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Projections of Washington-British Columbia Trade and Traffic, by Commodity, Route and Border Crossings

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SFTA Co-Principal Investigator

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SFTA Research Report # 22

May 2007

Border Policy Research Institute
Western Washington University

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SFTA Research Reports:
Background and Purpose

This is the 21st report in a series of research studies prepared as part of the Strategic Freight Transportation Analysis (SFTA) study. SFTA is a six year comprehensive research and implementation analysis that will provide information (data and direction) for local, state and national investments and decisions designed to achieve the goal of efficient and seamless freight transportation.

The overall SFTA scope includes the following goals and objectives:

- Improving knowledge about freight corridors.
- Assessing the operations of roadways, rail systems, ports and barges – freight choke points.
- Analyze modal cost structures and competitive mode shares.
- Assess potential economic development opportunities.
- Conduct case studies of public/private transportation costs.
- Evaluate the opportunity for public/private partnerships.

The five specific work tasks identified for SFTA are:

- Work Task 1 - Scoping of Full Project
- Work Task 2 - Statewide Origin and Destination Truck Survey
- Work Task 3 - Short Line Railroad Economic Analysis
- Work Task 4 - Strategic Resources Access Road Network (Critical State and Local Integrated Network)
- Work Task 5 - Adaptive Research Management

For additional information about the SFTA or this report, please contact Eric Jessup or Ken Casavant at the following address:

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Or go to the following Web Address:
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PROJECTIONS OF WASHINGTON-BRITISH COLUMBIA TRADE AND TRAFFIC, BY COMMODITY, ROUTE AND BORDER CROSSINGS

ABSTRACT

Continuing adaptation to the changing transportation needs is critical in maintaining efficiency and reducing costs of raw and manufactured goods. This study identified key commodity groups in order to create a profile and project future traffic at major and minor Washington State border port crossings. A central resource used to create the port profiles is the Strategic Freight Transportation Analysis (SFTA) database, which is a compilation of freight origin-destination survey results conducted by the Transportation Research Group (TRG) at Washington State University. The survey allowed for the examination of freight flow routes by commodity both northbound and southbound, thus allowing profiles to be created for seven border ports in Washington, many not known to be evaluated before this research effort.

Once the profiles were created, projections of northbound and southbound truck crossings to the year 2015 were estimated for each border port. Linear regression analysis was used to determine the potential growth of crossings by border port, based on the growth of trade between Washington and Canada and the commodity profile of each border crossing. Particular attention was paid to the effect of empty trucks on traffic growth.

Fifteen commodity categories crossing the various British Columbia border ports were identified and forecasted to 2015. Based on the growth of trade in these commodities, ten year growth in the number of annual truck crossings is expected to range from 3,000 trucks at Laurier to 159,000 trucks at the Blaine border port.

An additional analysis of the Washington State highway routes utilized was also conducted, to increase the understanding of highway arterials used in specific border crossings.

The methodology used is unique and was successful. Furthermore, these projections on the future composition of commodities crossing between Washington and British Columbia serve as a guideline for future transportation of traded goods and the infrastructure investments necessary to support those flows.

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CHAPTER 1

INTRODUCTION

Background

Continuing adaptation to the changing transportation needs is critical in maintaining efficiency and reducing costs of raw and manufactured goods to ensure economic stability and growth. As the North American Free Trade Agreement (NAFTA) moves into its thirteenth year of existence, there is need to continue adapting to the changing transportation environment. With bilateral trade in excess of $1.4 billion per day between the U.S. and Canada and over 200 million annual crossings (passenger vehicles and freight trucks), knowledge of the composition of commodities crossing the border and the growth of those commodities allow for easier adjustment (U.S. Embassy, Ottawa, 2006). This study focused on border flows by truck between Washington and British Columbia, by dissecting the northbound and southbound flows by industry and commodity and projecting the trade growth in those industries. By knowing the potential growth and increases in commodity flows and truck crossings across border port locations, policy makers can better adapt border ports to allow for continuing efficiency in truck movements.

Furthermore, as trade continues to develop between Canada and the U.S., impacts on the existing route and road systems being used will inevitably occur. Therefore, an analysis of the routes utilized (North-South and East-West) would also help in determining the future need for development and maintenance of highway networks.

Methodology

The unique component in this research that enables the creation of border port commodity profiles is databases from the Strategic Freight Transportation Analysis (SFTA) and the Eastern Washington Intermodal Transportation Study (EWITS). SFTA and EWITS are truck freight origin-destination surveys, conducted through the Washington State University Transportation Research Group (TRG) and are only known to be duplicated in one other state. EWITS, the first survey, was conducted in the years 1992-1993 and SFTA, the second survey, was conducted in the years 2002-2003. The most useful aspect about the surveys is they collected information that is not provided by the census or other government organizations. The surveys gathered information on origin of the movement, destination, route used, main commodity type carried, payload weight, operating company, number and location of LTL stops, number of axles, tractor/trailer type, and other similar characteristics. The surveys were conducted on four different days each and have combined sample observations of over 56,000 trucks. Each day was in a different season in order to account for seasonal variations in truck flows.

In order to better estimate future cross-border freight flows between Washington and British Columbia, the SFTA and EWITS databases were used to:

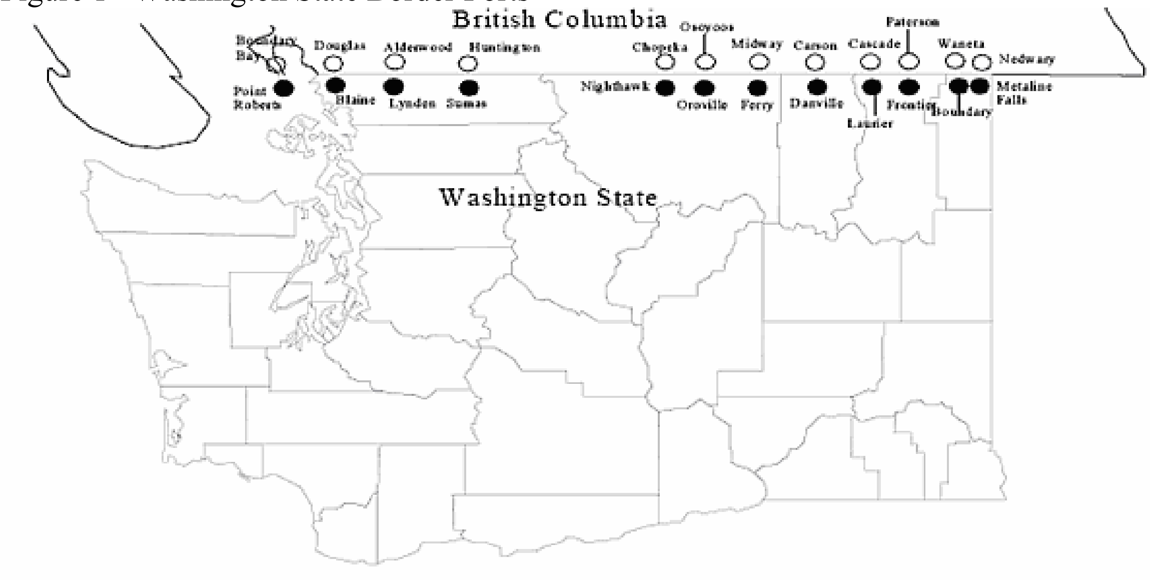
a) determine cross-border truck freight flows
b) dissect total cross-border flows into individual highway crossings
c) separate crossings into northbound or southbound directional flows
d) further dissect highway crossings into specific commodity groups (3-digit NAICS and 2-digit HS codes)

For the purposes of this paper, only the SFTA database is used for a profile analysis because SFTA is the most recent survey, offering the most current border port profile. A comparison between the SFTA and EWITS survey results is presented after the section detailing the border port profiles for each survey in order to track changes occurring over the past decade. In order to collect the specific profile information from SFTA, all British Columbia origin and destination locations were isolated.[1] The location of origin and/or destination determined the directional flow of the truck movements at the border ports (i.e. if origin is British Columbia then the direction of flow is "southbound"). After identifying the direction of flow, the border ports used for the crossing could be determined through examining the route characteristics. Washington has twelve British Columbia border crossing locations; ordered from west to east, they are:

Point Roberts/Boundary Bay, Blaine/Douglas, Lynden/Aldergrove, Sumas/Huntington, Nighthawk/Chopaka, Oroville/Osoyoos, Ferry/Midway, Danville/Carson, Laurier/Cascade, Frontier/Paterson, Boundary/Waneta, Metaline Falls/Nelway

[1] It is important to note that some observations (mainly LTL freight movements) had BC as both origin and destination locations. These observations were treated as "Southbound" observations if the survey location is identified as a "south" location and "Northbound" observations if the survey location is identified as a "north" location.

Figure 1– Washington State Border Ports

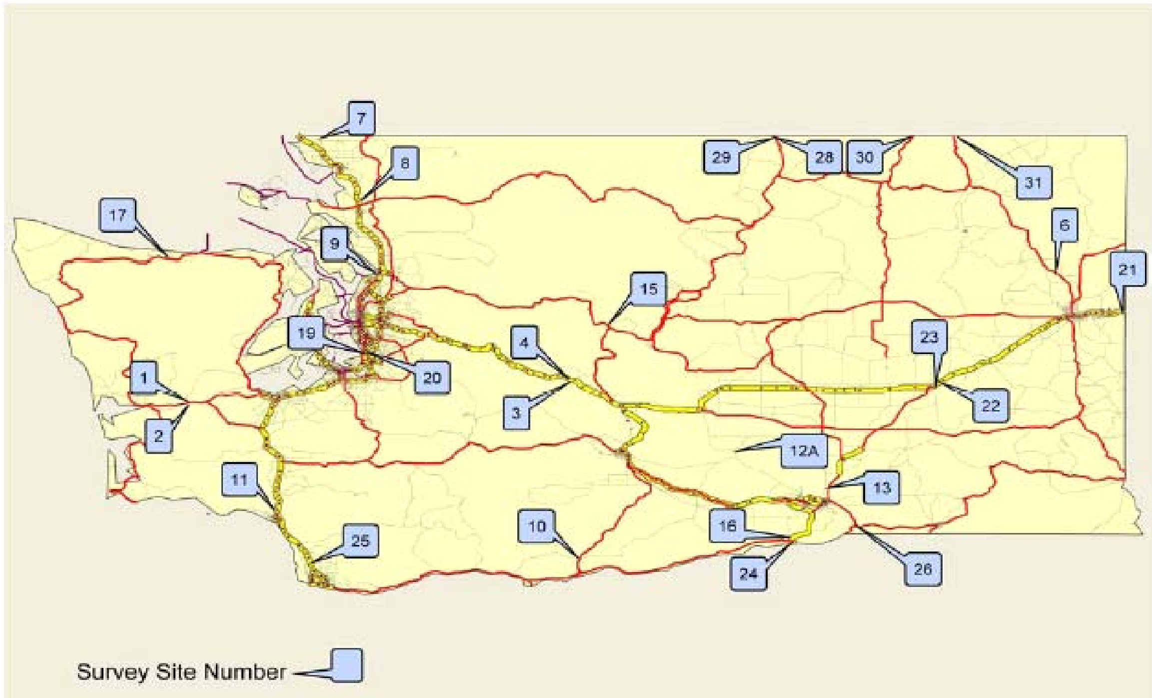


Source: Erickson, Ken. Impact of North American Free Trade Agreement (NAFTA) on Washington Highways: Part I: Commodity and Corridor Projections. EWITS Research Report Number 14. January 1997. http://ewits.wsu.edu/reports.htm

Of these listed border-crossing locations, Blaine (SR 543), Lynden (SR 539), Sumas (SR 9), Oroville (US 97), Laurier (US 395), Frontier (SR 25), and Danville (SR21 for SFTA only) were the only crossings that contained enough observations to analyze at a commodity level.

Only survey sites closest to the border or sites that would best identify trucks crossing the border were used in the analysis. However, some commodities at certain border ports, especially low truck volume ports in Eastern Washington, were not accounted for because the SFTA survey site that completed the survey was not near the border. The survey locations are identified in Figure 2 below.

Figure 2– SFTA Survey Locations



Source: Clark, Michael L., Jessup, Eric, Casavant, Ken. "Freight Truck Origin and Destination Study: Methods, Procedures and Data Dictionary." SFTA Research Report #2. December 2002.

The truck observations were broken down into 3-digit NAICS categories based on the description of the commodities contained in each truckload. Grouping of the commodities allowed for the development of border port commodity profiles, from which projections and analysis were then conducted. Furthermore, as stated above, the data provided in SFTA and EWITS allows for identification of specific routes. As a result, major Washington State arterial routes used in transfer were identified and evaluated by border port.

When border port profiles were created, analyses were conducted based on the top five commodities crossing. Many border port profiles contained a large percentage of empty, unknown, or mixed trucks. These were included in the evaluation, in addition to the top five commodity categories.

