars used on *West Coast Express*[4]. If the service were provided using Diesel Multiple Unit (DMU) equipment[5], the equipment acquisition costs might be somewhat lower. DMU equipment also would have lower fuel costs, but would require higher maintenance costs since each unit is self-powered.

Conventional Bi-Level Commuter Train

Table 4-4. Potential Capital Costs for Vancouver-Bellingham Commuter Service. In Millions of Dollars (U.S.)

Requirement	Estimated Cost
3 Locomotives @ $ 2.7	$ 8.1
7 Commuter Cars @ $ 2.0	$ 14.0
6 Stations, including parking, @ $ 0.9	$ 5.4
Storage & Maintenance Facility @ $ 8.0	$ 8.0
Track Capacity Improvements	---
TOTAL	**$ 35.5**

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[4] A *West Coast Express* train set consists of a locomotive and several coaches. The end coach has an operator's cab (ergo such a car is called a "cab-car"), allowing the equipment to be used in a push-pull operation. Push-pull operation eliminates the need for "turning" the locomotive from front to rear for a return trip. A locomotive, one regular coach, and one cab-car would be needed for a Bellingham-Vancouver commuter rail train set.

[5] DMU equipment consists of a single car, or 2 or 3 cars coupled as a unit, powered by individual diesel engines mounted under each car. Each end of a DMU would have an engineer's cab with all necessary train operating controls. DMUs can operate equally well in either direction and do not need to be turned at the end of a trip.

The capital costs in Table 4-4 include one spare locomotive and one spare commuter car, to allow for equipment out of service during maintenance cycles. The storage and maintenance facility would be needed at the south end of the service area[6]. No costs are shown for stations at Vancouver or Bellingham, since it is assumed the current facilities can support a limited level of commuter service. The six intermediate stations are assumed to consist of a simple platform, canopy shelter, lighting, ticket machines, and parking. The costs estimates above are based on previous WSA analyses for proposed commuter rail services in California and Alaska.

Track capacity cost estimates are beyond the scope of this preliminary analysis. Amtrak service expansion beyond the current single round trip has been held up pending negotiation and completion of track capacity improvements, and a commuter train operation would almost certainly trigger some additional capacity needs.

4.2.2 Commuter Service Institutional Issues

Commuter operations would have to be sponsored and financed by a public agency, which would likely contract for train operation and equipment maintenance. Potential contract operators include BNSF, Amtrak, or a private company such as Herzog Transit Services that operates several U.S. commuter lines. Service from Vancouver to White Rock could be sponsored by a British Columbia agency such as TransLink, which is the operator of regional transit services in the Vancouver area. Service across the international border would require a unique partnership between Canadian and U.S. agencies. The public sponsoring agency would need to have a continuing funding source for the annual operating deficit of the service.

Diesel Multiple Unit Commuter Train
Photo by Bill Farquhar

4.3 SUMMARY

At a conceptual sketch planning level, commuter rail service on the Cascade Gateway rail corridor appears to be of "border line" feasibility. The fare box recovery estimate (assuming the higher ridership level) is in line with other commuter rail services. However, the relatively small number of riders that would be attracted to the service in relation to the capital start-up costs,

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[6] The maintenance facility would be equipped to perform routine daily maintenance and cleaning as well as the government-mandated periodic inspections. Contractors would perform overhauls of equipment and other heavier maintenance functions (e.g. "wheel truing"). This arrangement would keep costs for the maintenance facility to a minimum. Contractors could include BNSF, CN or CP, among others.

together with the unknown requirements for providing track capacity, suggests that a commuter train service in the corridor would be difficult to justify.

In summary, the commuter service would:

- Generate relatively low ridership.
- Require a two-hour trip each way (from Bellingham).
- Attain only about 30 percent fare box recovery.
- Require a public operating subsidy of $1.1 to $2.4 million per year.
- Require about $35.5 million start-up capital.
- Require an unknown cost for track capacity improvements.

Chapter 5
CAPACITY IMPROVEMENTS

5.1 INTRODUCTION

The purpose of this chapter is to identify the minimum improvements for the rail corridor that will provide sufficient capacity for the freight and passenger train volumes forecasted in Chapters 2 and 3. The emphasis here is on the segment of the corridor between Everett and Vancouver. This emphasis recognizes that improvements planned for future SoundTransit commuter rail services between Seattle and Everett will effectively restore the historic double track configuration and thereby provide sufficient capacity for foreseeable freight and passenger volumes.

5.2 CASCADE GATEWAY CAPACITY ISSUES AND SOLUTIONS

The Cascade Gateway rail line capacity needs are analyzed in terms of specific segments. These are Pacific Central Station in Vancouver to Everett, Vancouver to Burlington via Sumas (an alternative routing for double-stack trains), and Everett to Seattle. Estimated train volumes for 2002 and forecast volumes for 2012 are noted in Chapters 2 and 3. Freight operators on the Cascade Gateway rail corridor include BNSF, CP, CN, and SRY. Passenger operators include Amtrak, VIA, Sounder, and Rocky Mountain Rail Tours. With the possible exception of Rocky Mountain Rail Tours, all carriers are likely to handle more traffic in 2012 than today.

5.2.1 BNSF Main line between Everett and Vancouver

The BNSF main track between the yard at Everett (PA Junction) and the Pacific Central passenger station in Vancouver is about 122 miles in length. Except for 9.3 miles between Still Creek (just east of Vancouver) and New Westminster, where there is double track, the line is single track.

New Westminster Rail Bridge

This bridge is approximately a fifth of a mile long and spans the Fraser River. It is owned by the Canadian government and used by the BNSF, SRY, CN, Amtrak, VIA and Rocky Mountain Rail Tours. The bridge has limited clearance above the Fraser River. Thus, it includes a "swing" span that opens to allow marine traffic to pass up and down the river. The rail line on the bridge is single track, with a severe speed restriction. The current operating speed across the river is only 8 mph or 13 kph. According to a recent study on a replacement for the bridge, total train movements over the bridge range generally between 1,200 and 1,300 for both freight and passenger services on a monthly basis[1].

The study estimated that opening of the swing bridge for marine traffic consumes over 30 percent of the overall availability of the bridge. Given this estimate, coupled with its single track

[1] "Supporting Rationale for the Replacement of the New Westminster Rail Bridge," prepared for the Greater Vancouver Gateway Council and Borealis; July, 2002.

configuration, speed restriction, multiple users and volume of traffic, it is reasonable to say the bridge is a corridor bottleneck which will become worse with increasing numbers of passenger and freight trains.

Principal Sidings

There are 10 significant sidings that can be used as passing tracks. The sidings vary in length from about 6,000 feet to just over 9,000 feet, but the longer sidings are few in number, far from each other, and in some cases, encumbered with one or more internal public road crossings that limit the railroad's ability to hold a long train in the siding.

Passing sidings, or comparatively short sections of double track paralleling the main line track, provide capacity to a single-track railroad. The principal sidings, their length and railroad milepost locations (from south to north), appear in Table 5-1.

Table 5-1: Principal Sidings Everett to Vancouver

Milepost	Name	Length (Ft)	Notes
45.9	English	9,026	One public crossings
55.5	Stanwood	6,381	Public Crossing
66.8	Mt. Vernon	6,075	Public Crossing
71.9	Burlington	5,900	Between Greenleaf St. and Pease Rd.
79.3	Bow	8,916	Public Crossing
92.9	South Bellingham	6,347	
106.3	Ferndale	8,610	North of Main St.
111.8	Custer	6,400	Distance is clear of road crossing
116.0	Swift	8,710	
119.3	Blaine	6,060	Not in CTC Signal System
139.9	Brownsville	5,908	Two sidings

Source: BNSF track charts and conversations with WSDOT consultant

The relatively long distances between sidings (20 miles Brownsville to Blaine; 13 miles South Bellingham to Ferndale; 12 miles Everett to English) all constrain the maximum practical capacity of the route. Capacity is further limited by frequent speed restrictions, which are either the effect of curves (Samish to South Bellingham), bridges (the Snohomish River and Steamboat Slough at Marysville; the Nicomekl and Serpentine Rivers near Colebrook; the Fraser River at New Westminster), or public law (White Rock, BC).

Dispatching Systems

Most of the corridor's single track is dispatched remotely, through a Centralized Traffic Control (CTC) system in which the train dispatcher electrically controls switch alignments and signal indications. There is still a 20.5-mile stretch between Swift (just south of Blaine) and Brownsville, and another 2-mile section between Still Creek (west of New Westminster) and Vancouver, that are protected only with Automatic Block Signals, and on which trains require track warrants or other "manual" authority, to operate. BNSF's main track terminates at Still Creek. From there to Pacific Central is yard trackage, and not remotely dispatched by CTC. Also, BC Rail dispatches the eight tenths of a mile of BNSF main line, used by CP and CN to and from Roberts Bank, at Colebrook.

Tunnels

Between Samish and South Bellingham there are four tunnels (Tunnel 18, 1,113 feet long; Tunnel 19, 141 feet long; Tunnel 20, 326 feet long; and Tunnel 21, 751 feet long) with vertical clearance restrictions that prohibit the operations of some double-stack trains. Presently, the clearances are sufficient for two "low cube" (8'6" high) containers atop one another, i.e. a "low-low" combination. This combination requires a vertical clearance of at least 18'2" above the top of the rail, according to BNSF. However, the vertical clearances are insufficient for either of the two following double-stack combinations: a low cube container and a "high cube" (9'6" high) container, i.e. a "low-high" combination; or two high cube containers, i.e. a "high-high" combination. The former requires a vertical clearance of at least 19'2", and the latter requires a minimum vertical clearance of at least 20'2" for containers 10'6" wide. The current tunnels permit 19' of vertical clearance for containers that are 10'6" wide[2].

Border Crossing Facilities

All southbound freight trains are subject to U.S. Customs inspection upon entry at Blaine, and some trains are required to set out individual cars for Customs to inspect. Setting out individual cars for U.S. Customs to inspect requires that trains be delayed long enough for the necessary switching to be completed, which can in turn delay other trains. U.S. Customs has indicated that the service will increase the number of inspections as an enhanced security measure. For northbound trains, Canadian Customs inspection is handled at White Rock. Trains are inspected on the main line. Stops frequently last for an hour.

Main Line Operations

The typical trip, for either a passenger or a freight train, takes relatively long for the distance it covers. A freight train may require 8-10 hours to travel between Everett and the BNSF yard at New Westminster (Sapperton) – especially if the train has any *en route* work to do. Such work may entail setting out or picking up blocks of railcars, or switching at sidings or industries along the line.

Current BNSF operations consist of 6 through freight trains (3 round trips or 3 trains each way) daily, 12 local freight trains (a high number for the main track distances involved), and 2 pairs of Amtrak *Cascades* passenger trains (one pair running between Seattle and Vancouver, and one pair running between Seattle and Bellingham[3]). CP, CN and SRY traffic add several trains a day in the corridor, but only north of Colebrook.

The Amtrak *Cascades* passenger trains operate in the morning and evening, in opposing directions. Five of the 6 BNSF through freight trains operate at night; the locals are a mix of daylight and nighttime operations.

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[2] Conventional intermodal containers come with two heights; 8'6" and 9'6". The latter are termed "high cube" because they provide more cubic space for loading cargo. The high cube containers are therefore becoming increasing popular with shippers. Indeed, for domestic container shipments, 9'6" high cube containers are becoming what the market demands. Accordingly, double-stack routes ideally should be planned with vertical clearances allowing for a "high-high" double-stack combination.

[3] In the Recommended Improvements discussion that follows, the analysis assumes that a second Amtrak *Cascades* train will be extended to operate between Bellingham and Vancouver in 2004, and a third round trip between Seattle and Vancouver will be implemented in 2008, per Working Paper 1.

Planned Improvements

Washington Department of Transportation, which sponsors the Amtrak *Cascades* Service, is planning various improvements along the Cascade Gateway rail corridor to facilitate more trains and faster speed up to 110 miles per hour. The list of improvements which WSDOT is contemplating, along with estimated cost costs, appear in Table 5-2.

Table 5-2. Amtrak *Cascades* Capital Improvements, Everett to Blaine, WA. (2002 US Dollars)

Project	Estimated Cost	Remarks
Everett - Marysville Speed Increases	$8,500,000	Realignment of curves and bridge improvements reduces current Seattle-Bellingham-Vancouver, BC travel time by 10 minutes.
Track geometry adjustments between Everett and Blaine	$22,000,000	Cuts another 10 minutes off the travel time.
Bellingham siding extension	$30,000,000	Capacity improvement to permit RTs 3 and 4. Travel time drops by 1 minute.
English to Mount Vernon second mainline	$120,000,000	Reaching speeds up to 110 mph. Reduces running time by 4 minutes.
Ferndale to Blaine second mainline	$120,000,000	Reaching speeds up to 110. Reduces running time by 1 1/2 minutes.
TOTAL	**$300,500,000**	Assumes current alignment into White Rock.

Note: Accuracy of cost estimates +/- 30%
Source: WSDOT, November 2002

Capacity Challenges

Given forecasts of increasing freight and passenger traffic, this analysis reviewed and evaluated the current capacity of the corridor to identify the challenges of accommodating more traffic.

The effective separation of the BNSF through freight service from the scheduled passenger service helps somewhat to reduce the pressure on the line capacity: most BNSF through trains operate at night, while the Cascades are daytime trains. But this separation is not a viable strategy in the long term if there is to be growth in the freight service.

As it is, if both passenger trains were to operate to Vancouver, then there would have to be two passenger train "meets" near Bellingham or Samish. The current daylight BNSF through freight train would have to meet or be overtaken by the two passenger trains, and all three through trains might have to meet or overtake at least some of the daylight locals.

At night, the 5 BNSF through freight trains must all meet their opposing mates: at least 6 meets per night, if all trains are more or less on time. Furthermore, all these conflicts tend to concentrate in the territory between Colebrook and Bow (that is, in the middle).

So, despite what appears to be a modest total demand, this is currently a difficult route to operate with consistent performance. If a train is delayed, there are likely to be ripple effects for the other trains, and not much the train dispatcher can do to recover.

Chapter 2 explored the potential for double-stack container trains operating on the corridor. However, there are physical challenges to doing this. First are substandard vertical clearances in four tunnels south of Bellingham. These would need improvement to handle two “high cube” or 9’6”-high containers stacked on top of one another, as well as for a high and a low cube (8’6”-high) container combination. Routing containers through the Sumas Gateway (as discussed below) would mitigate this particular challenge. But other institutional challenges remain, as this movement would imply an agreement sorted out between BNSF and most likely CP, which are competing railroads in many markets. Furthermore, there is the challenge of yet other vertical clearance problems for double-stacks in southern Oregon and northern California, which would have to be addressed to allow double-stacks to flow on the I-5 corridor between the Pacific Northwest and Southern California. These problems exist on both BNSF and UP, which has a right to market services in Vancouver. These improvements on the I-5 corridor between Seattle and Southern California reportedly total about $10 million for each railroad.

Other operators on this segment of the corridor include VIA, CP, CN, SRY and Rocky Mountain Rail Tours. These operations are limited mostly to between Downtown Vancouver and the south side of the Fraser River Bridge and at Colebrook. Double track north of the bridge mitigates some problems there, but the bridge itself remains a challenge for the reasons noted above. An ongoing study is looking at alternatives for replacing the bridge[4]. One alternative is a rail tunnel under the Fraser River. This poses several challenges in itself. The tunnel would have an underwater depth of 25 meters (about 80 feet), which would require an approach of at least 2 to 2.5 kilometers (1.2 to 1.5 miles) on each side. Given these parameters, it is reasonable to assume that the cost for such an alternative would be in the hundreds of millions of dollars. A goal of the study is to develop cost estimates for this and other alternatives.

Recommended Improvements

The following analysis pertains to improvements between the southern end of the Fraser River Bridge and Everett. This is because double track and CTC north of the bridge to Vancouver provides sufficient capacity for increased numbers of freight and passenger trains. Similarly, improvements proposed between Seattle and Everett for new commuter trains would provide sufficient capacity there for new trains. This study notes the need for alternatives to the New Westminster Rail Bridge over the Fraser River. However, it does not quantify these alternatives since they are the subject of the ongoing study referenced previously.

There are four significant issues involved in improving the corridor between Everett and the southern end of the New Westminster Rail Bridge so that it could efficiently handle as much as one to two additional BNSF freight trains a day in each direction, plus the extended (or even an expanded) passenger service. These issues are:

- Reducing the distance between longer sidings.

[4] “Greater Vancouver Region Major Commercial Transportation System Study”, being prepared for the Greater Vancouver Gateway Council.

- Improving the signal system.
- Providing surge capacity at Swift to mitigate the impact of customs inspections.
- Providing clearance in the tunnels if hi-cube double-stacks are to operate.

To address these issues, the analysis developed the following recommendations for capacity enhancements:

1. Construction of a 9,000-foot controlled siding at Colebrook, BC on existing subgrade (i.e., the earthen roadbed that underlies the track structure) immediately north of the west switch connection to the BC Rail line to Roberts Bank (approximately BNSF Milepost 131.25 to 133.50). BNSF wants 9,000-foot sidings that can handle 7,000-foot trains efficiently. The cost estimate associated with this improvement in Table 5-3 includes only rail, tie and ballast; the signal costs are included in the signal item.
2. Extension of the Centralized Traffic Control System from its present north limit at Blaine (BNSF MP 116.8) 20.5 miles to Townsend (BNSF MP 137.3) – a point just north of the North switch to the new Colebrook Siding, and the current southern limit of the CTC between the New Westminster Rail Bridge and Tilbury Line Junction (Townsend). This improvement would incorporate an existing CTC interlocking between switches at Colebrook. Current BNSF standards require coded track circuits replace line-side wires as a means for supplying the electric current that activates intermediate signals. Therefore, the cost estimates in Table 5-3 include the costs for replacing the entire signal system, not just the addition of CTC controls.
3. Extension of one more of the existing 6,000-foot sidings to 9,000 feet. From an operating perspective, the best location for this extension is probably South Bellingham: that location is about half-way between the long controlled sidings at Ferndale and Bow, and it is far enough north to help with meet/pass conflicts that cluster in the middle of the route. However, this extension may be very difficult to construct at South Bellingham: there is a tunnel to the south, and the waterfront to the north, either of which limit the engineering options. In addition, WSDOT currently has a contract with BNSF that calls for the Stanwood siding (MP 55.5) to be extended as a condition of future expansion of the state-sponsored Amtrak *Cascades* service.

   An alternate extension might be Mt. Vernon, which is about half-way between the long sidings at English and Bow, and where a 2,500-foot extension to the south would be significantly easier to engineer than one at South Bellingham. (Even here, however, there may be wetlands impacts from extending the subgrade.)
4. To aid in the handling of customs inspections on rail freight cars, a support track could be constructed immediately south of the Customs inspection shed at Swift, most likely on the west side of the existing main track. If cars for inspection were set out into this track, it would help keep the controlled siding clear for other movements, or even allow the main track and existing siding to exchange roles, so that the controlled siding is between the main track and the Customs shed. An additional recommendation is that U.S. and Canadian Customs inspection be performed at Swift. This will require institutional coordination, but the effect would be to free the main line of northbound trains stopped at White Rock for Canadian inspections.

5. If high-cube double-stack container trains are to be operated over this route, lower floors of Tunnels 18, 19, 20, and 21 to permit increased vertical clearance will be required. The assumption for double-stack trains is that they would originate and terminate at the BNSF New Westminster Yard for runs on the corridor to and from U.S. destinations. The costs for improvements in the yard itself for loading and unloading double-stack cars, as well as for the cars, are not part of this analysis.
6. Installation of electric lock protection on the non-controlled siding at Marysville to allow the area's local freight train to clear the main track without causing delay to other main line trains or being delayed itself by other main line trains.

The improvements noted above are located on Figure 5-1 below. Rough costs for these improvements appear in Table 5-3.

Table 5-3. Cost Estimates for Capacity Improvements between Everett and Vancouver (2002 US Millions of Dollars)

1.	A 9,000' controlled siding Colebrook @ $140/track-foot. (2 controlled No. 20 turnouts @ $200,000 each).	1.66
2.	CTC 20.5 miles Blaine to Colebrook and Colebrook to Townsend. 4 new control points at $850,000 each, plus 20.5 miles at $750,000 per track mile for coded track circuits.	18.78
3.	5,000-foot support track at Swift for Customs inspection (5000' @ $160/ track-foot including grading), and place in CTC system (2 Turnouts @$250,000 each).	1.30
4.	Construct a 2,000-foot extension to one existing siding (2,000' @ $160/ track-foot).	0.32
5.	Lower tunnel floors (2300 feet @ $820/ft).	1.90
6.	Electric lock protection on the non-controlled siding at Marysville.	.15
	TOTAL	**24.11**
	Contingency @ 40% Engineering @ 20%	9.64 4.82
	GRAND TOTAL	**38.57**

Source: Washington Infrastructure Services

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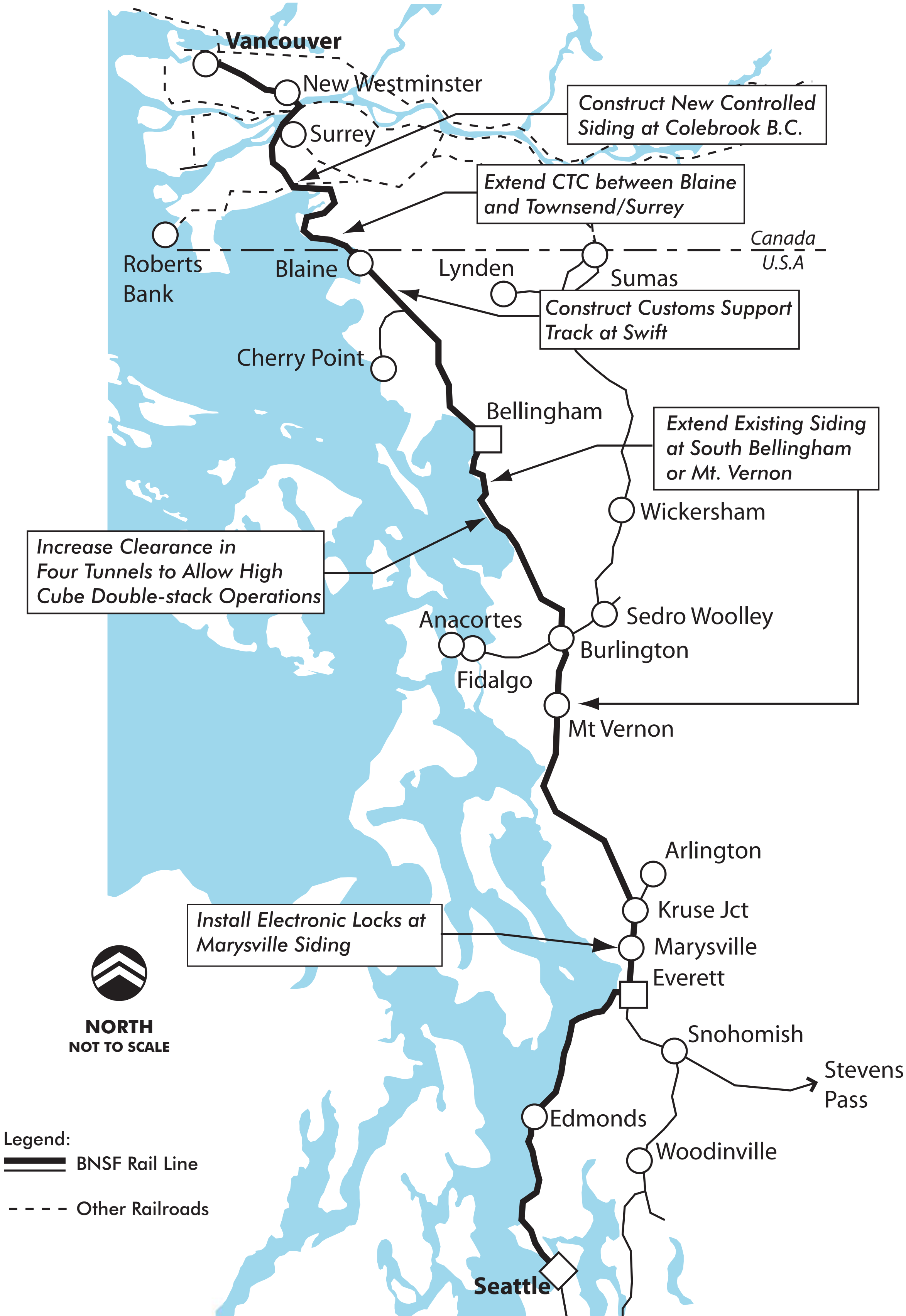

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Figure 5-1
RECOMMENDED IMPROVEMENTS - EVERETT TO VANCOUVER

377000\FINAL REPORT\FIGURE 5-1 - 11/26/02

These costs do not include any costs for environmental mitigation. Not appearing here are costs for vertical clearance improvements on both BNSF and UP for implementing double-stack services to and from Southern California.

Specifically related to increases in passenger service between New Westminster and Pacific Central Station, other improvements have been suggested. One study, "Vancouver BC Amtrak Service: Infrastructure and Operating Changes for Additional Trains" (1998), identified various improvements. The improvements included, among other things

- ***For a second Amtrak Cascades train***: a second track between CN Junction and Still Creek Phase 1 ($5.4 million), a Douglas Road grade separation ($12 million), CTC between CN Junction and Blaine ($7.9 million), and a Colebrook siding ($4 million).
- ***For a third Amtrak Cascades train:*** Various yard area changes at New Westminster ($2.8 million), a third main track between Piper and Brunette ($13.2 million), a second main track between CN Junction and Still Creek Phase 2 ($11.2 million), and a controlled siding Willington Junction to Sperling ($8.7 million).

Together, these improvements total $53.2 million in 1998 dollars, exclusive of CTC and the Colebrook siding. The consultant who worked on the study reported that this figure has been revised upward to over $100 million. Presumably these costs include engineering and contingencies. It is interesting to note that the 1998 estimate for the CTC is only $7.9 million, versus the $18.78 million, inclusive of coded track circuit (before engineering and contingencies), cited in Table 5.3. The 1998 study was sponsored by Amtrak, British Columbia Transportation Financing Authority, BNSF, and CN.

5.2.2 Main Line Alternative for Double-stack Trains via Sumas

As noted above, one of the larger cost items for improvements on BNSF Cascade Gateway rail corridor is for vertical clearance improvements to the four tunnels south of Bellingham through the Chuckanut range. This might be avoided if double-stacks were routed via Sumas, Washington. Traveling from Everett north to Vancouver, double-stack trains conceivably could use the following routing: BNSF Cascade Gateway main line from Everett to Burlington, thence on BNSF's Sumas Subdivision from Burlington to Sumas, thence on CP to Vancouver. This routing has vertical clearances that would allow for high cube double-stack trains. The routing is shown on Figure 5-2 and discussed in the text that follows.

The BNSF's Sumas Subdivision extends for 45 miles from Burlington via Sedro Wooley to Sumas, where it connects with the Canadian Pacific (CP). The Southern Railway of British Columbia also operates in Sumas, but does not have a direct connection to the BNSF there. The SRY track to Vancouver is accessed off of the CP at Sumas.

The BNSF line, while in very good physical condition, has no passing sidings anywhere between Sumas and Burlington. This segment has no signalization; train operates by track warrant control.

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Figure 5-2
ALTERNATIVE DOUBLE-STACK ROUTING VIA SUMAS

North of Sumas, the SRY operates a single track line to the Fraser River at New Westminster, where physical connections exist to the other carriers, and therefore to Vancouver. The CP operates a line approximately 8 miles from Sumas to its main line at Mission. From this CP line, there is also a physical connection to the CN main line, on the south bank of the Fraser, opposite Mission, but this connection is in the Northeast quadrant of the CN/CP crossing, and is used as part of a CP/CN directional running arrangement that extends east of Mission through the Fraser River Canyon. It is therefore not practical to operate between points on the CN east or west of Mission, and the Sumas border crossing.

There are some other physical limitations to this gateway and its supporting rail routes. The SRY line to New Westminster includes a very steep grade, with extremely sharp curves, as it climbs the Fraser Valley escarpment south of the Fraser River rail crossing near Brownsville[5]. The SRY lines also winds through residential neighborhoods in Surrey. The CP line is maintained to branch line conditions, and would probably need some tie and ballast work if any substantial increase in traffic were to develop.

A routing via Sumas using SRY would be less desirable given the various challenges in the route and alignment noted above. Despite limitations, it is likely that the CP/BNSF trackage could accommodate an additional double-stack through train four times a week (2 rounds trips per week) in 2012, provided that:

- The added train did not require intermediate switching or perform work en route, and
- The train could be scheduled so as not to require a meet in either direction with the daily turnaround local that operates on BNSF between Everett and Sumas during daylight hours (this is currently the only train that uses this route).

This last condition would probably restrict the added train to a nighttime schedule, and would further restrict it from operating daily (in other words, the added train would need to operate northbound one night; southbound the next). Such an operation sometimes produces crew scheduling difficulties, which can contribute to extra operating costs, but on the whole, it is likely such an operation could be implemented without any significant capital investment. In that respect, the Vancouver-CP-Sumas-BNSF-Burlington route may offer an alternate route for added double-stack trains: one that would not require altering any existing tunnels.

Apart from the physical feasibility of such a movement, there are institutional considerations. The purpose of running double-stacks on the Sumas Gateway would be to avoid making improvements in the Chuckanut tunnels, which would be costly, as noted above. However, there would have to be agreements in place between BNSF and CP that would allow this movement. Rates would have to be construed and an operating plan defined. Presumably, the trains would originate and terminate at a CP intermodal facility in Vancouver. However, more detail would have to be specified in the agreement between the railroads.

[5] A physical inspection of the line in August, 2002 revealed about a 3 percent grade climbing the escarpment and curves of about 10 to 14 degrees (uncompensated).

Also, double-stack trains operated on a BNSF-CP routing via Sumas, albeit infrequently (estimated 1 train every other day, or 2 round trips per week in 2012), could have the potential of causing delays to truck and motor vehicle traffic in Abbottsford and Huntington, BC.

5.2.3 BNSF Main Line between Seattle and Everett

It is unlikely that a small marginal increase in train volumes – either passenger or freight – would trigger a requirement for increased capacity between King Street Station in Seattle and Everett (PA Junction), a distance of 34 miles. It is also clear that a significant change in train counts would require more plant.

The principal driver of increased train volumes is likely to be extension of SoundTransit commuter service from Seattle to Everett. Previous studies, such as the WSDOT "Pacific Northwest Rail Corridor Passenger Plan" (1995) and subsequent *Sounder* and BNSF analyses have indicated that such an extension would require:

- Improvements and extensions to the existing CTC control system, particularly extending the control system from Ballard to King Street.
- Up to eight new crossovers between North Portal and Everett Junction.
- Construction of a second main track through some or all of the remaining single track bottlenecks: one through Interbay Yard in Seattle; one just north of the Ballard movable bridge; one at Edmonds; one at Mukilteo, and various segments between Everett Junction and Everett Station.

If these improvements are made in connection with increased passenger service, they would almost certainly bring about a sufficient increase in total rail capacity to accommodate any additional freight traffic to and from Canada. For one thing, the 8-mile-long Cascade Tunnel near Skykomish would remain an impediment (because of ventilation requirements) to any large increase in freight trains to and from the east. Consequently, the positive effect of the proposed track and signal improvements between Everett and Seattle on the BNSF freight service would pass down to any increased Canadian traffic. Track improvements planned by SoundTransit are shown in Figure 5-3.

On the passenger side, the Everett-Seattle improvements have been developed specifically to support added peak-period passenger service, and would therefore act also to support the running of an additional mid-day intercity service as well.

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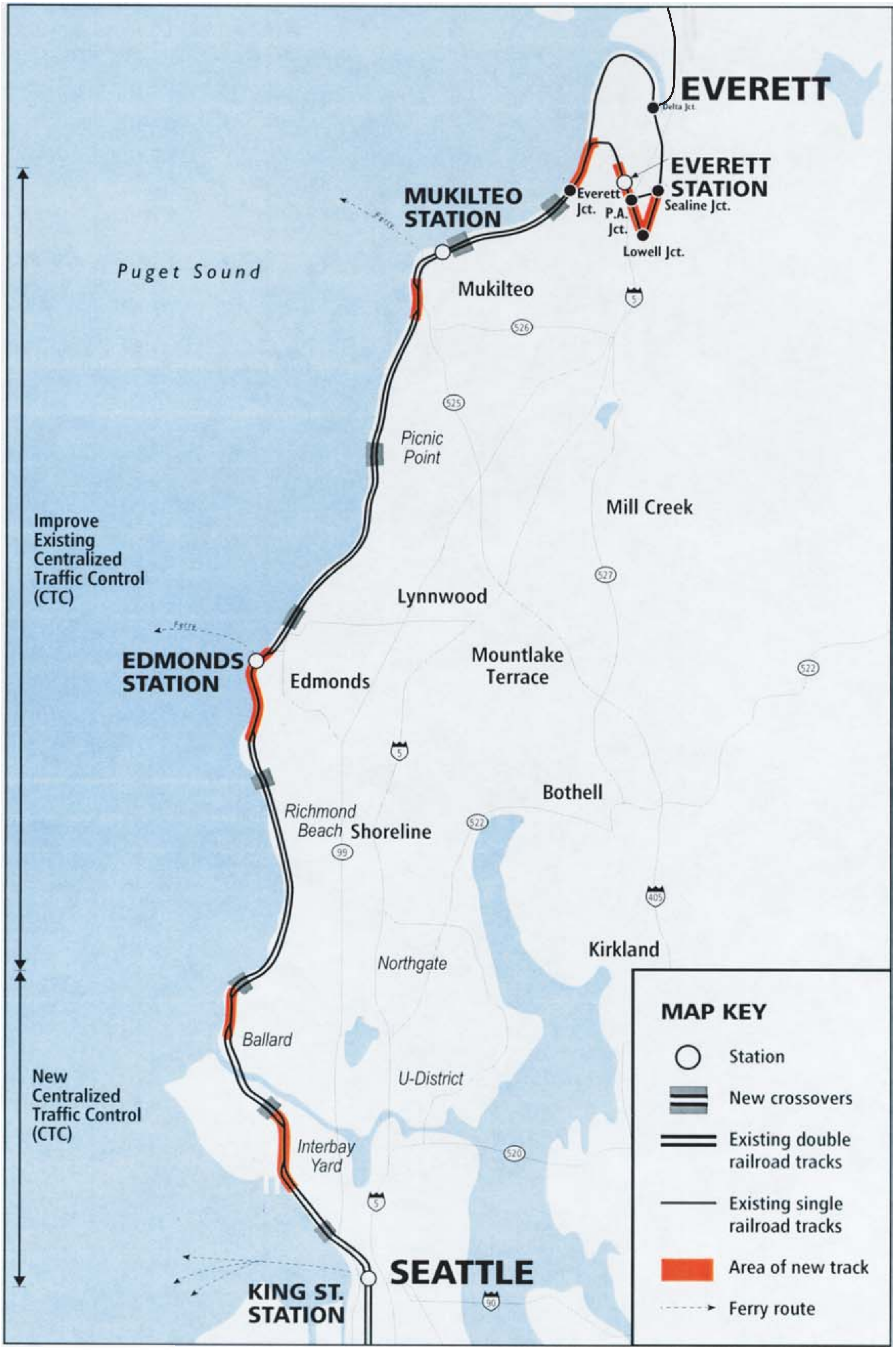

SOURCE: Graphic provided by SoundTransit

Figure 5-3
TRACK IMPROVEMENTS FOR SOUNDTRANSIT COMMUTER RAIL SERVICE

5.3 SUMMARY

The Cascade Gateway rail corridor improvements cited in Table 5-2 (between New Westminster and Everett) will create additional operating capacity and improve flexibility in handling of both freight and passenger service. All of the improvements outlined in Table 5-2, except the tunnel clearance projects, will benefit the growth of rail service on the route. These improvements total $38.57 million. Improvements, identified in a previous study for additional passenger trains between New Westminster and Vancouver, come with a price tag reportedly exceeding $100 million. These improvements will create additional flexibility and potentially enhance service reliability, but are not essential capacity improvements *per se*, as the line segment there is already double tracked and dispatched by CTC. In addition, the tunnel clearance projects will make full height high cube double-stack service feasible over the route. An alternative to the tunnel work might be operation of double-stack service via the Sumas line with only modest improvements to the connecting CP trackage, but this will only support limited double-stack train operations.

Chapter 6
SCOTT ROAD STATION PRE-FEASIBILITY ANALYSIS

6.1 INTRODUCTION

Establishment of an Amtrak Station at Scott Road in Surrey, BC is seen as a possible alternative to operating Amtrak *Cascades* across the Fraser River and into Downtown Vancouver. Track capacity across the New Westminster Rail Bridge over the Fraser River is constrained.[1] Capacity improvements for the bridge and along the route into Pacific Central Station that would facilitate additional freight and passenger rail movements would be very costly, and there is no timeline at present for these improvements. An alternative solution facilitating more passenger trains would be a convenient interchange to the popular SkyTrain service at Scott Road, which would provide the rail link to Downtown.

The purpose of this chapter is to provide a preliminary assessment of feasibility of a Scott Road Amtrak Station and interchange with SkyTrain. At first glance, the potential has various attractive features. SkyTrain crosses the Fraser River, connects to the Pacific Central Station and other points Downtown, and has a station stop about 3,000 feet distant from Amtrak's current routing. On the other hand, a Scott Road terminus for the Amtrak *Cascades* would require an interchange to transit for continuance to Downtown 13 miles distant. This could detract from its attractiveness for Amtrak passengers bound for central Vancouver. The station would also have potential adverse impacts to the surrounding area in terms of demand for parking and other traffic improvements. A station at Scott Road might also offer some positive economic development opportunities and traveler benefits. These considerations are outlined in the analysis that follows.

Pacific Central Station

6.1.1 Key Questions to Answer

- How best could an effective connection be established between the current Amtrak routing and the Scott Road SkyTrain Station?

[1] The bridge is a single-track movable span bridge with severe speed restrictions.

- What Amtrak station facilities would be required?
- Should all Amtrak trains stop at Scott Road or only added new trains?
- How receptive would rail passengers be to the new terminal?

6.1.2 Study Approach

A new Amtrak Scott Road station would have substantial implications for passengers, transport operators and the neighborhood. After determining the location for this station and linkage to SkyTrain (Section 6.3), this analysis approached the station assessment from four different perspectives:

- Rail and other public transit passengers, i.e. the consumers (see Section 6.4).
- Transportation service operators (Section 6.5).
- The neighboring community (Section 6.6).
- The agency responsible for implementing the project (Section 6.7).

The analysis reviewed experiences of peer remote (from Downtown) stations to understand how they have worked for their consumers (Section 6.8). Lastly, the analysis employed three "what if" scenarios to assess the project's flexibility to respond to different demands over its potential 50 to 100-year life (Section 6.9). The Scott Road terminus location was reviewed both as a short-to-medium term option (i.e. if necessary infrastructure improvements are not implemented to allow more passenger trains to/from Downtown Vancouver), and as a long-term option (i.e. permanent terminus).

Since the development of a new station at Scott Road is a speculative project, the inquiry into the desirability and feasibility was made discretely. An effort was made not to disturb station agents and customs/immigration staff with probing questions and thereby stir staff anxieties.

6.2 SCOTT ROAD SKYTRAIN STATION

The Scott Road SkyTrain Station, found near the eastern extent of the 17-mile Expo Sky Train Line, is strategically located in the Greater Vancouver (British Columbia, Canada) Region. The Scott Road Station is the first SkyTrain station east of the Fraser River crossing. Three other stations are located farther east of the Scott Road Station: Gateway, Surrey Central, and King George.

6.2.1 Physical Features

The Scott Road SkyTrain Station is an elevated center platform station with access provided on both sides of the highway access ramp to the King George Highway. The local bus transit center is accessed from the west-end of the platform, and the park-and-ride lots and taxi area are accessed from the east-end of the platform. The passenger elevator to the platform is at the east-end of the platform. A combination of paid and free parking is provided at the station.

Figure 6-1
Scott Road SkyTrain Station

6.2.2 SkyTrain Service

SkyTrain service operates from about 5:30 AM to 1:00 AM on weekdays and from 7:30 AM to midnight on weekends. The scheduled running times from the Scott Road Station to Pacific Central Station is 26 minutes and to the Waterfront Station is 32 minutes.

6.3 POSSIBLE STATION DEVELOPMENT AND LINKAGE CONCEPT

The first key question identified for the study was how best to make the connection between Amtrak and SkyTrain.

6.3.1 Station and Linkage Scenarios

The basic operating premise for a new Amtrak station at Scott Road was to serve all Amtrak trains at this location, and discontinue service to Pacific Central Station. However, there are two other operating options involving this station: (1) through routing of trains with service to both Scott Road and Pacific Central Station, or (2) operation of the current train to Pacific Central Station with only new trains stopping at Scott Road.

6.3.2 SkyTrain Linkage Philosophy

It is well established that passengers do not like to transfer, particularly if they have baggage and particularly if service on one or both connection services is infrequent. During a field reconnaissance in August, 2002, most of the Amtrak passengers were observed to have some baggage, although most could be categorized as light carry-on baggage. While the SkyTrain service is frequent, Amtrak service is not, and the penalty for missing a transfer connection to

Amtrak is thus substantial. Adding additional transfers to a shuttle bus between Amtrak and SkyTrain most likely would discourage patronage. Once passengers have transferred to a bus from Amtrak, they probably would prefer to stay on the bus to their hotel or Pacific Central Station rather than transfer again onto SkyTrain. Based on this industry experience, the only viable strategy to use SkyTrain as a "bridge" to the Pacific Central Station and to Downtown would seem to be to eliminate the need for the shuttle bus between Amtrak and SkyTrain.

If the Amtrak stop could not be located within convenient walking distance to the SkyTrain station, any stop along the approach to Surrey might be feasible. Field reconnaissance of the Amtrak approach using the Burlington Northern and Santa Fe Railway tracks failed to find a convenient location. Potential stop locations were in the middle of "nowhere" and not attractive to passengers, particularly at night. The planned widening of Bridge Road would severely limit site area available for station development between it and the Canadian National Railway tracks south of Tannery Road. (Amtrak uses the BNSF track which runs between Bridge Road and the CN track.)

Locating the Amtrak stop within convenient walking distance to SkyTrain is the only viable option.

6.3.3 Train-to-Station Linkage

The challenge, therefore, is how to get Amtrak trains close to the Scott Road SkyTrain Station. Amtrak trains approach Scott Road Station using the single BNSF track. This track begins to rise (south to north) on a trestle midway between Tannery Road and Yale Avenue. This trestle track feeds into the Fraser River Rail Bridge, together with two other railroad track alignment approaches. One of these two other track approaches, that belonging to the Southern Railway of British Columbia, comes with 1,500 feet of the Scott Road Station. It would appear that a track connection could be brought into the Scott Road Station from this SRY track alignment. East of Scott Road the new station tracks would diverge from the current SRY tracks and swing northward into the eastside of the Scott Road Station. Some property acquisition would be needed. Figure 6-2 describes this station access concept.

With this new connection into the station, the issue becomes how to get Amtrak trains on the BNSF tracks onto the SRY tracks. The simple concept would be to bring Amtrak trains onto the Fraser River Bridge and back them into the SRY tracks. This would obviously impact capacity of the critical Fraser River Rail Bridge. As such, this is not a viable option. A second concept would be to use the SRY track facilities along the west-side of Timberland Road to connect with the SRY tracks which come near the Scott Road SkyTrain Station. By constructing a new track connection just north of Tannery Road between the CN track and the SRY track (see Figure 6-3), Amtrak trains could reach the SkyTrain Station. Just south of Tannery Road a track connection exists between the CN and BNSF tracks to get Amtrak trains onto the CN track to make the connection to the SRY track.

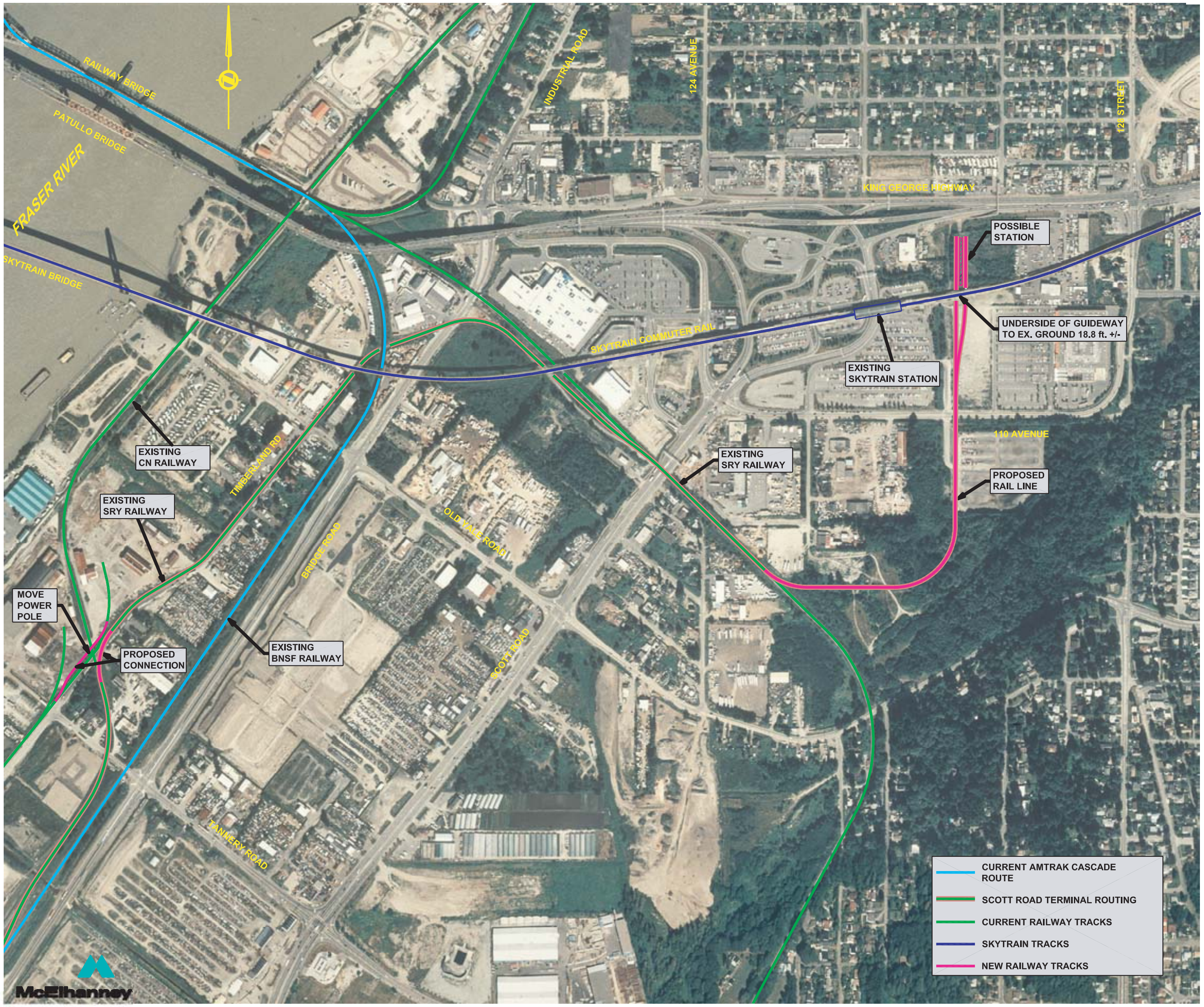

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Figure 6-2
POSSIBLE AMTRAK ACCESS CONCEPT TO SCOTT ROAD SKY TRAIN STATION

377000\FINAL REPORT\FIGURE6-2 - 12/2/02

Figure 6-3
View looking north along Timberland Road at CN & SRY Railroad Junction

6.3.4 Station Facilities

What sort of station facilities will be required if all Amtrak trains stop at this station or if only the new trains stop at Scott Road? Station functional elements will include tracks, platforms, customs/immigrations, ticketing and passenger access facilities.

The total site envelope for the platform area should be about 800 feet by 65 feet (245m by 20m), which would house two station tracks and a center passenger platform. With the current daily roundtrip, only a single station track would be required for the mid-day layover. Introduction of a second daily round trip (with an over-night layover) could be supported by the same single station track. A third daily round trip, however, appears to require a second station track, because there would be potentially two trains in the station at the same time. The Amtrak *Cascades* trains are approximately 750 feet (230m) long and typically consist of 14 Talgo style passenger cars, one F59 locomotive, and one unpowered locomotive. Approximately 65 feet (20m) should be allowed for installation of a train-stop arrester at the end of the track. As, such the passenger platforms should be about 815 feet (250m) in length. A 25-foot (8m)-wide center platform should be adequate.

A customs cage similar to the one at Pacific Central Station would be needed, and the platform should be covered with a canopy. A station house for ticketing and customs/immigration would need to be provided. The minimal size for this station depot would be 5,000 square feet (500 square meters) and desirably it should be 8,000 to 10,000 square feet (800 to 1,000 square meters). Currency exchange facilities should be included in the station.

For planning purposes, loading positions for four buses would be desirable, along with queuing area for eight taxis, short-term parking for 20 cars, and long-term parking for 50 to 100 cars.

As reported above, the only reasonable concept for bringing an Amtrak train within walking distance of the SkyTrain Station would be to bring it in from the south across 110th Avenue to the area between Home Depot and the drainage channel along the east side of the station parking lot. The distance between 110th Avenue and the elevated SkyTrain structure is less than 650 feet (200 m). Either the train would need to block 110th Avenue (not acceptable) or it would have to nudge 165 feet (50 meters) under the elevated structure. The SkyTrain structure provides a 19 feet (5.8m) vertical clearance from the ground. The Amtrak trains require a minimum 17 feet (5.2m) clearance. Thus, the proposed station plan would involve using the area immediate east of the station parking, adjacent to the drainage channel and extending the passenger platform about 130 feet (40m) north of the SkyTrain structure.

6.3.5 Rail Improvements

Two physical improvements to the rail infrastructure would be required (see Figure 6-1). A new track connection would be needed between the CN and SRY tracks just north of Tannery Road near Timberland Road. In order to minimize train conflicts, an industrial rail siding should be reconfigured to connect south of the new CN/SRY track connection. Minor property acquisition and relocation of a utility power pole would be required for this improvement. Train signal and track usage agreement issues would need to be worked out. The second physical improvement would involve constructing the station lead from the SRY tracks into the new station and building the station tracks. Some property acquisition would be required to construct these improvements. Figure 6-4 shows the proposed track alignment and the property parcel boundaries in the area.

Where the SRY tracks parallel Timberland Road, there may be property access issues that might complicate operation of Amtrak trains on these tracks.

Grade crossing protection improvements will be needed at the Timberland Road switch crossing and also farther to the north where the track re-crosses Timberland Road. New crossing protection would also be needed at 110th Avenue and at Bridge Road.

6.4 PASSENGER CONVENIENCE

Rail passenger service is a consumer-oriented business and therefore the perceptions of potential passengers are extremely important.

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Figure 6-4
PROPERTY PARCELS RELATIVE TO AMTRAK EXTENSION

377000\FINAL REPORT\FIGURE6-4 - 12/2/02

6.4.1 Current Features

No information was available concerning passenger origin/destinations at Vancouver for the Amtrak *Cascades* service. Anecdotal information, as well as comments from Amtrak's marketing staff, suggests that many of the passengers are from the United States, and that they are destined to or from Downtown Vancouver. The current schedule for Amtrak *Cascades* service favors travel from Washington State to Vancouver. The morning train leaves Seattle at 7:45 AM northbound and arrives at Vancouver at 11:40 AM. The evening train leaves Vancouver southbound at 6:00 PM and arrives in Seattle at 9:55 PM. Observations made in August, 2002 noted that most passengers had light carry-on type baggage. It appeared that access to the Pacific Central Station was evenly divided between private car pickup/drop-off, taxi and transit (SkyTrain and bus). It was difficult to ascertain how many passengers transferred to intercity bus or other passenger rail services. The schedules for the intercity buses and for other rail services, however, do not appear to be set for schedule coordinated transfers – suggesting little takes place.

6.4.2 Future Service

The second daily train is envisioned to depart Vancouver about 8:50 AM and return to Vancouver about 9:50 PM (extension of trains 513 and 516, which presently terminate at Bellingham). This schedule would be more convenient for BC residents to make day trips to Washington. Thus, passenger profiles for the second train might vary considerably from passengers of the current service. If more passengers are BC residents, this profile would suggest that a greater proportion would arrive by private car and by transit and fewer would depend on taxis.

6.4.3 Travel Time

The SkyTrain travel time from Scott Road to Pacific Central Station about 26 minutes, which compares to approximately a 30-minute travel time for the Amtrak *Cascades* train between the Scott Road area and Pacific Central Station today. Times are about the same when one adds in 5 minutes to transfer between Amtrak and SkyTrain.

The travel time added to existing schedules for making an <u>intermediate</u> stop at Scott Road is estimated to be about 25 minutes for each train. This includes time to travel the two-mile distance between the Fraser River track approach and the Scott Road Station, passenger loading/unloading time at Scott Road Station, time required to reverse train direction (signal clearance, crew positioning on board the train etc.) and time to travel between the Scott Road Station and the New Westminster Rail Bridge. It does not include added time required for customs/immigrations to process all passengers at Scott Road.

Travel times for motor vehicle traffic during the AM peak commute period were compared for both stations – Pacific Central Station and Scott Road – from Downtown Vancouver, North Vancouver, International Airport, Metrotown, Coquitlam, Simon Fraser University, and Richmond. As shown in Table 6-1, the Pacific Central Station was significantly quicker to reach (15 minutes or better) than the Scott Road Station from all these locations except Metrotown (only 6 minutes faster) and Coquitlam (6 minutes longer). Factoring in the 30-minute Amtrak ride from Pacific Central Station to Scott Road, the total "door-to-door" travel times (Vancouver to Seattle) would be faster for the Scott Road Station for all but the Downtown Station. This door-to-door travel time comparison can be understood simply by adding the 30-minute Amtrak travel time to the auto travel times, which are shown in Table 6-1 for Pacific Central Station, and then comparing these new totals to the Scott Road auto travel time. For example, the door-to-door travel time for Downtown Vancouver would be the 30-minute Amtrak time from Pacific Central Station to the Scott Road Station plus the 9-minute auto access time needed to reach Pacific Central Station (a total of 39 minutes door-to-door versus the 54 minutes shown in Table 6-1 to be required to drive from Downtown to Scott Road Station). Experience, however, has shown that travelers prefer to make mode transfers close to their origin/destination points. This would suggest that except for Coquitlam, Richmond, Simon Fraser University, and Metrotown, the Pacific Central Station would be the more convenient.

Table 6-1. AM Peak Period Automobile Travel Time Comparison

To/From	Pacific Central Station	Scott Road SkyTrain
North Vancouver	25 minutes	47 minutes
Vancouver Airport	31 minutes	51 minutes
Downtown Vancouver	9 minutes	54 minutes
Metrotown Burnaby	20 minutes	29 minutes
Coquitlam	33 minutes	27 minutes
Simon Fraser University	27 minutes	27 minutes
Central Richmond	28 minutes	42 minutes

6.5 TRANSPORTATION SERVICE PROVIDER EFFICIENCIES

Relocation of all Amtrak service from the Pacific Central Station to Scott Road would involve no customs/immigrations staffing increases, but some potential logistics costs for customs and immigrations staff. Amtrak's costs at the current Pacific Central Station are minimal and could be reinvested at the Scott Road Station with little change. To better service Canadian passengers using the second daily roundtrip, some minor cost increases might result (ticket machines, etc.). Based on current operations at Pacific Central Station, it is unlikely that intercity bus operators would staff this station. Tour bus operators probably would serve the station, but doing so would not likely increase their staffing needs. Customs/Immigration processing would be performed at the Scott Road Station even under the intermediate stop service scenario.

SkyTrain reportedly has sufficient capacity to accommodate pulse passenger loads associated with Amtrak train arrivals and departures. The filtering process at customs/immigrations would help to distribute passenger loads onto several SkyTrains. Through-ticketing of passengers would help to minimize passenger fare payment efforts and also would minimize currency conversion difficulties. Through-ticketing would provide passengers going to/from Amtrak service at Scott Road with free passage on SkyTrain. As SkyTrain is a "proof of payment" system, Amtrak tickets would need to be considered as valid fare payment on SkyTrain. For Canadian passengers purchasing tickets at Scott Road, the simplest approach would be to rebate the SkyTrain fare from the Amtrak fare.

A Scott Road station was one of several alternative Amtrak terminals in the Vancouver area examined in a 1998 report for the BC Transportation Financing Authority, i.e. "Route and

Terminal Alternatives in British Columbia for Amtrak Passenger Train Service between Vancouver and Seattle". The analysis suggested that SkyTrain services might be tailored to make a transparent interface with the Amtrak service, perhaps including SkyTrain equipment specially equipped for the needs of intercity travelers, integrated ticketing, and transfer assistance.

6.6 GOOD NEIGHBOR RELATIONSHIPS

Land use and good neighbor relationships were assessed in terms of potential station benefits, potential neighborhood implications, and public/private partnership opportunities for cost sharing and revenue/economic enhancements. Both positive and negative implications were sought.

6.6.1 Potential Benefits

Many communities have found that the establishment of a new train station can bring economic benefits, serve as a catalyst for development, and enhance local architecture and/or strengthen historic or other desired civic themes. They can also help establish a signature address or special "place." The SkyTrain Metrotown development success is one of the best examples of potential benefits. The potential promise depends very much on local features, including market strength, and on the amount of foot traffic (passengers, well wishers and greeters) that the project brings to an area.

The Scott Road Station area is developed with low intensity uses (e.g. lumber yards) and, therefore, substantial opportunity exists to intensify use. Property assemblage might be accomplished at modest cost. The absence of sensitive neighbors also reduces the likelihood of "Not in My Backyard" (NIMBY) opposition to intensified land uses around the station. The location of the station within a flood plain is a potentially limiting factor regarding intense development around the station site. The nature of passenger movements (a lot of transfers between Amtrak and SkyTrain) would also seem to limit economic benefits to retail business. The potential for residential development would be more dependent on SkyTrain than on Amtrak access. Amtrak's consumption of land around the station might even reduce the potential for maximum residential development (if permitted within the flood plain). Co-location of Amtrak and SkyTrain stations, along with the planned upgrading Scott Road, might provide sufficient market synergy to establish the station area as a "crossroads" address attractive to office development.

6.6.2 Potential Negative Features

Noise, vibration, traffic and parking are the most common adverse or blighting influences associated with Amtrak rail stations. Noise and vibration impacts are primarily a problem for residential areas. With few sensitive residential uses present, noise and vibration should not represent a problem. The current and proposed second train arrival and departure times are not coincident with SkyTrain commute peaks and, therefore, should not be a problem. The proposed alignment for bringing the Amtrak trains into the Scott Road SkyTrain Station, however, would increase traffic/train conflicts at the at-grade Scott Road, Bridge Road, Timberland Road and 110th Avenue crossings. The new crossing at 110th Avenue would be slow speed and could create conflicts for motorists rushing for SkyTrain. The station project would also involve modification of SkyTrain's Lot D parking lot.

6.7 IMPLEMENTATION CHALLENGES

Difficulties in developing new train stations typically include ability to acquire the site, site clean-up process, phasing dependence on externally controlled decisions, ability to obtain sufficient funds, regulatory approval times, and need for extension of expensive road and other infrastructure prior to station start-up. Development of political and community consensus also can be a challenge for historic and signature projects.

Modification of current railroad track, extension of track into the station, and station development are estimated to involve approximately $14.1 million in improvement costs. Acquisition of required right-of-way is not included in this cost. Portions or all of eight parcels would need to be acquired. Table 6-2 summarizes the estimated station development costs.

6.8 PEER STATION COMPARISONS

Experiences at two potentially peer remote stations were reviewed in order to understand the viability of the remote Scott Road Station. The peer stations reviewed were the Emeryville Station serving San Francisco (California, USA) and the Ottawa Station (Quebec, Canada) connected by Bus Rapid Transit to Downtown.

6.8.1 Emeryville Station

The Emeryville Station serves Amtrak's Coast Starlight and California Zephyr long distance trains and regional intercity Capitol Corridor and San Joaquin trains. Amtrak provides a bus connection from Emeryville to Downtown San Francisco across the Bay Bridge. San Francisco bound passengers can also connect to Downtown via transfer to BART at the Richmond Station. Review of mode of access data for the Emeryville Station reveals that approximately one-third of its passengers use the through-ticketed bus connection to San Francisco. Thus, transfers are tolerated to reach Downtown from an outlying train station. Not known is the potential patronage unrealized due to the transfer connection.

6.8.2 Ottawa Station

The Ottawa VIA rail station is connected to Downtown Ottawa by an exclusive right-of-way bus rapid transit line. The bus rapid transit station at the VIA rail station serves primarily people going to/from the station, as there are no other major destinations near this station. On an average weekday approximately 400 people board the bus rapid transit service leaving the VIA station and 500 arrive by bus rapid transit service to the VIA rail station. Twelve Ottawa-Toronto trains and six Ottawa-Montreal trains daily stop at the station. The bus rapid transit patronage probably includes some well-wishers and greeters as well as VIA rail passengers. As with the Emeryville Station, Ottawa rail passengers are accepting the remote station location, but some potential patronage undoubtedly is being lost.

Table 6-2. Estimated Station Development Cost			
Project Element	**Units**	**Unit Cost**	**Cost**
Reconfigure Rail Industrial Spur Lead			
New track	500 feet	$250/foot	$125,000
New switch	one	$100,000	$100,000
Culvert	one	$100,000	$100,000
Util. Pole relocation	one	$20,000	$20,000
Subtotal			*$345,000*
New Rail Track Connection Near Timberland Rd.			
Switches	two	$250,000	$500,000
New track	500 feet	$250/foot	$125,000
Crossing upgrade	one	$300,000	$300,000
BNSF signalization	one	$1,000,000	$1,000,000
Subtotal			*$1,925,000*
Perimeter & Bridge Road Crossings			
Crossing upgrade	two	$300,000	$600,000
Subtotal			*$600,000*
Station Track Extension			
New track	4,000 feet	$250/foot	$1,000,000
Station platform	900 feet	$500/foot	$450,000
Station building	one	$3 million	$3,000,000
Mainline RR switch	one	$250,000	$250,000
Station switch	one	$100,000	$100,000
110th Ave Crossing	one	$300,000	$300,000
Subtotal			*$5,100,000*
Miscellaneous			
Mod. to parking lot driveways		Lump Sum	$1,200,000
Signage		Lump Sum	$100,000
Subtotal			*$900,000*
TOTAL			**$9,070,000**
Contingencies		@30%	$2,720,000
Design and CM		@25%	$2,270,000
GRAND TOTAL			**$14,060,000**

Note: Costs stated in U.S. Dollars

6.9 "WHAT IF ASSESSMENT"

As noted previously, train stations tend to have long useful lives and their missions can change significantly during those lifetimes. The level of activity and even the passenger processing functions at Pacific Central Station over the past 50 years illustrate this point. The most obvious changed condition would be if the replacement of the New Westminster Rail Bridge and discussions over track improvements north of there were resolved. Such improvements would make the concept of an Amtrak station at Scott Road obsolete.

Another possibility would be for Amtrak service frequencies to increase to more than two daily trains per direction. The proposed double track station facilities at Scott Road would support this possibility.

A third possibility would be for new commuter rail services to terminate at the Scott Road Station with a seamless transfer provided to SkyTrain. (A commuter rail concept between Bellingham, WA and Vancouver is discussed in Chapter 4; this service conceivably could use a Scott Road Station.) A similar commuter rail-to-rail transit interface is currently being studied by BART in the San Francisco Bay Area. Such a concept would have implications on vertical circulation elements and station trackage needs.

6.10 SUMMARY

The findings for the four key questions posited at the beginning of this chapter and the conclusions of this analysis are summarized as follows.

- ***Best potential strategy:*** The most viable strategy for development of an Amtrak Station at/near the Scott Road SkyTrain Station would involve building a new track connection near Tannery Road and a station spur track from SRY tracks south of the station into the eastside of the station as shown in Figure 6-1.
- ***Facility requirements:*** An 800-foot passenger platform and a double track station track would be needed to support several Amtrak trains daily. A new customs/immigration cage and processing facility would be required along with ticketing and passenger waiting facilities. The estimated cost for track and station development would be $14.1 million, exclusive of property acquisition costs. Eight parcels would need to be partially or fully acquired.
- ***Service strategy:*** The significant amount of time required to make an intermediate stop at Scott Road Station going to/from Pacific Central Station (25 minutes), plus the unknown time for customs clearance, virtually precludes this service concept from consideration. Continuing to operate the current train to Pacific Central Station while running all new trains to a Scott Road Station would be confusing to passengers. While technically feasible, it would increase Amtrak costs (because of duplicate facilities) and require customs/immigrations operations to shift back and forth between stations. Operating all Amtrak service to a Scott Road Station (abandoning service to Pacific Central Station) would probably discourage U.S. resident Amtrak patronage to Vancouver. Impacts on BC resident travel to the U.S. are more difficult to judge.
- ***Passenger acceptance:*** Passengers prefer train stations located near their origin and destination points. Resident passengers from Washington State traveling to/from Vancouver would find the Pacific Central Station most convenient. The schedule for the second daily roundtrip, however, would probably attract more Canadian resident passengers, many of whom might find the Scott Road Station more convenient.
- ***Conclusions:*** Development of an Amtrak Station adjacent to the Scott Road SkyTrain Station appears technically feasible, but data on passenger preferences (favoring either

Pacific Central Station or a Scott Road location) are lacking. Amtrak and WSDOT should incorporate questions into future passenger surveys to (1) elicit more detailed information on passenger origins and destinations in the Vancouver area, and (2) assess passenger acceptance of a SkyTrain transfer between Scott Road and downtown Vancouver locations.

Chapter 7
TRAFFIC DIVERSION IMPACTS

7.1 INTRODUCTION

The purpose of this chapter is to describe the potential energy, environmental, safety, and congestion-related impacts of diverting freight and passenger traffic from I-5 to railroads.

7.1.1 Potential Freight Traffic Diversion

The impact analysis is based on traffic forecasts and estimates of potential highway-to-railroad traffic diversions described in Chapter 2, wherein “domestic” container traffic forecasts are presented for 2012. These forecasts reflect projected growth and assume the implementation of double-stack intermodal train service in the corridor. Double-stack presents perhaps the best opportunity for traffic diversions from truck to rail, due to its expedited travel times and truck competitive cost structure. There may indeed be other opportunities, such as conventional intermodal “Trailer on Flatcar” (TOFC) service, which might provide diversion potential as well.

Two potential freight diversions are analyzed: a “likely” scenario and an “optimistic” scenario. In the optimistic scenario, 81 containers per day are diverted from I-5 to the BNSF railroad.[1] Each diverted container is equivalent to one truck. On level terrain, each truck occupies the lane capacity of 1.5 passenger-cars. The optimistic traffic diversion would remove more than 121 passenger-car equivalents (PCEs) per day from I-5 in 2012. In the likely diversion scenario, 54 trucks or 81 PCEs would be diverted from I-5 each day.

These diversions are dependent upon improvements to the rail system in the Cascade Gateway rail corridor and in southern Oregon and northern California that would eliminate tunnel and vertical clearance constraints. The removal of these constraints would allow BNSF to stack two high cube containers in a well of a double-track car, thus making the traffic more attractive to the railroad.

7.1.2 Potential Passenger Traffic Diversion

In Chapter 3, rail passenger trips in the Cascade Gateway corridor were forecast through 2012. These forecasts reflect the recent history of Cascade ridership, current ridership trends, and expected passenger operations between Seattle and Vancouver in 2012. The forecast of 362,000 annual passengers in 2012 represents an increase of 225,000 travelers from present levels. This projected increase is dependent upon the capital improvements and service enhancements described in Chapters 3 and 5.

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[1] “Cascade Gateway Freight Demand Analysis,” September 25, 2002, prepared by Reebie Associates, was the primary source document for the forecast of the corridor’s freight diversion potential, as reported in Chapter 2. According to the Reebie data, with the initiation of double-stack services, a maximum of 46 containers would be diverted from the northbound movements. More than 93 percent of all this traffic would move between Seattle and Vancouver. To simplify the analysis, all 81 containers per day are assumed to move between Seattle and Vancouver.

If these passengers do not travel by train, they will travel by automobile. Traffic surveys indicate that the average vehicle occupancy rate in the corridor is approximately 2 persons per vehicle. Thus, the potential increase in train ridership would divert an average of 233 automobiles per day from I-5.[2]

7.1.3 Benefits of Potential Traffic Diversions

The diversion of traffic from I-5 would generate a wide range of benefits including:

- Direct traveler benefits
- Indirect traveler benefits
- Societal benefits

Direct Traveler Benefits

Direct traveler benefits accrue to shippers and passengers because trips are taken by train instead of by highway vehicle. Direct traveler benefits may include: out-of-pocket cost savings, reductions in travel time, improvements in travel-time reliability, and enhanced safety or lower accident risks. Time and cost-related benefits depend upon the relative rates, travel times, and travel-time variances of rail and truck modes in 2012. For example, if railroad freight rates for container shipments are lower than trucking rates in 2012, shippers will experience direct benefits from rail movements. Similarly, if train fares are lower than the cost of automobile travel (including parking costs) in 2012, rail passengers will experience direct benefits from traveling by rail instead of by highway.[3] Direct traveler safety benefits are quantified by comparing current rail and truck accident rates and assuming that the relative risks of travel remain unchanged for the analysis period.

Indirect Traveler Benefits

The removal of trucks and automobiles from I-5 will free-up scarce highway capacity for other users. Thus, benefits will accrue to highway travelers who are not directly involved in the traffic diversions. Higher average travel speeds and fewer delays will result in travel-time savings for all highway travelers. Moreover, fewer accidents and accident-related delays will result in lower crash costs.

Societal Benefits

Truck-to-rail traffic diversions may benefit all members of society, even those persons who do not travel in the I-5 corridor, because of reductions in energy consumption, air pollution, and noise. Rail freight shipments are more energy-efficient than truck shipments. Similarly, rail passenger travel is more energy-efficient than automobile travel.

It is not practical to analyze all societal costs in this study. Reductions in fuel consumption may lower railroad, motor carrier, and automobile operating costs. The magnitude of these cost

[2] This value (233) is a weighted-average for the Seattle-to-Blaine segment. Not all passengers will travel the entire length of the corridor. In this analysis, passengers are assigned to each segment of I-5 based on passenger boardings at each station. This detailed assignment results in the allocation of 188 to 272 divertible automobile trips to various segments of I-5.

[3] Direct travel time and cost savings are dependent upon future unknown price and travel-time relationships among modes and involve potential questions of price subsidies. Although direct traveler cost savings are not estimated in this paper, it is important to note their potential existence.

savings will vary with the market price of fuel. However, the market price of fuel may not reflect its true long-run cost if the value of "energy security" could be quantified.

Noise impacts are localized phenomena that depend upon existing noise levels, the location of highway and railroad facilities in relation to residential land uses and sensitive noise receptors, the presence of noise barriers or rows of buildings that act as acoustical shields, and the distribution of traffic among daytime and nighttime hours. A very detailed study of individual highway and railroad segments would be necessary before inferences could be drawn about potential noise impacts.

7.1.4 Overview of Analytical Framework and Data

Framework for Comparison

In order to estimate the benefits of highway-to-railroad traffic diversions, it is necessary to compare conditions for two scenarios. In the *null case*, no traffic is diverted from I-5 to the railroad. Both freight and passenger travelers use I-5. The null case is the benchmark against which all traffic diversion scenarios are analyzed.

In a diversion scenario, a portion of the projected 2012 highway traffic is shifted to railroad. Highway and railroad indicators for a diversion case are compared to indicators in the null case. Benefits are estimated from changes in travel, safety, environmental, and energy indicators.

Comparisons between modes are made using average or marginal costs. Marginal cost is the change in cost associated with a small change in travel activity. Marginal costs are typically measured on a vehicle-mile or ton-mile basis. For some impacts, marginal cost estimates are not available for both modes. In these cases, the average cost of each mode is used in the comparison.