After evaluation of border port profiles, projections of future truck crossings and future trade were made. Truck crossing time series data gathered from the Bureau of Transportation Statistics and Statistics Canada allowed for trend line regression forecasting of future truck crossings, referred to as the truck crossing method, indicating growth or decline in the number of trucks crossing at specific border ports. Secondly, trade data gathered from Stat-USA (part of the U.S. Department of Commerce) and Statistics Canada allow for trend line regression analysis and forecasting of trade by commodity, referred to as the trade/profile method between Washington State and Canada.

The truck crossing method gave a basis for comparison for the varying growth rates in trade. Theoretically, the weighted average growth rates of trade[2], by commodity and frequency of crossing at each border port, should be roughly equal to the growth rate of truck crossings at each border port. Additionally, different rates of changes in commodity trade growth at the different border crossings may lead to a higher or lower level of truck crossings than those projected using truck crossing data. Therefore, these trade growth projections by commodity should allow for a more accurate depiction of projected truck crossings.

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[2] In this case trade refers to the level of trade between Washington and Canada, and British Columbia and Washington.

Trade projections were further "ground truthed" with a survey of industry personnel. The survey was designed to determine if the regression results obtained from time series trade data coincide with current industry expectations of trade.

To help streamline the truck crossing projection process, we assumed that the percentage growth in trade is indicative of and equal to the percentage growth in the number of truck crossings. Therefore, if trade in the food sector is growing at 3%, then the number of truck crossings that contain food products at border port (*i*) is growing at 3%.

After projections were completed, the observed growth rates in trade were then combined with the current profile of commodities developed from SFTA. The frequency of truck crossings were compounded annually for ten years (from 2006 to 2015) based on the respective growth rates of the commodity categories. At 2015, a new border port profile was developed and analyzed to determine changes in profile structure.

Mathematically the methodology followed the following form:

The projection of trucks at a given port was based on a function of trade growth in a given commodity i and the profile of the port j.

(1.1) $$F_{jt+1} = f(g_i(t), p_j(t))$$

(1.2)

where: g_i - average % trade growth in i^{th} commodity at time t

p_j - profile of port j at time t

F_{jt} - number of trucks at port j at time t

The profile of the port at a given time *t* was the sum of each commodity group over the total number of survey observations crossing at that port.

(1.3) $$p_{ij} = \sum \frac{C_i}{n}$$

(1.4)

where: C_i - commodity i

n – number of port observations

Then each commodity group was summed together to develop the profile (i.e. 22% wood, 11% chemicals, etc)

(1.5) $$p_j = \sum p_{ij}^n$$

(1.6)

where: p_{ij}^n - n^{th} commodity i at port j

Trade projections for each major commodity group were developed using linear regression trend line analysis based on historical trade levels.

(1.7) $$T_{it} = a + \beta T + \varepsilon$$

(1.8)

where: T_i – trade in commodity i

α – constant

β – trade growth ($)

ε – error term assume $\varepsilon = 0$ as $n \rightarrow \infty$

Assume the average percent trade growth in dollars equals the average percent growth in the number of truck crossings. Therefore, projected truck crossings based on trade growth can be made.

(1.9) $$g_{it} = \left(\frac{T_{it+10}}{T_{it}}\right)^{\frac{1}{10}}$$ [3]

(1.10)

where: g_{it} - Compounded average % trade growth for ten years

From here, projections of truck crossings using total growth in trade by commodity were determined.

(1.11) $$\#Trucks_{it+1} = F_{it+1} = F_{it}(1 + g_{it})$$

and

(1.12) $$F_{it+10} = F_{it+9}(1 + g_{it})$$

and

(1.13) $$F_{jt} = \sum F_{ijt}$$

(1.14)

where: F_{ijt} - number of loaded trucks with i^{th} commodity at j^{th} port at time t

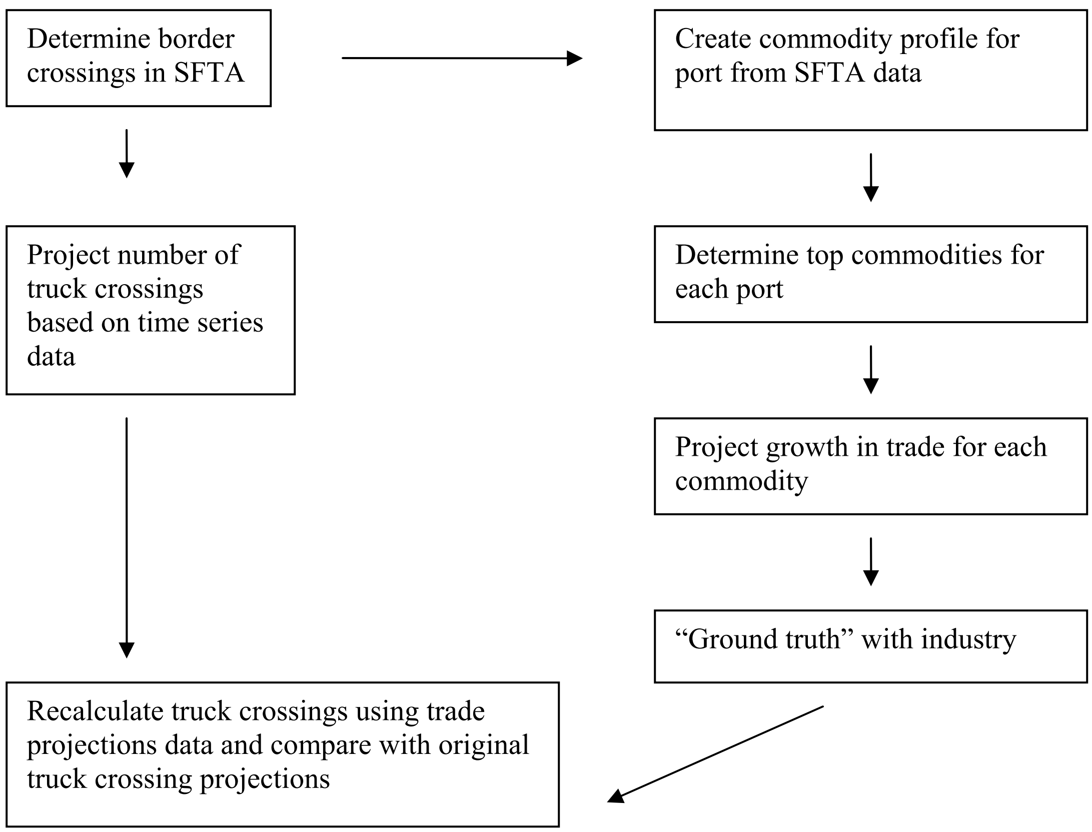
There are two specific advantages to using this methodology. First, as more information becomes available adjustments to trade by commodity can be made very easily to produce new and more accurate projections. Secondly, this method allows for

[3] In the projection section the compounded growth rates change due to different starting years

tracking changes in port profiles over time, since trade growth for different commodity groups varies.

The flow chart in Figure 3 below shows how the process is put together to produce the end result of total truck crossings by border port.

Figure 3 – Methodology for Projecting Border Port Crossings and Profiles



CHAPTER 2

PORT PROFILE ANALYSIS

SFTA and EWITS Results

EWITS and SFTA are both truck freight origin and destination studies. EWITS (Eastern Washington Intermodal Transportation Study) was established as the result of the Intermodal Surface Transportation Efficiency Act of 1991. SFTA (Strategic Freight Transportation Analysis) was a follow-up on EWITS, designed to maintain up to date information on the evolving transportation network and flows. Both studies are a survey based collection of information on truck configuration, trailer style, number of axles, name of carrier company, city and state of origin, city and state of destination, payload weight, commodity type, route and value-ton. For the purposes of this study, focus was primarily on route, commodity type, and origin and destination.

This section analyzes the dissection of the border ports by commodity groups. SFTA (the main data tool) was reviewed and is discussed first, followed by its predecessor EWITS. Then the two data sets and results were compared to each other to highlight changes in profiles between the time span of the two studies. The SFTA analysis was then used to determine what commodities need trade growth projections in order to make new projections on the level of truck crossings. A full profile of each border port can be found in Appendix A (SFTA, 2003).

SFTA (2002-2003) Results

Northbound Movements

Blaine Crossing.--Blaine has the largest volume of Washington State – British Columbia truck crossings and represents roughly 55% of all Washington-BC northbound crossings. The average daily number of trucks to cross northbound through Blaine in 2002 (the time frame of the SFTA survey) was 1,073 trucks (WCOG, 2006).

The percentages below are based on a 4 day survey, taken one day in each season (Winter, Spring, Summer and Fall) to represent the average day in a year. The survey site used to produce the following statistics was the Douglas, BC (north) survey location, otherwise known as survey site #7.

The top five commodities (3-digit NAICS), passing through the Blaine location, were[4]:

Empty	= 37.4%
Crop Production (111)	= 10.1%
Other	= 7.4%
Processed Food (311)	= 6.9%
Unknown	= 6.1%
Paper Products (322)	= 4.9%
Chemical Products (325)	= 3.7%
Plastics & Rubber (326)	= 3.3%

One interesting aspect to mention is that over a third of the trucks, crossing northbound at the Blaine location, are empty. This is consistent with the findings of a

[4] Note that for some crossings, more than five categories of trucks/cargo are represented. Some of the cargo is classified as mixed freight, unknown, or the trucks are empty, therefore preventing a classification of industry. If this group fell between the top five industries, then they were included in the results.

2000 survey conducted for the Whatcom County Council of Governments (WCOG) International Mobility and Trade Corridor, titled Cross-Border Trade and Travel Study. In that study 32% of all northbound truck crossings in Whatcom County were empty (WCOG-IMTC, 2001).

Lynden Crossing.--Lynden, located along SR 539, is the smallest of the three Whatcom county border crossing locations, in terms of truck traffic volume. The average daily truck traffic count for the Lynden crossing in 2002 was 218 trucks (WCOG, 2006). The survey location utilized for the following data was the Everett-north (site 8) location.

The top five commodity groups for the Lynden crossing were:

Empty	= 33.6%
Crop Production (111)	= 19%
Plastics & Rubber (326)	= 9.5%
Machinery (333)	= 9.5%
Other	= 9.5%
Wood Products (321)	= 4.8%
Processed Food (311)	= 4.8%

Sumas Crossing. -- Sumas, located on SR 9, had a 2002 annual average northbound daily truck volume of 240 trucks, as reported by WCOG (WCOG, 2006). The survey location utilized for the following data was the Everett (north) location, otherwise known as survey site #8, and the Sea-Tac (north) location, site #20.

The top five commodities for the Sumas crossing were:

Unknown	= 17.8%
Forestry & Logging (113)	= 11.2%
Other	= 15.7%
Fabricated Metal (332)	= 10.3%
Empty	= 11.5%
Printed Material (323)	= 15.2%

Chemical Products (325)	= 7.6%
Crop Production (111)	= 7.5%

Oroville Crossing.--Oroville, located on U.S. 97, is the largest Washington-British Columbia crossing in Eastern Washington. Furthermore, U.S. 97 is a large arterial road network that crosses Washington and Oregon into Northern California, eventually intersecting with I-5. It appears Oroville is used more heavily than other eastern Washington border ports, most likely due to the increased number of cities and communities located north of the border crossing on the same arterial. Most other border port locations in eastern Washington do not have many cities located north of the border port, except Frontier, WA on SR 25.

According to Statistics Canada, the average annual daily truck traffic (AADT) at this border port in 2002 was 98 (Statistics Canada, 2006). The survey location utilized for the following data was the Osoyoos, BC (north) location, site 28.

The top five commodities for the Oroville crossing were:

Empty	= 57.6%
Crop Production (111)	= 14.2%
Wood Products (321)	= 5.7%
Beverage Manufacture (312)	= 4.1%
Non-Metallic Mineral (327)	= 3.6%
Transportation Equip (336)	= 3.5%

Danville Crossing.--Danville, located on SR 21 had the fewest SFTA observations of any border port. However, enough observations were collected to get a general picture of the commodity flows. Of the 5 observations collected over 2 days of the survey, 4 observations were wood products (321), and one observation was an empty truck.

Based on Statistics Canada data, the AADT in 2002 was 5 trucks (Statistics Canada, 2006).

Therefore, the breakdown was as follows:

Wood Products (321)	= 80%
Empty	= 20%

Laurier Crossing.--Laurier, located on U.S. 395, is the third largest Eastern Washington border crossing location. Though U.S. 395 is a major Washington arterial, there are not a large number of communities located on the British Columbia side of the border crossing. Therefore, goods cross the border less frequently than the U.S. 97 and SR 25 border crossings.

Statistics Canada recorded 32 AADT crossings for 2002 at Laurier (Statistics Canada, 2006). The survey site used was the Laurier (site 31) location.