Primary Data Sources

The primary sources of data used in the impact analysis are:

- WSDOT highway and traffic data from the 2000 Highway Performance Monitoring System (HPMS)
- Forecasts of traffic and safety indicators from the Highway Economic Requirements System (HERS)
- Marginal unit costs of highway travel from the *1997 Federal Highway Cost Allocation Study: Final Report* of the Federal Highway Administration (FHWA)
- Freight railroad safety and operational data from Federal Railroad Administration (FRA)
- Rail passenger safety data from Amtrak as reported by the FRA
- Railroad fuel consumption data from the American Association of Railroads (AAR)
- Emission rates of primary air pollutants for locomotives and heavy diesel truck engines as published by the Environmental Protection Agency (EPA) and the Surface Transportation Board (STB)

The Highway Economic Requirements System (HERS) is a highway performance model used by Federal Highway Administration to develop testimony for Congress on the status of the nation's highways. HERS uses the state Highway Performance Monitoring System (HPMS) database developed by WSDOT. In this study, HERS is used to forecast highway traffic, capacity conditions, and crash costs in the northern I-5 corridor for 2012. HERS is used in conjunction with FHWA cost factors from the 1997 federal highway cost allocation study. In the 1997 study, FHWA developed 2000 marginal pavement and congestion cost estimates for classes of vehicles traveling over rural and urban highways.

7.1.5 Magnitude of Potential Impacts

As described in this paper, the diversion of container traffic from I-5 to the railroad would result in significant benefits in 2012. In the likely diversion scenario, \$833,000 of accident, congestion, energy, and air pollution benefits would result in 2012. In the optimistic freight diversion scenario, the estimated accident, congestion, energy, and air pollution benefits would equal \$1.288 million in 2012. In the rail passenger traffic diversion scenario, \$1.495 million of accident and congestion-related benefits would result in 2012.

7.1.6 Potential Impacts in British Columbia

Many of the potential impacts described in this paper for the Seattle-to-Blaine segment of I-5 may occur on the Canadian side of the border. However, comparable highway and marginal cost factors are not available for highway travel in Vancouver, British Columbia. If highway impacts in Vancouver are estimated at a later time, they can be added to the impacts estimated in this paper.

7.2 PROJECTED 2012 TRAFFIC ON I-5

Highway traffic and travel conditions are forecast using the Highway Economic Requirements System and HPMS database. These forecasts reflect normal growth rates in highway traffic for all classes of vehicles before any traffic diversions are simulated. The HPMS database includes a 2020 forecast of average annual daily traffic (AADT) for each HPMS segment, developed by WSDOT. Forecasts of 2012 AADT are derived from the 2020 forecasts and base-year AADT. Specifically, a concave geometric growth factor is calculated for each HPMS segment as shown below, using base year (2000) AADT and forecast year (2020) AADT.

$$AADTGR = \left(\frac{FAADT}{AADT} \right)^{1/(FAADTYR - AADTYR)}$$

Where:

AADTGR = constant growth rate
FAADT = future AADT from HPMS section record
AADT = current AADT from HPMS section record
FAADTYR = year of future AADT from HPMS section record
AADTYR = year of current AADT from HPMS section record

AADT for 2012 is projected along a concave curve as:

$$AADT_{2012} = AADT_{2000} * AADTGR^{(2012-2000)}$$

Table 7-1 shows the HPMS sample segments included in the I-5 corridor between Blaine and Seattle. The forecasted AADT for each segment is shown in column 3.[4]

Table 7-1. Forecast 2012 AADT for I-5 HPMS Sample Segments between Seattle and Blaine		
Beginning Milepost	**Ending Milepost**	**2012 AADT Forecast**
164.60	165.35	239,124
165.35	165.75	341,397
165.75	166.26	341,397
166.26	167.57	306,963
167.57	168.12	356,721
168.12	169.24	274,649
169.24	169.69	299,455
171.56	173.89	280,456
176.22	177.82	236,389
180.81	181.59	220,761
181.59	182.67	243,587
186.49	189.37	177,388
202.51	203.78	117,553
203.78	206.12	117,553
206.12	208.71	101,431
208.71	210.35	78,665
226.45	227.81	87,696
228.93	230.20	86,358
230.20	230.52	69,507
230.52	231.27	69,507
242.69	246.30	51,547
248.97	250.83	57,168
250.83	253.05	61,576
253.88	254.88	69,997
254.88	256.30	72,025
262.63	263.11	50,505
263.11	263.55	50,505
263.55	264.64	43,335
264.64	266.04	43,335
266.04	270.30	33,239
274.23	275.21	26,686
275.21	276.29	10,473
276.29	276.62	22,580

[4] It is important to note that AADT on a highway segment may be declining, in which case the forecast year traffic will be less than the base year traffic.

In the likely freight diversion scenario, 54 trucks per day would be removed from each segment of I-5 shown in Table 7-1. In the optimistic freight forecast, 81 trucks per day would be removed from each segment of I-5 shown in Table 7-1. In the rail passenger diversion scenario, an average of 233 automobiles per day would be removed from the segments of I-5 shown in Table 7-1.

7.3 IMPACTS OF POTENTIAL FREIGHT DIVERSION

7.3.1 Accident Impacts

The diversion of container traffic from I-5 to the BNSF rail line will affect both highway and railroad accident costs. The diversion will reduce highway crash costs, while increasing railroad accident costs. The change in highway accident cost will reflect lower crash costs as a result of removing trucks from the highway traffic stream. Crash benefits will accrue not only to the divertible truck traffic but to other highway users who might be affected by truck accidents.

Marginal accident costs are not available for both modes. For railroads, it is assumed that the marginal accident rate is equal to the average train accident rate. The same generalized analysis process is used for both modes: (1) estimate annual accidents, fatalities, and injuries for the divertible traffic and (2) multiply the annual events by the applicable unit cost per accident, fatality, or injury.

Highway Crash Costs

Changes in highway crash costs for individual I-5 segments from Seattle-to-Blaine are estimated using the Highway Economic Requirements System. The HERS accident analysis program is essentially a three-step procedure:

1. Estimate annual crashes using separate procedures for major facility types
2. Use specific injury/crash ratios and fatality/crash ratios for each functional class to estimate annual injuries and fatalities
3. Multiply the predicted crashes, injuries, and fatalities by the applicable unit cost per crash, fatality, or injury to produce estimates of total crash cost

HERS estimates the number of crashes per 100 million vehicle-miles on rural freeways as a function of AADT and lane width (LW).

$$Crash_{RuralInterstate} = 17.64 * AADT^{0.155} * \exp(0.0082 * (12 - LW))$$

Similarly, HERS estimates the number of crashes per 100 million vehicle-miles on urban freeways as a function of AADT, lane width, and ACR, which is computed as: AADT divided by two-way hourly capacity.

$$Crash_{UrbanInterstate} = (154.0 - 1.203 * ACR + 0.258 * ACR^2 - 0.00000524 * ACR^5) * \exp(0.0082 * (12 - LW))$$

Highway crashes result in costs paid by persons undertaking the additional travel as well as accident-related costs that accrue to other highway users. Theoretically, drivers decide to adjust the amount of travel they undertake after considering crash costs. Generally, crash costs consist of three primary categories: property damage, injury, and fatality. Specifically, crash costs include:

- Property damage.
- Lost household production and earning.
- Medical costs and emergency services.
- Vocational rehabilitation and workplace costs.
- Administrative and legal costs.
- Pain, suffering, and lost quality of life.

Table 7-2 shows the estimated change in annual highway crash cost for the northern I-5 corridor as a result of the potential container traffic diversions.

Table 7-2. Estimated Annual Change in Highway Crash Cost in Cascade Gateway Corridor Associated with Diversion of Container Traffic in 2012

	Likely Diversion Scenario	Optimistic Diversion Scenario
2012 Base Case	$ 571,254,000	$ 571,254,000
2012 Diversion Case	$ 571,026,000	$ 570,912,000
Difference	$ 228,000	$ 342,000

Note: Includes divertible vehicle-miles in the Blaine-to-Seattle segment of the corridor.
All cost in 2000 dollars.

Railroad Accident Costs

The risks of train accidents are a function of train-miles, track quality and condition, frequency and characteristics of at-grade highway crossings, and many other operational factors. In this study, railroad accident costs are estimated using accident rates and property damage costs for BNSF. Injury unit costs represent the average costs of fatal and nonfatal unintentional injuries.[5] Comprehensive fatality costs include economic costs plus a measure of the value of "lost quality of life."[6] The railroad accident rates and unit costs used in the analysis are shown in Table 7-3.

Table 7-3. BNSF Train Accident Rates and Cost Factors

Train Trip Distance in Corridor (Miles)	120
Incremental Trains per Week	4
Train Accident Rate per Million Train-Miles	3.25
Property Damage Cost per Train Accident	$ 103,996
Injuries per Million Train-Miles	9.05
Cost per Injury	$ 35,000
Fatalities per Million Train-Miles	0.95
Cost per Fatality	$ 2,700,000

[5] This description of comprehensive costs is paraphrased from: *Injury Facts, 1999 Edition*, National Safety Council.

[6] The same fatality unit cost is used for both modes.

The estimated annual railroad accident cost for the divertible traffic is approximately $80,000. [7] This total includes the following component cost estimates:

- Annual Property Damage Cost of $8,400.
- Annual Injury Cost of $7,900.
- Annual Fatality Cost of $64,000.

An additional 4 trains per week probably will be needed in both the likely and optimistic scenarios. In the optimistic scenario, the new intermodal trains will be longer than in the likely scenario. However, railroad accident rates are a function of train-miles. Thus, the estimated costs are the same for both diversion scenarios.

Net Change in Accident Costs

The likely diversion of trucks from I-5 in 2012 is projected to reduce accident costs by $148,000 per year. The optimistic diversion is projected to reduce accident costs by $262,000 per year.

7.3.2 Congestion-Related Impacts

Definition of Highway Capacity

The capacity of a highway segment is the maximum flow that can be accommodated during an interval of time, as measured in passenger-cars per hour per lane (pcphpl). The *Highway Capacity Manual* defines six levels of service for basic freeway segments (A-F).[8] Table 7-4 shows the maximum flows and travel conditions associated with these service levels for a "free-flow" speed of 70 mph under ideal conditions.[9]

Two important indicators of congestion are minimum travel speed and volume-to-capacity (v/c) ratio[10]. Generally, highway segments with v/c ratios of .75 to .95 are described as "moderately congested." Urban highway segments with v/c ratios of .96 or greater are described as "highly congested."[11] A v/c ratio of .80 typically corresponds to Level of Service D. At this ratio, the volume of traffic is 80 percent of the maximum that can be accommodated on a highway. A driver's "freedom to maneuver is noticeably limited" and incidents "result in substantial delays."[12]

As level of service declines from A to E for a basic freeway segment with a free-flow speed of 70 mph, the volume-to-capacity ratio increases from .29 to 1.0, while travel speed declines from

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[7] The predicted accident cost reflects average accident frequencies for all BNSF rail lines. Specific accident rates in the Cascade Gateway Corridor are unknown and may differ from BNSF's system average because of: (1) frequencies and types of grade crossings, (2) trains per day, (3) track condition, and (4) traffic control systems.

[8] Transportation Research Board, National Research Council. *Highway Capacity Manual, Special Report 229*, Washington DC, 1998.

[9] Free flow represents traffic flow that is unaffected by upstream or downstream conditions (TRB, 1998).

[10] The source of the data is Table 3-1 of the *Highway Capacity Manual*. The average travel speeds shown in Table 3-1 represent ideal conditions. Average speeds under less-than-ideal conditions may be lower than those shown in Table 3-1.

[11] The United States Secretary of Transportation. *The Status of the Nation's Highways, Bridges and Transit: Conditions and Performance, 1993*, page 98.

[12] U. S. Department of Transportation, Federal Highway Administration. *1999 Status of the Nation's Surface Transportation: Conditions and Performance Report*, Washington, DC, Page 4-3.

70 mph to 53 mph (Table 7-4). At level of service E, the traffic volume consumes the theoretical capacity of the lane. Below level of service E, travel speeds are unstable with frequent speed-change cycles.

Table 7-4. Level of Service Criteria for Basic Freeway Sections: Free-Flow Speed = 70 mph

Level of Service	Minimum Speed (mph)	Maximum Flow Rate (pcphpl)	Maximum v/c Ratio
A	70.0	700	.29
B	70.0	1120	.47
C	68.0	1632	.68
D	64.0	2048	.85
E	53.0	2400	1.00
F	variable	variable	variable

Source: Transportation Research Board. *Highway Capacity Manual*.

Passenger-Car Equivalents of Commercial Trucks

The theoretical (ideal) capacity of a basic freeway segment with a free-flow speed of 70 mph at level of service E is 2,400 passenger-cars per hour per lane. It is important to note that the addition of trucks to a traffic stream reduces the theoretical capacity of a lane by more than one unit. On a general freeway segment, each additional truck is equivalent to 1.5 passenger-cars on level terrain and 3.0 and 6.0 cars on rolling and mountainous terrain, respectively.[13]

In rolling terrain, 5 percent trucks in the peak-travel period lowers the ideal flow of a highway section (in pcphpl) to 91 percent of its theoretical maximum. This latter value is the maximum flow possible if all vehicles in the traffic stream are passenger-cars. Moreover, peak-period lane capacity drops to two-thirds of ideal capacity with 25 percent trucks in the peak-period traffic stream, and to half of its theoretical maximum with 50 percent trucks in the peak-period traffic stream.

In this study, highway capacity is assumed to be fixed for the analysis period — i.e., the number of interstate highway lane-miles remains the same in the corridor. Congestion-related benefits are defined as travel-time cost savings for drivers and passengers, and in-transit inventory cost savings, assuming the divertible container traffic is moved by rail instead of truck.

Marginal Highway Congestion Cost

In the 1997 federal highway cost allocation study, FHWA estimated marginal congestion costs per vehicle-mile of travel (VMT). These congestion costs were estimated for a range of traffic levels and mixes of vehicles. They reflect both peak period and non-peak period traffic conditions. In essence, the congestion costs are weighted averages, based on estimated percentages of peak and off-peak travel for different vehicle classes. The effects of trucks are partially offset by their relatively low volumes of travel during peak periods when congestion is greatest.

[13] These are typical factors for travel on a general freeway segment. The data are derived from Table 3-2 of *Highway Capacity Manual 1997*, Transportation Research Board.

Table 7-5 shows FHWA's high, middle, and low estimates of marginal external congestion costs in cents per vehicle-mile. These costs represent the additional delay to motorists already using a highway segment as a result of one additional vehicle in the traffic stream.

Table 7-5. 2000 Marginal External Congestion Cost (Cents per Vehicle-Mile)

	Rural Highways			Urban Highways		
	High	**Middle**	**Low**	**High**	**Middle**	**Low**
Automobiles	3.76	1.28	0.34	18.27	6.21	1.64
Pickups and Vans	3.80	1.29	0.34	17.78	6.04	1.60
Buses	6.96	2.37	0.63	37.59	12.78	3.38
Single Unit Trucks	7.43	2.53	0.67	42.65	14.50	3.84
Combination Trucks	10.87	3.70	0.98	49.34	16.78	4.44
All Vehicles	4.40	1.50	0.40	19.72	6.71	1.78

Source: Federal Highway Administration, *1997 Federal Highway Cost Allocation Study*.

The costs shown in Table 7-5 are additive to normal travel time and vehicle operating costs. Congestion costs are *external* to the trip maker in the sense that they represent the delay cost imposed on other motorists by the additional trip.

The relevant congestion costs for the freight diversion scenarios are the ones shown for combination trucks. Table 7-6 shows the estimated change in congestion cost in the Blaine-to-Seattle segment associated with the divertible container traffic. The trip distance of this segment is approximately 111 miles, roughly 65 of which are urban highway miles. In the likely scenario, the divertible traffic is equivalent to 19,710 trucks per year. In the optimistic scenario, the divertible traffic is equivalent to 29,565 trucks per year.

A range of estimated highway congestion cost savings is shown in Table 7-6 for the likely container diversion scenario. Analogous values are shown in Table 7-7 for the optimistic container diversion scenario.

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Table 7-6. Estimated Change in Highway Congestion Cost in Cascade Gateway Corridor Associated with the Likely Container Diversion Scenario			
	High	**Middle**	**Low**
Rural	$ 139,261	$ 47,403	$ 12,555
Urban	$ 447,346	$ 152,138	$ 40,256
Total	$ 586,607	$ 199,540	$ 52,811

Note: Includes divertible vehicle-miles in the Blaine-to-Seattle segment of the corridor

Table 7-7. Estimated Change in Highway Congestion Cost in Cascade Gateway Corridor Associated with the Optimistic Container Diversion Scenario			
	High	**Middle**	**Low**
Rural	$ 208,892	$ 71,104	$ 18,833
Urban	$ 671,019	$ 228,206	$ 60,384
Total	$ 879,911	$ 299,310	$ 79,216

Note: Includes divertible vehicle-miles in the Blaine-to-Seattle segment of the corridor

Some judgment must be exercised in deciding which set of marginal costs to use in the analysis. Although high congestion levels exist in some areas of the Seattle-to-Everett segment, much lower congestion levels are present on I-5 north of Everett. Thus, the middle-range congestion cost of $200,000 a year is probably the most appropriate one for the likely diversion scenario. Similarly, the middle range estimate of $299,000 per year shown in Table 7-7 is probably the most appropriate estimate for the optimistic freight diversion scenario.

7.3.3 Energy Consumption

Table 7-8 shows the estimated gallons of fuel consumed each year for each mode in the Everett-Blaine corridor for the container traffic subject to diversion. The comparison among modes is based on revenue ton-miles per gallon (RTMG). As shown in Table 7-8, Class I railroads average 396 RTMG. This factor, which is computed by the American Association of Railroads (AAR), reflects empty and loaded movements of all types of trains. Coal unit trains probably yield the greatest RTMG. For example, the Surface Transportation Board estimated that western coal trains yield 900 to 1,000 RTMG. Way or local train movements generate substantially fewer revenue ton-miles per gallon. The fuel efficiency of a doublestack container train is somewhere in the middle. These trains have high tare-to-net weight ratios. Thus, they are much less fuel-efficient than coal unit trains. For container trains, the average AAR factor is probably a representative value.

A comparable RTMG factor is estimated for trucks by assuming that each loaded container holds 17 revenue tons and the truck fuel efficiency rating is 6.5 mpg. Each truck is assumed to incur 25 percent empty miles. This empty-mile factor is appreciably lower than the 70 percent empty-to-loaded car-mile ratio reflected in the AAR's composite RTMG value.

As shown in Table 7-8, train movements are more than 4 times more fuel efficient than truck movements. Thus, in the likely container diversion scenario, transportation by truck would require roughly 319,000 additional gallons of fuel per year. In the likely container diversion scenario, transportation by truck would require roughly 479,000 additional gallons of fuel per year.

Table 7-8. Annual Gallons of Fuel Consumed to Move the Divertible Container Traffic Under the Most Likely Container Diversion Scenario

	Railroad	Truck
RTMG	396	88
Tons/Day	918	918
Distance	120	111
RTM/Day	110,160	101,898
Gallons/Day	278	1153
Gallons/Year	101,536	420,733

Table 7-9. Annual Gallons of Fuel Consumed to Move the Divertible Container Traffic Under the Most Optimistic Diversion Scenario

	Railroad	Truck
RTMG	396	88
Tons/Day	1,377	1,377
Distance	120	111
RTM/Day	165,240	152,847
Gallons/Day	417	1729
Gallons/Year	152,305	631,099

The market price of fuel is the best available proxy of fuel value. Because highway congestion and safety benefits are stated in 2000 dollars, the average price of diesel fuel in 2000 is used in the analysis. This average price of $1.16 per gallon represents the net value of fuel purchased in Washington State after the state fuel tax of 23 cents per gallon and the federal fuel tax of 24.4 cents per gallon have been deducted from the price paid at the pump.[14] If the change in fuel consumption is valued on the basis of average 2000 market prices, the annual fuel cost savings is $370,040 in the likely freight diversion scenario and $555,640 in the optimistic diversion scenario. Clearly, petroleum fuel has a much higher value than its market price when energy security goals are considered. Moreover, diesel fuel prices may fluctuate substantially in future periods as a result of supply, demand, and geopolitics.

7.3.4 Emission of Air Pollutants

The emission of air pollutants from locomotives and trucks is a function of the gallons of fuel consumed. Four primary pollutants are analyzed in this comparison:

- Carbon Monoxide (CO).
- Nitrous Oxides (NO_x).
- Hydrocarbons (HC) or Volatile Organic Compounds (VOC).

[14] The source of this price is: the Energy Information Administration, U.S. Department of Energy, *Monthly Time Series of Petroleum Product Prices*. This price series is available on-line at: http://www.eia.doe.gov/emeu/states/oilprices/oilprices_wa.html.

- Particulate Matter (PM) less than 10 microns in diameter.

Table 7-10 shows comparable emission standards for locomotives and heavy diesel trucks manufactured in 2002, in grams per gallon. For purposes of comparison, actual emissions are assumed to equal maximum emissions for each mode. Actual emissions may vary with operating speeds, conditions, and other factors. Moreover, these modal comparisons may change for older equipment.

Table 7-10. 2002 Rail and Truck Emission Standards (Grams per Gallon)

Pollutant	Railroad	Truck
CO	26.6	322.4
HC	9.8	27
NO_x	139	83.2
PM	6.7	2.1

It is necessary to convert grams to tons in order to assign a dollar value to the incremental pollutants. Table 7-11 shows the estimated annual tons of emissions for each mode in the likely diversion scenario, as well as the difference in annual emissions.

Table 7-11. Annual Tons of Emissions for Likely Container Diversion Scenario

Pollutant	Railroad	Truck	Difference
CO	2.98	149.52	146.54
HC	1.10	12.52	11.43
NO_x	15.56	38.59	23.03
PM	0.75	0.97	0.22

Note: Reflects divertible ton-miles in the Blaine-to-Seattle segment of the corridor

Table 7-12 shows the estimated annual tons of emissions for each mode in the optimistic diversion scenario, as well as the difference in annual emissions.

Table 7-12. Annual Tons of Emissions for Optimistic Container Diversion Scenario

Pollutant	Railroad	Truck	Difference
CO	4.47	224.28	219.82
HC	1.65	18.78	17.14
NO_x	23.34	57.88	34.54
PM	1.12	1.46	0.34

Note: Reflects divertible ton-miles in the Blaine-to-Seattle segment of the corridor

7.3.5 Air Pollution Damage Costs

The first column of Table 7-13 shows the air pollution damage unit costs used by HERS, weighted by the frequency of rural and urban miles in the I-5 study corridor.[15] These air

[15] U.S. Department of Transportation, Federal Highway Administration. Highway Economic Requirements System: Technical Report, 2002. These unit costs are weighted by the miles of urban versus rural highway in the I-5 corridor from Seattle to Blaine.

pollution damage costs are derived from a widely-cited study by McCubbin and Delucchi (1996) entitled *Health Effects of Motor Vehicle Air Pollution*.[16]

Table 7-13. Annual Increase in Air Pollution Damage Cost			
		Annual Damage Cost for Diversion Scenario	
Pollutant	**Damage Cost per Ton**	**Likely**	**Optimistic**
CO	$ 15.85	$ 2,323	$ 3,484
HC	$ 1,362.30	$ 15,571	$ 23,350
NO_x	$ 1,971.36	$ 45,400	$ 68,091
PM	$ 1,919.44	$ 422	$ 653
Annual Increase: All Pollutants		$ 63,716	$ 95,578

The unit costs shown in Table 7-13 reflect *moderate* rather than *high* costs.[17] They represent nationwide average damage costs per ton from exposure to main pollutants in primarily rural areas. The weighted-average costs shown in Table 7-13 reflect the fact that emissions in rural areas are widely dispersed and population densities are relatively low.

In the likely diversion scenario, shifting the containers from rail-to-truck would reduce air pollution damage costs by approximately $64,000 per year. In the optimistic diversion scenario, shifting the containers from rail-to-truck would reduce air pollution damage costs by approximately $96,000 per year. However, these estimates must be interpreted with caution. It is very likely that continual truck emission reductions will occur between now and 2012. It is possible that the small projected change in emissions cost may never be realized.

7.3.6 Changes in Pavement Preservation Costs

In the 1997 highway cost allocation study, FHWA estimated a set of marginal pavement costs for a 60,000-pound combination truck. This is the type of truck that most closely resembles the trucks used to transport containers. The 2000 marginal pavement costs for a 60,000-pound combination truck are:

- 3.3 cents per VMT on rural interstate highways.
- 10.5 cents per VMT on urban interstate highways.

Although these pavement costs are significant, they will be offset by the marginal truck user fees generated from the container truck traffic. Truck user fees include motor fuel taxes, excise taxes, and heavy truck use taxes. When federal and state user fees are considered, heavy trucks generate more than 10.5 cents per VMT. For this reason, marginal pavement costs are not estimated in this study.[18]

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[16] McCubbin, D. and M. Delucchi. Health Effects of Motor Vehicle Air Pollution, Institute for Transportation Studies, University of California, Davis, 1996.

[17] The level of the incremental traffic is of a modest nature that probably would not justify using the high damage cost values sometimes used by FHWA.

[18] It is possible that pavement impacts would occur on individual highway segments. However, a detailed analysis of individual pavement segments of I-5 is beyond the scope of this paper.

7.4 RAIL PASSENGER DIVERSION ANALYSIS

As described in Chapter 3, an increase of 225,000 travelers per year is projected to occur in the Seattle-to-Vancouver corridor by 2012. This projected increase is dependent upon the capital improvements and service enhancements described in Chapters 3 and 5. If these new rail passengers do not travel by train, they will travel by automobile. This section of the chapter describes the safety and congestion-related benefits of having these people travel by train instead of by automobile.[19]

7.4.1 Passenger and Vehicle-Miles Diverted

The HERS analysis requires the conversion of the projected increase in rail passengers in the corridor to I-5 AADT. The following conversion calculation is performed as shown in Table 7-14. First, the projected increase in rail passengers is apportioned to the corridor's rail station-pairs by the percentage of corridor total passengers currently served by each rail station-pair. Second, the annual passenger-car equivalent is computed using the average vehicle occupancy rate in the corridor of approximately 2 persons per vehicle as noted in Section 7.1.2. Finally, the AADT is computed using the annual passenger-car equivalent value for each rail station-pair.

Table 7-14. I-5 2012 Increased AADT and Passenger-Car Equivalents from Rail Passenger Forecast

Rail Station-Pair	Current Passengers	Percentage of Total Current Passengers	Projected Increase 2012 Passengers	Annual Passenger-Car Equivalent	2012 Increased AADT
Vancouver-Seattle	61,095	41.31%	92,940	46,470	127
Bellingham-Seattle	32,642	22.07%	49,656	24,828	68
Vancouver-Edmonds	11,266	7.62%	17,138	8,569	23
Mt Vernon-Seattle	11,166	7.55%	16,986	8,493	23
Vancouver-Everett	9,147	6.18%	13,915	6,957	19
Vancouver-Bellingham	5,030	3.40%	7,652	3,826	10
Vancouver-Mt Vernon	4,311	2.91%	6,558	3,279	9
Bellingham-Edmonds	3,975	2.69%	6,047	3,023	8
Everett-Seattle	3,869	2.62%	5,886	2,943	8
Edmonds-Seattle	2,667	1.80%	4,057	2,029	6
Bellingham-Everett	1,194	0.81%	1,816	908	2
Mt Vernon-Edmonds	497	0.34%	756	378	1
Mt Vernon-Everett	481	0.33%	732	366	1
Bellingham-Mt Vernon	457	0.31%	695	348	1
Everett-Edmonds	109	0.07%	166	83	0

The rail station-pair AADT is converted to I-5 HPMS segments in Table 7-15. The table also includes the computed 2012 VMT forecast for the increase in corridor rail passengers.

[19] It is not possible to estimate differences in fuel consumption and emissions of air pollutants for passenger rail movements at this time. Detailed studies of passenger locomotive fuel consumption and emission rates would be required, as well as individual analysis of automobile energy and emission rates for various types of passenger vehicles.

Table 7-15. Forecast 2012 AADT and VMT for I-5 HPMS Sample Segments between Blaine and Seattle for Projected/Diverted Rail Passengers				
Beginning Milepost	**Ending Milepost**	**Rail Station-Pair / Highway Segment**	**2012 AADT Forecast**	**2012 VMT Forecast**
164.60	181.59	Seattle-Edmonds	232	1,437,924
181.59	202.51	Edmonds-Everett	258	1,972,442
202.51	226.45	Everett-Mt Vernon	272	2,379,516
226.45	254.88	Mt Vernon-Bellingham	257	2,670,145
254.88	276.62	Bellingham-Blaine	188	1,494,298

7.4.2 Safety Benefits of Rail Passenger Diversion

The safety costs associated with rail passenger diversion include rail accident costs resulting from the projected increase in passengers and the resulting passenger-miles. These costs are estimated using data from Amtrak's accident/incident overview and accident table as reported by the Federal Railroad Administration. The rail accident cost per passenger-mile is illustrated in Table 7-16. As shown in the table, the four-year weighted average of reportable rail accident damage per passenger-mile used in the analysis is $0.00275.

Table 7-16. Amtrak Reportable Damage per Passenger-Mile				
Year	**Accident Count**	**Reportable Damage**	**Passenger-Miles**	**Reportable Damage per Passenger-Mile**
1998	122	$8,771,465	5,324,191,727	$0.00165
1999	116	$20,816,334	5,288,677,392	$0.00394
2000	187	$11,277,149	5,573,991,695	$0.00202
2001	192	$19,036,559	5,570,567,754	$0.00342
Total/Weighted Average	617	$59,901,507	21,757,428,568	$0.00275

Rail accident costs per rail station-pair are estimated in Table 7-17. The total estimated rail accident cost for the corridor is $59,456. The calculation uses the reportable damage per passenger-mile cost reported in Table 7-16.

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Table 7-17. Estimated Rail Accident Cost for 2012 Projected/Diverted Rail Passengers				
Rail Station-Pair	**Projected Increase 2012 Passengers**	**Miles between Stations**	**Projected Increase 2012 Passenger-Miles**	**Rail Accident Cost**
Vancouver-Seattle	92,940	120	11,152,800	$30,670
Bellingham-Seattle	49,656	98	4,866,288	$13,382
Vancouver-Edmonds	17,138	102	1,748,076	$4,807
Mt Vernon-Seattle	16,986	70	1,189,020	$3,270
Vancouver-Everett	13,915	87	1,210,605	$3,329
Vancouver-Bellingham	7,652	22	168,344	$ 463
Vancouver-Mt Vernon	6,558	50	327,900	$ 902
Bellingham-Edmonds	6,047	80	483,760	$1,330
Everett-Seattle	5,886	33	194,238	$ 534
Edmonds-Seattle	4,057	18	73,026	$ 201
Bellingham-Everett	1,816	65	118,040	$ 325
Mt Vernon-Edmonds	756	52	39,312	$ 108
Mt Vernon-Everett	732	37	27,084	$ 74
Bellingham-Mt Vernon	695	28	19,460	$ 54
Everett-Edmonds	166	15	2,490	$ 7
Total				**$59,456**

Note: Miles within British Columbia are not counted in the miles between stations.

Table 7-18 shows the estimated change in annual highway crash cost for the northern I-5 corridor as a result of the potential rail passenger diversion. Section 7.3.1 details the HERS highway crash cost analysis.

Table 7-18. Estimated Annual Change in Highway Crash Cost in Cascade Gateway Corridor Associated with Diversion of Passenger Traffic in 2012	
	HERS Highway Crash Cost
2012 Base Case	$ 571,254,000
2012 Passenger Diversion Case	$ 570,114,000
Difference	$ 1,140,000

Note: All cost in 2000 dollars.

7.4.3 Congestion Benefits of Rail Passenger Diversion

The highway congestion analysis for rail passenger diversion is similar to the freight traffic diversion analysis described earlier. However, there is one major difference. In the rail passenger diversion scenario, automobiles are removed from the highway traffic stream instead of trucks.

Marginal congestion costs from the Highway Cost Allocation Study are used in this analysis. For urban highways, the 2000 marginal congestion cost per automobile-mile is 6.21 cents (Table 7-5). For rural highways, the marginal congestion cost per automobile-mile is 1.28 cents (Table

7-5). Using these factors, a weighted-average congestion cost of 4.16 cents per VMT is computed for automobile travel in the Seattle-Blaine corridor.

The divertible rail passenger-miles described earlier are equivalent to 9,954,325 automobile miles of travel in the I-5 corridor. Thus, if these highway travelers are diverted to trains, annual roadway congestion costs would be reduced by approximately $414,100.

7.5 SUMMARY

The diversion of container traffic from I-5 to the railroad would result in significant benefits in 2012 (Table 7-19). In the likely diversion scenario, the estimated accident, congestion, energy, and air pollution benefits would be $782,000. In the optimistic diversion scenario, the estimated accident, congestion, energy, and air pollution benefits would be $1.213 million.

Table 7-19. Summary of 2012 Benefits of Freight Traffic Diversion Scenarios (Thousands of Dollars)

	Diversion Scenario	
Benefit	**Likely**	**Optimistic**
Accident	$148	$262
Highway Congestion	$200	$299
Energy	$370	$556
Air Pollution	$64	$96
Total	$782	$1,213

In the rail passenger traffic diversion scenario, the estimated accident and congestion benefits could equal $1.495 million in 2012. Potential energy and air quality benefits would also result from the rail passenger diversion. However, quantification of these benefits is beyond the scope of this paper. Detailed studies of locomotive fuel consumption and emission rates per passenger-mile would be required, as well as individual analysis of automobile energy and emission rates for various types of passenger-car vehicles.

Table 7-20. Summary of 2012 Benefits of Rail Passenger Traffic Diversion Scenario (Thousands of Dollars)

Accident	$1,081
Highway Congestion	$414
Total	$1,495

This paper has identified the scope and potential magnitude of benefits that would result in 2012 as a result of diverting freight and passenger traffic from I-5 in the Seattle-to-Vancouver corridor. However, in order for a benefit-cost analysis to be performed, the timing of the rail improvements must be specified. Moreover, an appropriate discount rate must be derived. Benefits accruing in future years must be converted to present value and compared to the present value of the needed railroad investments. Since the benefits associated with the potential freight traffic diversion would accrue in 2012 and beyond, the present value of these benefits would be substantially less than the values shown in Table 7-19.

The essential conclusion of this paper is that significant benefits would result from shifting future traffic growth from I-5 to the railroad. However, a benefit-cost analysis cannot be performed until the timing and details of the projects are specified. A follow-up study is needed to quantify the potential energy and air quality benefits of rail passenger traffic diversion in the corridor and to estimate potential out-of-pocket cost savings to shippers and travelers.

Chapter 8
CONCLUSIONS AND RECOMMENDATIONS

8.1 INTRODUCTION

The purpose of this chapter is to summarize the findings of the Cascade Gateway Rail Study, and to site recommendations and next steps. The findings below are summaries of the key points in the preceding chapters. The recommendations that follow are based on the findings.

8.2 FINDINGS

8.2.1 Freight Traffic Forecasts

The study looked at freight traffic moving in two segments of the corridor: Vancouver to Everett and Everett to Seattle. Both segments will see increases in traffic during the period 2002 to 2012. Consistent with the focus of the IMTC Project, the major focus of the analysis was on through trains operating across the international border at Blaine. Normal growth of the existing carload cross-border traffic will increase by more than 50 percent, from an estimated 6 million tons today to 9.33 million tons in 2012. If double-stack service were initiated in the corridor, the total tonnage would increase slightly. (Such an eventuality would assume that vertical clearance restrictions for high cube double-stack trains between Vancouver and Southern California were removed.) In 2012, total carload trains should total about 2,900; double-stack intermodal trains would total about 200.

Between Everett and Seattle, current traffic includes 15 intermodal trains, 8 carload trains, and 2 garbage trains on a typical day, plus locals. As intermodal train volumes in Seattle and Tacoma are related in the most part to international maritime traffic, it is reasonable to expect that intermodal trains will increase at similar rates. A mid-range growth rate estimated for the ports for their loaded and empty container traffic is between about 43 percent over the 10-year period. Accordingly, there might be as many as 21 intermodal trains per day on this segment in 2012, or 7,600 for the year. Carload growth can be expected to grow at a rate similar to that expected for Vancouver to Everett, totaling about 4,300 trains per year.

8.2.2 Passenger Traffic Forecast

The focus in this forecast was the increase in ridership on the Amtrak *Cascades* between Seattle and Vancouver, if the present Seattle-Bellingham train were extended to Vancouver in 2004, and a third round trip Seattle-Vancouver were added in 2008. Based on the past experience and that of other state-sponsored trains in California, this study forecasts that there would be a total of 362,000 Amtrak *Cascades* riders on the three trains between Seattle and Vancouver in 2012.

8.2.3 Bellingham-Vancouver Commuter Rail

The study performed a pre-feasibility or preliminary assessment of the potential for a cross-border commuter rail service between Bellingham and Vancouver. The assessment assumed two northbound trains in the morning and two southbound trains in the evening. There would be no weekend service. Stations included were Blaine, White Rock, Crescent Beach, South Surrey, North Surrey, New Westminster, and Pacific Central. On the high side, the service would generate 288 one-way riders per day. At the same time, the required a public operating subsidy of $1.1 million per year and capital costs at start-up would be $35.5 million (excluding track improvements). Costs seem to outweigh the benefits.

8.2.4 Capacity Improvements

To support the new double-stack container trains and Amtrak *Cascades* forecasted crossing the border at Blaine, the study recommended various improvements. These include:

- A 9,000-foot controlled siding Colebrook.
- CTC installed 20.5 miles from Blaine to Colebrook and Colebrook to Townsend.
- A 5,000-foot support track at Swift for Customs inspection and the consolidation of U.S. and Canadian Customs inspection at Swift.
- A 2,000-foot extension to one existing siding.
- A lowering of Chuckanut tunnel floors.
- Electric lock protection on the non-controlled siding at Marysville.

Specifically related to capacity, these recommendations total to $38.57 million, inclusive of contingencies and engineering.

8.2.5 Scott Road Amtrak Station

The study performed a preliminary assessment of an Amtrak Station at Scott Road in Surrey, BC. Establishment of such a station, with an easy transfer to SkyTrain, has been seen as a possible alternative to operating Amtrak *Cascades* across the Fraser River and into Downtown Vancouver. This study analyzed the station concept in terms of both a terminus and an intermediate stop. SkyTrain would provide for furtherance to Downtown and other Vancouver area locales. The study's estimate for this station totaled $14.1 million, inclusive of engineering and contingencies. Development of an Amtrak Station adjacent to the Scott Road SkyTrain Station appears technically feasible, but data on passenger preferences (favoring either Pacific Central Station or a Scott Road location) are lacking.

8.2.6 Diversion Impacts

Implementation of double-stack intermodal trains and additional Amtrak *Cascades* round trips on the Cascade Gateway rail corridor will result in diversions of truck traffic and motor vehicle traffic that would otherwise use I-5. This study attempted to ascribe monetary values to these diversions. The economic/societal impact assessments of diversions of trucks to rail results in savings in four areas: accident savings, highway congestion savings, energy savings, and air pollution savings. Annual savings totaled to a range of $782,000 to $1,213,000 in 2012, given either likely or optimistic forecasts of truck diversions. The additional Amtrak *Cascades* will generate annual accident and highway congestion savings of $1,495,000 in 2012. Accordingly, the total high-side savings from truck and motor vehicles diversions could be $2,708,000 in 2012. These values pertained only to U.S. side savings. This is because statistics are not kept in the same format in Canada, which makes savings estimates north of Blaine problematic. Nevertheless, the same types of benefits (differing only in degree) can be expected there.

8.3 RECOMMENDATIONS

The following are the recommendations of this study.

- ***Pursue the extension of the second the Amtrak Cascades train from Bellingham to Vancouver, perhaps as soon as 2004.*** Introduce a third train by perhaps 2008. The ridership potential appears to be there to justify this. The justification for additional trains are the anticipated ridership (362,000 passengers in 2012) and the public benefits that would ensure (savings estimated at $1.5 million in 2012).
- ***Working with the railroads, identify and construct rail improvements necessary to support the second Amtrak Cascades train to Vancouver.*** These improvements would include the controlled siding at Colebrook and CTC between Blaine and Townsend. These two improvements have a total cost with contingencies and engineering of $32.7 million (and a previous study indicated the costs could be substantially less). This is not to say that these are all that BNSF will negotiate for. As Chapter 5 notes, there are various estimates for improvements between New Westminster and Downtown Vancouver. In one case these reportedly exceed $100 million. These other improvements are aimed principally at maintaining service reliability on the line, given the advent of additional passenger trains.

  BNSF's motivation for more improvements presumably is coming from CN, which has trackage rights on the line from New Westminster to downtown Vancouver and would understandably be wary of passenger trains interfering with its operations between its Thornton Yard in Surrey and Downtown. (This agreement[1] was not available from BNSF for review in this study.) BNSF itself has comparatively light traffic on the line[2], while CN runs about 24 trains a day and regularly "parks" its trains on portions of the line's double track. However, as CN continues to become a "scheduled railroad"[3], the need to park trains could diminish and the opportunity to reliably fit in passenger trains with minimal effect to CN could increase. Such an eventually might obviate calls for the expensive improvements between New Westminster and Downtown.
- ***Study the feasibility of eliminating all vertical clearance obstructions for high cube double-stack trains on the BNSF and UP rail lines paralleling I-5 between Seattle and Los Angeles.*** The cost for doing so is reportedly around $20 million. (The actual numbers were not available from BNSF and UP for this study.) Part of this study would be a detailed analysis of the benefits from truck diversions in Washington, Oregon, California.

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[1] "Contract - Vancouver, Victoria and Eastern Railway and Navigation Company and Canadian Northern Pacific Railway Company", 1915. The former interurban rail company is a predecessor railroad of BNSF, and the latter is a predecessor railroad of CN. BNSF and CN thus are heirs to the agreement's specified responsibilities and rights.

[2] Light engine moves New Westminster-Downtown and two shifts five days per week to/from the Barge Slip at Burrard Inlet.

[3] Comments by Paul Tellier, President and Chief Executive Officer, of Canadian National Railway, at the TransComp 2001 Awards Luncheon, Charlotte, NC, November 13, 2001; also at the 2001 Annual Meeting of Shareholders, Vancouver, BC, April 17, 2001.

Chapter 7 indicates that there will be significant benefits in diverting trucks between Blaine and Seattle. It is reasonable to assume that the same types of benefits (differing in degree) will exist for diversions between Seattle and Los Angeles.

- ***There is no need of a commuter rail service between Bellingham and Vancouver (either Pacific Central Station or Waterfront Station).*** As shown in Chapter 4, the ridership likely would be very low. At the same time, the subsidy and required capital improvements likely would be very high.
- ***Survey Amtrak riders to determine their origin and destination patterns in Vancouver, as well as their interest in using a Scott Road station and a SkyTrain transfer.*** The survey would be crafted to test further the feasibility of an Amtrak stop or terminus there.

APPENDICES

Appendix A
CASCADE GATEWAY FREIGHT DEMAND ANALYSIS

The report that follows analyses the freight demand though the study area over a 10-year period, from 2002 to 2012. The focus of the report is on cross-border traffic. It excludes port-related traffic, which was analyzed separately (see Appendix B). The report was prepared by Reebie Associates, at the request of WSA.

Cascade Gateway Freight

Demand Analysis

Prepared for

Whatcom Council of Governments

November 25, 2002

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Key Findings

During the course of Reebie Associates' investigation into the freight flows moving across the Cascade Gateway, we have developed the following key findings:

1. It is highly unlikely that the railroads will introduce a new technology to serve demand in this area, as there is insufficient demand to make the risk of such an investment worthwhile. They may invest in a proven technology, such as double-stack intermodal trains, but due to low demand, such investment is only likely to occur as part of an attempt to build up a West Coast intermodal system.

2. It is very difficult, if not impossible, to predict any future increase in the amount of freight being hauled by the railroad over the Canada/United States border in concert with imports and exports to and from the ocean ports. If such a shift were to occur, it would likely be between the railroads, and not railroad traffic that is taken away from the motor carrier.

3. Significant amounts of lumber are shipped from the Canada to the United States and that amount is expected to increase over the next 10 years. This makes the issue of tariffs with respect to lumber movements from Canada to the United States especially relevant. In 2001, the United States imposed tariffs on the importation of lumber from Canada. This immediately decreased the volume of lumber being shipped. Were the tariffs to be removed, obviously the forecast volumes would be higher.

4. The number of tons shipped into the United States from Canada by motor carrier and the number of tons shipped the other direction are almost equal. For rail, on the other hand, the number of tons shipped southbound is more than 10 times the number of tons shipped northbound. One possible explanation is that the commodity mix southbound is far more suitable to rail than the commodity mix northbound.

Introduction to TRANSEARCH

Much of this report will be based on the database that Reebie Associates has sold to Whatcom County, that is, the TRANSEARCH® database. This database is produced each year by Reebie Associates and provides information on the number of tons of freight flowing within the United States and for freight flowing between the United States and Canada. This information is provided on the basis of geography, commodity, and mode, as follows.

1. Geography. The definition of the geographic resolution varies between the United States and Canada. In the United States, geography is resolved to the county level. In Canada, geography is resolved to the Canadian Metropolitan Area (CMA) level.[1] The United States has 3164 counties and Canada has 38 CMAs. For United States geographies, we will also report data at the Business Economic Area (BEA) level. There are 172 BEAs in the United States. They are aggregations of counties and the United States Bureau of Economic Analysis determines their boundaries.

2. Commodity. This variable is defined down to the four-digit level of the Standard Transportation Commodity Code (STCC). The STCC is a numeric set of designations used by the United States Government to classify freight. There are approximately 740 different commodity codes at the four-digit level.

3. Mode. The TRANSEARCH database shows seven different modes of transportation: rail carload, rail/truck intermodal, truckload, less-than-truckload, private truck, water, and air. For flows between the United States and Canada, this is reduced to five: truck, rail, water, air, other

The TRANSEARCH database contains no direct information on gateway. For example, a shipment moving from Houston to Calgary may or may not go through the Cascade Gateway. In order to allocate certain origin and destination pairs by gateway, some loss of resolution was required. As a result, there the commodities are reduced in resolution to two-digit STCC. In addition, freight bound for Canada by rail could only be classified to the level of the Canadian Province. However, as the volume of rail traffic to Canada is quite small, little is lost in this lack of geographic resolution.

Since the basic TRANSEARCH data are unable to distinguish flows at the sub-county level, the tons provided for flow through Whatcom County do not distinguish between Sumas and Blaine. It is the case, however, that nearly all the tonnage moves through Blaine. Because of the nature of the infrastructure, this arrangement is likely to be the case for quite some time, if not permanently. The 10-year projection considered in this report does not account for any diversion of freight volume from Blaine to Sumas.

Data developed regarding truck movements in the "Cross-Border Trade and Travel Study" (2001) was reviewed prior to development of the forecasts based on TRANSEARCH data.

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[1] A Canadian Metropolitan Area is defined by Statistics Canada as an urban core of at least 100,000 population and surrounding areas that have a high degree of social and economic integration.

Base Rail Forecast

As proposed, Reebie Associates has prepared a database containing information on the flow of freight over the Cascade Gateway through Whatcom County, Washington. This database includes information on the flow of freight over the gateway both by railroad and by motor carrier. It is important to have information on the latter because enhancing rail volumes, as will be seen later in this report, depends on diverting them from motor carrier volumes.

In preparing the data, we found that one of the largest elements of the 2000 rail flow has to do with a major construction project – the expansion of Roberts Bank Port. This special construction project resulted in the delivery of approximately one and a half million tons of rip-rap (Standard Transportation Commodity Code 1421) by rail from the United States. This shipment overwhelms all other data for 2000. As BNSF does indicate that they are not currently moving rip-rap to Canada, Reebie Associates has removed that commodity from the forecast and from the estimate of 2002 tons.

The information on current and forecast freight flows is provided in the TRANSEARCH database provided separately on CD. This information, which has been adjusted as described in the preceding paragraph, is summarized in the Appendix.

Enhanced Rail and Improved Facilities Forecast

Possibilities for Increasing Rail Demand

It is possible that the railroad may be able to capture more traffic were it to offer service superior to what it can offer today. If this were to be the case, then some of the demand for motor carrier facility construction at the Gateway may be relieved.

It is important, however, to make a distinction between traffic moving to Canada and traffic moving to the United States. Currently, very little of the northbound traffic moves via rail – it is almost all motor carrier. Due to the types of commodities being carried, the forecast indicates that the rail share of the northbound market is likely to get even smaller. Nevertheless, this forecast will look at possible enhancements to rail traffic in both directions.

For purpose of creating the forecast, Reebie Associates considered the following possibilities:

1. Additional traditional rail intermodal

2. Additional rail carload traffic

3. Additional non-traditional rail intermodal

Our discussion of the additional traditional rail intermodal traffic includes double-stack service to and from the ports at Vancouver, Seattle, Tacoma, and Roberts Bank.

It would appear, however, that a major increase in traffic associated with the ocean ports is not likely over the short or medium term. Any increase in that traffic would imply a land movement between two countries (Canada and the United States) and between multiple railroads. More than one railroad would be needed to complete such a shipment for the following reasons:

1. The Canadian railroads have no track in the northwestern portion of the United States.

2. While BNSF, the only United States railroad operating in that geographic area, has access to Burrard Inlet port area, it has not developed the container handling infrastructure there; also, BNSF cannot access Roberts Bank directly.

These impediments will make growth in that traffic occur, if it does occur, only in the far future.

There are events that could remove or alter these impediments substantially. Any policies that would affect movements through the United States or Canada for trade with a third nation; economic conditions that would favor the United States or Canada in international trade, including exchange rates; policies that will cause one country as opposed to the other to capture a larger share of the port traffic, such as a port subsidy. Last, were a merger between a United States carrier and a Canadian carrier (such as the previously proposed one between the BNSF and CN) to occur, the multi-railroad impediment could be removed. However, the bi-national impediment would remain. Also, in that case, improvements to port facilities would still be necessary. As a forecast for these items is not feasible, there is no basis for a forecast of the amount of additional rail freight that may or may not move through the Cascade Gateway as a result of improvements to non-rail facilities.

Clearly, however, there is no credible technique to prepare a forecast of port-related intermodal traffic other than the normal growth forecast. Therefore, the improved facilities forecast, which assumes improvements in facilities other than the railroad, is one that cannot be credibly prepared. For that reason, we have combined the enhanced rail forecast with the improved facilities forecast to create one additional forecast for the client to consider. We have prepared that forecast, however, at two levels: likely and optimistic.

Before discussing these forecasts, however, it will be useful to have a short discussion of the other two items on the list presented earlier of additional rail traffic that may be possible, that is, carload traffic and non-traditional intermodal traffic.

Railroads have been making a number of attempts over recent years to increase their share of traffic by carload along the Pacific Coast. That market, known as the I-5 corridor because of the United States highway that passes through the area, has been regarded as a useful potential market by the Canadian railroads and the railroads in the western United States (UP and the BNSF). These railroads have announced a number of joint marketing agreements in which they can prepare their own pricing for service along the corridor. In particular, the BNSF and CN have announced a joint marketing agreement for service to and from Vancouver, BC.

While it is possible that these agreements could create more rail demand, increases that are part of the baseline forecast implicitly consider general marketing and technology trends, such as joint marketing agreements or improvements in motive power technology that may occur for existing services. If rail service is truly enhanced, it will result in services that are not currently offered. The increment to rail volume due to enhancement is calculated in this report on the basis of new rail services only. This increment does not include carload service, which is part of the base forecast.

Finally, consideration needs to be given to the possibility that an alternative technology may catch on in this corridor. The United States railroads have been expanding their RoadRailer networks over the last several years. With RoadRailer technology, trailers pulled by motor carriers can be assembled directly into trains without having to be stacked or placed on railroad flatcars. This technology results in a lower cost of operation for the railroads. However, it increases the cost of operation for the motor carrier as the equipment has a higher capital cost and, due to its having a higher tare weight, cannot carry as much freight.

Although RoadRailer can be hauled less expensively by a single railroad, the equipment cannot be interchanged freely with other roads. This results in the need to have dedicated RoadRailer networks to make the technology work. While that is possible, the economics, in most cases, are insufficiently compelling. Similar economics are available with a double-stack operation and it uses equipment that is more universal.

Based on the preceding discussion, there appears to be left only one potential area where a reasonable assessment of enhancement to the rail demand can be made, that is for double-stack intermodal service between British Columbia and the western United States. An increase in demand for this service assumes that the route between these points will have double-stack impediments due to inadequate tunnel clearances removed.

Operating Plans for Solid Intermodal Trains

Before proceeding further with this discussion, though, it is important to know how a solid intermodal train generally operates.

The operation of a "solid" intermodal train is similar in some respects to the operation of a unit train. The solid intermodal train will not contain any cars other than those carrying intermodal containers. In some cases, these trains may carry trailers as well; however, that is becoming a less frequent occurrence, especially in Canada.

There is a big difference, however, between the solid intermodal train and a unit train. While the unit train will operate all the way from one origin to one destination with a single collection of cars, the solid intermodal train does not. Generally, there is insufficient demand at one location for this to be the usual case.

In that respect, it may be said that the operation of this kind of train is similar to carload, with frequent visits to yards and with classification. However, due to the limited nature of the individual origins and destinations (intermodal ramps only) the disaggregation of commodity flow is not quite that fine.

As a result, the reorganization of destinations for the intermodal train occurs at locations where the railroad can perform an operation known as a "block swap." In a block swap, cuts of cars bound for an alternate set of destinations will be removed from a train while a block of cars headed the way the train is going will be picked up. This is really no different from the full classification in a yard that is done with carload service. However, it is much more aggregate. That is, there are many fewer blocks and far less classification that is required. In some respects, it is much like grain service, where railroads will pick up cuts of 25 cars each and assemble them into unit trains.

The following list a compilation from BNSF staff (Messrs. Don Fyffe, Roger Jacobsen and Marty Marasco) indicates the required improvements:

1. Increase vertical clearances in the Chuckanut tunnels.

2. Install CTC completely between Vancouver and Everett

3. Build a better facility for customs clearance at Swift.

4. Install 20 miles of double track between Blaine to Ferndale.

5. Install a siding at North Colebrook.

6. Increases in vertical clearance for five tunnels along the Oregon Trunk Line (along the Deschutes River).

7. Install a track capable of handling 286,000-pound cars along the Inside Gateway and the Oregon Trunk Line.

The WSA capacity analysis, conducted separately from the forecast, revealed that not all of these improvements are necessary to allow double-stack container moving between Everett and Vancouver. Nevertheless, were the required improvements to be made, BNSF would be able to compete for OSB (strand board) and double-stack (FAK) traffic. OSB markets would be in Southern California and Phoenix.

The BNSF personnel added that UP would have a superior route from Portland south, with CTC and track robust enough to handle 286,000 cars. However, UP has its own clearance problems in Southern Oregon and Northern California. UP has rights to market traffic out of Vancouver, which BNSF would haul for them.

Double-Stack Potential to the United States from Canada

Table 1, on the next page, provides a summary of traffic that currently moves from British Columbia to points in the western United States and may be divertable from motor carrier to a double-stack intermodal train. The analysis here is limited using these assumptions about which freight demand levels ought to be counted:

Origin Prov. Code	Prov.	Origin CMA Code	CMA	Dest. BEA Code	BEA Name	Truck 2002	Rail 2002	Truck 2012	Rail 2012	Divertable 2002	Divertable 2012	Low 2012 Diverted	High 2012 Diverted
80	BC	240	Non-CMA BC	167	Portland, OR	857,734	519,499	1,321,993	831,457	397,468	634,436	63,444	95,165
80	BC	240	Non-CMA BC	160	Los Angeles, CA	475,833	333,727	799,125	580,401	307,684	483,183	48,318	72,477
80	BC	240	Non-CMA BC	163	San Francisco, CA	212,275	118,685	320,379	168,274	126,372	183,885	18,388	27,583
80	BC	240	Non-CMA BC	169	Richland, WA	155,738	65,673	291,736	108,167	96,944	175,566	17,557	26,335
80	BC	240	Non-CMA BC	147	Spokane, WA	150,702	74,278	272,104	128,502	89,000	160,581	16,058	24,087
80	BC	240	Non-CMA BC	166	Eugene, OR	143,403	88,840	254,435	159,304	65,475	115,531	11,553	17,330
80	BC	240	Non-CMA BC	164	Sacramento, CA	49,661	35,565	86,126	63,045	29,613	48,883	4,888	7,332
80	BC	240	Non-CMA BC	161	San Diego, CA	44,005	31,137	76,170	54,589	26,682	44,225	4,423	6,634
80	BC	240	Non-CMA BC	158	Phoenix, AZ	47,155	165,769	78,936	279,551	25,014	40,755	4,075	6,113
80	BC	240	Non-CMA BC	168	Pendleton, OR	50,085	23,635	75,447	38,444	21,456	37,440	3,744	5,616
80	BC	223	Vancouver BC	158	Phoenix, AZ	13,640	27,061	22,035	43,647	8,674	13,231	1,323	1,985
80	BC	223	Vancouver BC	160	Los Angeles, CA	676	655	1,060	1,018	526	787	79	118
										1,185,707	1,924,485	192,448	290,775
				Analysis of trains in the southbound direction				*Tons per container*				17	17
				assuming two trains per week				*Number of filled containers per year*				11,320	17,104
								Number of filled containers per week				217.70	328.93
								Slots per train				200	200
								Trains per week				2	2
								Percent full				54.4%	82.2%
				Analysis of trains in the southbound direction				*Tons per container*				17	17
				assuming three trains per week				*Number of filled containers per year*				11,320	17,104
								Number of filled containers per week				217.70	328.93
								Slots per train				200	200
								Trains per week				3	3
								Percent full				36.3%	54.8%

Table 1. Potential Southbound Diversions (Tons per Year)

1. Count only freight that is divertible (i.e., can be placed in a container). Freight that is not containerizable, for example, liquid chemicals that are shipped in tank cars, would not be attracted to a double-stack operation. Reebie Associates maintains a data bridge that shows the percentage of a particular commodity that is divertible to a container. In this process, it is important to understand that the STCC shown in TRANSEARCH is only two digits long. As a result, it can be difficult to know whether any one of those commodities can be diverted to rail. For example, our data shows a lot of STCC 24, Lumber or Wood Products, being divertible. However, many of the products within the Lumber category are not really very divertible. For example 2421, Lumber or Dimensional Stock, is only carried as 30 percent divertible. On the other hand, Kitchen Cabinets (STCC 2434) are 100 percent divertible. Overall, 40 percent of STCC 24 is considered divertible.

2. Count only freight that originates in British Columbia. The freight that moves from Canada south to the United States through the Cascade Gateway by motor carrier is not all geographically amenable to rail diversion. Some of the freight originates in places too far away for it to be considered reasonable to ship by motor carrier all the way to a BNSF facility. Reebie therefore elected to eliminate all origins outside of British Columbia from this analysis. The amount of freight eliminated was not adequate to interest another rail carrier for purpose of providing connecting service.

3. Count only freight whose destination is in the western part of the United States. Some of the freight had destinations, such as New York, which would not create, by itself, sufficient demand for a double-stack train. It is possible that there could be a New York block on an eastbound train. However, such an approach to the market is not likely to occur until after service has been established for a while.

4. Count only freight that is moving at least 500 miles. Freight that moves a relatively short distance will not go by rail at all for even part of its journey; it will simply stay with a motor carrier. Goods that need to travel a total of 300 miles are not going to move 75 miles to a terminal, 150 miles on the railroad and then another 75 miles to the destination. The terminal costs are simply too large for that to be worthwhile. Reebie therefore looked only at freight that is moving at least 500 miles. Even with this restriction, however, it is important to understand that the miles from a BEA to a CMA are measured centroid to centroid.

Based on the data in Table 1, it would appear that there might be enough demand for a double-stack train headed south out of British Columbia if two conditions exist:

1. The railroad runs service on a two or three times per week basis. It is possible that the market would respond positively to a service at once per week, but unlikely to respond to anything less frequently than that.

2. The railroad is able to capture at least 10 percent of the market for freight that can be diverted to rail. However, at this level of market capture, the railroad would find only 54 percent of the slots full on a 200-container train twice per week.

One of the difficulties with this scenario is that the Southern California area has a surplus of containers. Therefore, this scenario, which would make containers empty in that area, would not be very economic. That said, past work on merger analyses using its diversion model, Reebie Associates has found a 10 percent diversion quite feasible. While diversions higher than 15 percent may be found, they are generally capped at that level for the direction of major demand.

To understand the level of demand being considered here, please refer to the earlier discussion on train operation for solid intermodal trains. As they do not operate as a true unit trains, these collections of containers can have more that one destination in spite of being on the same train. For example, a double-stack train out of British Columbia may be carrying some containers bound for the Spokane BEA. These containers would likely move south to Everett, WA and then be switched in a block swap to a train headed east. As mentioned earlier, this has some similarity to the classification seen with carload freight, but it is much more aggregate and requires fewer blocks.

Because of this, our optimistic forecast for enhanced rail tonnage is capped with a diversion of 15 percent of the eligible tons. At this level of capture, the railroad will be able to fill 82 percent of its slots on a 200-position train (100 platforms each stacked two high) twice per week in 2012.

Table 2, shown on the next page, provides a commodity-based view of the divertable freight. It appears that well over two-thirds of the divertable freight will consist of lumber, paper, and clay or concrete products.[2]

Reebie's forecast of freight flow under the enhanced rail scenario does not depend on an increase in the amount of freight flowing. Rather, the freight that does flow is simply shifted to another mode. Table 3 provides a summary of the total tons to be shipped by motor carrier and rail modes over the gateway 10 years from now.

Year	Motor Carrier Tons	Railroad Tons
2002 base year	6.37 million	5.62 million
2012 standard forecast	10.34 million	8.72 million
2012 likely enhanced	10.15 million	8.91 million
2012 optimistic enhanced	10.05 million	9.01 million

Table 3. Forecast Summary for Southbound Traffic (Tons per Year)

It is important to realize that the railroad option cannot be considered a panacea for the movement of freight traffic. Note that even in the more optimistic case, the total amount of traffic diverted from the highway is about 291,000 tons per year. This represents little less than 3 percent of the freight traffic moving on the highway.

[2] This last finding makes the issue of tariffs with respect to lumber movements from Canada to the United States especially relevant. In 2001, the United States imposed tariffs on the importation of lumber from Canada. This immediately decreased the volume of lumber being shipped. Were the tariffs to be removed, obviously the forecast volumes would be higher.

STCC	STCC Name	Truck 2002	Rail 2002	Truck 2012	Rail 2012	Divertible 2002	Divertible 2012	Low 2012 Diverted	High 2012 Diverted
24	Lumber Or Wood Products	1,068,860	849,350	1,856,274	1,481,811	427,544	742,510	74,251	111,376
26	Pulp, Paper Or Allied Products	317,599	164,010	440,584	229,632	317,599	440,584	44,058	66,088
32	Clay, Concrete, Glass Or Stone	205,444	209,586	368,799	365,338	205,444	368,799	36,880	55,320
28	Chemicals Or Allied Products	62,754	156,249	94,117	235,468	50,203	75,294	7,529	11,294
20	Food Or Kindred Products	142,261	3,304	264,620	6,169	42,678	79,386	7,939	11,908
33	Primary Metal Products	36,767	47,546	51,988	67,642	36,767	51,988	5,199	7,798
	OTHER	367,222	54,480	523,163	70,338	114,671	179,942	17,994	26,991
	TOTAL	2,200,908	1,484,525	3,599,546	2,456,398	1,194,907	1,938,503	193,850	290,775

Table 2. Divertible Southbound Freight by Commodity (Tons per Year)

It is important as well to put this number in perspective. At 17 tons per container, a diversion of 291,000 tons results in removing about 17,000 trucks per year from the highway[3]. This demand would be approximately 330 trucks per week, or about 50 trucks per day, or about two loaded trucks per hour. As the base forecast results in about 70 loaded trucks per hour crossing the border into the United States (compared to today's volume of about 43 trucks per hour), this increment will not change dramatically the amount of highway infrastructure needed.

In contrast, consider what would be required to achieve this result:

1. BNSF must create sufficient vertical clearance along the entire I-5 corridor and construct intermodal facilities at locations needed to serve it (Vancouver at the very least).

2. BNSF may need to create additional line capacity improvements between Seattle and Vancouver, as discussed earlier.

3. Shippers must be agreeable to some rather long drays, especially in British Columbia.

4. The BNSF must make significant adjustments to its operating plan to ensure that service can be provided to some of the BEAs in the United States. For example, consider shipments bound for Spokane from the non-metropolitan areas of British Columbia. These containers will need to be hauled from a suitable origin yard in British Columbia (likely the Vancouver yard modified to handle intermodal transfers) to Everett in the United States (where a block swap would occur) and finally to Spokane.

5. The demand for the double-stack service must come from current demand for motor carrier service and not from rail carload service.

It is reasonable to estimate that the investment required to achieve the rail infrastructure necessary for this result is likely to be several millions of dollars at a minimum. That noted, there are societal benefits to be gained from these diversions (e.g., accident, congestion, energy, air pollution savings). These might justify public participation in these investments. Such public sector interest might provide BNSF with an incentive to join in a public/private partnership to make these investments.

Further, were there to be an increase in rail traffic due to greater port origins and destinations, that business would likely be traded between the railroads, rather than being diverted from the highway. It would appear, therefore, that provision of highway resources should count upon the fact that there will be significant increases in demand for the highway facilities needed to accommodate freight flows across the border.

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3 Previous work done by Reebie Associates indicates that intermodal containers have about 17 tons each.

Beside double-stacks, other types of rail operations conceivably might be able to achieve diversions. For example, conventional intermodal Trailer on Flatcar (TOFC) service or dedicated unit trains of lumber and paper products might make inroads on shipments now moving by truck. This approach would require pooling loads from various shippers and moving them on expedited schedules to major markets such as Southern California. However, these diversions might end up being achieved at the expense of what could be gained from double-stack trains, which are by definition unit trains operated on expedited schedules.

Double-Stack Potential from the United States to Canada

Table 4, on the next page, provides a summary of traffic that currently moves to British Columbia from points in the western United States and may be divertable from motor carrier to a double-stack intermodal train. The analysis here is limited using the same assumptions about which freight demand levels ought to be counted as were used in the analysis of freight flows moving in the opposite direction.

An advantage with the northbound direction is that it will provide a way for the containers heading south to come back. Since the analysis shows the potential for northbound diversion to be almost equal to southbound diversion, the economic plausibility of the diversion potential is somewhat enhanced.

Again, the total number of tons that could be expected to move in this manner is less than 300,000 annually (see Table 5 following page with Table 4). As in the case of the southbound traffic, this will represent a very small number of load truck moves into Canada and a very small proportion of loaded trucks that are expected to move in that direction.

To be sure, public agencies are very concerned about whether transportation facilities will be sufficient in the future and how much public effort ought to be placed in ensuring this sufficiency. As this analysis shows, there will be considerable additional demand on the highway infrastructure to accommodate freight movements. Certainly, a portion of that demand can be taken away by moving some of the freight via a double-stack rail service, were it to be inaugurated. However, the railroad is not likely to make investments in double-stack service unilaterally.

Private organizations base their investments on the potential return of it as well as its risk, that is, what is the likelihood that a sufficient financial return will be experienced. There are likely to be very significant costs associated with creating a double-stack train service between the western United States and Canada. This analysis shows further that the potential demand for such a service is not large.

These findings need to be coupled with the fact that a railroad is a very risk-averse enterprise. Unless their return on investment is virtually guaranteed, they will not make the investment. In this case, it is hard to see such a guarantee. The efficacy of the investment may be improved if additional demand along the West Coast of the United States were to make these improvements work financially as part of a system of improvements. But it is a virtual certainty that the private railroads would not invest unilaterally in the necessary improvements in the hope that the traffic in this forecast would materialize.

Origin BEA Code	CMA	Dest. Prov. Code	Prov.	Dest. CMA Code	CMA	Truck 2002	Rail 2002	Truck 2012	Rail 2012	Divertable 2002	Divertable 2012	Low 2012 Diverted	High 2012 Diverted
167	Portland, OR	80	BC	240	Non-CMA BC	709,135	69,801	1,061,704	105,093	478,434	756,652	75,665	113,498
160	Los Angeles, CA	80	BC	240	Non-CMA BC	314,899	16,831	474,318	26,518	174,847	274,028	27,403	41,104
163	San Francisco, CA	80	BC	240	Non-CMA BC	303,052	14,849	461,304	21,577	92,435	134,387	13,439	20,158
147	Spokane, WA	80	BC	240	Non-CMA BC	270,607	2,437	424,612	3,548	69,150	109,764	10,976	16,465
169	Richland, WA	80	BC	240	Non-CMA BC	310,187	3,971	470,996	5,924	64,681	97,811	9,781	14,672
166	Eugene, OR	80	BC	240	Non-CMA BC	92,443	3,636	133,897	5,383	39,513	59,351	5,935	8,903
168	Pendleton, OR	80	BC	240	Non-CMA BC	63,170	1,560	97,357	2,336	27,095	41,990	4,199	6,299
160	Los Angeles, CA	80	BC	223	Vancouver BC	2,070	-	2,968	-	591	854	85	128
										946,747	1,474,838	147,484	221,226
				Analysis of trains in the NB direction				*Tons per container*				17	17
				assuming two trains per week				*Number of filled containers/year*				8,676	13,013
								Number of filled containers/week				166.84	250.26
								Slots per train				200	200
								Trains per week				2	2
								Percent full				41.7%	62.6%
				Analysis of trains in the NB direction				*Tons per container*				17	17
				assuming three trains/week				*Number of filled containers/year*				8,676	13,013
								Number of filled containers per week				166.84	250.26
								Slots per train				200	200
								Trains per week				3	3
								Percent full				27.8%	41.7%

Table 4. Potential Northbound Diversions (Tons per Year)

STCC	STCC Name	Truck 2002	Rail 2002	Truck 2012	Rail 2012	Divertible 2002	Divertible 2012	Low 2012 Diverted	High 2012 Diverted
33	Primary Metal Products	162,294	11,076	260,734	17,921	162,294	260,734	26,073	39,110
28	Chemicals Or Allied Products	162,782	34,090	252,573	52,846	130,225	202,058	20,206	30,309
26	Pulp, Paper Or Allied Products	120,903	35,165	174,243	51,134	120,903	174,243	17,424	26,136
29	Petroleum Or Coal Products	113,682	19,673	172,870	31,266	96,629	146,939	14,694	22,041
32	Clay, Concrete, Glass Or Stone	96,264	350	136,951	520	96,264	136,951	13,695	20,543
24	Lumber Or Wood Products	252,347	1,895	318,479	2,373	100,939	127,392	12,739	19,109
	OTHER	1,157,293	10,836	1,811,306	14,317	239,492	426,521	42,652	63,978
	TOTAL	2,065,564	113,086	3,127,156	170,378	946,747	1,474,838	147,484	221,226

Table 5. Divertible Northbound Freight by Commodity (Tons per Year)

Tons by commodity for divertable northbound freight are shown in Table 5. As this table clearly shows, the northbound tons are far less concentrated by commodity than southbound tons (see Table 2). For rail, northbound tons are far less than southbound tons. For truck, the split is nearly equal. It could be that a lack of concentration by commodity is the reason for this. Trucks are better at handling a less concentrated commodity mix versus rail.

Railroads tend to ship freight in very large quantities. Unless there is a large amount of freight going from one location to another in a single shipment, the railroad cannot efficiently provide the necessary service.

Motor carriers, on the other hand, depend far less on this concentration of demand to function efficiently. They ship much smaller quantities at a time to a much more dispersed set of locations geographically.

This difference between the way motor carriers and the way railroads market and operate could possibly make the more optimistic figure rather difficult to achieve. Railroads may just find the operational and marketing challenges associated with developing the service to Canada too formidable.

Table 6 shows the total expected volume for rail and motor carrier demand across the Cascade Gateway toward Canada in 2012. As has been noted, even in the more optimistic of the cases, rail diversion will do little to reduce the demand for additional highway capacity.