The commodity groups represented by SFTA for the Laurier crossing were:

Empty	= 50.5%
Wood products (321)	= 34.9%
Non-Metallic Mineral (327)	= 9.7%
Unknown	= 2.7%

Frontier Crossing.--Frontier, located on SR 25, is the second largest eastern Washington border crossing location. The reason for more truck crossings at Frontier most likely stems from the larger number of communities located north of the border crossing.

The reported level of AADT crossings at Frontier in 2002 was 60 (Statistics Canada, 2006). Since there were no survey locations near the Frontier border port, the profile was constructed based on survey results from the Plymouth station (site 16).

From the survey, only two commodities were surveyed as crossing this location:

Empty	=	64.4%
Chemical (325)	=	22.6%
Wood Products (321)	=	13%

Southbound Movements

Southbound AADT counts were collected from two sources. The Whatcom Council of Governments provided data on the Blaine, Lynden, and Sumas crossings. The remaining crossing data for Washington State were collected from the U.S. Bureau of Transportation Statistics (BTS). To determine entry points, the SFTA data identified U.S. entry state routes or U.S. highways. When analyzed, the highways indicated ports of entry.

Blaine Crossing.--The 2002 AADT for Blaine, according to WCOG, were 1114 trucks (WCOG, 2006). The survey site used to measure the Blaine southbound crossings was Everett south (site 9).

The top five commodities were:

Empty	=	24.5%
Wood Products (321)	=	19.7%
Paper Products (322)	=	8.5%
Processed Food (311)	=	7.1%
Non-Metallic Mineral (327)	=	6.2%
Fabricated Metal (332)	=	5.8%

Lynden Crossing.--WCOG reported 162 AADT crossings for 2002 (WCOG, 2006). The survey site used was Everett south (site 9).

The commodities identified were:

Wood Products (321)	= 39.9%
Unknown	= 25.7%
Fabricated Metal (332)	= 11.8%
Beverage Products (312)	= 11.8%
Transportation Equip (336)	= 10.7%

Sumas Crossing.--The AADT crossings for 2002 was 407 (WCOG, 2006). The survey sites used were Everett south (site 9) and Sea-Tac south (site 19). The Sea-Tac south survey location was used because not enough survey observations were collected at the Everett south location.

Top five commodities were:

Empty	= 38.1%
Wood Products (321)	= 23.6%
Chemical Products (325)	= 17.4%
Plastics & Rubber (326)	= 8.7%
Processed Food (311)	= 6.0%
Miscellaneous (339)	= 6.0%

Oroville Crossing.--The AADT crossing, according to BTS for 2002 was 105 (BTS, 2006). The survey site used was Oroville south (site 29).

Top five commodities were:

Wood Products (321)	= 36.4%
Empty	= 11.8%
Non-Metallic Mineral (327)	= 7.3%
Plastics & Rubber (326)	= 6.7%
Crop Production (111)	= 5.7%
Transportation Equip (336)	= 5.3%
Unknown	= 5.1%

Danville Crossing.--The AADT crossings in 2002 according to BTS were 6 trucks (BTS, 2006). The survey site used was Danville (site 30).

The top commodities were:

Empty	= 57.1%
Wood Products (321)	= 35.7%
Unknown	= 7.1%

Laurier Crossing.-- AADT crossing for 2002 was 26 (BTS, 2006) . The survey site used was Laurier (site 31).

Top five commodities at Laurier were:

Wood Products (321)	= 69.9%
Empty	= 16.7%
Non-Metallic Mineral (327)	= 7.2%
Forestry & Logging (113)	= 1.7%
Chemical Products (325)	= 1.7%
Unknown	= 1.7%
Processed Food (311)	= 1.2%

Frontier Crossing.-- AADT crossing for 2002 is 59 trucks (BTS, 2006). The survey site used was Deer Park south (site 6).

The top commodities were:

Chemical Products (325)	= 73.4%
Empty	= 16.8%
Wood Products (321)	= 4.9%
Unknown	= 4.9%

The large percentage of chemical products can be explained by the Cominco Ltd. Mine, located in Trail, BC. Cominco produces a chemical as a byproduct of its zinc and lead refinery that is used to produce fertilizer (Teck Cominco, 2007).

EWITS (1992-93) Results

EWITS, the predecessor origin-destination freight study to SFTA, took place in 1992 and the winter of 1993. This survey allowed for determination of commodity profiles by border crossings ten years earlier than the SFTA analysis. Most of the survey locations that were utilized in EWITS were also used in SFTA, allowing for easier cross-comparison between the two survey results. The data analysis procedures for EWITS were the same as SFTA to determine border crossing location and direction of flow.

Northbound Movements

The following analysis breaks down each border port by percentage of trucks crossing that contain a specific commodity. In the EWITS survey, commodities were classified in 4-digit Standard Classification of Transported Goods (SCTG) codes. Based on the SCTG codes and commodity description, the data was reclassified into 3-digit NAICS codes.

Blaine Crossing.--The AADT of trucks crossings in 1993 was 858 (WCOG, 2006). The survey site used was the Douglas north (site 7). This is the same as the SFTA survey. The top commodities crossing at Blaine were:

Crop Production (111)	= 21.8%
Processed Food (311)	= 11.6%
Unknown	= 9.4%
Other	= 5.9%
Wood Products (321)	= 5.5%
Chemical Products (325)	= 5.4%
Fabricated Metal (332)	= 5.1%

Empty	= 4.9%

Empty was included in the top industries to allow for a cross comparison between SFTA and EWITS. The largest difference in the commodity profile that crosses at the Blaine location is the large jump in the number of empty trucks from 1992 to 2002. In 1992, the percentage of empty trucks crossing at Blaine was just shy of 5%. In 2002, this number increased to 37.4%. This significant jump is even more remarkable when the increase in truck volume from 858 per day in 1993 to 1,073 trucks in 2002 is considered. Another significant change was the drop of crop production and processed food, which, when combined, made up 33% of the crossings in EWITS. In SFTA, only 17% of the crossings were food and agriculture products, almost a 50% decrease.

Lynden Crossing.--The AADT in 1993 for Lynden was 102 trucks (WCOG, 2006). One important aspect to note about this location is only one day of observations were taken at the Everett north (site 8) location that crossed at the Lynden border port. As a result, seasonal variation may not be captured in the profile.

The top commodities crossing at Lynden were:

Empty	= 33.3%
Other	= 16.6%
Non-Metallic Mineral (327)	= 16.6%
Processed Food (311)	= 16.6%
Paper Products (322)	= 16.6%

Sumas Crossing.--The AADT for Sumas in 1993 was 99 trucks (WCOG, 2006). The survey sites used were Everett north (site 8), and one observation from Tokio west (site 23).

The top commodities crossing at Sumas were:

Empty	= 45.7%
Processed Food (311)	= 20.9%
Unknown	= 16.7%
Animal Production (112)	= 10.2%
Machinery Production (333)	= 6.4%

Oroville Crossing.--The AADT in 1993 for Oroville was 66 trucks (Statistics Canada, 2006). The survey site used was Osoyoos, BC (site 28).

The top commodities crossing at Oroville were:

Empty	= 45.9%
Non-Metallic Mineral (327)	= 11.9%
Crop Production (111)	= 6.3%
Transportation Equip (336)	= 6.2%
Wood Products (321)	= 5.5%
Machinery Production (333)	= 5.0%

Laurier Crossing.--The AADT for the border port was 38 trucks (Statistics Canada, 2006). The survey sites used were Othello (site 12), Plymouth (site 16), East Spokane west (site 21), Tokio east (site 22). Through combining the observations at these sites a relatively strong profile could be created.

The top industries crossing at Laurier were:

Empty	= 31.4%
Processed Food (311)	= 28.4%
Crop Production (111)	= 10.8%
Chemical Production (325)	= 10.7%
Fabricated Metal (332)	= 9.4%
Beverage (312)	= 9.4%

Frontier Crossing.--The AADT for Frontier in 1993 was 41 trucks (Statistics Canada, 2006). The survey sites used to collect these observations were Plymouth (site 16) and Tokio east (site 22).

All commodities identified at Frontier were:

Processed Food (311)	= 36.8%
Appliances (335)	= 29.4%
Unknown	= 13.3%
Empty	= 11.6%
Other	= 8.9%

Southbound Movements

The EWITS southbound description is in many ways similar to the SFTA southbound data description. However, differences do occur in that some commodity groups are no longer in the top five, or the ranking has changed, in addition to the changes in the percentage of the commodities crossing over the border. This may indicate changes in industry trade, such as trade in some commodity groups are growing at a faster rate than others, or some domestic (Canadian and U.S.) industries involved in trade are shrinking in the wake of globalization.

Blaine Crossing.--According to WCOG, the AADT for Blaine in 1993 was 788 trucks (WCOG, 2006). The survey site used to collect the southbound flows was Everett south (site 9).

The top five commodities at Blaine were:

Empty	= 29.6%
Wood Products (321)	= 25.9%

Other	=	8.9%
Paper Products (322)	=	6.9%
Processed Food (311)	=	5.0%
Fabricated Metal (332)	=	3.9%
Printed Material (323)	=	3.7%

Lynden Crossing.--The AADT in 1993 was 59 trucks (WCOG, 2006). The survey sites used were Everett south (site 9), Kelso south (site 11), Othello (site 12), Sea-Tac south (site 19), and Umatilla south (site 24).

The top commodities at Lynden were:

Wood Products (321)	=	53.9%
Empty	=	24.8%
Paper Products (322)	=	14.6%
Other	=	6.7%

Sumas Crossing.--The AADT for Sumas in 1993 was 215 trucks (WCOG, 2006). The survey sites used were Everett south (site 9) and Kelso south (site 11).

The top commodities at Sumas were:

Empty	=	29.9%
Wood Products (321)	=	28.0%
Forestry & Logging (113)	=	14.0%
Transportation Equip (336)	=	14.0%
Other	=	14.0%

Oroville Crossing.--The AADT, as reported by BTS, for 1993 was 75 (BTS, 2006). The survey site used was Oroville south (site 29).

The top five commodities crossing at Oroville were:

Wood Products (321)	=	34.7%
Empty	=	23.3%
Crop Production (111)	=	10.0%
Non-Metallic Mineral (327)	=	6.0%

Beverage (321)	= 5.1%
Transportation Equip. (336)	= 5.0%

Laurier Crossing.--The AADT of trucks in 1993 was 25 (BTS, 2006). The survey location used was Deer Park south (site 6).

The top five commodities were:

Wood Products (321)	= 47.4%
Chemical Products (325)	= 31.3%
Empty	= 9.0%
Fabricated Metal (332)	= 4.6%
Non-Metallic Mineral (327)	= 3.1%
Forestry & Logging (113)	= 3.0%

Frontier Crossing.--The AADT of trucks in 1993 was 42 (BTS, 2006). The survey location used was Deer Park south (site 6).

The top commodities were:

Chemical (325)	= 66.4%
Wood Products (321)	= 17.6%
Empty	= 11.0%
Unknown	= 2.5%
Fabricated Metal (332)	= 2.5%

EWITS and SFTA Movements General Comparisons

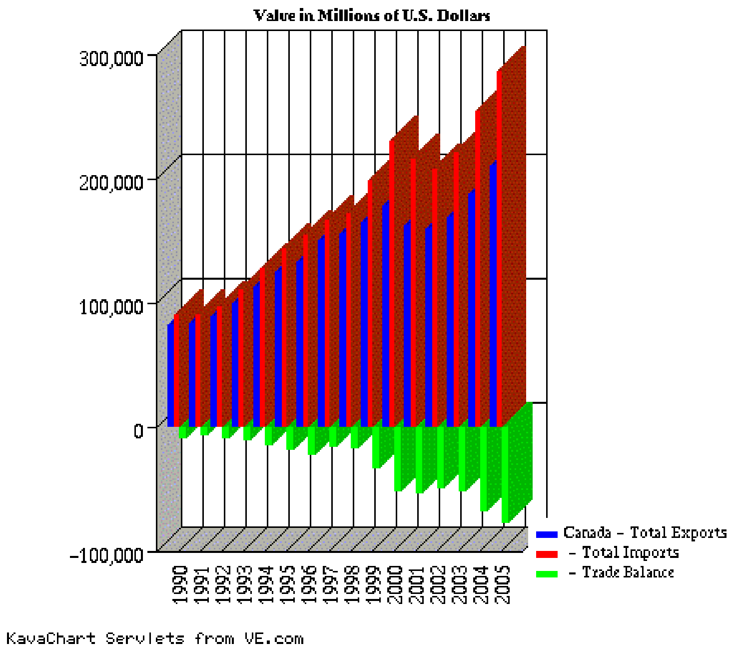
As noted above in the EWITS northbound description of the Blaine crossing, there is a large change in the number of empty trucks crossing between the two surveys. This section outlines several notable and apparent differences between the SFTA and EWITS time frames, indicating the dynamic changes of the border port's commodity composition. Furthermore, the changes in the frequency of commodities passing through a particular border port may also indicate changes in industry growth or reduction, one focus of this study.