Year	**Motor Carrier Tons**	**Railroad Tons**
2002 base year	5.74 million	0.41 million
2012 standard forecast	10.40 million	0.61 million
2012 likely enhanced	10.25 million	0.76 million
2012 optimistic enhanced	10.18 million	0.83 million

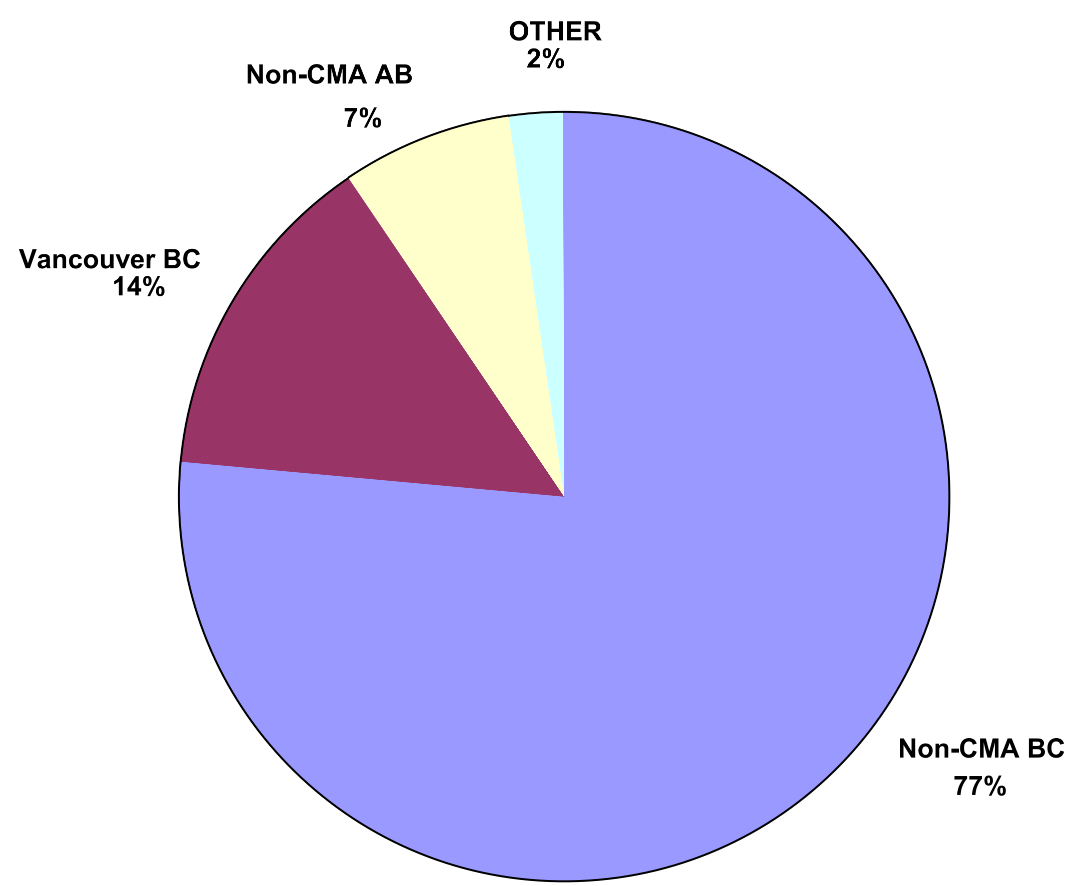
Table 6. Summary of Forecast for Northbound Freight (Tons per Year)

Charts of Motor Carrier Traffic Demand

United States to Canada

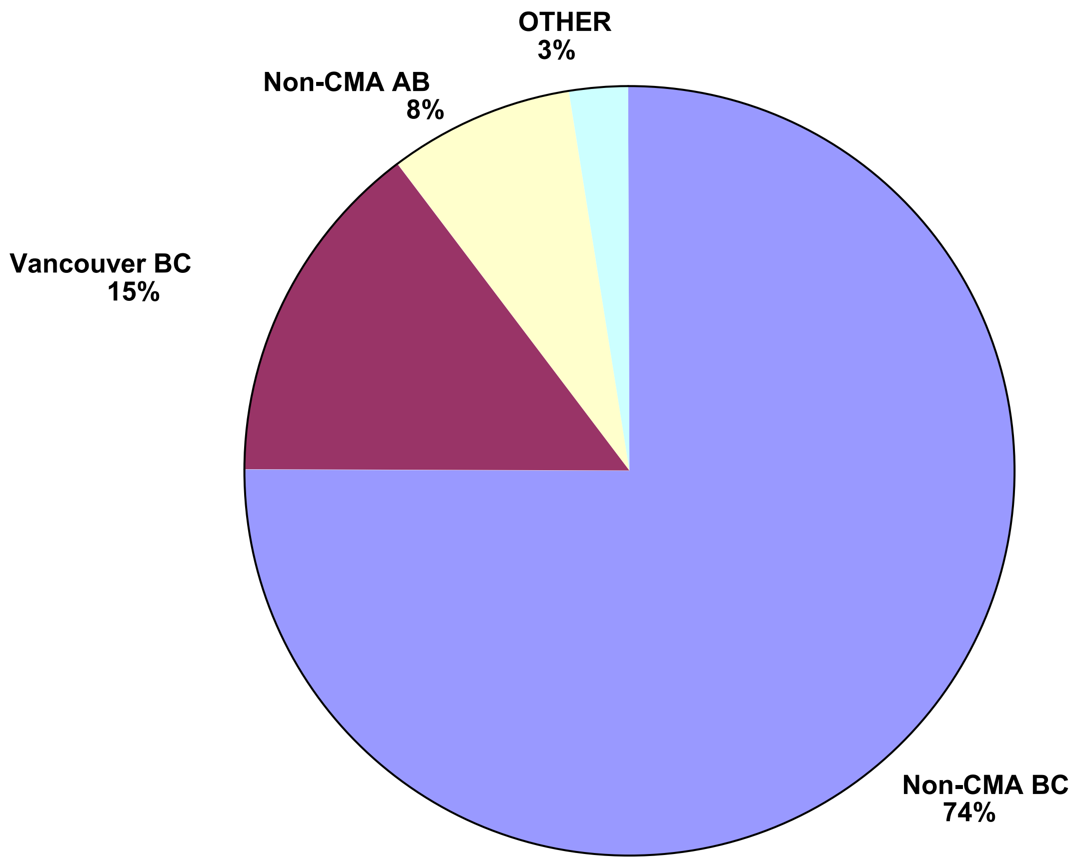
REEBIE

CMA Destinations by Truck (2002)



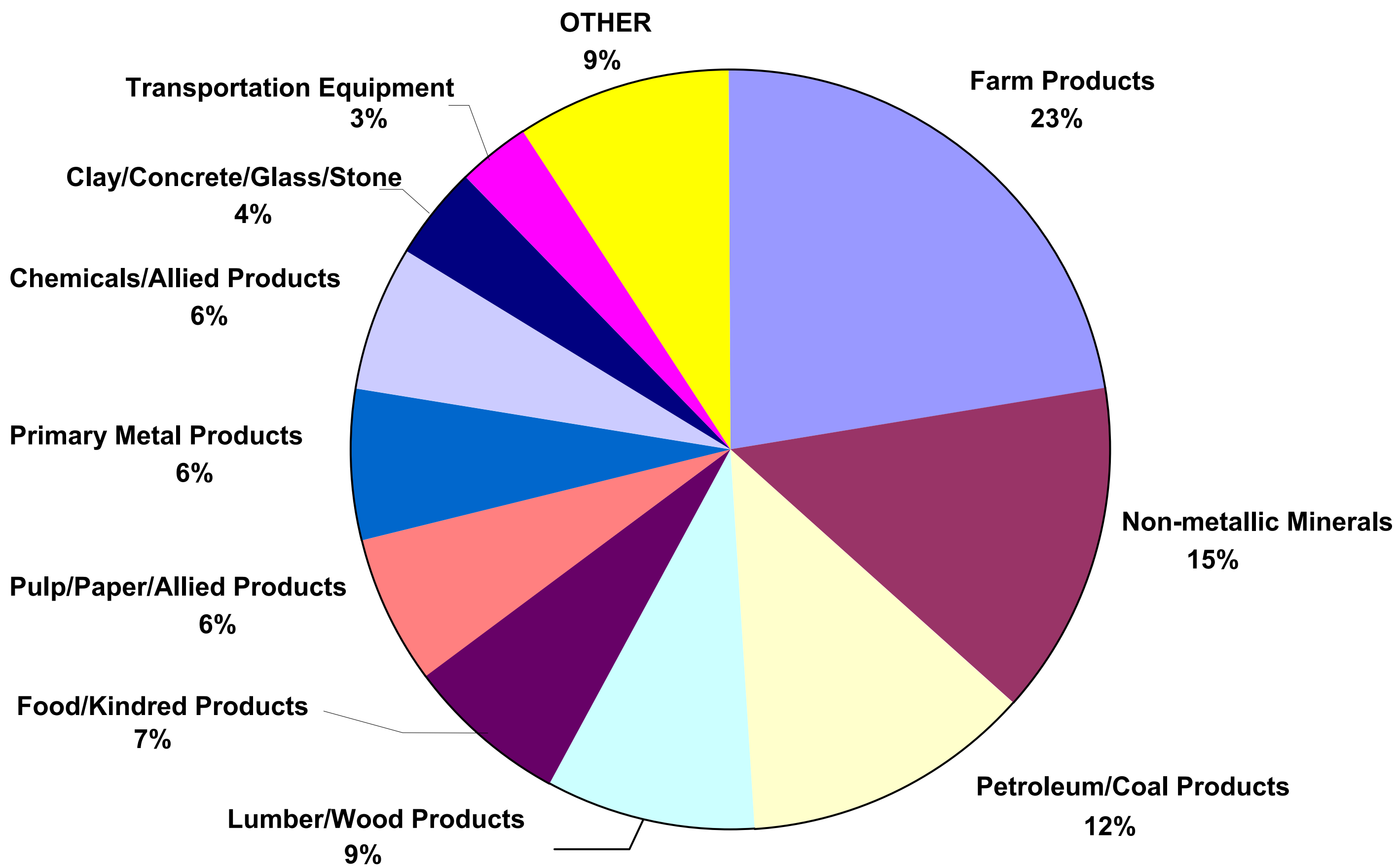
Total Tonnage = 5.74 million

CMA Destinations by Truck (2012)



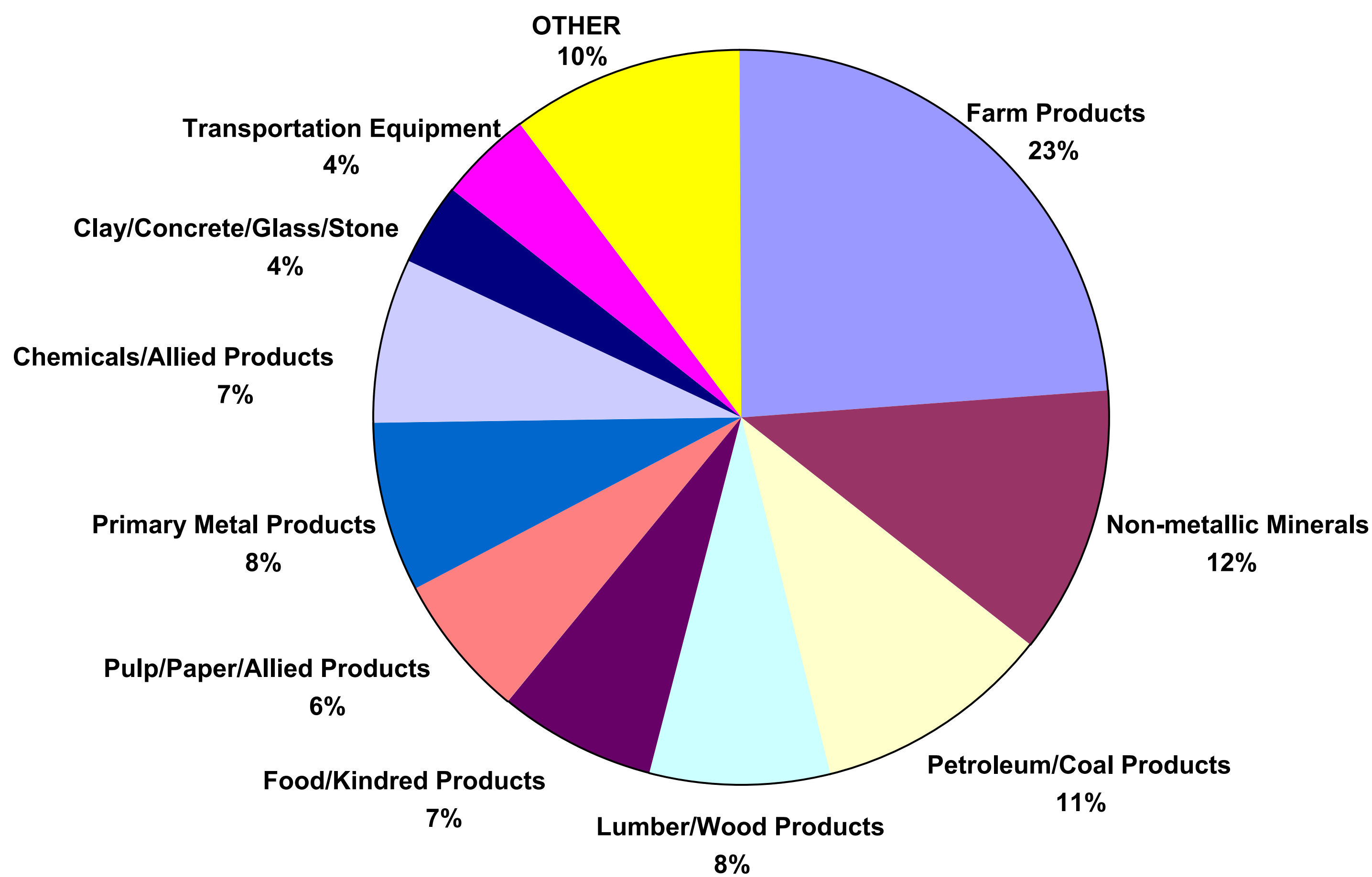
Total Tonnage = 8.32 million

Commodities by Truck to Canada (2002)



Total Tonnage = 5.74 million

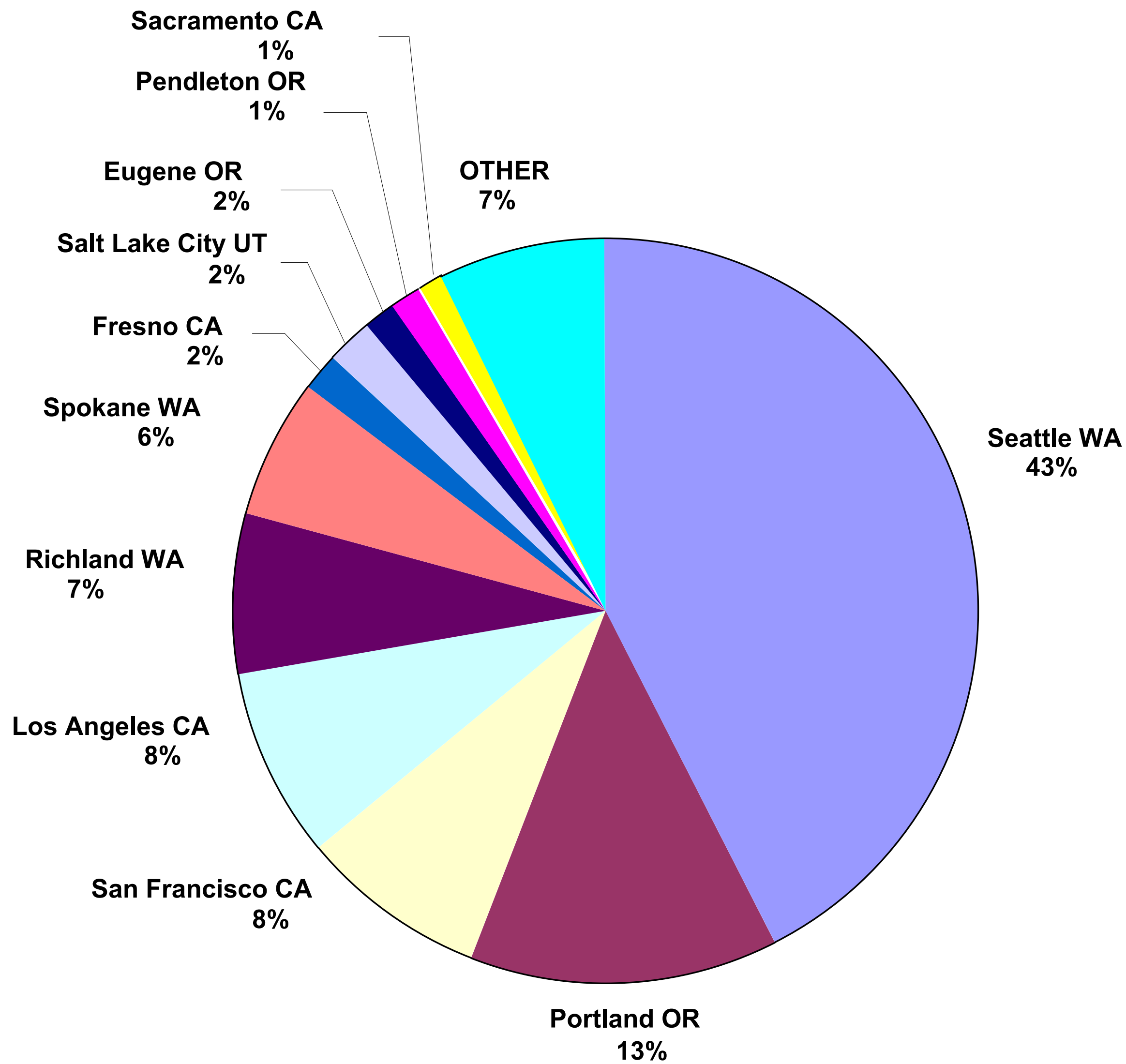
Commodities by Truck to Canada (2012)



REEBIE

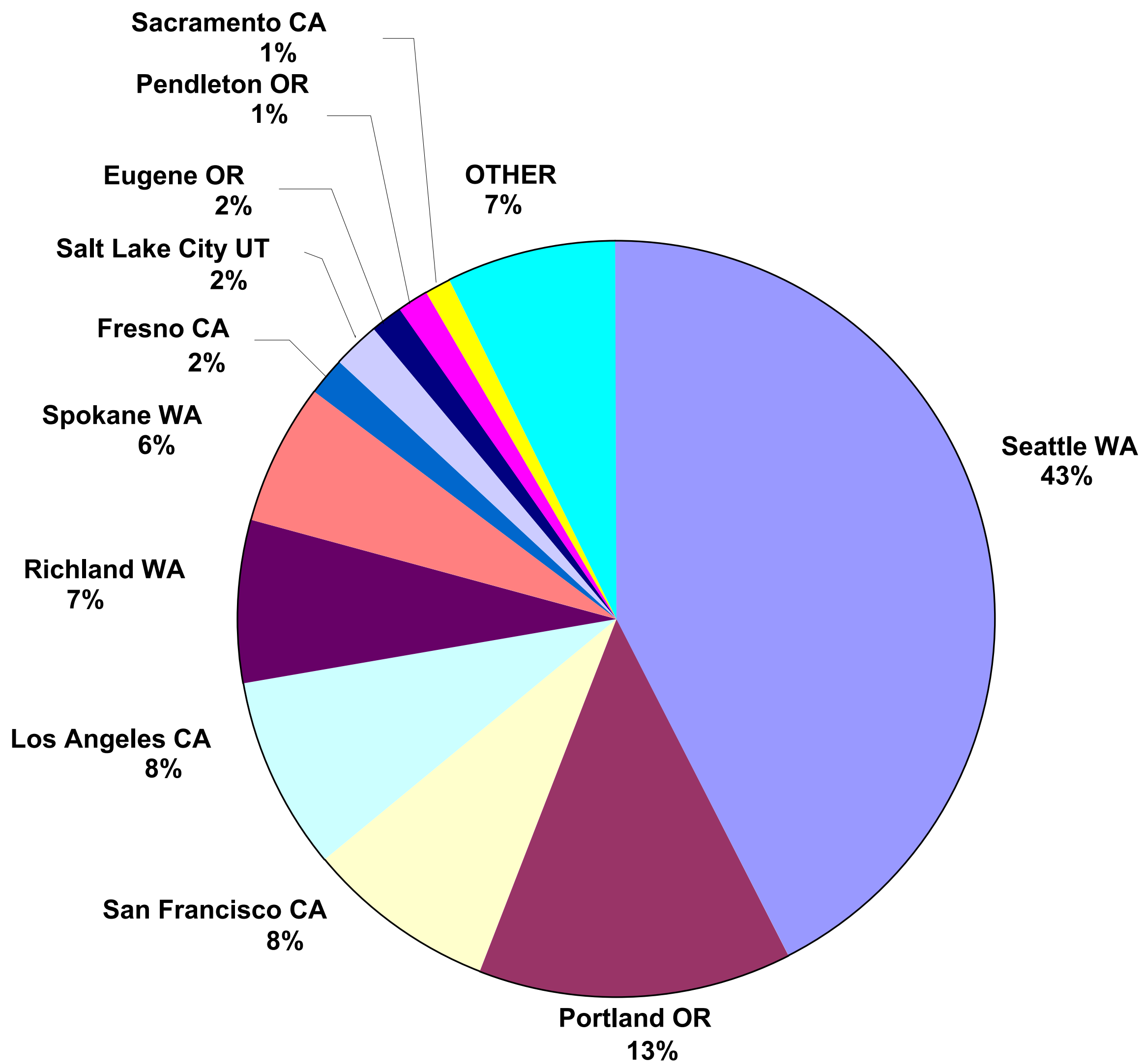
Total Tonnage = 8.32 million

U. S. Origin BEAs by Truck (2002)



Total Tonnage = 5.74 million

U. S. Origin BEAs by Truck (2012)

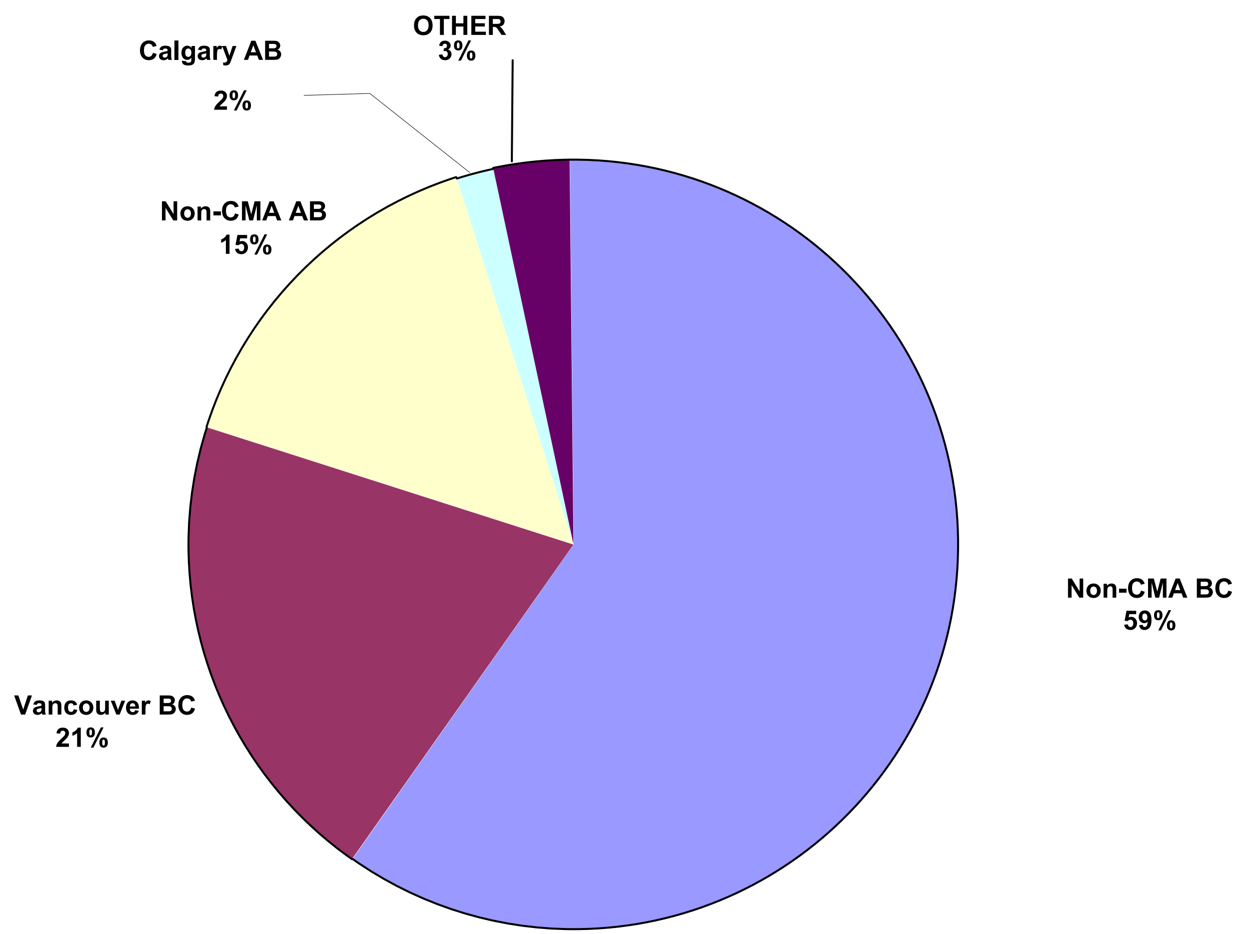


Total Tonnage = 8.32 million

Charts of Motor Carrier Traffic Demand

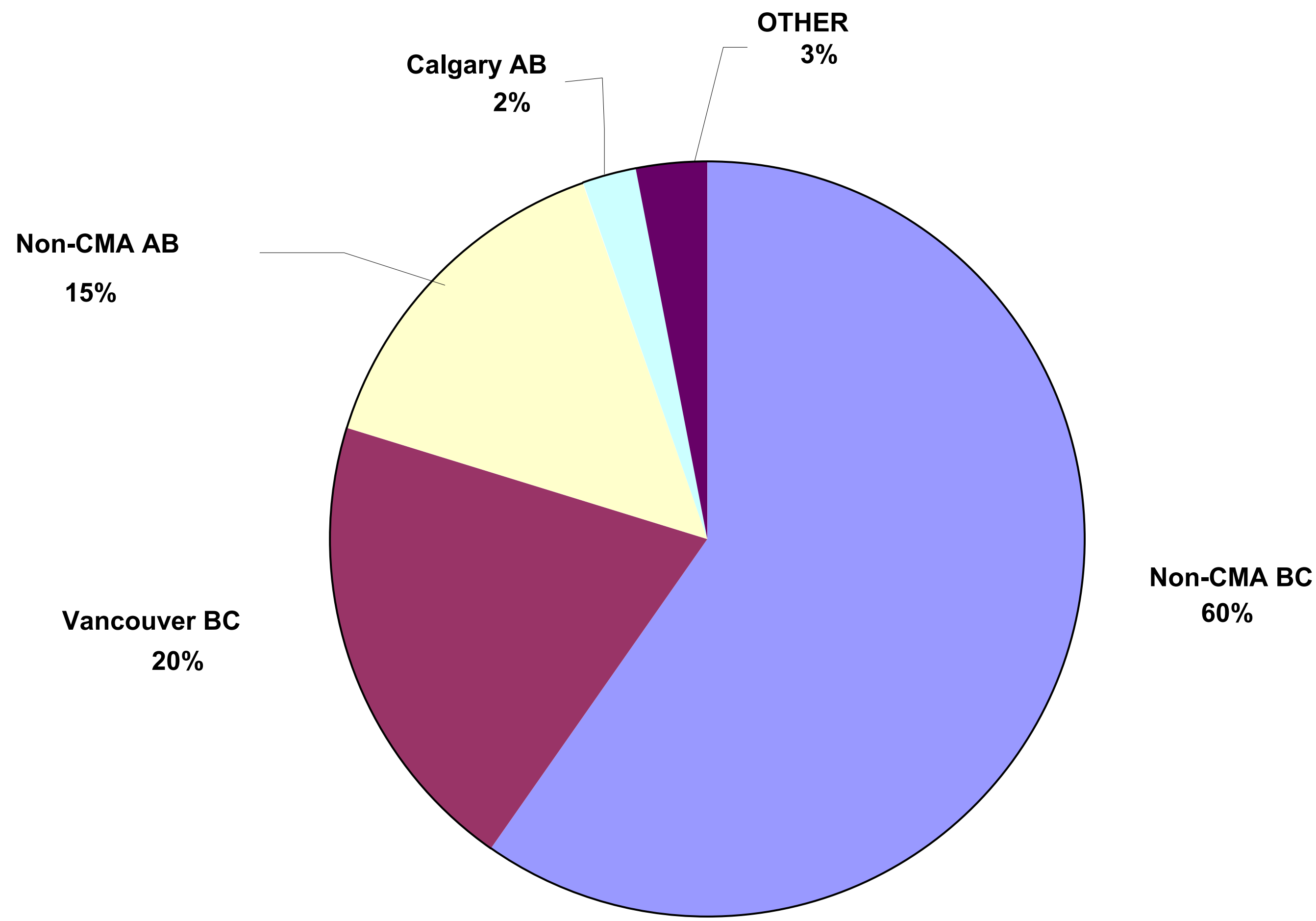
Canada to the United States

CMA Origins by Truck (2002)



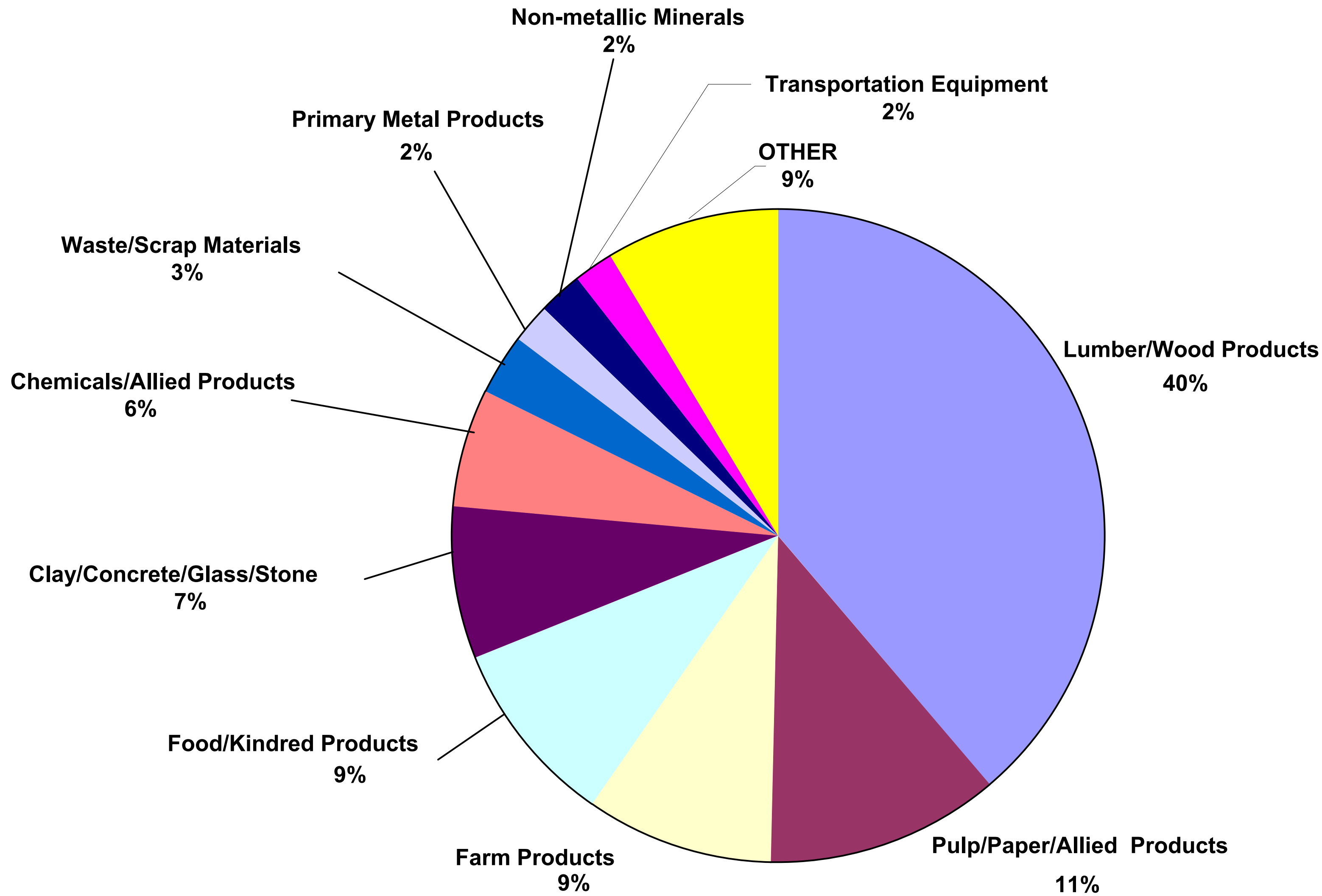
Total Tonnage = 6.37 million

CMA Origins by Truck (2012)



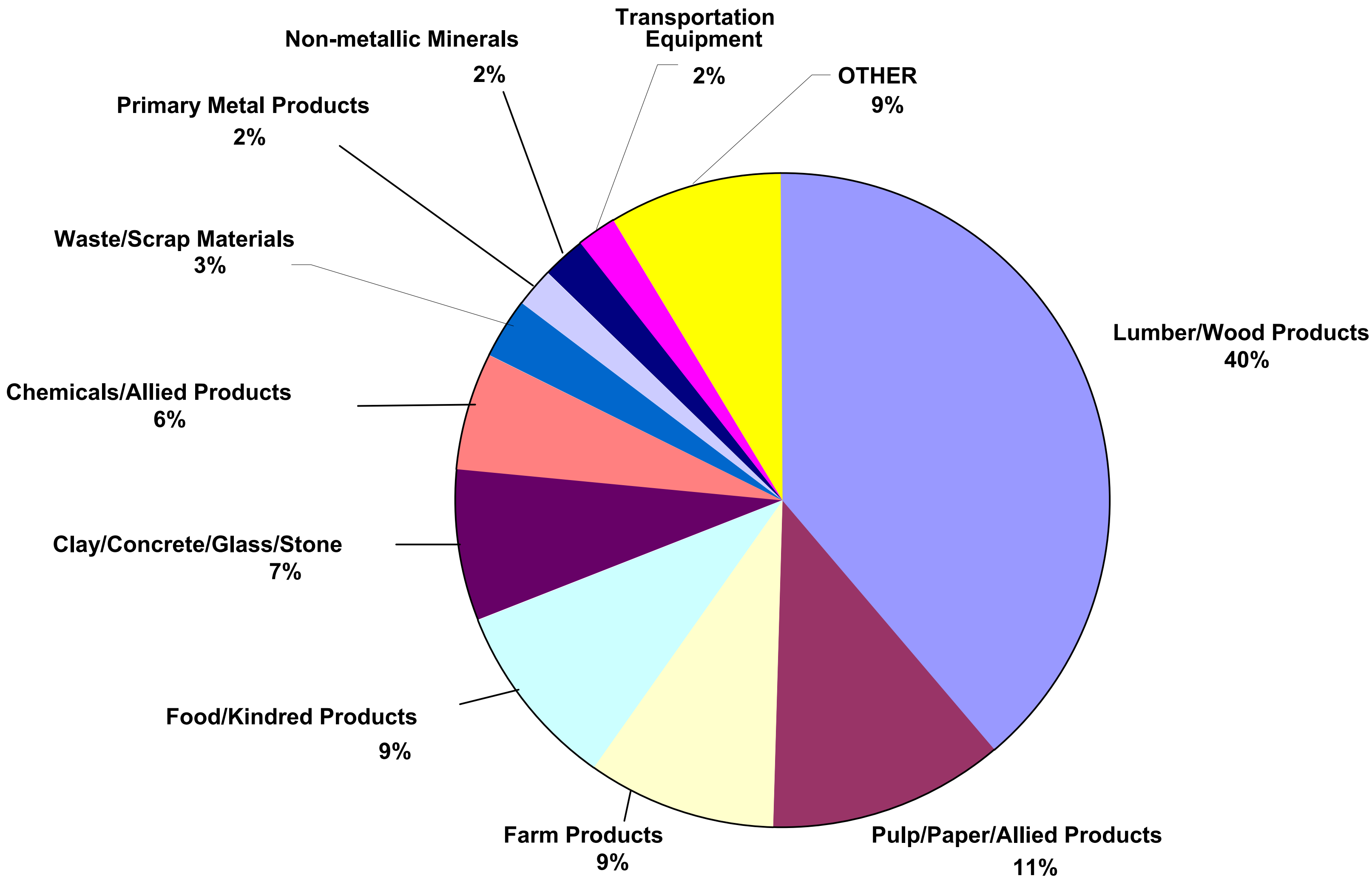
Total Tonnage = 10.34 million

Commodities by Truck to the U. S. (2002)



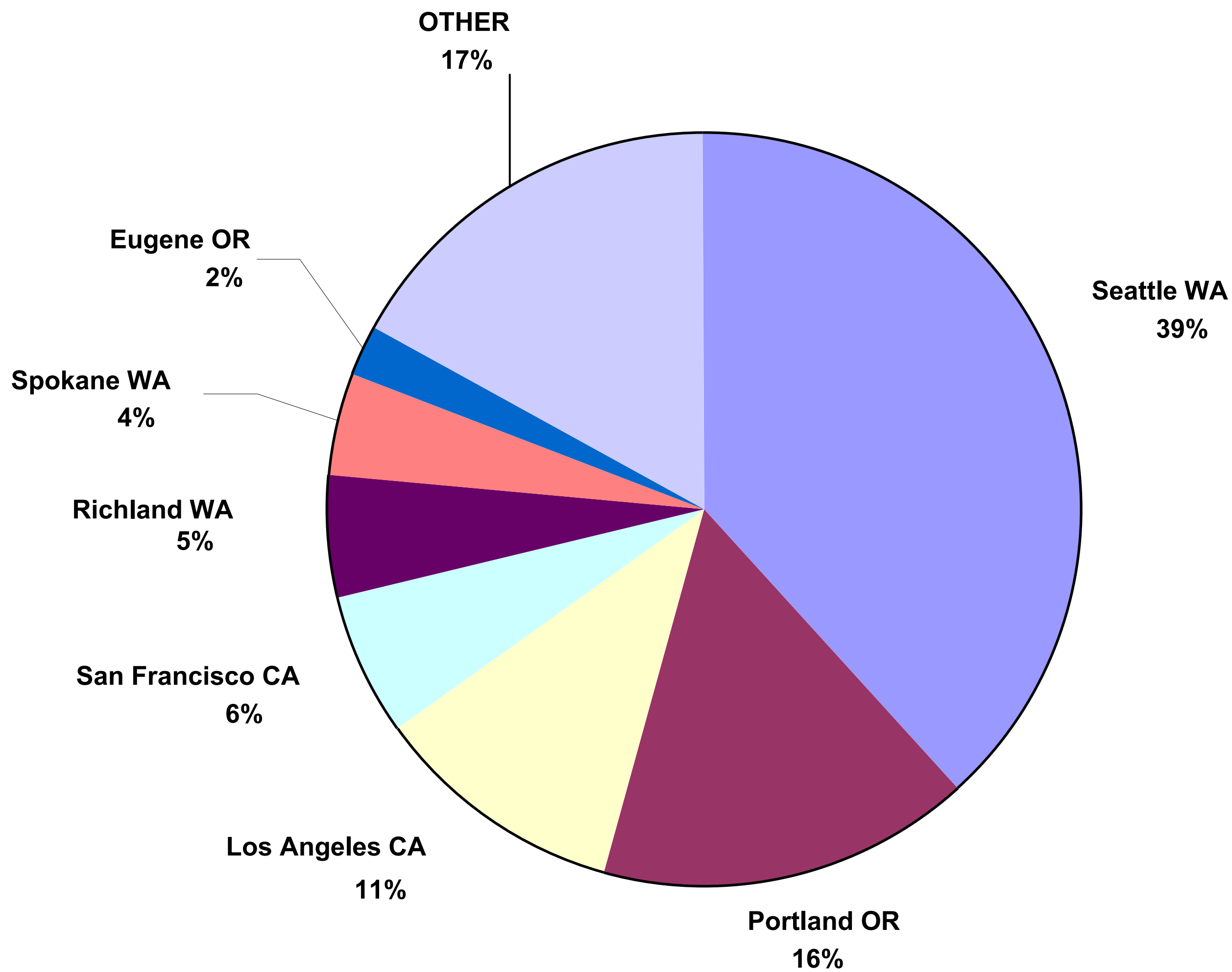
Total Tonnage = 6.37 million

Commodities by Truck to the U. S. (2012)



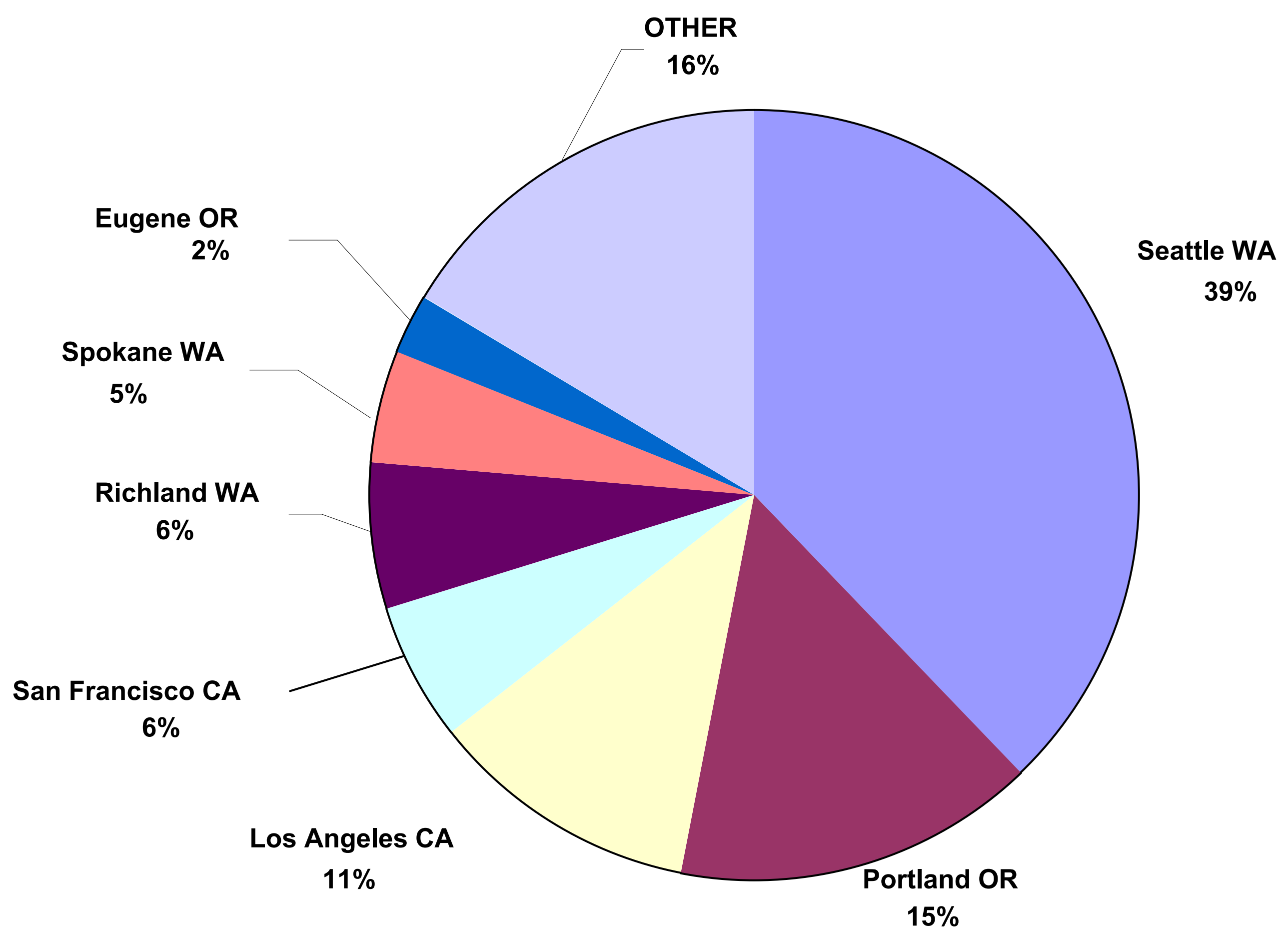
Total Tonnage = 10.34 million

U. S. Destination BEAs by Truck (2002)



Total Tonnage = 6.37 million

U. S. Destination BEAs by Truck (2012)

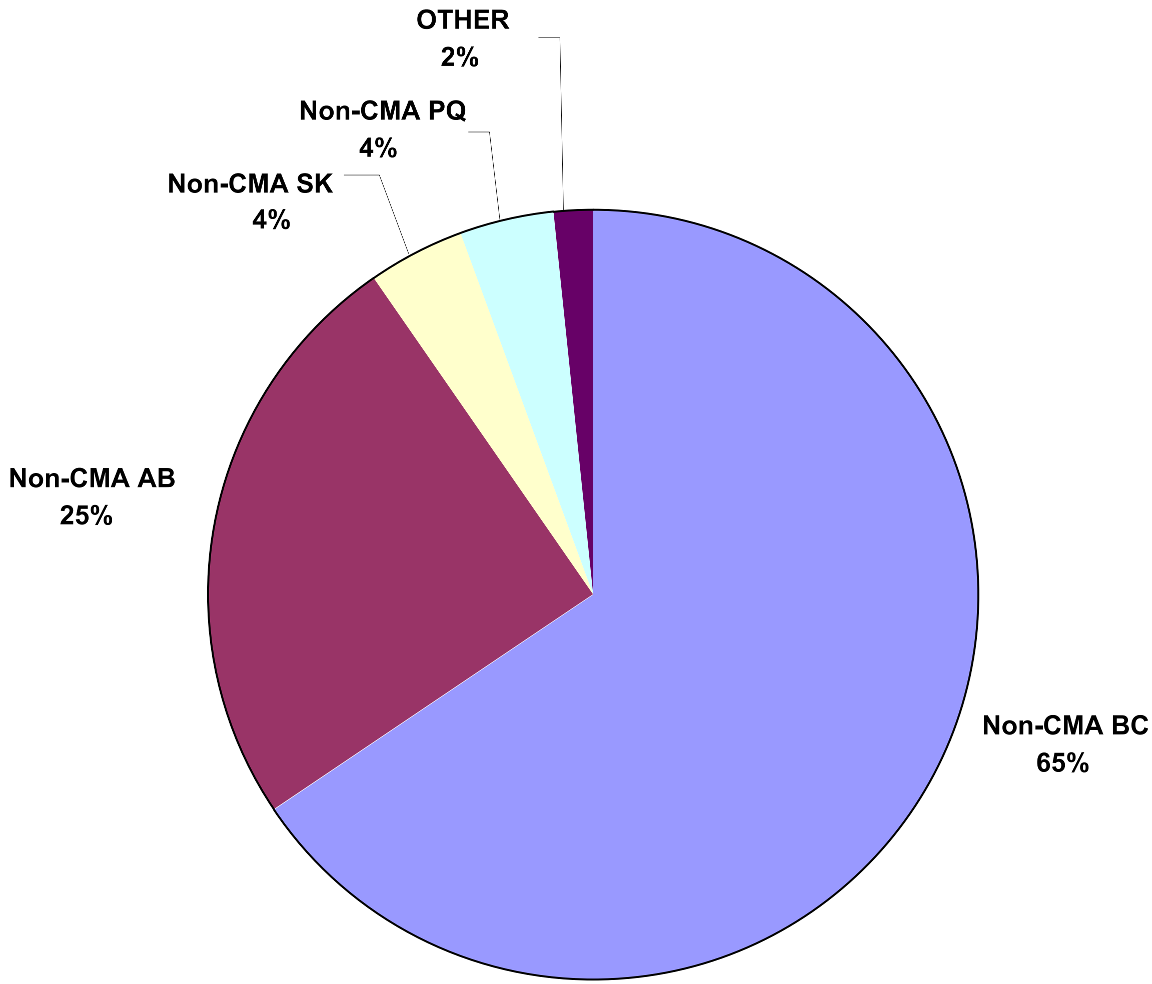


Total Tonnage = 10.34 million

Charts of Rail Traffic Demand

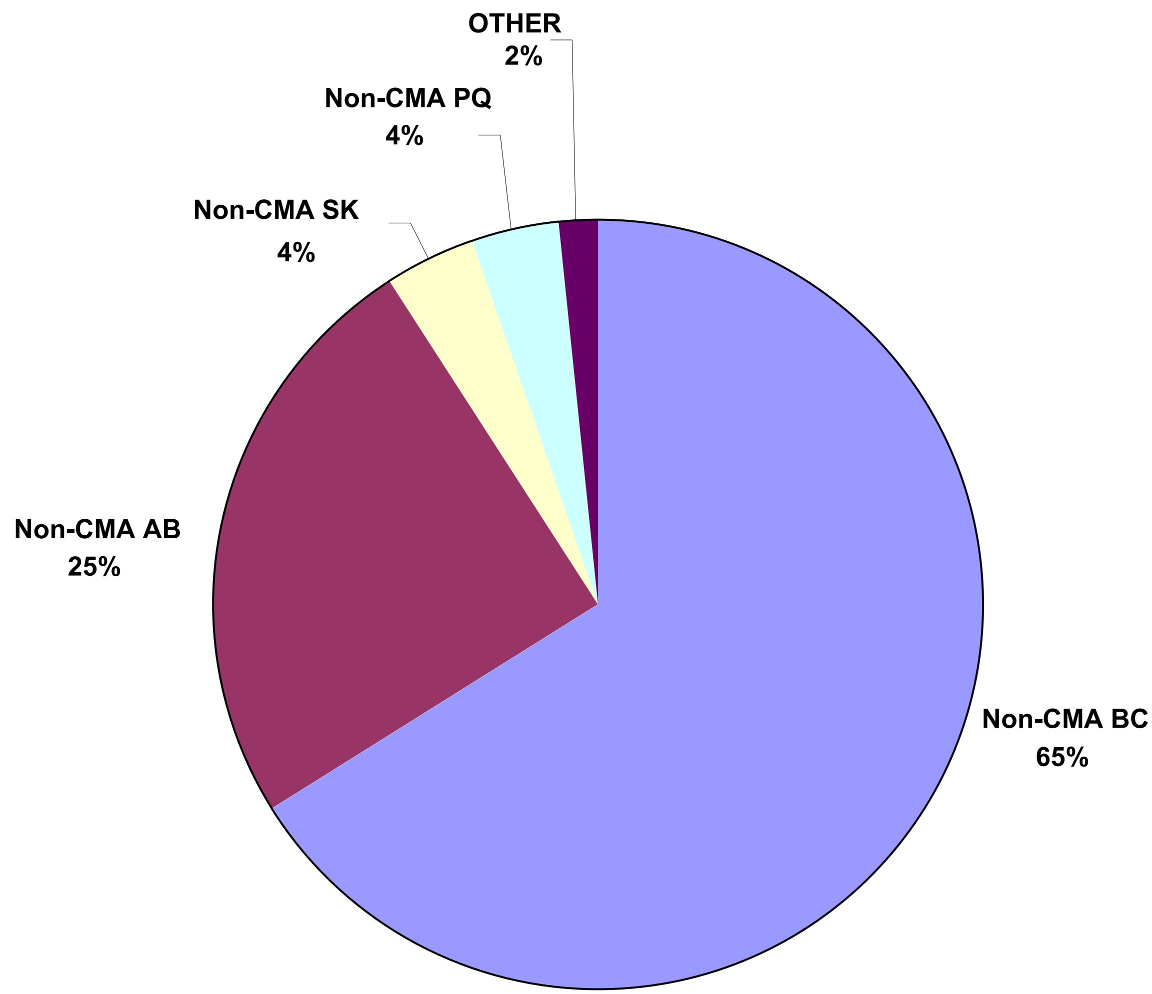
United States to Canada

CMA Destinations by Rail (2002)



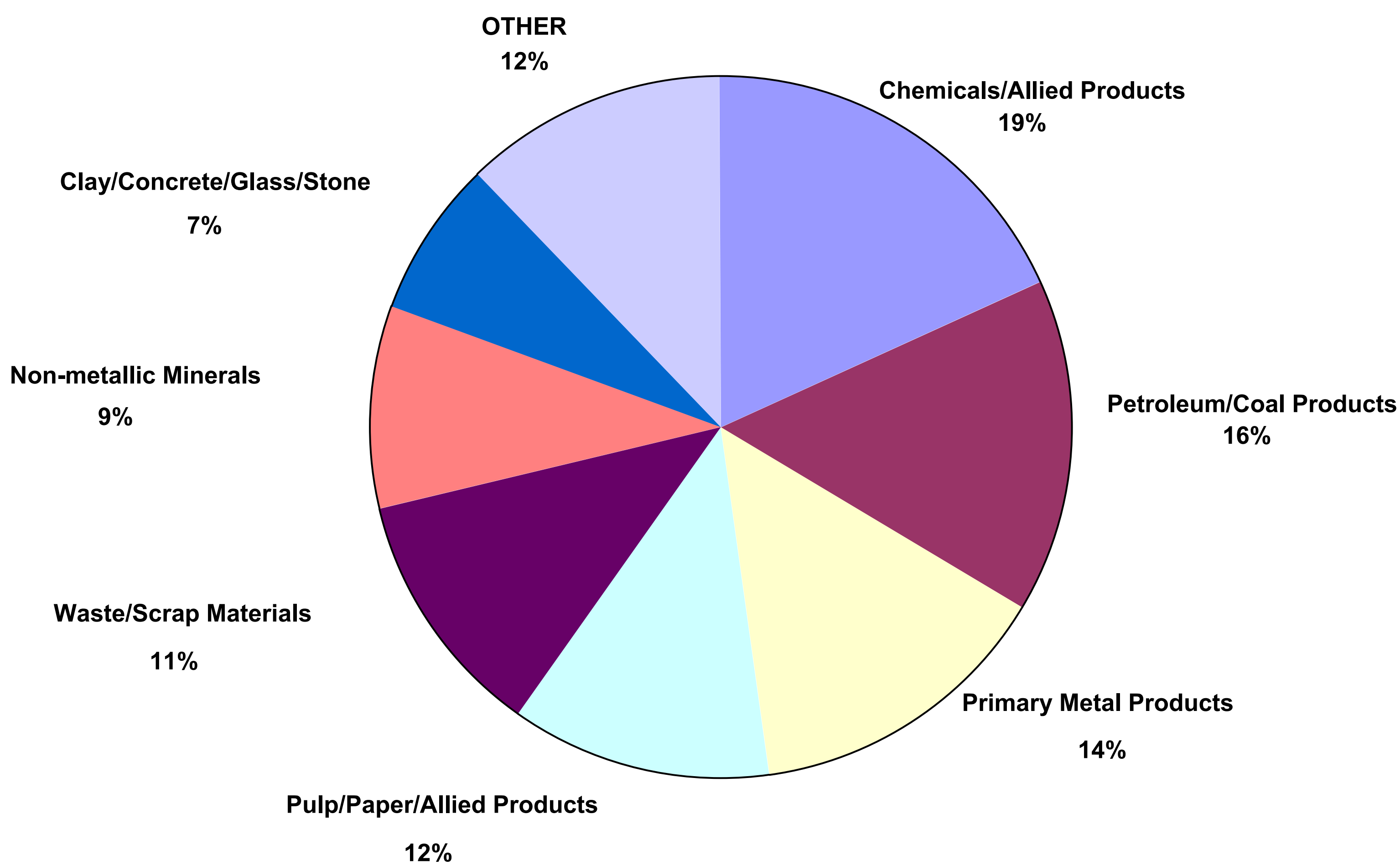
Total Tonnage = 411,869

CMA Destinations by Rail (2012)



Total Tonnage = 612,447

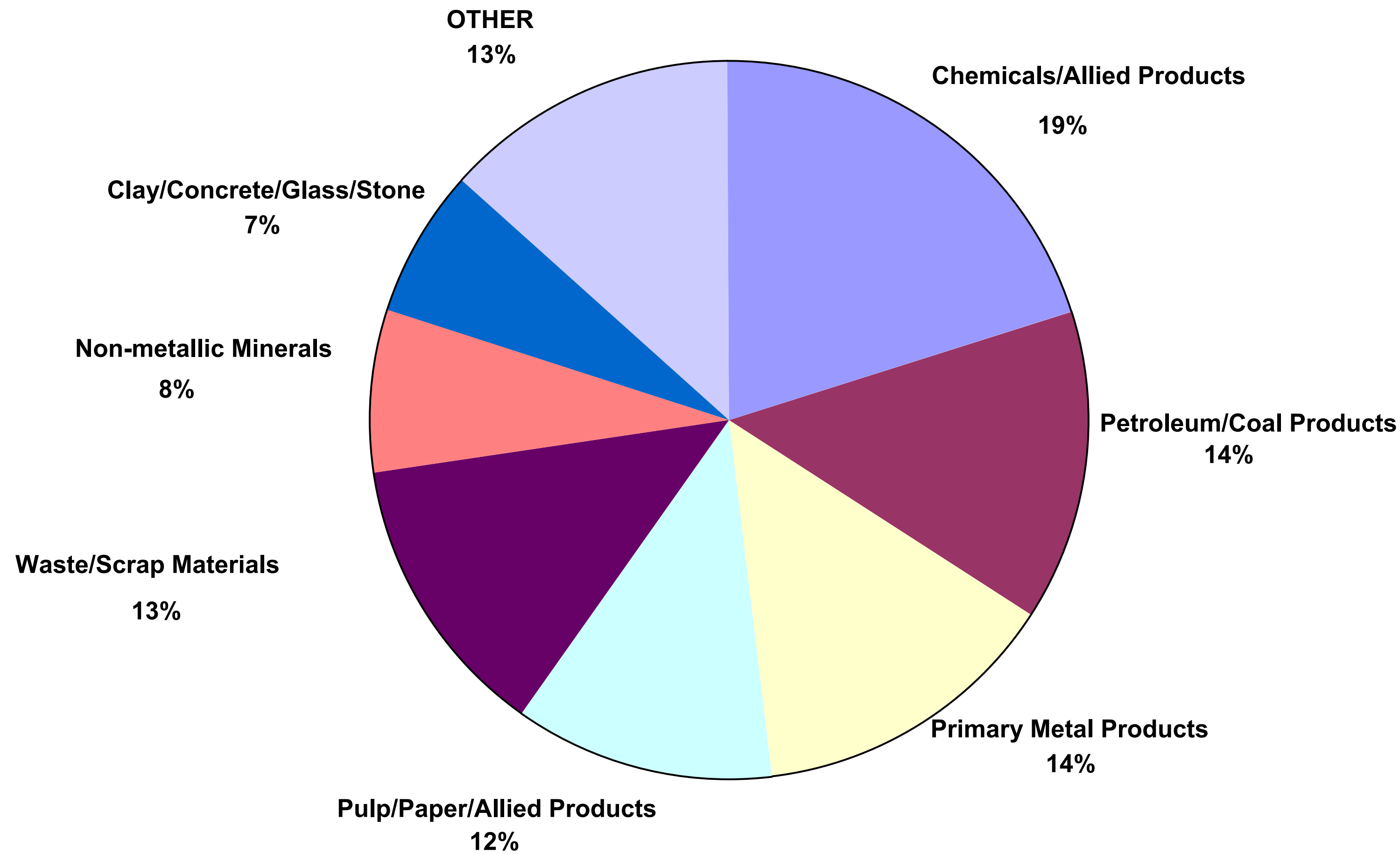
Commodities by Rail from the U.S. (2002)



REEBIE

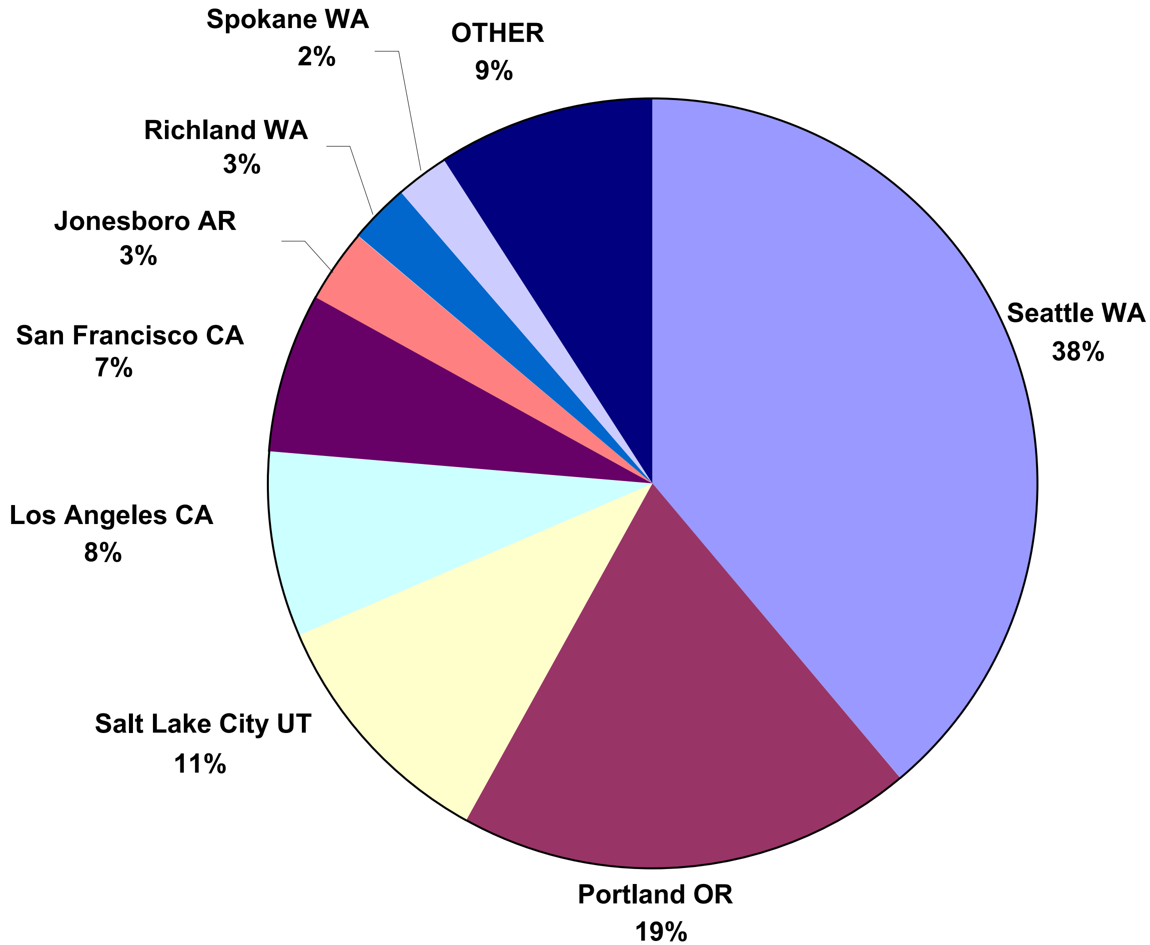
Total Tonnage = 411,869

Commodities by Rail from the U. S. (2012)



Total Tonnage = 612,447

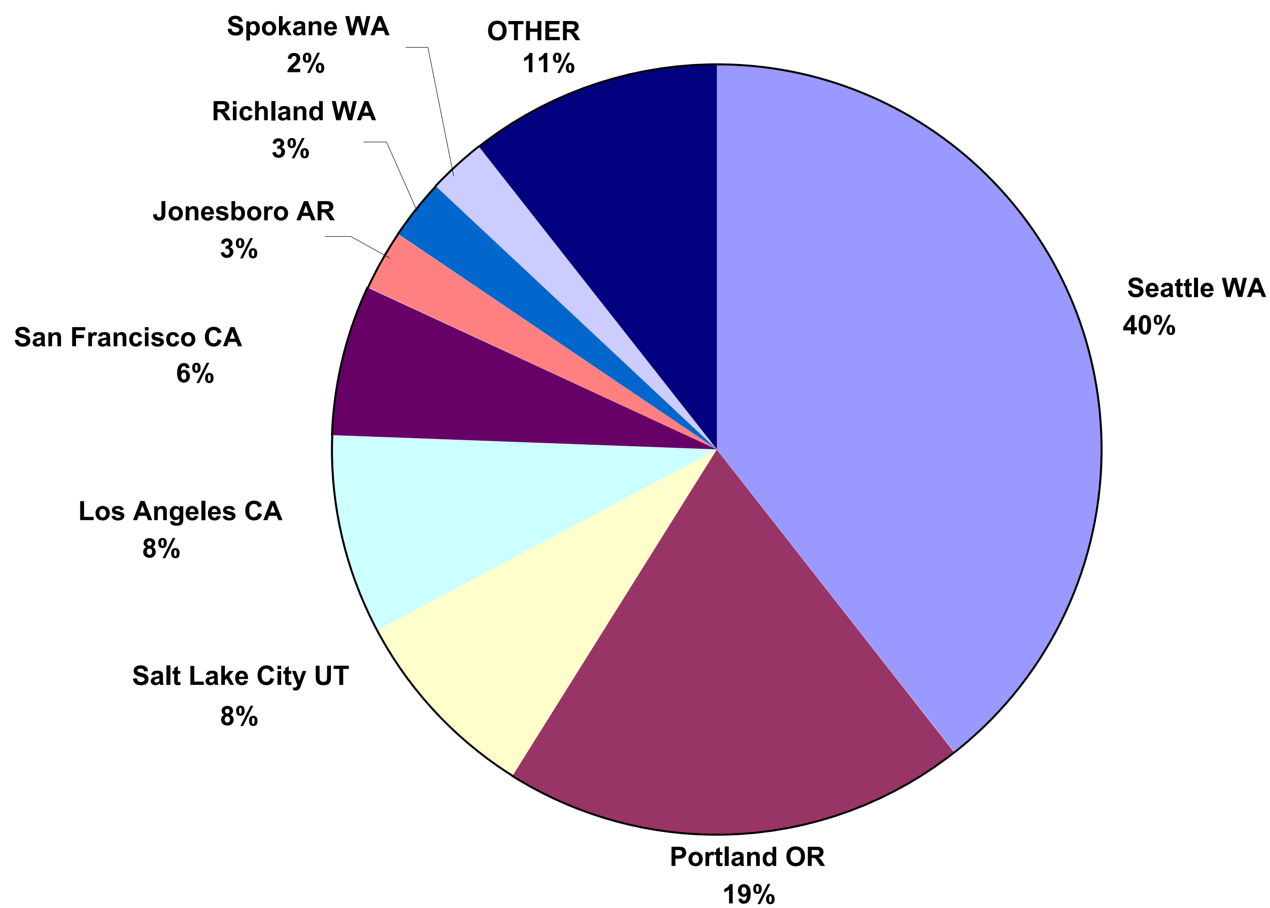
U. S. Origin BEAs by Rail (2002)



Total Tonnage = 411,869

REEBIE

U. S. Origin BEAs by Rail (2012)



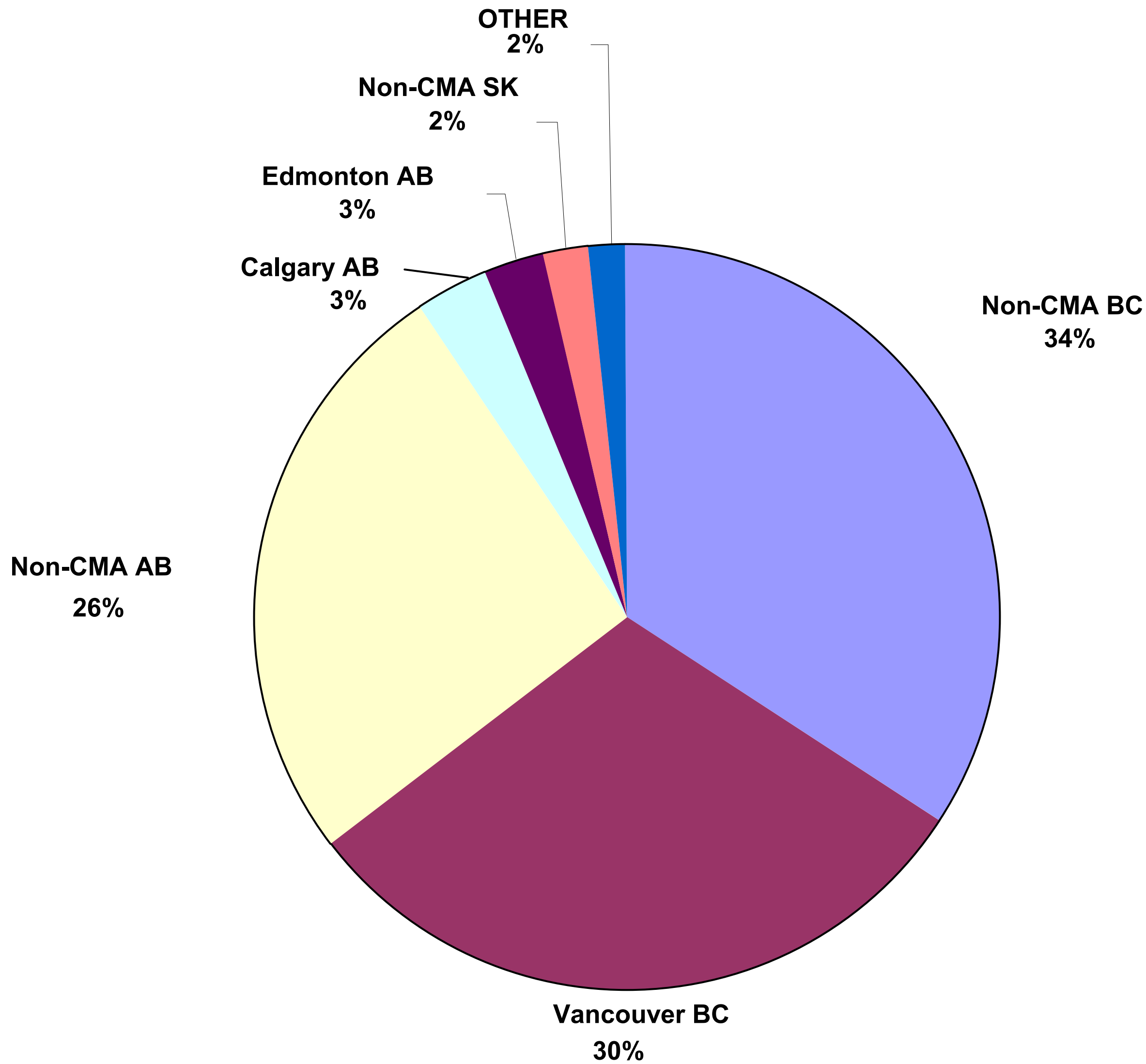
REEBIE

Total Tonnage = 612,447

Charts of Rail Traffic Demand

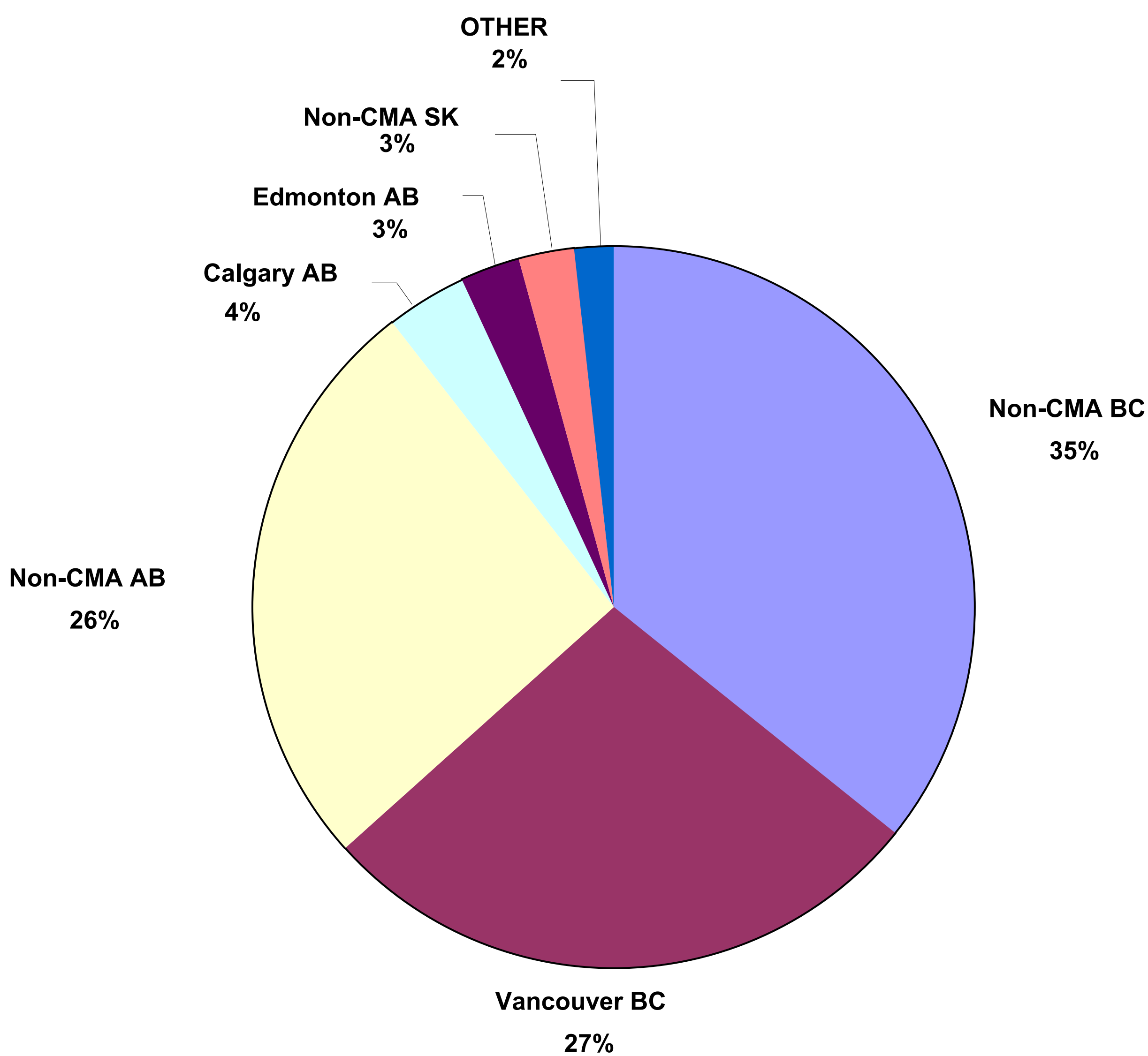
Canada to the United States

CMA Origins by Rail (2002)