Northbound

Blaine Crossing

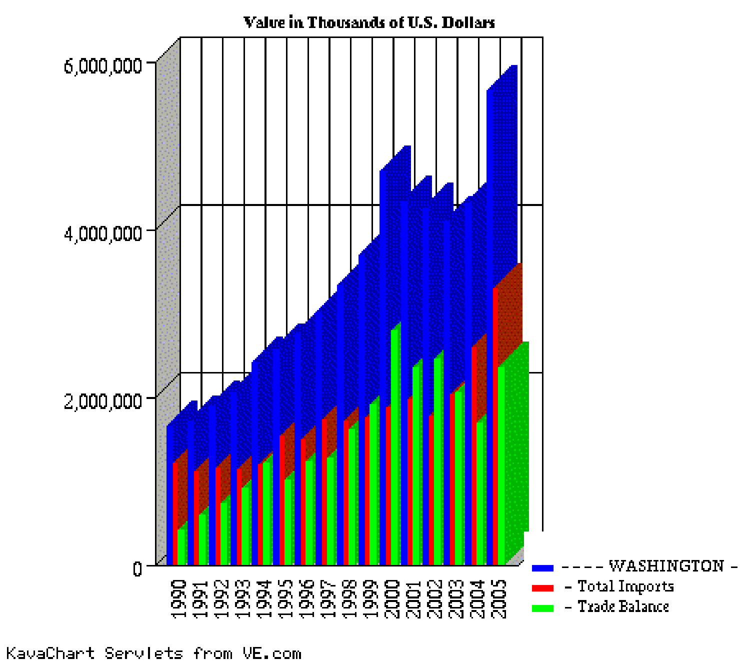
The most pronounced change was noted earlier: the number of empty trucks jumped from 4.9% to 37.4%. This change may lend to some interesting implications. One, the level of trade between the U.S. and Canada has changed. If the number of empty trucks returning to Canada has increased, then one possibility is that the U.S. or Washington's imports from Canada are greater than its exports, creating a negative trade balance with Canada at this border crossing. However, data from Statistics Canada shows the opposite with Canada having a negative trade balance with the U.S. in total. See graphs below.

Figure 4 - Canada's Trade Balance with U.S.



Source: Statistics Canada (strategis.gc.ca)

Figure 5 - Washington's Trade Balance with British Columbia



Source: Statistics Canada (strategis.gc.ca)

As the graphs and data indicate, there has been an overall increase in Washington's trade balance and, moreover, U.S. exports to Canada. This increase appears to also be accompanied by an increase in empty truck crossings from the U.S. to Canada. If trade between two countries increases, especially northbound trade, one would expect the number of empty trucks returning or going into Canada to decrease.

The number of northbound truck crossings increased from 858 trucks per day to 1073 trucks per day between 1993 and 2002, peaking in 1998 at 1477.5 trucks per day. Other changes at the Blaine crossing entail over a 50% decrease in the level of crop movements from 21.8% to 10.1%. This is also followed by a decrease in the percentage level of processed food from 11.6% to 6.9%. In fact, as a result of the high level of empty trucks crossing the border, almost all commodity groups decreased. One commodity group, paper products increased only marginally from 4.3% to 4.9%.

Another explanation may lie in the type of commodity shipped. If Canada is shipping high volume, low value goods, there will inevitably be more empty trucks returning northbound. If Washington and the rest of the U.S. are shipping low volume, high value finished goods, then there will be fewer truck crossings and the U.S. could have a positive trade balance.

Lynden Crossing

The number of crossings more than doubled from 102 trucks per day to 218 trucks per day. The percentage level of empties has not changed. There were no observations for crop movements in EWITS, but in SFTA the percentage composition is 19%. This suggests a potentially strong increase. The “other” category, which is a category for mixed freight, decreased from 16.6% to 9.5%. Furthermore, processed food movements decreased significantly from 16.6% to 4.8%.

Sumas Crossing

At the Sumas crossing, the number of crossings increased almost 140% from 99 trucks to 241 trucks per day. The percentage of empties decreased significantly from 45.7% to 11.5%. Some commodities that were not observed in EWITS were found in SFTA at reasonably high levels. For instance, forestry & logging constitutes 17% of the Sumas crossings in 2002. Fabricated metal and printed material each make up around 11.5% of the crossings and chemicals represents about 5.8%. This may indicate a shift in the profile of commodities crossing at Sumas.

Oroville Crossing

The number of observed crossings at Oroville increased 50% from 66 to 98. The percentage composition of commodities has some pronounced changes. First, the level of empties increased from 45.9% to 57.6%. Also, the level of crop movements increased from 6.3% to 14.2%. The percentage of transportation equipment decreased from 6.2% to 3.5%. However, based on a number count, the number of trucks carrying transportation equipment has not changed. Wood products did not see any percentage change.

Danville Crossing

There were no observations for Danville in the EWITS survey; this is due to no survey location in 1993. Danville is a low frequency border port for trucks. In 1993, there was an AADT of 2 trucks. In 2002, an abnormally high year in terms of the number of truck crossings, there was an AADT of 5 trucks.

Laurier Crossing

The number of average daily crossings at Laurier decreased from 37.5 to 32. The annual level of truck crossings stayed relatively constant, only varying 1,000 to 2,000 trucks per year (3-5 trucks per day). The percentage of empty truck crossings dropped from 50.5% to 31.4%. As for the remaining observations, there appears to be a complete change in the type of commodities crossing northbound. Unfortunately, the same situation at Lynden may also explain the dramatic shift at Laurier (i.e. there were simply not enough observations captured to make a good assessment of the composition of border crossings). On the other hand, there may in fact be a shift in the type of commodities crossing at the Laurier border port.

Frontier Crossing

The number of trucks crossing at Frontier increased from 41 trucks to 60 trucks per day. The number of empty trucks increased dramatically from 11.6% to 64.4%. The profile appears to have shifted toward chemicals and wood products.

Southbound

Blaine Crossing

Based on WCOG data, the number of daily truck crossings increased 40% from 789 to 1114, which is supported in the above noted graphs on imports and exports at the Blaine location. First, there was a reduction in the number of empty truck crossings from 29.6% to 24.5%. This would indicate that southbound commodity flows may have decreased, or the supply chain logistics have become more efficient and are loading empty trucks to move southbound freight. Figures 4 and 5 both support this conclusion because both indicate that the number of total Canadian exports and the number of total Washington imports has increased between 1992 and 2002. As for the remainder of the commodity profile for Blaine, the percentage of wood product crossings decreased from 25.9% to 19.7%. Paper products increased from 6.9% to 8.5%, processed food increased from 5.0% to 7.1% and fabricated metal increased from 3.9% to 5.8%. Printed material was no longer on the top 5 list, dropping from 3.7% to 1.4% and non-metallic mineral moved into the top five commodities crossing list, increasing from 1.5% to 6.2%.

Lynden Crossing

The AADT at Lynden increased 170% from 59 to 162. The profile of the commodities analyzed in the survey data, however, has changed. The percentage of wood products decreased from 53.9% to 39.9%. In the EWITS survey, 24.8% of the crossings were empty trucks, but in SFTA no empty trucks were observed. Also, in EWITS, there were only two identifiable commodities: wood products and paper products. In SFTA, four commodities were identified: wood products, fabricated metal, beverage products, and transportation equipment, wherein the latter three commodities each consist of roughly 10% of the commodity profile for the Lynden border port.

Sumas Crossing

The AADT at Sumas increased 90% from 215 trucks to 407. Empty trucks still make up the highest percentage of crossings and have increased from 29.9% to 41.9%. Wood products have decreased from 28.0% to 18.5%. Although there is a decrease in the percentage of wood products crossing, there has still been an increase in the total number of truck crossings that contain wood products. According to the data, the AADT for wood products increased from 60 in 1993 to 75 in 2002. Little other comparisons are possible. In EWITS the remaining commodities (forestry & logging and transportation equipment) do not appear in SFTA. The SFTA commodity categories are chemical products, processed food, miscellaneous, and plastics & rubber.

Oroville Crossing

Oroville's border port profile has remained very similar between 1993 and 2002. The number of crossings has increased from 75 to 105 average trucks per day. Wood products still occupies the top percentage of crossing trucks, increasing from 34.7% to 36.4%. The number of empty trucks has decreased from 24.7% to 11.8%. Crop movements have decreased from 10.0% to 5.7%, but non-metallic mineral and transportation equipment have increased marginally from 6.0% to 7.3% and 5.0% to 5.3% respectively. Beverage products was not captured in the SFTA observations and therefore does not occupy the top 5 list, though accounted for 5.1% of the crossings in EWITS.

Danville Crossing

As noted above, EWITS did not capture Danville in the survey observations. However, southbound and northbound SFTA results are worth comparing. In terms of AADT, there was little difference between northbound and southbound crossings. The northbound direction had an AADT of 5 trucks and the southbound direction had an AADT of 5.6 trucks. The northbound flows consisted of two categories: wood products and empty, where wood products make up 80% of the crossings. The southbound crossing contained three categories: empty, wood products, and unknown, while empty trucks make up 57.1% of the crossings and wood products make up 35.7% of the crossings. This suggests that the Danville crossing is predominately used for wood products transportation and returning empty trucks.

Laurier Crossing

The Laurier crossing was the only border port which decreased from 1993 to 2002, though marginally. The AADT in 1993 was 37.5 trucks and 32 trucks in 2002. Wood products still made up the top percentage of crossings, increasing from 47.4% to 69.9%. The percentage of empty trucks increased from 9.0% to 16.7%. This roughly translates into 2 more empty trucks per day. Chemical products had the largest reduction in crossings, moving from 31.3% to 1.7%. Forestry & logging also reduced from 3.0% to 1.7%. Non-metallic mineral increased from 3.1% to 7.2%. The only category of commodity that appeared in EWITS, but did not appear in the SFTA observations, was fabricated metal.

Frontier Crossing

The Frontier crossing has maintained a similar profile. The number of AADT crossings increased from 41 to 60 trucks. The percentage of chemical products, which is also the dominate feature of this border port profile, increased from 66.4% to 73.4%. This is the result of Cominco Ltd. Mine in Trail, BC. The number of empty trucks increased from 11% to 16.8% and the number of wood products decreased from 17.6% to 4.9%. The percentage of unknown commodities increased from 2.5% to 4.9%

Substantial commodity shifts have occurred across most of the border crossings. Traffic counts have increased, the number of empty truck crossings has increased and the border port profiles have shifted or completely changed. The shifting of border port profiles can partially be the result of changing rates of trade growth for the commodities crossing the border. This rationale is the basis for justification of using the methodology outlined above and analyzed in the following sections.

Additional Smaller Port Analysis

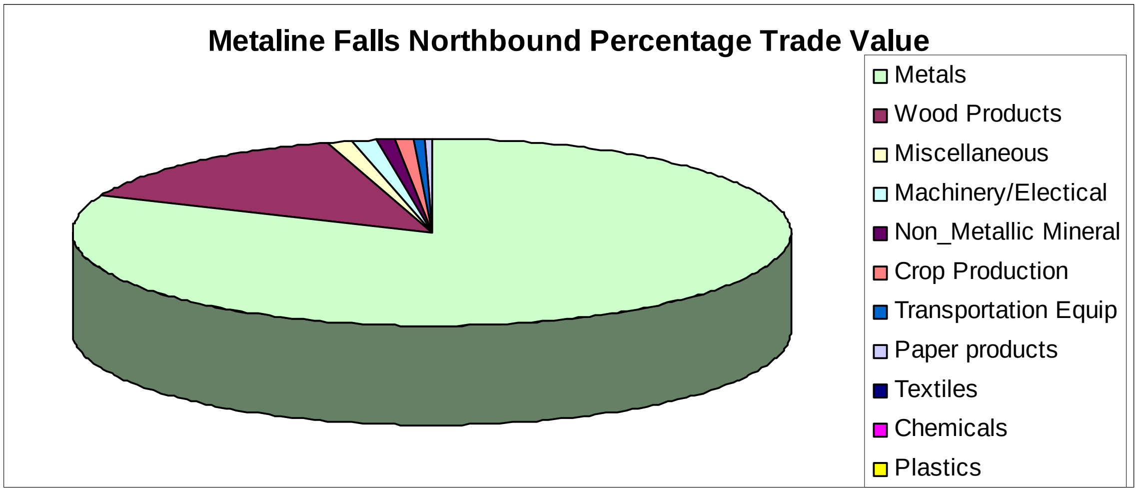
Eastern Washington border port profiles were developed, using data purchased from Statistics Canada on the dollar trade value of crossing commodities, to further enhance the available information. The ports evaluated are Metaline Falls, Ferry, and Boundary. There was no data available for commodities crossing southbound at Boundary. These ports were not included in the original analysis because the data gathered only contains the value of the commodities crossing. Attributing the specific number of crossings to the values becomes less reliable because the values of the commodities vary greatly. Also, the data obtained contains only border customs transactions and declarations. As a result, multiple transactions can represent only one truck crossing, carrying mixed freight, thereby making credible predictions on the truck crossings by commodity very difficult. However, based on the trade value obtained for both northbound and southbound crossings, there is strong evidence to support specific commodity flows.

Northbound

Metaline Falls

Based on the trade volume value in 2002 at the Metaline Falls border crossing, there was a large percentage of metal (primary and fabricated) moving northbound, followed by wood products. The pie chart in Figure 6 below and the remainder of the pie charts are ranked in order based on the legend.

Figure 6 – Metaline Falls (North) Commodity Composition



The percentage breakdown and corresponding value is in Table 1.

Table 1 – Metaline Falls (North) Port Profile

Metaline Falls Northbound		
Commodity	Percentage	Trade Value
Metals	81.36%	$13,911,004
Wood Products	13.93%	$2,382,104
Miscellaneous	1.11%	$189,249
Machinery/Electrical	1.06%	$181,720
Non-Metallic Mineral	0.86%	$146,346
Crop Production	0.80%	$137,394
Transportation Equip	0.68%	$115,810
Paper products	0.17%	$28,771
Textiles	0.02%	$2,789
Chemicals	0.01%	$2,025
Plastics	0.00%	$343

Boundary

The Boundary/Waneta port appeared to have a high value of trade in chemical products, more specifically manganese dioxide, a relatively low value/pound good. Machinery and non-metallic mineral also have high trade values. The percentage composition is in Table 2.

Figure 7 – Boundary (North) Commodity Composition

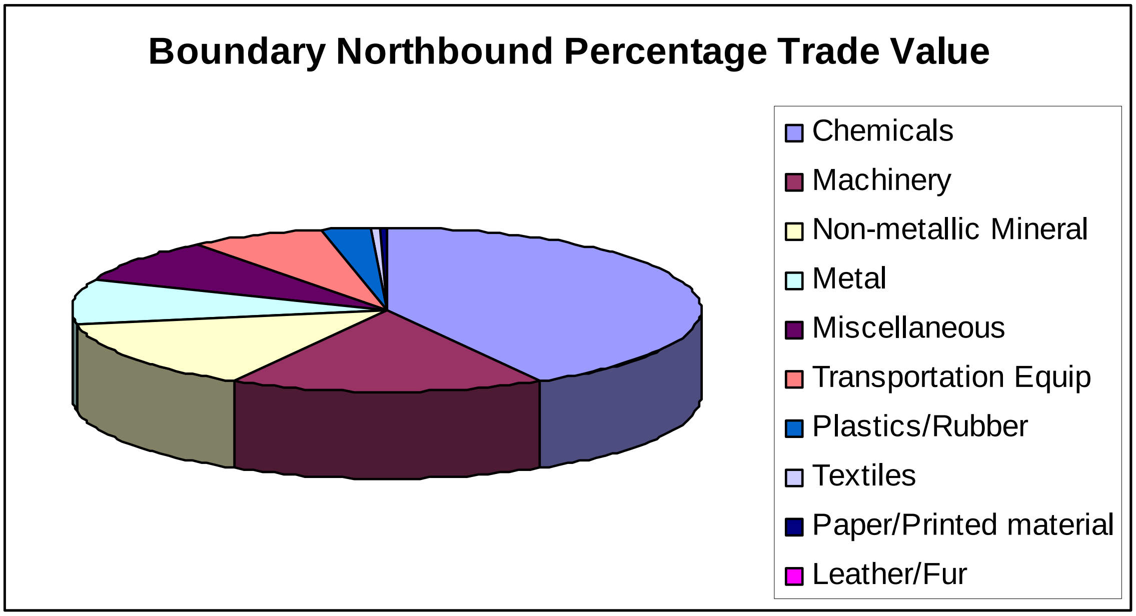


Table 2 – Boundary (North) Port Profile

Boundary Northbound		
Commodity	Percentage	Trade Value
Chemicals	41.91%	$203,600
Machinery	16.10%	$78,235
Non-metallic Mineral	13.80%	$67,059
Metal	9.20%	$44,676
Miscellaneous	8.78%	$42,662
Transportation Equip	6.99%	$33,956
Plastics/Rubber	2.33%	$11,328
Textiles	0.56%	$2,714
Paper/Printed material	0.27%	$1,299
Leather/Fur	0.06%	$273

Ferry

The two dominating commodities in terms of trade value at the eastern Washington Ferry/Midway crossing were paper products and transportation equipment. Since transportation equipment was identified as motorboats, there is an assumption of low number of crossings associated with this commodity. However, paper can be viewed as a low value commodity, therefore assuming a higher level of crossings associated with this commodity. The percentage breakdown can be viewed in Table 3.

Figure 8 – Ferry (North) Commodity Composition

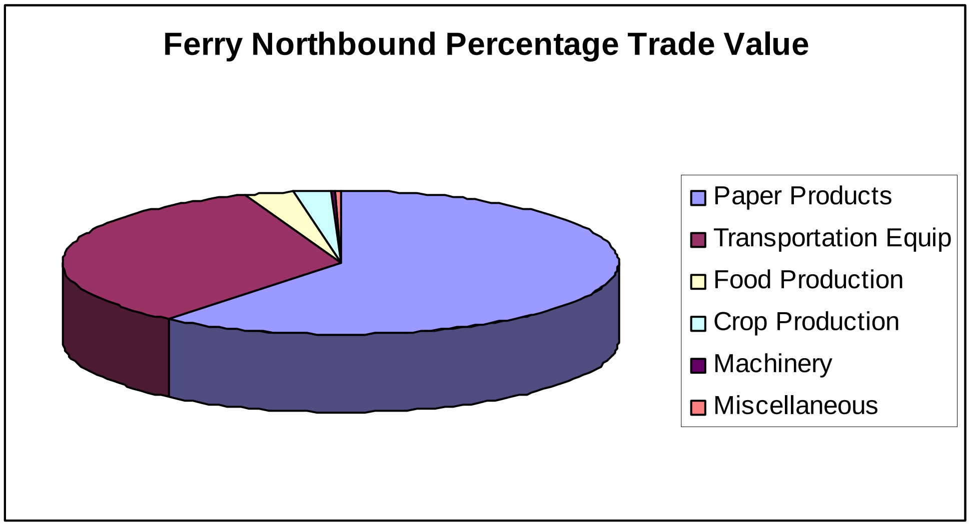


Table 3 – Ferry (North) Port Profile

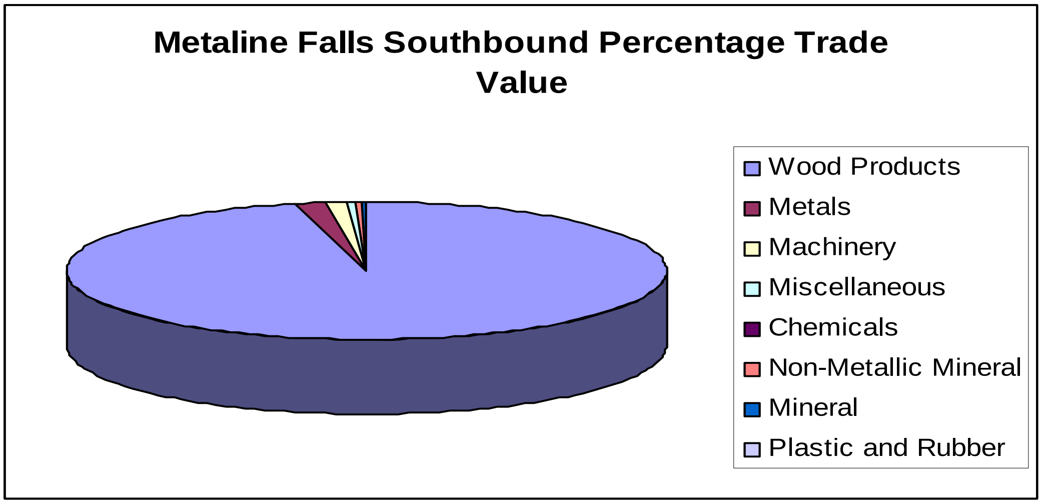
Ferry Northbound		
Commodity	Percentage	Value
Paper Products	60.54%	$57,231.00
Transportation Equip	33.90%	$32,049.00
Food Production	2.84%	$2,682.00
Crop Production	2.08%	$1,970.00
Machinery	0.33%	$316.00
Miscellaneous	0.30%	$284.00

Southbound

Metaline Falls

Wood products were the only commodities that stand out in southbound trade value at the Metaline Falls/Nelway border port.

Figure 9 – Metalline Falls (South) Commodity Composition



The percentage breakdown and corresponding values are located in Table 4.

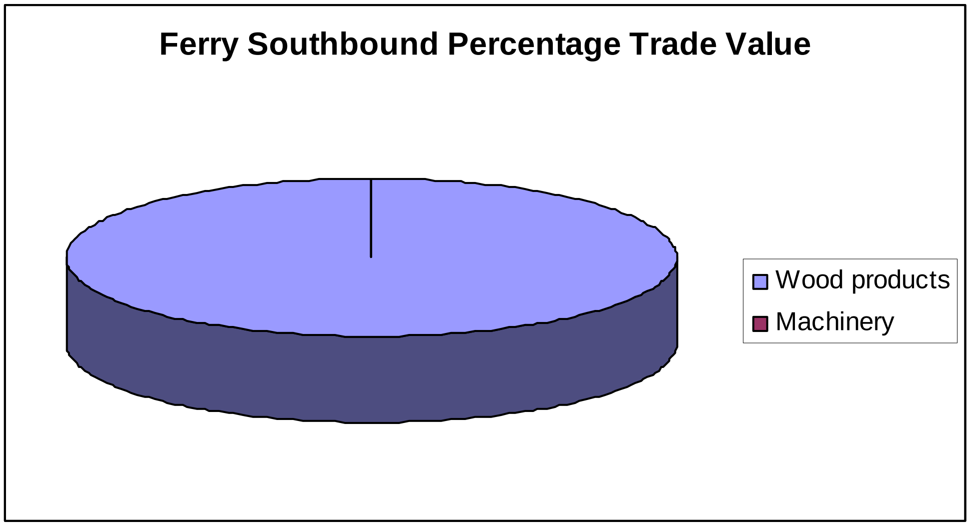
Table 4 – Metaline Falls (South) Port Profile

Metaline Falls Southbound		
Commodity	Percentage	Value
Wood Products	96.17%	$24,258,271
Metals	1.51%	$381,267
Machinery	1.10%	$276,970
Miscellaneous	0.55%	$137,977
Chemicals	0.25%	$64,100
Non-Metallic Mineral	0.25%	$63,121
Mineral	0.13%	$33,375
Plastic and Rubber	0.04%	$10,122

<u>Ferry</u>

Only two recorded commodity groups passed southbound at Ferry. These two are wood products and machinery. Wood products account for over 99% of the crossing value.

Figure 10 – Ferry (South) Commodity Composition



The percentage breakdown and values are in Table 5.

Table 5 – Ferry (South) Port Profile

Ferry Southbound		
Commodity	Percentage	Value
Wood products	99.99%	$23,343,072
Machinery	0.01%	$2,787

BORDER PORT ROUTE USAGE

Description

This section focuses on the main arterial routes utilized by trucks at the various border ports. The reasoning for determining the road networks used at specific border ports was to suggest the effect that increased trade and industry growth will have on specific Washington arterial highways as goods are moved across the Washington-British Columbia border. In this section, both EWITS and SFTA databases were examined and nine highways identified as arterials, namely:

Interstate 5
Interstate 405
Interstate 82
Interstate 90
U.S. Highway 97
U.S. Highway 395
U.S. Highway 2
U.S. Highway 12
U.S. Highway 14

These highways and interstates represent the bulk of north-south and east-west travel in Washington. The analysis did not focus on specific distances traveled on the arterial; rather the focus was on road network usage. Additionally, through GIS technology, highway usage maps and density flows per border port can be created. This will allow evaluation of distances traveled on arterial networks.

Interstate 5 and Interstate 405 capture much of the north-south traffic flows (a.k.a. the I-5 corridor) between Washington, Oregon, and California. After reviewing much of the route data, I-405 appears to be more heavily used by truck flows moving west or east across I-90. U.S. 97 and U.S. 395 capture the remaining majority of the north-south traffic flows, especially for goods that have an origins and destinations in regions located east of the Pacific coast. I-90 is the main arterial for east-west travel in Washington and in terms of border crossings was used in part or in full, depending on the origin and destination of the goods being transported. For example, goods crossing at Oroville, WA (U.S. 97) may only use a part of I-90, whereas goods crossing at Blaine, WA (SR543) may have an origin in Spokane and use the entire Washington portion of I-90. U.S. 2 captures east-west travel across northern Washington and is an important arterial for eastern Washington border ports. U.S. Highway 12 and SR14, though not as heavily used as other arterials, represent the east-west travel across southern Washington and are important entrances into the Washington road-network system from areas such as Idaho and Oregon.