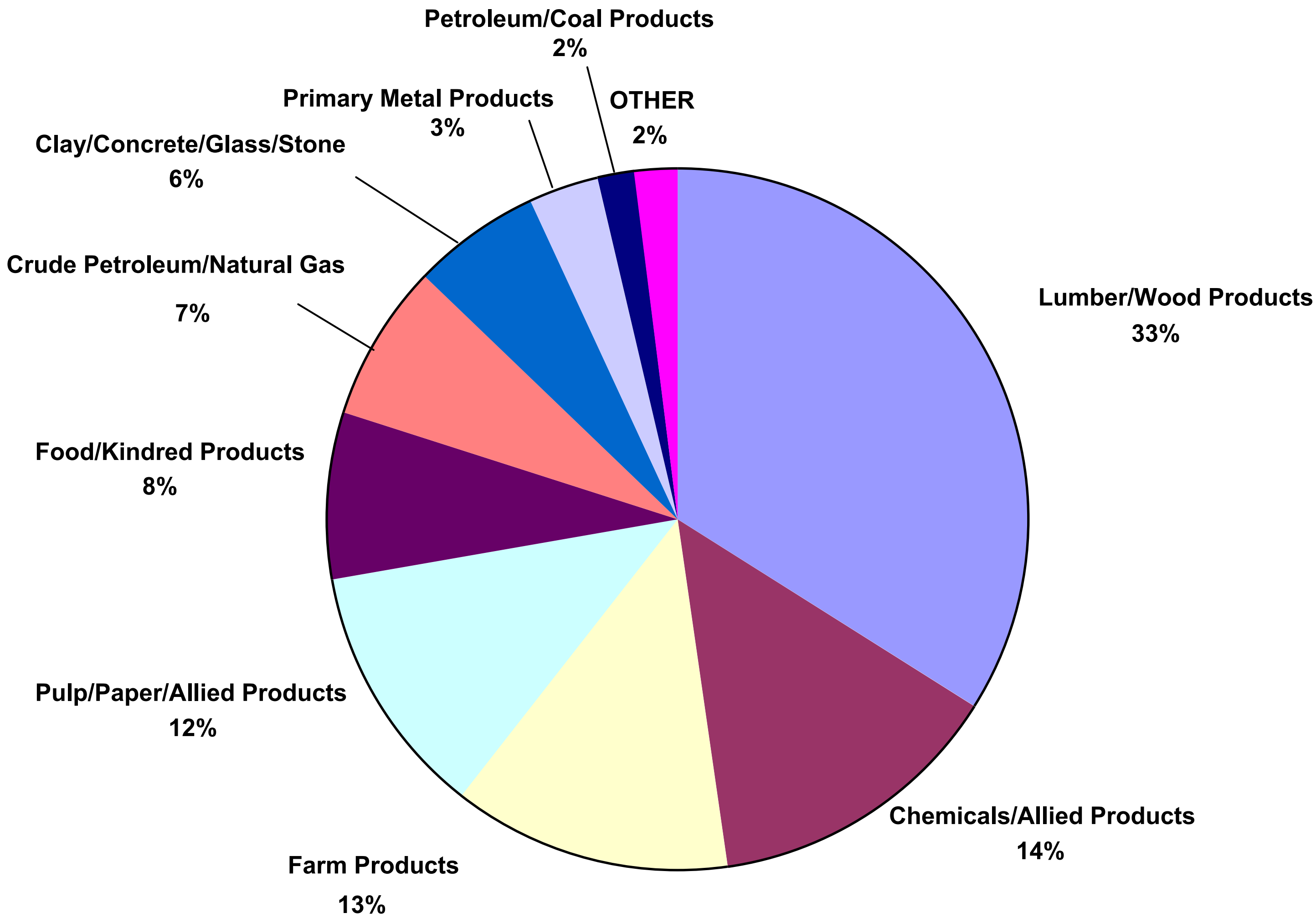
Total Tonnage = 5.62 million

CMA Origins by Rail (2012)



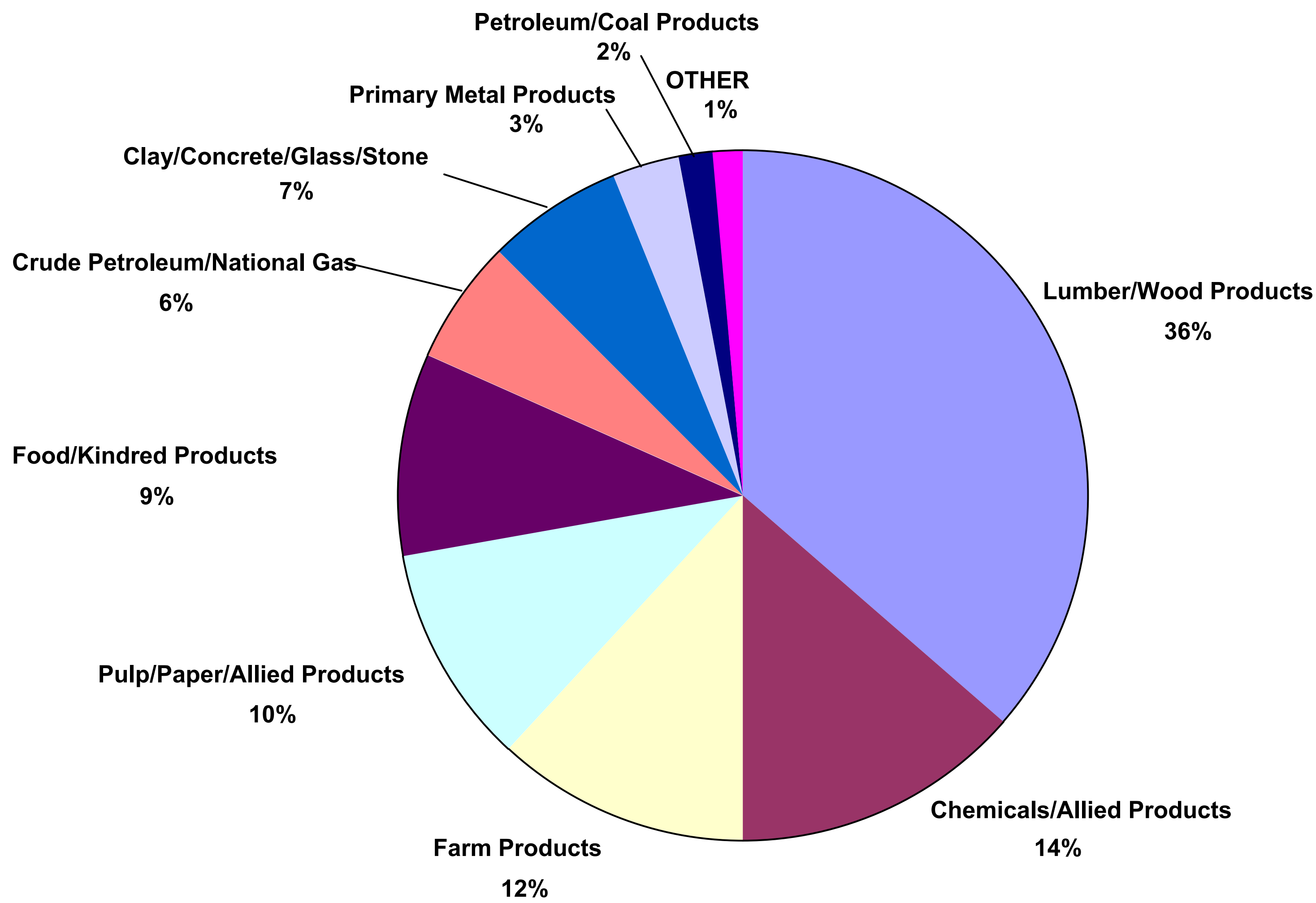
Total Tonnage = 8.72 million

Commodities by Rail to the U. S. (2002)



Total Tonnage = 5.62 million

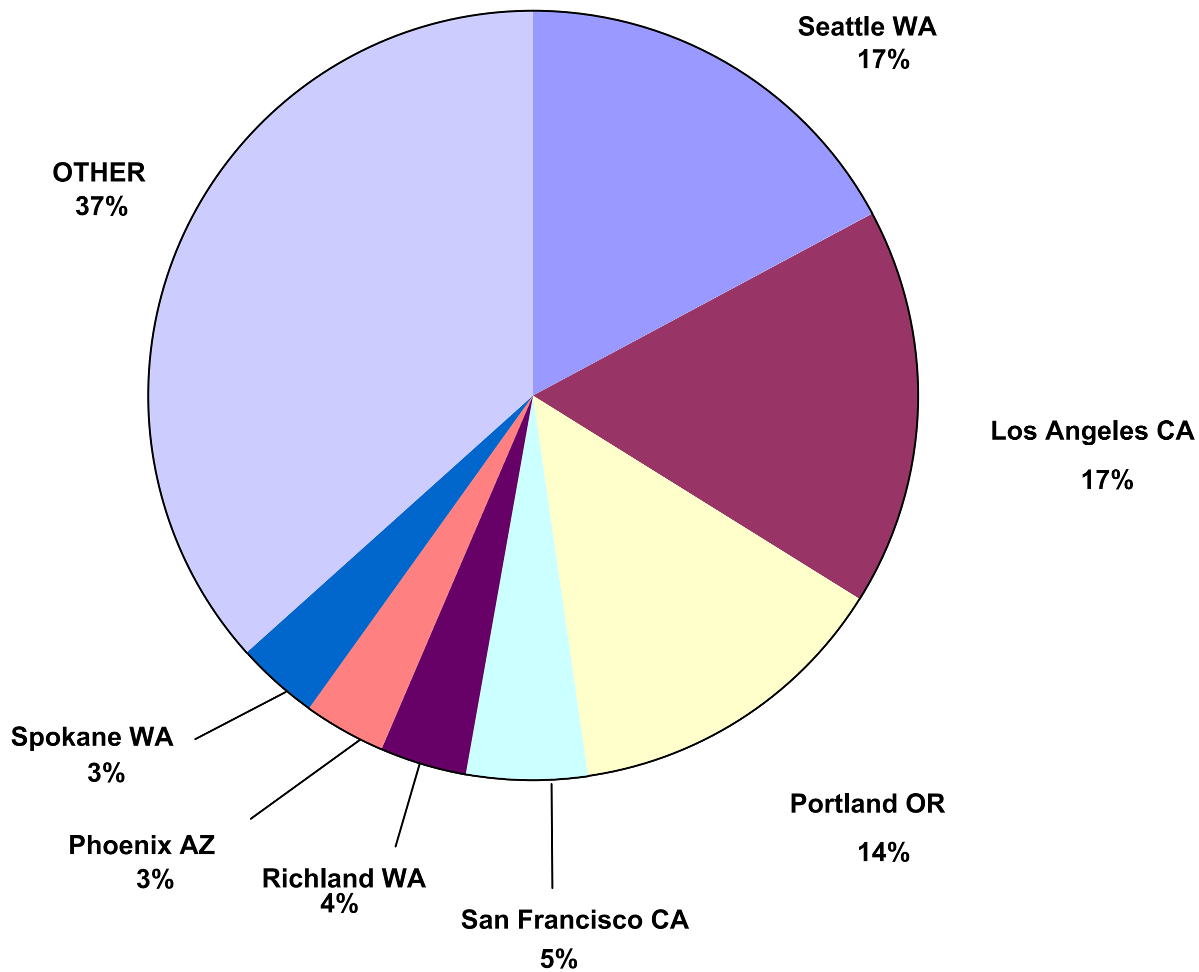
Commodities by Rail to the U. S. (2012)



REEBIE

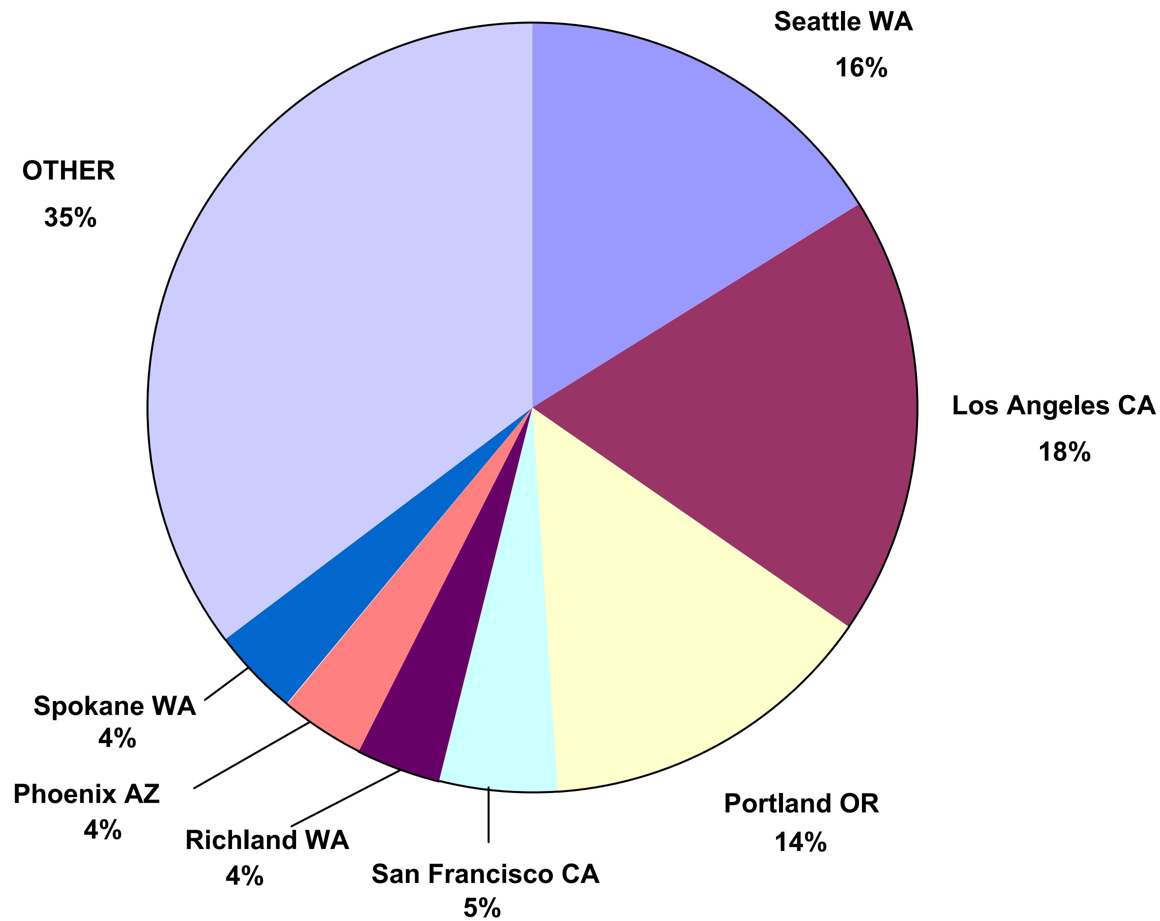
Total Tonnage = 8.72 million

U. S. Destination BEAs by Rail (2002)



Total Tonnage = 5.62 million

U. S. Destination BEAs by Rail (2012)



Total Tonnage = 8.72 million

REEBIE

Appendix B
PORT-RELATED RAIL TRAFFIC ANALYSIS

The report that follows analyses the port-related freight rail traffic through the study area over a 10-year period, from 2002 to 2012. The report was prepared by BST Associates, at the request of WSA.

Cascade Gateway Rail Corridor Port-Related Rail Traffic Analysis

Presented by

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November 25, 2002

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Freight Rail Demand
CASCADE GATEWAY RAIL STUDY

Introduction

The Wilbur Smith team was tasked with developing a complete multimodal freight profile of the Cascade Gateway rail corridor between Vancouver and Seattle. As part of this team, BST Associates was assigned the task of examining port-related traffic moving on the corridor. The following document presents the results of BST Associates' work.

The data elements in this analysis include: port-related traffic volume history and forecasts; analysis of the modal split for port-related traffic; and examination of improvements planned to increase the capacity of the corridor. In addition, a number of Canadian and US shippers were interviewed to determine the factors that they use in deciding what mode of transportation to use for cross-border shipments.

Container Cargo

The first section of this report discusses container movements in and out of the ports in the Cascade Gateway region. Although there are a number of ports in the region, the primary ports handling containers are Seattle, Tacoma, and Vancouver, and, to a lesser extent, Fraser Port.

Traffic History - Containers

In the Puget Sound region, the Port of Seattle was the leading container port from the mid-1980s to the present time. In 1984 Seattle accounted for approximately 84% of container traffic on Puget Sound and 72% of container traffic in Washington and British Columbia. Since that time, Seattle, Tacoma and Vancouver have all invested heavily in container facilities. Seattle's container terminals are located at the south end of Elliott Bay, Tacoma's are located in the Tideflats area, and Vancouver's are located both downtown and at the Roberts Bank facility. Fraser Port has also invested in container facilities, but not to the extent of the other three ports.

In the Cascade Gateway region (Washington and British Columbia ["BC"]) the container volumes moving through the three major ports are now approaching parity, with Seattle accounting for 36%, Tacoma 34%, and Vancouver 28% of total container traffic.

Cascade Gateway container traffic grew at an average annual rate of 8.7% from 1984 through 2000, with a higher rate of growth earlier in the period. The average rate of growth during the latter half of the 1990's slowed to just under 6%. The slower growth later in the period was due mainly to the maturation of the industry as well as to economic problems in Asia.

The rate of container traffic growth was slowest in Seattle, averaging 4.2% from 1984 through 2000 and remaining almost flat from 1995 through 2000. Growth lagged in Seattle as new facilities in Tacoma and Vancouver captured much of the increase in cargo volumes. In addition, the Southern California ports of Los Angeles and Long Beach increased their shares of the West Coast market. Tacoma growth averaged 14.8% from 1984 through 2000, then slowed to 4.7% from 1995 through 2000. Vancouver growth was slightly lower than Tacoma's over the entire period, averaging 13.6%. However, the opening of the new container facility at Roberts Bank caused Vancouver's container growth rate to jump up to an average annual rate of 18.6% in the last half of the 1990's.

Container traffic volumes moving through Fraser Port are small, relative to the other three major ports. They also varied substantially between 1984 and 2000, growing from just over 13,000 twenty-foot equivalent units (TEU[1]) in 1987 to more than 60,000 in 1990 (when Foss Maritime started a barge service between Fraser Port and Puget Sound), then back to just over 8,200 TEU in 1992 (with the cessation of the Foss service). However, during the last half of the 1990's, container growth through Fraser Port was strong and steady, growing from approximately 13,300 TEU in 1996 to nearly 67,000 TEU in 2000.

Table 1 – Comparison of Container Trends (Loaded and Empty TEUs)

Year	Vancouver (BC)	Fraser Port	Seattle	Tacoma	Total
1984	151,551		775,670	150,300	1,077,521
1985	178,175		627,164	504,807	1,310,146
1986	222,781		850,616	666,155	1,739,552
1987	280,777	13,044	1,026,000	696,800	2,016,621
1988	305,738	31,586	1,024,035	781,816	2,143,175
1989	305,688	28,608	1,041,000	924,974	2,300,270
1990	322,569	60,675	1,171,091	937,691	2,492,026
1991	383,563	15,990	1,154,854	1,020,707	2,575,114
1992	441,055	8,210	1,151,261	1,054,449	2,654,975
1993	434,004	25,460	1,151,405	1,074,558	2,685,427
1994	493,843	27,934	1,414,000	1,027,928	2,963,705
1995	496,365	24,624	1,479,076	1,092,087	3,092,152
1996	616,692	13,343	1,473,561	1,073,471	3,177,067
1997	724,154	18,788	1,475,613	1,158,685	3,377,240
1998	840,098	24,911	1,543,726	1,156,495	3,565,230
1999	1,071,171	31,921	1,490,048	1,270,000	3,863,140
2000	1,163,178	66,842	1,488,267	1,376,000	4,094,287
1984-2000	13.6%	NM	4.2%	14.8%	8.70%
1995-2000	18.6%	22.1%	0.1%	4.7%	5.78%

Note: – includes Vancouver BC and Fraser Port; NM means not meaningful
Source: BST Associates using data from AAPA, individual ports

Traffic Forecasts - Containers

For this study, a forecast of container traffic was prepared using a number of different sources. The primary source was the 1999 Marine Cargo Forecast of container tonnage in Puget Sound prepared for the Washington Public Ports Association (WPPA) and the Washington State Department of Transportation (WSDOT) by BST Associates and the Columbus Group. The WPPA forecast projected that Puget Sound full export containers (TEU) would decline until the turn of the century and then increase at rates between 4% and 5% beginning in Year 2000 and

[1] The standard unit for reporting shipping container movements is the twenty-foot equivalent unit, or TEU. Containers are available in a number of sizes, such as 20-foot, 40-foot, 43-foot and 45-foot, but are all converted into TEU for reporting purposes.

continuing throughout Year 2020. Full import containers (TEUs) were expected to grow at rates between 3.8% and 5.4% during the forecast period.

In the few years since those forecasts were completed, both the Port of Seattle and the Port of Tacoma have used the forecasts as inputs for planning documents. For this analysis, changes in various factors that occurred after 1999 were added to the forecasts to produce updated projections. As a result, a range of forecast container volumes is presented in Table 2, giving baseline, high and low forecasts.

Forecasts for Vancouver and Fraser Port are not made publicly available, as a matter of policy for these ports. Therefore, an alternative means of forecasting was used. DRI/WEFA produces forecasts of world trade based on demand. This model is able to provide projections of the container trade to various world regions and from specific coastal regions of the U.S. Because both the commodity mix and the trading partners are similar for all of the Cascade Gateway container ports, the DRI/WEFA growth rate forecasts of U.S. North Pacific container trade with Asia were used to estimate container traffic growth at both Vancouver and Fraser Port.

Lastly, these Puget Sound growth rates reflected in Table 2 differ from the earlier WPPA forecasts, because they take into account the loss of West Coast market share that Puget Sound ports have experienced in the recent past.

Table 2 – Forecast of Container Movements
(Loaded and Empty TEUs)

Forecast	Year	Seattle	Tacoma	Vancouver	Fraser
Low	2002	1,593,693	1,473,552	1,245,848	71,463
Low	2007	1,874,545	1,733,513	1,505,989	86,113
Low	2012	2,187,052	2,022,409	1,868,187	106,623
Medium	2002	1,596,577	1,476,436	1,268,630	72,889
Medium	2007	1,904,332	1,761,125	1,609,153	92,559
Medium	2012	2,282,674	2,110,569	2,103,551	121,163
High	2002	1,643,421	1,519,400	1,279,447	73,586
High	2007	2,063,977	1,908,297	1,672,709	96,257
High	2012	2,532,204	2,341,128	2,286,269	131,593

Source: BST Associates

Major Commodities - Containerized

For both Seattle and Tacoma, the major foreign containerized exports include forest products (lumber, pulp and paper), food products (meat, apples and other consumables), farm products (hay cubes, hides and animal feeds), and scrap metal and aluminum products. Major foreign imports include consumer products (electronics, toys, sporting goods and apparel) and industrial products (auto parts and equipment).

In Vancouver, the highest volume containerized imports include meat, metals and metal ores. However, the volumes of these commodities are not high, relative to total containerized imports. Rather, containerized import tonnage is spread across a wide array of goods, and the mix of these cargoes is similar to that in Seattle and Tacoma. Outbound, forest products account for approximately 43% of containerized tonnage, and most of this consists of wood pulp and lumber.

The remaining 57% is split between a variety of commodities, including fish, grain and animal feed, chemicals, metals, and others.

Detailed containerized commodities statistics were not available for Fraser Port. However, it is likely that the cargo mix is similar to that of Vancouver.

Current Share by Mode - Containers

The three major container ports in the Pacific Northwest share similar patterns of inland distribution of cargoes. On the import side, approximately one-third of containers are distributed inland by truck and two-thirds by rail, for Seattle, Tacoma, and Vancouver. Fraser Port handles mainly domestic BC container cargoes, and as a result most containers leave the port by truck.

On the export side, the modal share of container movements is the opposite of that for imports. For Vancouver, approximately two-thirds arrive by truck and one-third by rail. In Seattle and Tacoma, the shares were similar, until recently. Lately the share of export containers arriving at the ports by truck has climbed closer to 80%, and by rail has fallen to as low as 20%. For Fraser Port, the split is about the same as for imports, 90% truck and 10% rail.

The impact of port-generated container traffic on the Cascade Gateway varies both by port and by railroad. The main line between Seattle and Tacoma currently handles approximately 80 freight trains per day, approximately 50 of which are Burlington Northern and Santa Fe Railway (BNSF) trains and 30 of which are Union Pacific Railroad (UP) trains. These train totals include container trains, grain trains, and other types of freight trains. In general, the port-related container traffic is split evenly between the two railroads, but this varies over time. For example, Terminal 5 in Seattle is served by the UP. Since the number of containers moving through that terminal is currently low, the share of Seattle container traffic handled by UP is currently low.

The effect of port-related container traffic on the Cascade Gateway rail corridor varies by railroad due to the routes used by trains. For example, UP trains moving to and from the Ports of Seattle and Tacoma have no effect on the Cascade Corridor between Seattle and Everett, because they approach and depart the area to and from the south. On the other hand, BNSF container trains to and from both Seattle and Tacoma move via the Stevens Pass route, and so travel between Seattle and Everett.

At Vancouver, intermodal cargo travels the corridor in two ways. Some Burrard Inlet traffic runs on CN, which uses BNSF trackage rights from Tunnel Junction to the Fraser River Bridge. Containers to and from Roberts Bank run on the corridor for less than a mile at Mud Bay (BC Rail provides the connection for Canadian National Railway and Canadian Pacific Railway to Roberts Bank from Pratt; both carriers reach Pratt via trackage rights on the SRY). Fraser Port generates very little container traffic on Cascade Gateway rail corridor.

Table 3 – Share of Container Movements, by Mode of Transport (Loaded and Empty Containers)

	Imports		Exports	
Commodity	**Truck**	**Rail**	**Truck**	**Rail**
Vancouver (BC)	34.8%	65.2%	63.0%	37.0%
Fraser Port	90.0%	10.0%	90.0%	10.0%
Seattle	35.0%	65.0%	80.0%	20.0%
Tacoma	35.0%	65.0%	80.0%	20.0%

Source: Individual ports

Future Share by Mode - Containers

The share of containers moving by rail and truck is not likely to change substantially in the future. This probability reflects the fact that the Pacific Northwest container industry is relatively mature, and the traffic patterns that have evolved are likely the ones that serve the industry in the most efficient manner.

In the Pacific Northwest, import containerized cargoes outnumber the exports. The share of exports arriving by truck reflects the fact that most of the containerized exports shipped from the Pacific Northwest are cargoes generated in the local area. The container-handling infrastructure in the region has been sized to support the level of import containers that move through these ports. Since import cargoes outnumber export cargoes, there tend to be large numbers of empty containers that are repositioned to the Pacific Northwest for export. These empty containers are available to local shippers at attractive rates for transportation overseas.

The share of imports departing by rail reflects the fact that most of the containers off-loaded in the Pacific Northwest are destined for population centers in the Midwest and East Coast locations. Population patterns are not expected to change enough that this import distribution will change over the study period.

On the other hand, there are factors that could affect the distribution mode in the future. One of these is that an increasing number of Fraser Port containers are destined to or arriving from points in eastern Canada. If this trend continues, then the modal split for Fraser Port could change. However, Fraser Port is a relatively small player in the Pacific Northwest container market, and does not have adequate water depth to allow for much growth.

Another factor that could change modal distribution is if Vancouver is able to attract container cargoes bound for the U.S. Midwest. Canadian rail carriers now have direct access into the Chicago area, which is the primary destination of containerized imports, and the rail distance from Vancouver is similar to that from Tacoma and Seattle. In addition, Vancouver has priced aggressively in order to attract some of this cargo. To date the number of containers moved by this route has been limited. If they were to grow, then the modal split for Vancouver imports could shift more toward rail.

Lastly, decisions made by container shipping lines could affect the modal split. All of the major shipping lines have a number of options they can use for West Coast container ports, including, Los Angeles/Long Beach, Oakland, Portland, Seattle/Tacoma, and Vancouver. These lines base their decisions on what is the best use of their assets, and not necessarily on a strict time and distance basis. The container lines have opted to import most containers through Los Angeles and Long Beach. By doing so, they can serve the huge Southern California market, and at the same time they can serve the Midwest. Decisions made by the container lines could shift the modal share in either direction.

Methods of Movement

The following section describes how containers are moved between ships and trains at each of the four container ports.

Seattle

In Seattle, containers are moved between ships and trains either at on-dock intermodal facilities, or at railroad-owned intermodal yards. As discussed previously, the two newest terminals in

Seattle, T-5 in West Seattle and T-18 on Harbor Island, both have on-dock intermodal yards. The older facilities east of the East Waterway, T-25 and T-46 do not have on-dock intermodal yards, but are located very close to the railroad intermodal yards.

The off-dock intermodal yards owned by the railroads include the BNSF Seattle International Gateway Yard (SIG) and the UP Argo yard. The SIG yard is located just east of the terminals on the East Waterway, on the opposite side of Alaskan Way. The Argo yard is located a few blocks south and east of Spokane Street, which is one of the primary access routes to all of Seattle's container terminals and runs adjacent to Terminals 5, 18, and 25. Access to the off-dock intermodal yards is over city streets.

Tacoma

Container traffic at Tacoma is handled at one of three port-owned intermodal yards within the port, or at the Northwest Container facility located on the Tideflats. The port facilities include the North Intermodal Yard, South Intermodal Yard, and Washington United Terminal (Hyundai Terminal). These terminals allow containers to move between ships and trains with little or no driving on public streets.

Rail service at the Port of Tacoma is provided by three railroads: BNSF, UP, and Tacoma Rail, which is a division of Tacoma Public Utilities. Tacoma Rail provides the majority of the switching and terminal service within the Tacoma Tideflats. Tacoma Rail is the only railroad with access to the North Intermodal Yard and Hyundai Terminal, while all three railroads have access to the South Intermodal Yard.

Intermodal trains handled by Tacoma Rail are exchanged with the BNSF and UP at one of four locations: Bullfrog Junction (at the entrance to the Tideflats), near the Puyallup River bridge, at the BNSF Yard near the Tacoma Dome, or at the UP yard in Fife. Each of these locations is within a few miles of the container docks.

Vancouver

The Port of Vancouver has three container terminals, Centerm and Vanterm, both located in Burrard Inlet, and Deltaport, located at Roberts Bank. Deltaport is a new, state-of-the-art facility with on-dock rail that allows containers to move between ships and trains within the terminal. Both the Canadian Pacific Railway (CP) and Canadian National Railway (CN) serve Deltaport. Centerm and Vanterm are smaller terminals. Both have intermodal yards served by the CP and CN. In addition, the CP operates an intermodal yard east of Vancouver, in Pitt Meadows, and CN has a yard in Surrey.

Fraser

Fraser Surrey Docks, the Fraser Port facility handling containers, has on-dock rail that is served directly by five railroads (CN, CP, BNSF, BC Rail [BCR] and Southern Railway of British Columbia [SRY]). In addition, the CN and CP intermodal yard in Surrey and Pitt Meadows are easily accessible from Fraser Surrey.

Non-containerized Cargo

The following section is intended to answer the following questions. What are the current and forecast break-bulk volumes inbound and outbound? What amount is and will be carried by rail and motor carrier? What are the top non-containerized commodities carried through the Port today? What is the forecast? What are the ultimate origins and destinations of this traffic?

Traffic History – Non-containerized

Seattle

Almost 80% of non-containerized foreign imports moving into Seattle are construction materials. Nearly 40% of Seattle non-containerized tonnage is limestone, followed by Portland cement (16%), gypsum (13%), aggregates (6%), and sand (4%). The remaining 20% is made up of steel product and steel scrap, motor vehicles, forest products, and a small amount of coal.

Imports of construction materials are cyclical, and are tied directly to the level of construction in the region. From 1997 through 2000 (the last year for which this data was available), most construction materials grew in volume. The exception was limestone, which ended the period at a level slightly below that in 1997.

Scrap steel and coal imports experienced high growth rates, but the total volume of these materials is small relative to construction materials. Non-containerized imports that decreased in volume in Seattle included lumber, waferboard/OSB, and automobiles.

Table 4 – Top Non-containerized Imports at the Port of Seattle (1,000's of Metric Tons)

Rank	Commodity	1997	1998	1999	2000	CAGR
1	Limestone	1,576	1,343	1,574	1,497	-1.7%
2	Portland Cement	574	642	490	611	2.1%
3	Gypsum	322	499	555	471	13.4%
4	Aggregates	124	173	278	234	23.6%
5	Sand	69	118	146	145	27.8%
6	Scrap Steel	18	42	76	140	99.7%
7	Coal	40	94	78	101	36.2%
8	Lumber	153	194	206	95	-14.7%
9	Waferboard, OSB	89	168	226	73	-6.3%
10	Automobiles	47	29	50	44	-2.0%
	Other	437	462	577	338	-8.2%
	Total	3,449	3,764	4,254	3,749	2.8%

Source: MARAD Waterborne Commerce data
Note: "CAGR" means Compound Annual Growth Rate

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Non-containerized exports in Seattle consist mostly of grain and animal feed. Various other commodities, including small quantities of iron ore, calcium carbonate, sand, and logs, make up between 12% and 18% of exports.

Table 5 – Top Non-containerized Exports at the Port of Seattle (1,000's of Metric Tons)

Rank	Commodity	1997	1998	1999	2000	CAGR
1	Grain	3,184	1,061	1,665	1,128	-29.2%
2	Animal Feed	700	322	362	720	0.9%
3	Iron Ore	-	-	39	32	N/M
4	Calcium Carbonate	-	-	5	31	N/M
5	Sand	-	0	18	20	N/M
6	Logs	106	11	4	19	-43.1%
7	Other	406	282	369	235	-16.7%
8	Total	4,397	1,676	2,461	2,186	-20.8%

Source: MARAD Waterborne Commerce data
Note: "N/M" means Not Meaningful (division by 0)

Tacoma

Non-containerized imports at Tacoma include are mainly bulk commodities, including alumina and gypsum. Tacoma is also a significant automobile port of entry. Breakbulk cargoes, or those cargoes traditionally unloaded on pallets or in nets, account for a very small share of Tacoma imports. This type of cargo declined by an average of 8% per year from 1997 through 2001, and now accounts for only one-half of one percent of all trade moving through Tacoma.

Table 6 – Top Non-containerized Imports at the Port of Tacoma (1,000's of Metric Tons)

Rank	Commodity	1997	1998	1999	2000	CAGR
1	Alumina	464	466	483	353	-8.7%
2	Salt	182	330	342	305	18.8%
3	Gypsum	298	319	300	260	-4.4%
4	Limestone	123	187	186	177	13.0%
5	Automobiles	120	125	141	196	17.8%
6	Lumber	-	-	39	115	N/M
7	Scrap Steel	39	82	73	102	38.3%
8	Petroleum Products	42	21	45	117	40.9%
9	Coal	13	10	30	35	38.0%
10	Cement	-	54	146	28	N/M
	Other	179	201	169	115	-13.8%
	Total	1,459	1,795	1,953	1,802	7.3%

Source: MARAD Waterborne Commerce data

Grain is the primary non-containerized commodity exported through Tacoma. Within this category, corn makes up the largest share, but soybeans, grain sorghum and wheat also move in substantial volumes. (Note: Soybeans are technically not grain, but are typically included with grain when reporting trade figures.)