As mentioned previously, the data analysis doesn't differentiate by distance. As a result, border crossings located on or near major north-south arterials tend to show 100% usage of the arterial. The presented information should be cautiously used because many of the truck crossings only used a portion of the arterial near the border crossing. To help in understanding the road networks used, an additional category (e.g. I-5 Only) was added in the route table to indicate if only the arterial was used and no other highway/road networks. However, one further caution deals with the origin and destination on a single arterial. For example, a truck may have an origin in Omak, WA (north-central Washington on U.S. 97) and an Osoyoos, BC destination. As a result, only U.S. 97 is used, but only a 45 mile section of the arterial.

In order to circumvent this, one further analysis was used, namely: GIS geo-coding. Through the use of geographic information systems technology (GIS), the SFTA survey data collected on the routes used to transfer goods both northbound and southbound was geocoded. Geocoding is a method of using characteristic data and translating that data to a real map. Route information was used to illustrate the frequency and flow of traffic throughout arterials in Washington State.

Arterial Usage

SFTA Survey

Northbound

Blaine Crossing.--As stated earlier, the Blaine border crossing is the largest border crossing in the state of Washington. One interesting aspect about this border crossing in terms of arterial route usage was the majority of the routes (77.8%) were I-5 Only routes. In other words, the origins of the trucks crossing the border are located on I-5 or the trucks cross the Washington-Oregon border on I-5. In addition, 36.1% of the 77.8% I-5 Only truck crossings originated in another state (i.e. utilized the entire Washington State portion of I-5).

Another highway was also used to further illustrate the point regarding the distances traveled on an arterial. State Route 543, which originates in Blaine, made up 2.1% of the northbound Blaine border crossings. The distance to the British Columbia border is less than 1 mile.

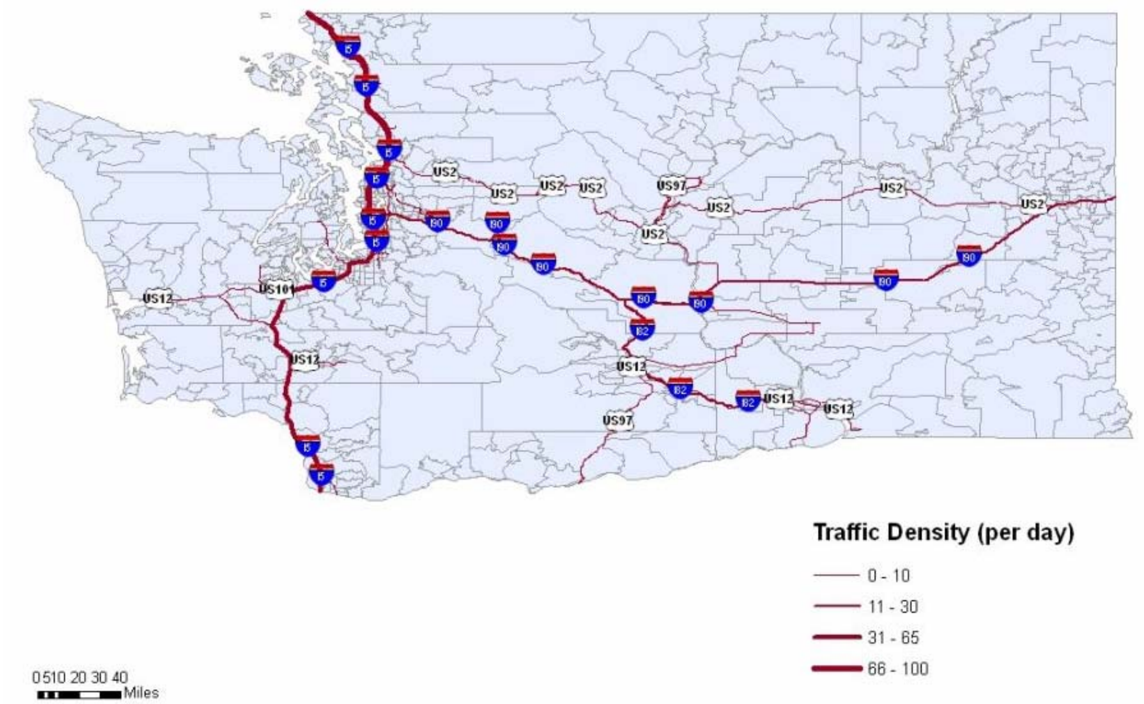
The percentages of arterials used are listed below in Table 6.

Table 6 – SFTA: Blaine (North) Route Usage

Blaine SFTA (north)	
Highway	%AADT
I-5	97.87%
I-5 (only)	77.83%
I-90	12.09%
I-82	4.02%
SR543	2.13%
I-405	2.12%
US2	0.99%
US97	0.75%
US12	0.51%
US395	0.16%

From the traffic density map (Figure 11), I-5 is obviously used the most frequently; however there is also indication of interstate flows traveling north from the Oregon border on US 97 and I-82, as well as flows from Spokane, WA and the Idaho panhandle on I-90.

Figure 11- Northbound Crossings at Blaine



Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

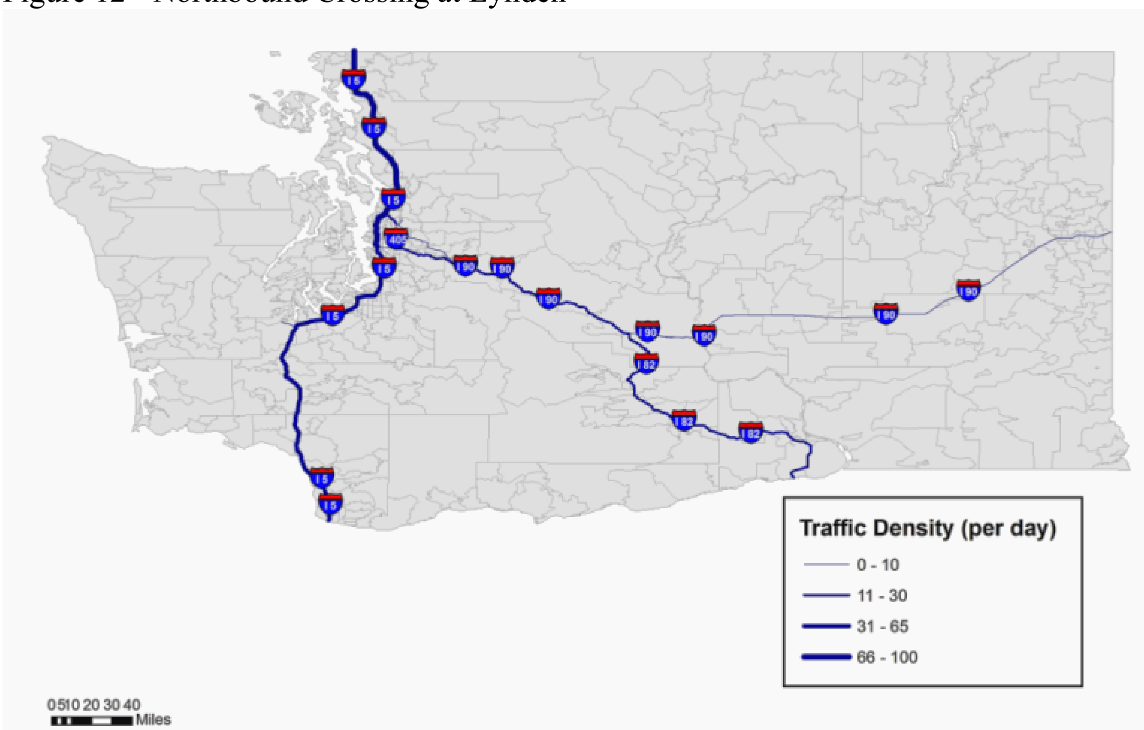
Lynden Crossing.--Like the Blaine crossing, the Lynden crossing has a large portion of I-5 Only arterial usage with 58% of the I-5 Only category originating from states other than Washington. A characteristic that differs between Blaine and Lynden was the higher percent usage of other arterials. As shown in figure 12, I-90, I-82, and I-405 were all used more often at the Lynden crossing than at Blaine. Due to low usage, US97 and US2 were not included in the map.

Table 7 - SFTA: Lynden (North) Route Usage

Lynden SFTA (north)	
Highway	%AADT
I-5	100.00%
I-5 (only)	57.02%

I-90	23.76%
I-82	19.01%
I-405	18.97%
US97	4.75%
US2	4.75%

Figure 12 - Northbound Crossing at Lynden



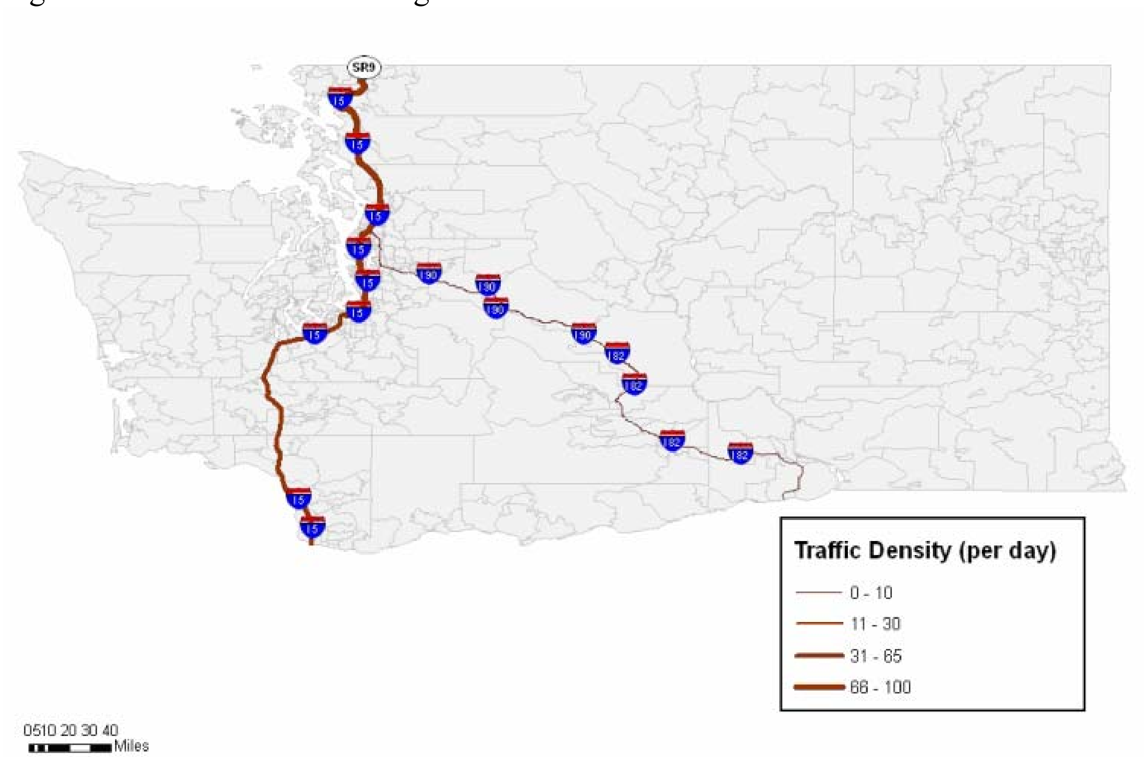
Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

Sumas Crossing.-- The Sumas, WA crossing also had similar characteristics, showing that almost 85% of all crossings contained only I-5 and SR542 (the connecting highway between I-5 and SR9). As depicted by the traffic density for I-5 in Figure 13, 39% originated in another state. Produce from eastern Washington makes up the remaining 15%. Based on the information and data collected from SFTA, the Cascade Gateway border ports (Blaine, Lynden, and Sumas) appear to be used heavily for international trade of goods for other states.

Table 8 - SFTA: Sumas (North) Route Usage

Sumas SFTA (north)	
Highway	%AADT
I-5	100.00%
I-5 & SR542(only)	84.91%
I-405	7.58%
US97	7.51%
US2	7.51%

Figure 13 - Northbound Crossing at Sumas



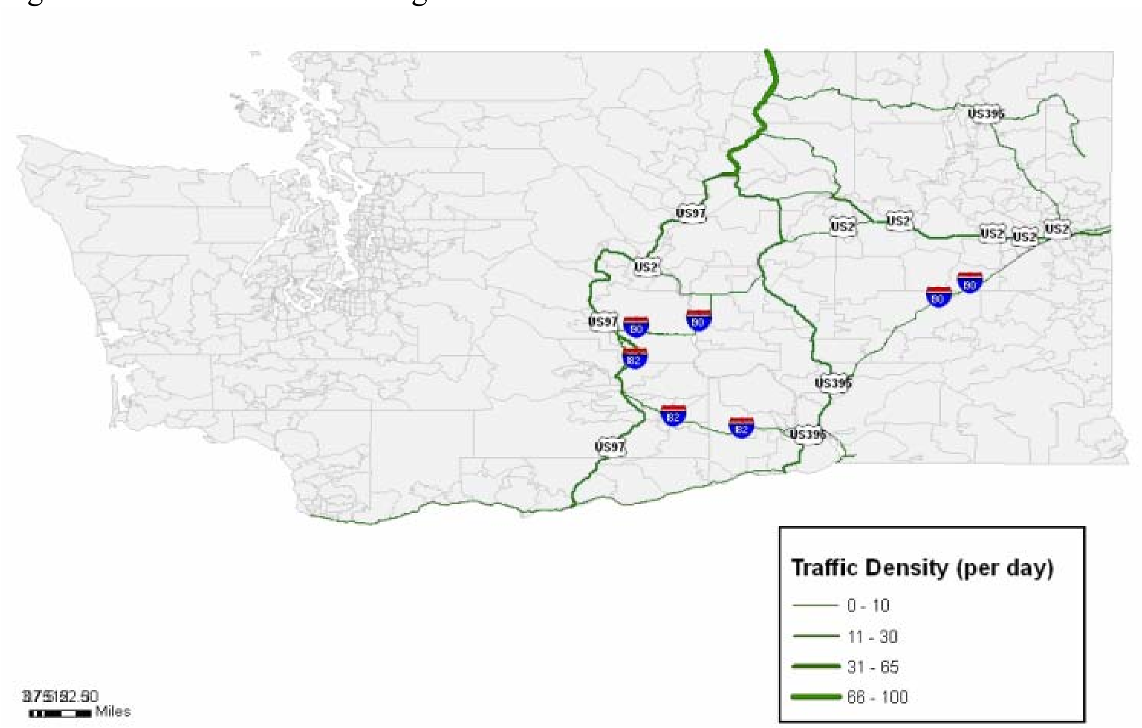
Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

Oroville Crossing.-- In Table 9, over half of the crossings at Oroville utilized only U.S. 97, followed by strong usage of I-90, U.S. 2, and U.S. 395. Of the U.S. 97 Only category, only 9.1% originated from another state, indicating that U.S. 97 is not used predominately as an interstate arterial (see Figure 14). However, almost 30% of the crossings at Oroville originated in another state.

Table 9 - SFTA: Oroville (North) Route Usage

Oroville SFTA (north)	
Highway	%AADT
US97	100.00%
US97 (only)	51.58%
I-90	21.70%
US2	11.96%
US395	10.94%
I-5	5.72%
I-82	2.38%
US12	1.42%
I-405	0.85%

Figure 14 - Northbound Crossing at Oroville



Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

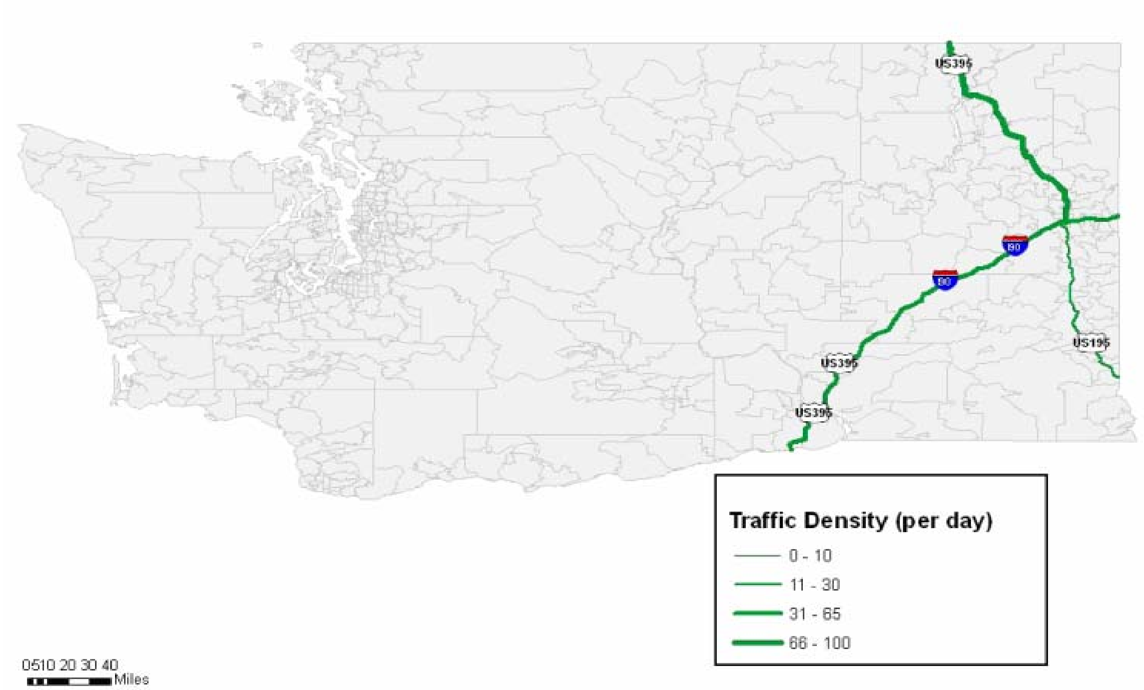
Laurier Crossing.-- Laurier, located on U.S. 395, did not have any other major arterials listed in the observations gathered during the survey (see Table 10). However, as described earlier, there are not many cities located above the Laurier border crossing. Therefore, there was not much freight movement at this location. Additionally, there was no interstate movement on the crossings that originated on the U.S. 395 Only corridor, though 14.6% of the total crossings originated from another state (as shown in Figure 15).

Figure 15 below shows some usage on I-90, which runs with US 395 south and west of Spokane, as well as some freight entering the state on I-90. Also included is US 195 that runs to Lewiston, ID. Usage of this route constitutes the majority of interstate travel and is most likely the result of the Potlatch paper mill in Lewiston, ID because the main commodity transported is a component of paper production.

Table 10 - SFTA: Laurier (North) Route Usage

Laurier SFTA (north)	
Highway	%AADT
US395	100.00%
US395 (only)	85.44%

Figure 15 - Northbound Crossing at Laurier



Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

Danville Crossing.--The Danville crossing was unique in that all five recorded crossings had an origin on SR21 at Republic or Curlew, Washington and only used SR21 in the crossing.

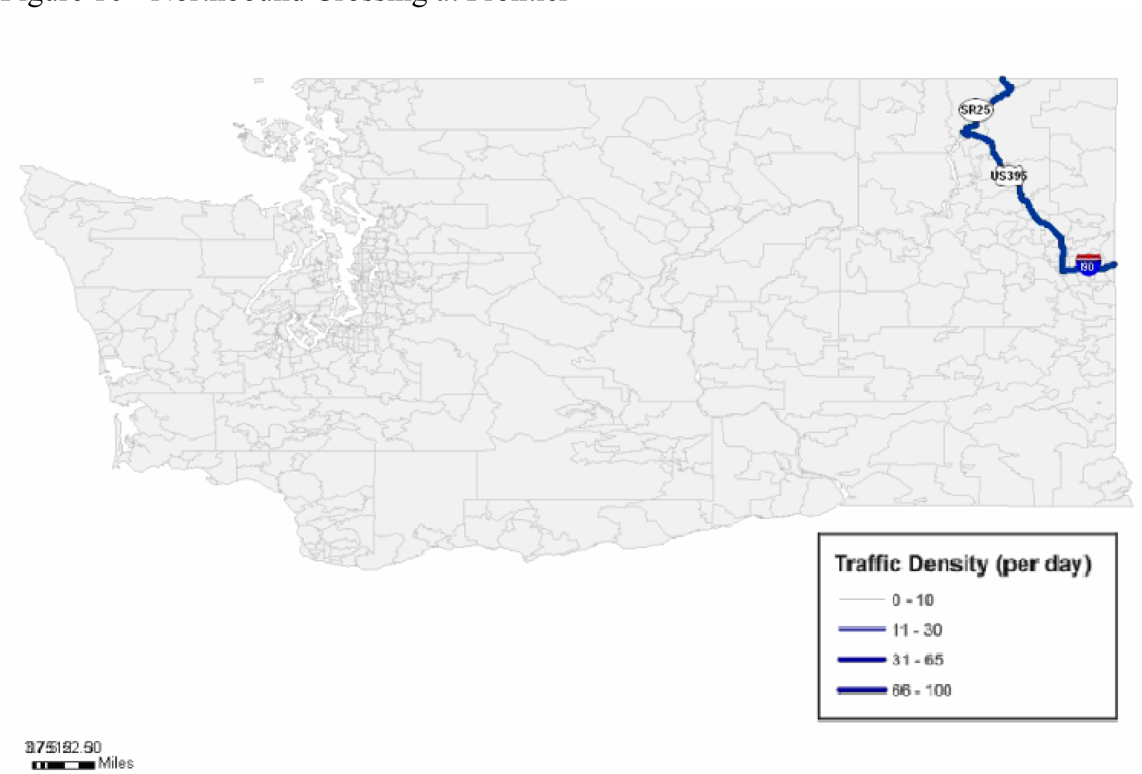
Frontier Crossing.-- At the Frontier crossing, U.S. 395 was the most frequently used arterial, though the final crossing was at SR25, which divides at Kettle Falls, WA. I-90 was also frequently used, of which 64% of the trucks using I-90 originated from another state.

Table 11 - SFTA: Frontier (North) Route Usage

Frontier SFTA (north)	
Highway	%AADT
US395	100.00%
I-90	63.48%
US97	13.94%
US2	13.94%
US395 (only)	13.93%
I-5	12.96%

Figure 16 below focuses on the I-90 and US 395 arterials because of the low level of AADT for the remaining highways.

Figure 16 - Northbound Crossing at Frontier



Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

Southbound

Blaine Crossing.--The number of I-5 Only routes for southbound truck crossings (71.3%) was very similar to that of the northbound crossings (77.8%). From Table 12, 62% of the I-5 Only routes had destinations in other states. This 62% figure almost doubles that of the northbound crossings, indicating I-5 is a large arterial for international crossings destined for interstate travel. Overall, the percentage of crossings destined for other states was 35.7%. Of the remaining routes, I-90 was utilized about 12.5%, I-405 10%, and I-82 about 3.7%. US97, US2, and US12 constitute less than 1% of the crossings. The main finding was most northbound and southbound crossings at Blaine appear to stay on I-5, with I-90, I-82, and I-405 serving as feeders to the movement.

From figure 17, there is little extended road network usage for import goods. Over one-third of the southbound crossings are interstate travel, therefore little deviation from the main arterials was seen.

Table 12 - SFTA: Blaine (South) Route Usage

Blaine SFTA (south)	
Highway	%AADT
I-5	100.00%
I-5 (only)	71.29%
I-90	12.54%
I-405	9.96%
I-82	3.70%
US97	0.46%
US2	0.46%
US12	0.46%

Figure 17 - Southbound Crossings at Blaine

Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

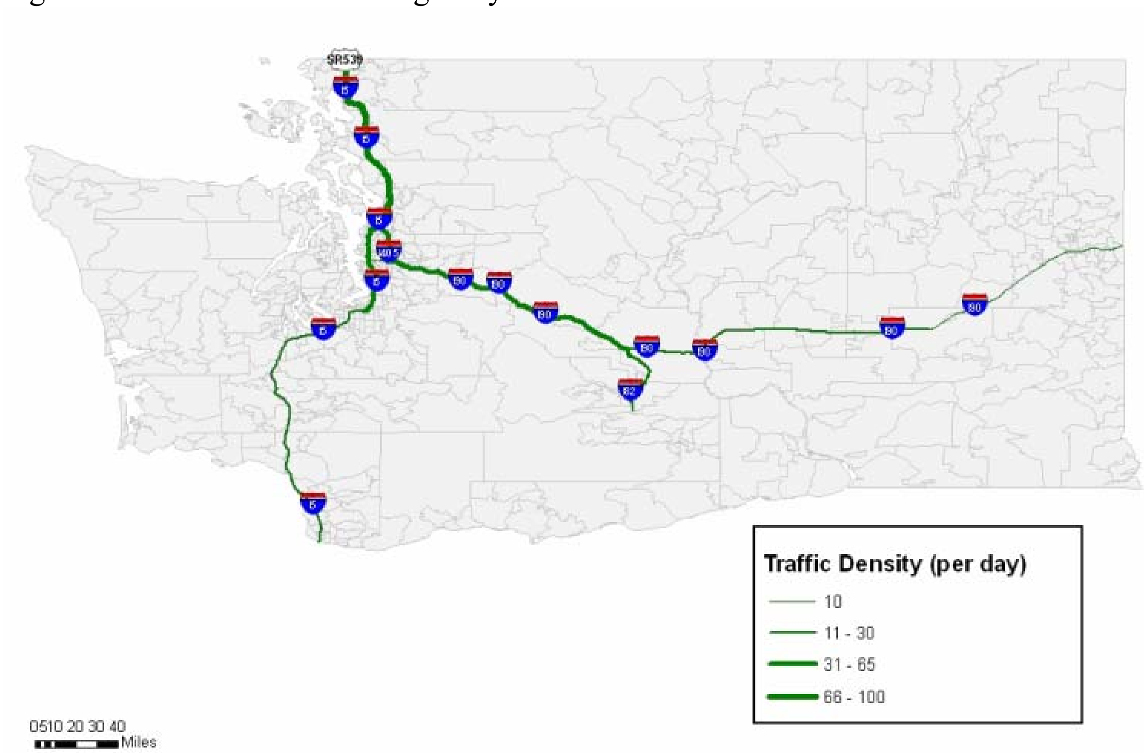
Lynden Crossing.--At the Lynden crossing (SR543), the level of I-5 Only travel dropped significantly to 25%, as compared to 57% for northbound crossings. The level of I-405, I-90 and I-82 travel increased significantly to 48.6%, 34.4%, and 23.7%, respectively. As seen in Figure 18, the Lynden border port had a larger percentage of interstate travel, roughly 48.3%. Additionally, I-405 served predominately as a feeder route to I-90 and I-82.