Other non-containerized commodities exported through Tacoma include logs, wood chips, and scrap steel. Log exports have continued to decline at Tacoma, as they have throughout the

Pacific Northwest. As recently as 1997, logs accounted for almost 6% of Tacoma tonnage, but by 2001 that share had fallen to less than 3%. Log exports declined every year from 1997 through 2001 at an average annual rate of 22%. Wood chip exports peaked in 1998, but fell during each subsequent year. For the period of 1997 through 2001, wood chip exports declined by an average annual rate of 12%. Scrap steel volumes have fluctuated over time, and in 2000 accounted for 5% of Tacoma non-containerized exports.

Table 7 – Top Non-containerized Exports at the Port of Tacoma (1,000's of Metric Tons)

Rank	Commodity	1997	1998	1999	2000	CAGR
1	Corn	2,420	1,248	3,408	2,450	0.4%
2	Soybeans	856	169	247	580	-12.2%
3	Logs	953	822	766	506	-19.0%
4	Woodchips	428	567	472	333	-8.1%
5	Scrap Steel	271	146	215	210	-8.2%
6	Sorghum	94	44	75	106	4.3%
7	Wheat	59	-	13	34	-16.9%
8	Tallow	48	52	28	27	-17.8%
9	Animal Feed	1	12	30	10	115.5%
10	Sodium Compounds	49	24	21	16	-31.7%
	Other	144	135	118	120	-6.0%
	Total	5,324	3,218	5,394	4,391	-6.2%

Source: MARAD Waterborne Commerce data

Vancouver

In terms of tonnage, movements of dry bulk commodities account for nearly 80% of the trade moving through Vancouver, and nearly all of these movements are exports. Bulk and breakbulk imports at Vancouver are handled in relatively limited volumes, relative to exports, and have decreased in volume in recent years. Overall, the volume of non-containerized imports at Vancouver dropped by an average of 8.5% per year between 1997 and 2000, and imports of phosphate rock were hit especially hard, declining at more than 36% per year. Not all of the non-containerized commodities were as hard hit, though, and the volumes of both metal ores and fuel oil grew at more than 10% per year over the same period.

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Table 8 – Top Non-containerized Imports at the Port of Vancouver (1,000's of Metric Tons)

Rank	Commodity	1997	1998	1999	2000	CAGR
1	Metal/Ores Concentrates	496	495	592	653	11.8%
2	Fuel Oil	369	375	345	300	10.2%
3	Salt	283	328	322	262	0.5%
4	Phosphate Rock	1,011	1,069	1,130	725	-36.3%
5	Other	777	705	470	531	-11.9%
	Total	3,044	3,094	2,410	2,333	-8.5%

Source: BST Associates, estimated using data from Vancouver Port Corporation

Coal is the largest of the non-containerized exports, accounting for more than one-third of all cargo tonnage shipped through Vancouver. Grain accounts for 16% of non-containerized export tonnage, sulfur 7%, and various other commodities the remainder. These remaining non-containerized exports include chemicals, animal feed, metal ores, minerals, and wood chips. While most of these commodities are moved strictly in bulk form, some have seen a small shift toward containerization. These include grain (3.7% containerized); chemicals (10.2% containerized), animal feed (41.5% containerized), and metals ores (23.0% containerized).

Table 9 – Top Non-containerized Exports at the Port of Vancouver (1,000's of Metric Tons)

Rank	Commodity	1997	1998	1999	2000	CAGR
1	Coal	28,477	28,213	26,864	27,331	-1.4%
2	Grain	12,561	10,168	10,640	12,014	-1.5%
3	Sulfur	5,510	5,216	5,207	5,400	-0.7%
4	Potash	4,279	3,413	3,347	3,883	-3.2%
5	Chemicals – Misc.	1,695	1,863	1,927	1,907	4.0%
	Other	7,856	8,834	7,679	10,032	8.5%
	Total	60,378	57,707	55,664	60,566	0.1%

Source: BST Associates, estimated using data from Vancouver Port Corporation

Fraser

Fraser Port primarily handles three major non-containerized cargo types, along with miscellaneous others. The primary cargoes include imported steel, imported vehicles, and exported forest products.

International traffic passing through the facilities of Fraser Port is relatively balanced between imports and exports. In 2001, imports accounted for 45% of tonnage and exports 55% in 2000, imports accounted for 57% and exports 43%. In 1999, imports accounted for 49% and exports 51%.

Import tonnage grew at a compound annual growth rate of 8% from 1997 through 2001. Import tonnage jumped nearly 60% in 2000, primarily due to a surge in steel imports. In 2001, import tonnage fell off again, but was still at a level 30% higher than in 1999.

Steel is the biggest import commodity at Fraser Port, averaging between approximately 570,000 and 640,000 metric tons per year (with the exception of 2000). On average, import steel tonnage grew 3% per year from 1997 through 2001. Automobiles rank second in import tonnage, and showed strong, steady growth over the same time period. Automobile import tonnage grew by an average rate of 9% per year, with increases each year. One commodity that has shown very strong growth is chemicals. Chemical imports did not exist in 1997, but grew to 45,302 metric tons in 2001.

Table 10 – Top Non-containerized Imports at Fraser Port (1,000's of Metric Tons)

Commodity	1997	1998	1999	2000	2001	CAGR
Steel	568	639	617	951	637	2.9%
Autos	259	259	297	318	370	9.3%
Other	18	29	28	40	103	54.7%
Chemicals	-	1	3	7	45	N/M
Wood Products	1	1	10	2	18	106.0%
Heavy Equipment	3	9	10	10	4	7.5%
Paper	-	-	10	0	1	N/M
Metal (Non-Ferrous)	3	3	-	-	-	-97.6%
Total Imports	852	941	974	1328	1179	8.5%

Source: Fraser Port Harbor Commission

Forest products have traditionally accounted for most export tonnage. From 1997 through 2000, three-quarters of Fraser Port export tonnage was in forest products. However, in 2001 their share of total tonnage dropped to less than 50%. There were two primary reasons for this. First, exports of lumber, paper and other wood products declined steadily from 1997 through 2001. Only pulp exports grew, at 6% per year. Second, tonnage in the miscellaneous "Other" category shot up from 51,448 tons in 2000 to 403,594 tons in 2001.

Overall, export tonnage grew by an average of 2% per year, from 1997 through 2001. Excluding the "Other" category, export tonnage dropped by an average of 5% per year.

Table 11 – Top Non-containerized Exports at Fraser Port (1,000's of Metric Tons)

Commodity	1997	1998	1999	2000	2001	CAGR
Other	1	22	62	51	404	232.1%
Pulp	293	294	331	363	373	4.9%
Lumber	696	554	409	395	368	-12.0%
Cement	129	49	78	-	289	17.5%
Paper	90	115	91	61	47	-12.2%
Wood Products	63	38	15	91	14	-26.0%
Steel	106	97	9	22	9	-38.9%
Chemicals	12	24	14	26	8	-7.8%
Metal (Non-Ferrous)	1	0	0	2	5	38.0%
Autos	0	1	2	2	2	N/M
Heavy Equipment	1	2	2	3	0	-100.0%
Bulk (NOS)	33	-	15	15	-	-95.0%
Total Exports	1,426	1,196	1,029	1,032	1,520	1.3%

Source: Fraser Port Harbor Commission

Traffic Forecasts – Non-containerized

For most of the ports studied in this analysis, exports account for the majority of non-containerized cargo volumes, with the exception being Seattle. Overall, exports account for more than 88% of non-containerized tonnage, and imports less than 12%. Also, Vancouver is the leading gateway for non-containerized trade. Vancouver handles 10 times the volume of non-containerized tonnage as does Seattle or Tacoma, and more than 20 times as much as Fraser Port.

In Seattle and Tacoma, total cargo tonnage is relatively evenly split between containerized and non-containerized cargoes; while in Vancouver and Fraser Port 85% to 90% of total tonnage is non-containerized. In Seattle, imports are evenly split between containerized and non-containerized, but only one-third of exports are non-containerized. In Tacoma, imports are also relatively evenly split, but more than 60% of exports are non-containerized. In Vancouver, approximately 40% of imports and 90% of exports are non-containerized, and at Fraser Port approximately 90% of both imports and exports are non-containerized.

In Seattle, the majority of non-containerized imports move in dry bulk form. As described above, nearly 80% of non-containerized foreign imports moving into Seattle are construction materials. The remaining non-containerized imports move in either breakbulk form (steel product and steel scrap, forest products) or on wheels (motor vehicles). Non-containerized exports in Seattle are made up almost entirely of coarse grains, such as corn and sorghum, as well as oilseeds. Forecast growth rates for each of these commodity types are presented in Table 12.

In Tacoma, non-containerized imports consist primarily of alumina, which is used in smelters in Tacoma and Spokane, and gypsum, which is processed in Tacoma. Exports of non-containerized cargoes consist primarily of grain and forest products. Gypsum imports are projected to climb gradually through Year 2012, but alumina imports are forecasted to remain unchanged. On the export side, grain and wood chip exports are projected to grow steadily through Year 2012, but log exports will only increase slightly.

Vancouver handles more non-containerized cargoes than any other port in the region, with volumes approximately 10 times higher than those in Seattle or Tacoma. The majority of Vancouver's non-containerized tonnage consists of export coal and grain. However, substantial volumes of metal ores and other minerals are imported through Vancouver, and significant volumes of sulfur, potash, and various other chemicals are exported. In the near term, coal exports are projected to decrease slightly, as are grain exports. Sulfur exports are expected to remain stable, but potash and pulp & paper exports are also expected to decline.

At Fraser Port, steel and autos make up the majority of non-containerized import tonnage, while forest products and cement make up the majority of exports. Fraser Port is expecting little growth in exports or imports, as the port's facilities are operating at or near capacity now. If new public/private partnerships can be created to expand facilities, then there will be opportunities for growth. But at this time, there are no plans for expansion.

Table 12 – Forecast of Non-containerized Commodities and Share Moving by Rail

Rank	Commodity	Thousand Metric Tons (Year 2000)	Forecast Annual Growth Rate	% Rail
Seattle				
1	Construction Materials	2,958	2.3%	10.0%
2	Grain & Animal Feed	1,848	3.0%	100.0%
3	Scrap Steel	140	1.2%	0.0%
	Other	988	-1.0%	15.0%
	Grand Total	5,935	2.4%	
Tacoma				
1	Grain	3,180	3.0%	100.0%
2	Logs	506	0.2%	0.0%
3	Alumina	353	0.0%	50.0%
4	Wood Chips	333	3.9%	0.0%
5	Gypsum	260	1.3%	10.0%
	Other	1,561	0.0%	0.0%
	Total	6,193		
Vancouver				
1	Coal	27,331	N/A	100.0%
2	Grain & Animal Feed	12,014	N/A	100.0%
3	Sulphur	5,400	N/A	100.0%
4	Potash	3,883	N/A	100.0%
5	Chemicals	1,907	N/A	50.0%
6	Petroleum Products	502	N/A	0.0%
7	Metal Ores/Concentrates	691	N/A	100.0%
8	Other	10,563	N/A	
	Total	62,899		
Fraser				
1	Steel	951	N/A	10.0%
2	Forest Products	910	N/A	60.0%
3	Autos	318	N/A	90.0%
4	Other	182	N/A	
	Total	2,361		

Source: BST Associates, using MARAD and port data

Current Share by Mode – Non-containerized

Relatively little port-related non-containerized cargo travels on the Cascade Gateway north of Seattle, so this type of cargo generates little impact on track capacity between Seattle and Vancouver. While a large volume of non-containerized cargoes is shipped to and from the ports by rail, the routes used tend to avoid the corridor. For example, although most of the grain exported through Seattle and Tacoma originates in the Midwest, these trains travel through the

Columbia River Gorge then up the I-5 Corridor, rather than crossing the mountains via Stevens Pass. Therefore, they do not affect the Cascade Corridor north of Seattle.

Two exceptions to this are coal exports and alumina imports. The Roberts Bank coal export facility handles approximately one train of US coal per month, and these trains travel via the Cascade Gateway. The other major exception is alumina imported to Tacoma, half of which is used in Tacoma and the other half of which moves by rail via Stevens Pass to the Spokane area.

Descriptions of the major non-containerized cargoes and their modal splits are described below.

Seattle

Almost 80% of non-containerized imports moving into Seattle are construction materials. Nearly 40% of Seattle non-containerized tonnage is limestone, followed by Portland cement (16%), gypsum (13%), aggregates (6%) and sand (4%). The remaining 20% is made up of steel product and steel scrap, motor vehicles, forest products, and a small amount of coal. For the most part, the construction materials are imported directly to the plant that will process them into products such as concrete and wallboard. Most of the non-containerized import cargoes are ultimately destined for local markets, and leave the port by truck. However, Portland cement is manufactured at the port from the imported limestone, and some of this is shipped out by rail.

In Seattle, most of the non-containerized export tonnage is made up of grain and animal feeds. The majority of these commodities originate in the Midwest, and all of them are transported to the port by rail. Apples are another non-containerized export in Seattle, but over the past 15 years nearly all apples have shifted into containers. Containerized or non-containerized, apples arrive at the port by truck.

Tacoma

In Tacoma the largest non-containerized import is alumina, which traditionally has been used in the Kaiser Aluminum smelters in Tacoma and Spokane[2]. This material accounts for 20% of Tacoma's non-containerized import tonnage. Alumina has moved by rail to the Tacoma and the Spokane smelters. Salt, gypsum, and limestone are next biggest non-containerized imports, and each of these is processed at plants located at the port. Automobiles account for more than 10% of non-containerized imports, and 78% to 80% of these leave the port by rail.

Grain and oilseeds dominated the non-containerized exports at Tacoma, and all of these commodities arrive at the port by rail. Forest products make up most of the remaining non-containerized exports, and all of these arrive at the port by truck from the local area. Together, grain/oilseeds and forest products account for essentially all of Tacoma's non-containerized exports.

Vancouver

Vancouver is the biggest bulk port in the Pacific Northwest, by a wide margin. Exports of coal alone are more than four times higher than all of the non-containerized tons at either Seattle or Tacoma. Grain exports are also a key commodity in Vancouver, with volumes four to six times higher than grain volumes in Seattle or Tacoma. In total, Vancouver facilities handle more than 60 million tons of non-containerized cargo, with coal and grain accounting for nearly two-thirds

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[2] The recent bankruptcy of this company naturally qualifies the forecast of this commodity.

of the total. Other key non-containerized commodities at Vancouver include sulphur, potash, chemicals, petroleum products, and metal ores.

For the most part, these commodities are shipped into or out of the port by rail. The two exceptions are chemicals and petroleum products. Chemicals move by a combination of modes, including rail, truck and water, while petroleum products move by water, pipeline or truck.

Fraser

At Fraser Port, the main non-containerized import commodities include steel and vehicles. The major portion of the steel is bound for western Canada, with nearly all moving by truck. There is also a small volume of steel that moves to eastern Canada, and this is shipped by rail. Imported vehicles are nearly all shipped east by rail, although a small volume stays in BC and is distributed via truck.

Forest products make up the majority of Fraser Port exports, and these products move both by truck and by rail. Interior BC is a major center of production for forest products. This area is located 500 to 750 miles from Fraser Port, making it economical to serve by rail, and BC Rail provides rail service to the region. As a result, approximately 60% of Fraser Port forest products exports arrive at the terminal via rail. Lower Mainland BC is also a major center for production of forest products. This area, along with parts of northern Washington, is served by truck, and accounts for 40% of Fraser Port forest products exports.

Future Share by Mode – Non-containerized

Barring major changes in commodity mix or other factors, the modal split between truck and rail for non-containerized products should remain similar to the current mix. Locally generated cargoes, such forest products and apples, will move mainly by truck. The exception is forest products from Interior BC, of which substantial volumes move via rail. Coal and grain exports will move exclusively by rail. Construction bulks, such as limestone, cement, gypsum, and aggregates, will be processed at dockside plants and then distributed mainly by truck. Automobiles will move eastbound by rail, with a small share distributed locally by truck.

Because little change is likely in how port-related non-containerized rail traffic will move, there should be little effect on rail capacity in the corridor.

In-transit Cargo

In-transit cargoes are those goods that are imported or exported through one country, but whose ultimate destination or origin is in a different country. Historically, the Ports of Seattle and Tacoma have both handled a substantial volume of containerized cargo that originates in or is destined for Canada. Bigger, more efficient facilities in Seattle and Tacoma, combined with better labor conditions in those ports, tended to push Canadian containerized cargoes to use the U.S. ports.

Since the mid 1990's, however, the volume of cargo moving in-transit has decreased substantially. One reason for this change was the development of the container facilities at Roberts Bank. This terminal is a state-of-the-art rail-served container yard with on-dock rail located away from the congestion of Vancouver's Inner Harbor. With this facility, the Port of Vancouver has been able to attract shipping lines that did not previously call in Vancouver.

Another reason that Vancouver has been able to recapture former in-transit cargoes is that labor relations have improved substantially from the confrontational situation of the early 1990's.

Finally, the transportation industry in Vancouver has cooperated to offer financial incentives to ocean carriers to call in Vancouver, especially if they make Vancouver the first port of call inbound or the last port of call outbound, or if they provide large numbers of containers.

The result of these changes is shown in the following two graphs, Figures 1 and 2. Between 1990 and 1994, the volume of in-transit containerized cargo originating in Canada but loaded on ships at Seattle and Tacoma nearly doubled, growing from 390,000 metric tons to 750,000 metric tons. However, the changes made in Vancouver led to a dramatic drop in these exports, with volumes falling to under 300,000 metric tons in 1998. In 1999 (the last year for which data was available), in-transit exports were just above their 1990 level.

In-transit imports declined from 1990 through 1996, with volume falling from a high of 500,000 metric tons to a low of 220,000 metric tons. Since 1996, however, in-transit imports have increased in volume, with 1999 tonnage of more than 420,000 metric tons. One possible explanation for this is that Maersk/SeaLand no longer has ships calling at Vancouver. The carrier's Pacific Northwest operations are now concentrated in Tacoma.

Few of the remaining in-transit containers move via rail. Currently most of these moves are handled by truck, although in the past there has been waterborne service moving containers between Seattle/Tacoma and Lower Mainland BC.

The other type of in-transit move, imports and exports of U.S. cargo through Canadian ports, account for a relatively minor share of BC port traffic. Fraser Port reports little in-transit U.S. export or import traffic, and of this small amount only a small fraction moves by rail. Vancouver does hope to eventually capture a share of the U.S. container cargo moving to and from the Midwest, and does appear to have the intermodal system in place to be competitive with Seattle and Tacoma for these cargoes. Currently, though, only 5 percent of Vancouver's container volume is U.S. origin/destination traffic, and none of this is shipped by rail on the Cascade Gateway rail corridor.

Overall, the Cascade Gateway likely will see very few port-related in-transit rail shipments, with the possible exception of U.S. coal exported through Roberts Bank. The Vancouver Port Corporation's Roberts Bank coal terminal does handle monthly shipments of US coal, and this coal is shipped by BNSF via the Cascade Gateway. The future of these shipments is quite uncertain, however, as increased demand for coal overseas leads to increased competition from Indonesian, African, and Australian sources as well as from U.S. exports through Southern California.

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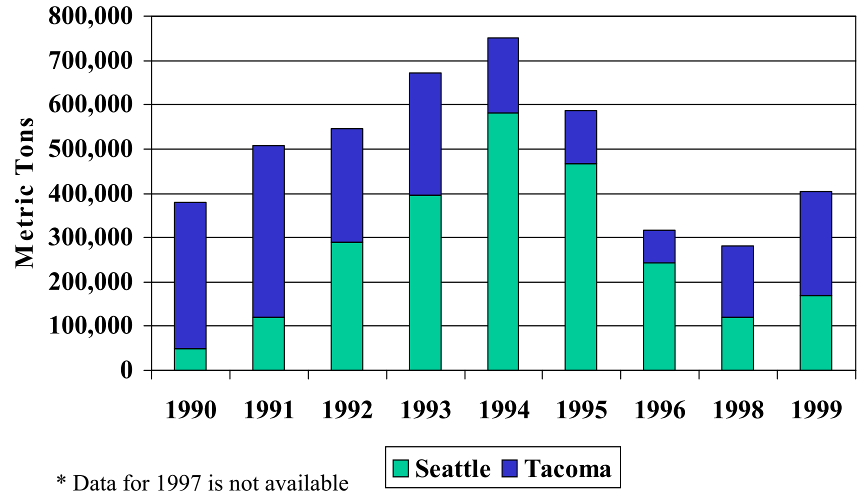
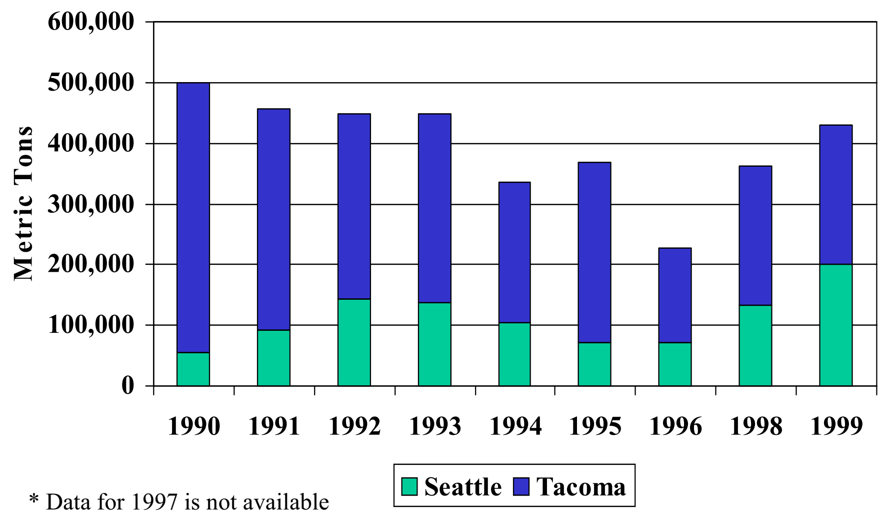
Figure 1 – In-transit Containerized Exports – Canadian Exports through U.S. Ports



* Data for 1997 is not available

Figure 2 – In-transit Containerized Imports – Canadian Imports through U.S. Ports



* Data for 1997 is not available

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Planned Improvements

The following section describes corridor improvements that are planned or that could help to increase corridor capacity for port-related traffic.

FAST Corridor

Most of the freight-related rail improvements planned for the Seattle-Tacoma area are included in the regional plan known as the "FAST Corridor". This plan, the "Freight Action Strategy for Seattle and Tacoma", includes a number of projects designed to separate rail traffic from road traffic, thereby increasing the efficiency of both modes while decreasing delays. The FAST Corridor is defined as running from Tacoma to Everett, and includes the rail, highway, and street systems in the region. This effort, started in 1996, is a partnership among the state, ports, railroads, and other public and private organizations.

The FAST Corridor list shown in Table 13 represents both a wish list and a realistic list of projects designed to promote the efficient movement of freight and goods. It is a wish list insofar as funding is not yet available for all of the projects, especially for Phase II projects such as the SR-167/I-5 connector. On the other hand, the list is realistic, because as funding becomes available the projects are being started. As of the end of September 2002, two of the 15 Phase I projects have been completed, and seven are under construction. The remaining Phase I and Phase II projects are in various stages of planning, or are awaiting funding.

The Phase I projects are 27% federally funded and 73% funded from other public and private sources.

Phase II of the FAST Corridor project will focus on improving the mobility of trucks in the region. Efforts will be concentrated on corridors that currently carry significant volumes of truck traffic, but were not designed for such a traffic load. Each of the projects from Phase I and Phase II is listed in Table 13, along with the status as of the end of August 2002.

The main thing that would make improvements difficult or impossible to achieve is funding. Freight-related projects that are dependent on the proposed increase in the Washington state gasoline tax (i.e. proposed in the November 2002 vote) include the SR-167/I-5 connector in Fife (Tacoma) and the SR-519 project in Seattle.

None of these projects is designed to increase the amount of cargo that moves through the ports of Seattle and Tacoma. Rather, they are designed to accommodate the volumes that are currently forecast to move through the ports over the next 10 to 20 years.

Table 13 – FAST Corridor Project Status

Phase	Location	Project	Status
2001			
I	Tacoma	SR-509/Port of Tacoma Rd	Completed
I	Seattle	SR-519/Royal Brougham	Under Construction
I	Auburn	3rd Street SW	Completed
I	Auburn	S 277th St	Under Construction
I	Everett	California St Overcrossing	Under Construction
I	Everett	Riverfront Pkwy	Under Construction
I	Pierce County	8th Street E	Under Construction
I	Pierce County	SR-167/Right of Way	ROW Purchase
2002			
I	Tukwila	S 180th St	Under construction
I	Seattle	S Spokane Street	Under construction
2003			
I	Puyallup	Shaw Rd Extension	Construction to begin
I	Tacoma	D Street	Construction to begin
I	Everett	E Marine View Drive	Construction to begin
II	Pierce County	Lincoln Avenue	Construction to begin
II	Kent	S 228th	Construction to begin
II	Puyallup	70^{th}	Construction to begin
II	Seattle	Duwamish ITS Project	Implementation to begin
II	Region	Regional ITS Improvements	Implementation to begin
II	Snohomish County	SR-9 Widening	Construction to begin
2004			
I	Seattle	E Marginal Way	Construction to begin
I	Everett	E Marine View Drive	Construction to begin
I	Pierce County	N Canyon Rd Extension	Construction to begin
II	Auburn	M Street	Construction to begin
II	Pierce County	8th Street - UP	Construction to begin
II	Seattle	Lander Street	Construction to begin
II	Kent	Willis Street	Construction to begin

Source: Washington State Department of Transportation

One hypothetical project that is not on the FAST Corridor list and could lead to an increase in the volume of cargo moving through the ports is a joint intermodal facility that would serve both Seattle and Tacoma and would be used by both the UP and BNSF railroads. Currently, the majority of the containerized cargo imported through Seattle and Tacoma is shipped to the Chicago area by train, and is then either distributed from there or is moved to another train for transport further east. The purpose of the joint intermodal facility would be to generate large enough volumes of containers that whole trains could be sent directly to New York or other East Coast destinations, rather than being split up in Chicago. The resulting efficiencies would then draw additional cargo to move through Seattle and Tacoma.

The two railroads have differing levels of interest in the project. Such a project would likely involve some sort of partnership between the railroads and public entities. One of the main sources of reluctance on the part of the railroads is the amount of control that they would have to give up, and the concessions that the public partners would require from them. A good example of the difficulty in operating a joint-use intermodal facility is Oakland. The joint use intermodal facility in Oakland was designed for use by both the BNSF and UP railroads, and both BNSF and UP now uses it.

Seattle

In Seattle, containers are transferred to railcars either at the ocean terminal, or at railroad intermodal yards. The rail intermodal yards in Seattle are Argo Yard, owned by UP, and SIG Yard, owned by BNSF. The two newest container terminals in Seattle, T-18 on Harbor Island and T-5 in West Seattle, have rail facilities located within the terminals, while the older facilities, including T-25 and T-46, do not have on-dock intermodal facilities.

One idea that has been discussed is to reconfigure some of the marine terminals on the east side of the East Waterway (i.e. T-25, T-30, T-43, T-46) into a larger container terminal with on-dock rail. This idea is currently on hold, however, due to current financial and economic conditions. In addition the port has decided to build an interim cruise facility at Terminal 30.

With the exception of the marine terminal reconfiguration, the most important infrastructure improvements in Seattle were included on the FAST Corridor project list, and were discussed earlier in this document. The most critical of these included the railroad grade crossing on East Marginal Way and the SR-519/Royal Brougham interchange. As shown in the project list, the SR-519 project is currently under construction, but the Marginal Way grade crossing is not. Because of the importance of the Marginal Way grade crossing, it is described in more detail in the following paragraph.

Rail traffic destined to the terminals on Harbor Island and in West Seattle uses a branch line that crosses East Marginal Way at-grade, and the physical constraints of this line force trains to move at slow speeds. At the same time, East Marginal Way is a critical route for moving trucks in and out of the area. The proposed project would separate the rail grade from the road grade, most likely by raising the road. At the same time the tracks would be realigned to improve rail access to the BNSF SIG Yard, and well as to shared storage track (i.e. "Whatcom Yard") north of the grade crossing and between East Marginal Way and SR-99. At this point, four alternatives have been developed, and a funding package is being developed to begin initial design work.

Tacoma

The Port of Tacoma has a number of critical infrastructure and marine terminal expansion projects in the planning phases, underway, or recently completed. Expansion projects recently completed include deepening the Blair Waterway, extending the Maersk Pacific Terminal Pier, and expanding the Washington United Terminal from 60 to 80 acres. The Washington United Terminal now includes 80 acres, with 20 acres available for future expansion. The expansion project also doubled the size of the dockside intermodal yard.

Planned expansion projects include widening the Blair Waterway and redeveloping the Pierce County Terminal. Pierce County Terminal currently houses the port's auto-handling facilities, but could be developed into a 230-acre container terminal with on-dock rail.

In order to handle the increasing levels of containers that these projects will bring, the capacity of the road and rail system in the vicinity of the port must be increased. A number of projects included in the FAST Corridor list are designed to address these capacity needs. These include the Port of Tacoma Road overpass and the SR-167 connector to Interstate 5 and SR-509 at the Port of Tacoma.

The Port of Tacoma does have a number of projects within the Tideflats that are not included in the FAST Corridor list, including improvements to intermodal rail terminals, the Tideflats rail system, and road infrastructure.

As discussed earlier in this document, there are currently three intermodal terminals on the Tacoma Tideflats. Two of the terminals are on-dock, and the other is near-dock. To handle the expected increases in containers, existing intermodal yards will have to be expanded, and new intermodal yards will have to be added to service new terminals. In the past, the length of working tracks in intermodal yards was based on 305-foot double-stack cars. The appearance of 48 and 53-foot domestic containers has resulted in double-stack cars with lengths up to 345 feet, so both new yards and existing ones will need to accommodate these longer cars. In addition, expansion of existing ocean terminals may necessitate the relocation of the existing on-dock intermodal yards.

The rail system between the intermodal yards and the main line rail are also an area in which improvements are needed. To handle the increasing rail traffic, the port has added more staging and storage tracks. The port is also in the process of adding three arrival and departure tracks. However, the amount of track does not fully remove the identified constraints, and as container volumes increase, additional trackage will be needed for the storage, interchange capacity, and arrival and departure of railcars.

The growth in container shipping and the expansion and additional ocean terminals will also necessitate improvements to the road system within the Tideflats. For example, closure and removal of the 11th Street viaduct, from the Puyallup River to Milwaukee Way, would offer expansion and intermodal improvement potential to the Maersk-SeaLand Terminal. Similarly, the closure and abandonment of Alexander Avenue would allow Pierce County Terminal to expand eastward and would also allow the development of the East Blair Terminal. The realignment of Port of Tacoma Road would provide space to the Hyundai terminal and to potential new terminals north of the Hyundai facility. Also, the realignment of SR-509 would open up an additional parcel immediately adjacent to deep water.

Vancouver and Fraser

Currently the Gateway Council, a lobbying group from the Vancouver transportation industry, is conducting an analysis of rail needs in the Vancouver area. This study is intended to develop a "wish list" of all the projects that would help to increase the efficiency of rail transportation in the region. At the time of this writing, no results are yet available from this study.

A conference was held in November of 2001 in Vancouver to discuss regional transportation issues, including both passenger and freight movement by road and rail. During this conference, the "Greater Vancouver Community Leadership Summit", a number of rail-related projects were discussed. These included replacing the New Westminster rail bridge, rail improvements south of the New Westminster rail bridge, and improvements to the Pitt River rail bridge.

The New Westminster bridge is a high-priority need for the region. This bridge is a single-track swing-span crossing of the Fraser River that carries both freight and passenger traffic. Because this bridge crosses a navigation channel, vessel operations have priority over train operations. This, in turn, causes delays for rail traffic and make the expansion of both freight and passenger service difficult. A potential replacement for this bridge would be a tunnel under the river, but such a tunnel would require long approaches in order to achieve acceptable grades.

Shipper Interviews

In addition to the port-related rail traffic analysis, BST also interviewed a number of shippers on both sides of the border by telephone in May, 2002, in order to determine what factors are used in deciding which mode of transportation to use. Another goal was to develop a list of improvements that could lead to an increase in the share of border traffic that moves via rail. Shippers contacted in BC included Weyerhaeuser, Abitibi, and Molsons. Those in the U.S. included Weyerhaeuser, Fresh Express, and Ash Grove Cement. The interviews revealed the following perceptions:

- Volume is the main consideration for shippers of forest products. In general, rail makes sense if the volume being shipped is relatively large, while smaller shipments tend to move by truck.
- Along with volume is the distance that the product must travel. In general, rail tends to not be economical for distances of less than 750 miles[3]. As a result, between Washington and Lower Mainland BC truck tends to carry most cargo. For moves between Interior BC and Washington, however, the distances can easily be 750 miles. As a result, a large share of the forest products produced in that region is shipped by rail.
- Another factor is the availability of rail service at the customer's door. For example, one shipper stated that the volume of scrap paper shipped might justify using rail, but a number of the suppliers do not have rail to their facilities. For example, there are a

[3] Depending on the commodity, the threshold of an economical rail haul distance varies. For double-stack container train traffic, the economical distance could be as low as 500 miles. As a phrase, "Double-stack" refers intermodal trains consisting of specialized cars having wells that can handle two containers, with one on top of another. Double-stacks are known to be competitive with trucks in terms of price, service reliability and travel times in various markets in the North America.

number of scrap paper warehouses located in the Vancouver area. These warehouses are not rail-served, so the product is shipped by truck.

- Speed and reliability is another important factor is deciding between truck and rail, and is one in which the railroads do not compete well. For example, one shipper of forest products said that trucking lines that his firm uses guarantee an on-time delivery window of less than one day, and this margin is decreasing. For railroad service, this firm plans on a delivery window of +/- 3 days, which means that a boxcar shipped by rail may show up at the customer's address at any time over an entire week.
- Most forest products do not move in containers, so tunnel clearances are typically not an issue. However, for products that do move in containers, tunnel clearances are a concern. According to shippers, double-stack service along the I-5 Corridor between Vancouver and California could potentially shift cargoes from truck to rail. However, it appears that the vertical clearances in some rail tunnels in southern Oregon and northern California are not high enough to allow "high-cube"[4] double-stack container service. And without double-stack service, rail does not enjoy a major advantage over trucking.
- Maximum weight limits are also a concern. The main line railroads in North American have adopted a loaded car weight 286,000 pounds as a maximum, and most of the main line system has been upgraded to handle this type of car. However, according to one shipper, there are sections of line on the I-5 Corridor (rail lines paralleling I-5 between Blaine and Southern California) that have weight limits lower than this. As a result, less product can be loaded on railcars, decreasing the advantage of shipping by rail.
- Customer preference is another factor in the transportation decision. For many shippers, product is sold FOB the producer's loading dock, and the choice of mode is made by the customer.

In summary, shippers felt that, in order to attract additional rail cargoes across the BC/Washington border, railroads need to guarantee more timely service, provide double-stack service, and allow heavy weight cars in the I-5 Corridor.

[4] High-cube pertains to the height of a container. A high-cube container is 9'6" in height. A "low-cube" container is one foot shorter. A double-stack combination of a high-cube and a low-cube container would require one foot more of vertical clearance than a two low-cube containers. Two-high cube containers would require two more feet of clearance.

Appendix C
IMTC RAIL SUBGROUP MEMBERS

Members of the IMTC Rail Subgroup assisted this study effort with their review of the four working papers and the draft report. Members of these groups are as follows:

RAIL SUBGROUP

- Bruce Agnew, Cascadia Project - Discovery Institute
- Randy Armour, Wilbur Smith Associates
- Roger Bergh, WGRTA
- Roger Bull, Better Borders Northwest
- Paul Daniell, Cascadia Institute
- Philip Davies, Transport Canada
- Kirk Fredrickson, WSDOT - Public Transportation and Rail
- Donald Fyffe, Burlington Northern Santa Fe Railway
- Mike Hopkins, U.S. Representative Rick Larsen's Office
- Roger Jacobsen, Burlington Northern Santa Fe Railway
- Chris Jones, Railway Association of Canada
- Anthony Kelley, Everson Nooksack Chamber of Commerce
- Doug Kelsey, West Coast Express
- Martin Kobayakawa, TransLink
- James Kohnke, Pacific Corridor Enterprise Council
- Kurt Laird, Amtrak
- Mark Lynch, B.C. Transportation Financing Authority
- Stephen Smith, U.S. Federal Railroad Administration
- Mimi Sukhdeo, Transport Canada
- Gary Vlieg, City of Surrey