Figure 18 shows one of the earlier conflicts with the table representation of the traffic flows, namely less than total arterial usage. The majority of the trucks, crossing at Lynden and using I-82, stopped in the Yakima Valley region and did not continue to the Oregon border. Most crossings at Lynden used only the interstate arterials.

Table 13 - SFTA: Lynden (South) Route Usage

Lynden SFTA (south)	
Highway	%AADT
I-5	100.00%
I-405	48.55%
I-90	34.39%
I-5 (only)	25.73%
I-82	23.67%

Figure 18 - Southbound Crossing at Lynden



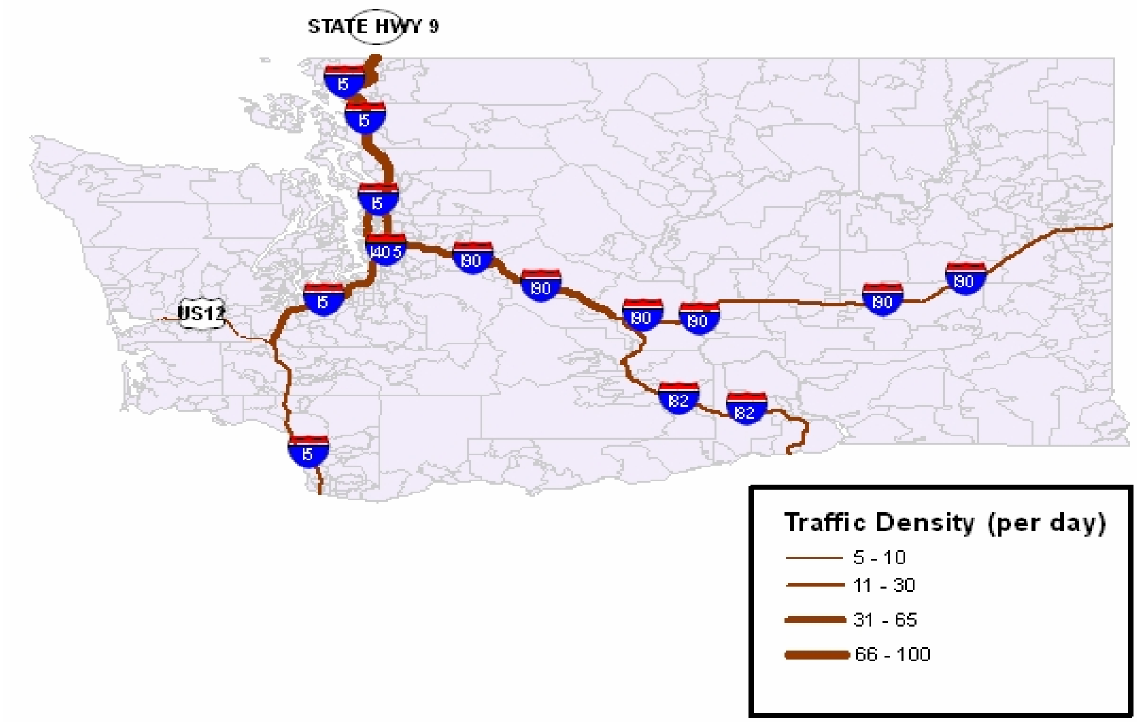
Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

<u>Sumas Crossing</u>.--At Sumas, the level of I-5 Only travel also significant decreased, compared to the level of northbound crossings, which is roughly 26.1%.[5] In addition, the percentage of interstate travel at this port was roughly 42.4%

Table 14 - SFTA: Sumas (South) Route Usage

Sumas SFTA (south)	
Highway	%AADT
I-5	100.00%
I-405	24.18%
I-90	15.45%
US12	7.63%
I-82	6.73%

Figure 19 - Southbound Crossing at Sumas



Source: Peunpatom, Tosmai. Custom Map. April, 2007.

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[5] Although the route requires travel on SR 9, and SR 542 in order to get to I-5, the observations that follow this route are treated as I-5 only observations.

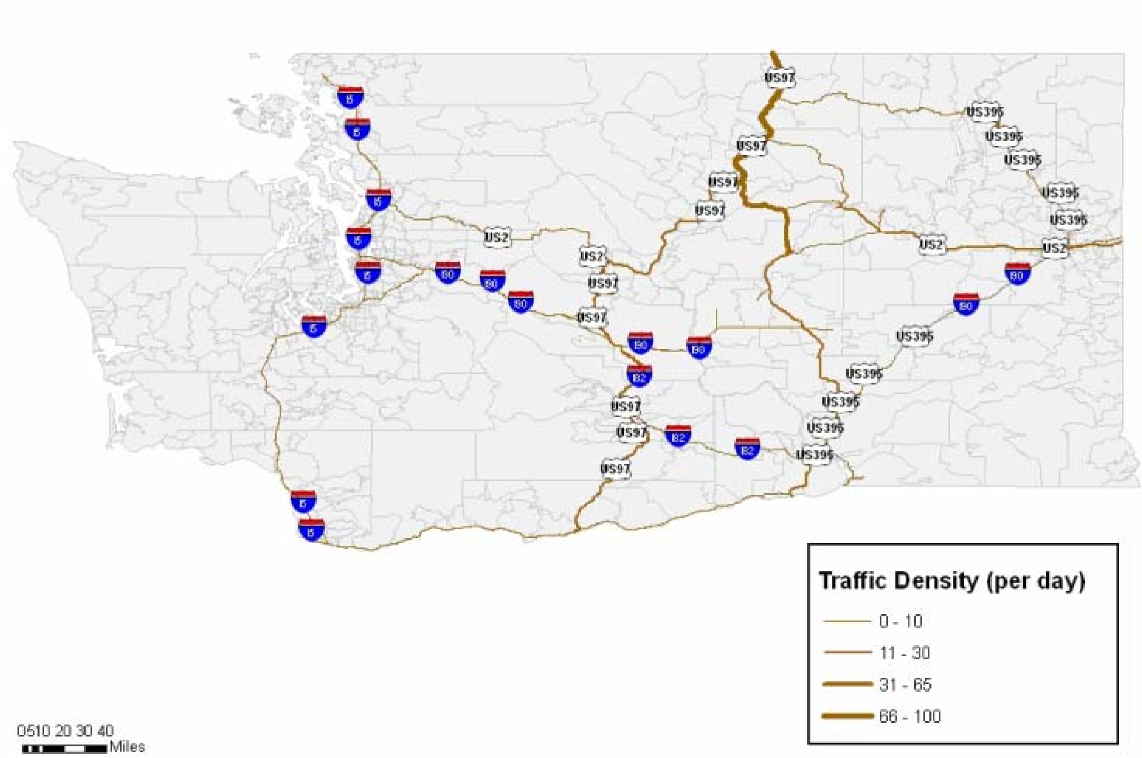
Oroville Crossing.--Oroville, located on U.S. 97, had the highest level of traffic among the eastern Washington border crossings. Of the crossings described in Table 15 and shown in Figure 20, 35.5% were only on U.S. 97, with 49.5% of the total crossings destined for interstate travel. About 23% of the crossings used I-90, as well as U.S. 2, as part of their route. This represented the bulk of the east-west travel. I-5, as expected, is low because most crossings in eastern Washington do not use the I-5 corridor. I-82 and U.S. 12 also appeared to have low utilization, which would lead one to conclude that goods are not transported very far after entering the state, or the goods are shipped east-west on I-90. This point is somewhat supported by the 17% of total truck crossings traveling to Idaho and Montana.

Table 15 - SFTA: Oroville (South) Route Usage

Oroville SFTA (south)	
Highway	%AADT
US97	100.00%
US97 (only)	35.54%
I-90	29.48%
US395	23.40%
US2	22.94%
I-5	5.35%
I-82	3.38%
US12	1.69%

An extensive view of the various roadways used to distribute southbound freight flows from Oroville is shown in Figure 20.

Figure 20 - Southbound Crossing at Oroville



Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

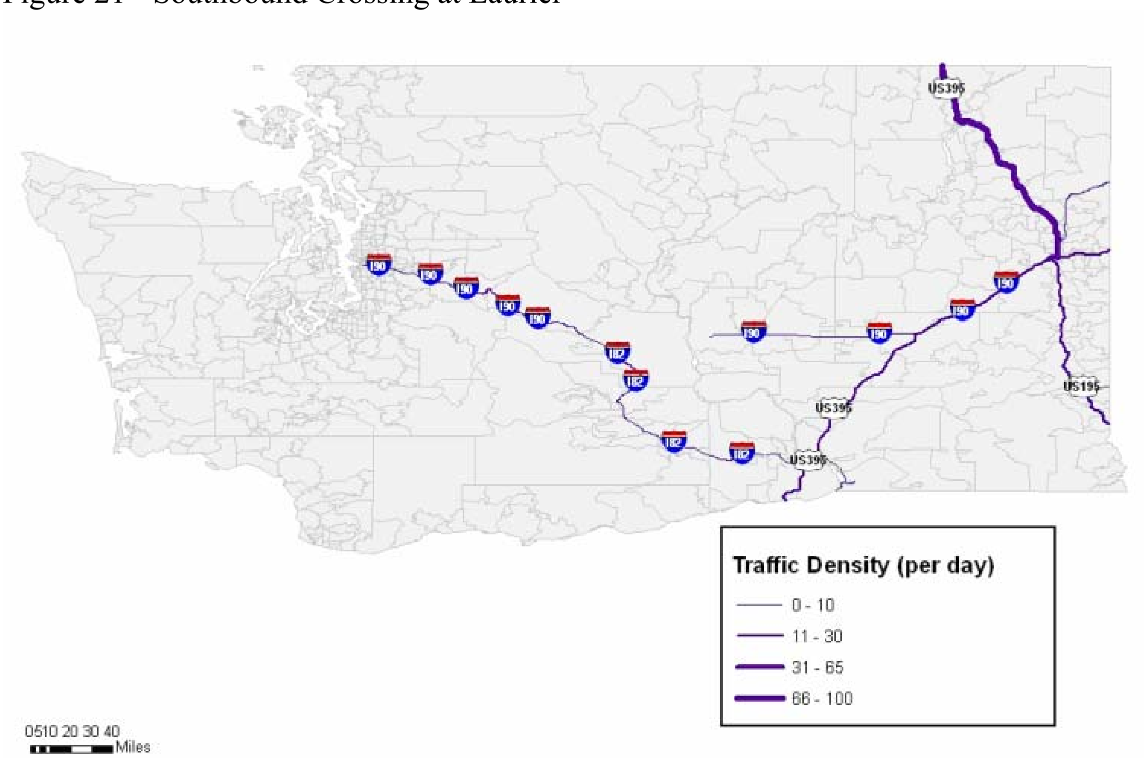
<u>Laurier Crossing</u>.--Laurier southbound truck crossings, as seen in Figure 21, are very similar to that of the northbound crossings. US 395 was predominately used; however, I-90 was also used as part of the route about 20% of the time. The percentage of interstate travel was about 34%, of which 75% of the interstate travel had a destination of Lewiston, ID. The reason this phenomenon is mentioned deals with the commodities being transported through the Laurier border port. As stated in the border port commodity description, 69.9% of the trucks crossing at Laurier contained wood products, more specifically sawdust and hog fuel. The main destinations for these products include Kettle Falls, WA, where there is a Boise-Cascade wood product manufacturing plant, and Lewiston, ID, where there is a Potlatch, Corp paper mill. These destination locations

make up 65.2% of the crossings at Laurier. Furthermore, the origins of these trucks are Midway and Grand Forks, BC, where Pope and Talbot, Inc own and operate sawmills and pulp mills. Given the quantitative data and qualitative description of the movements, one could strongly infer that Laurier is a border port that relies heavily on the wood and paper products industry. If the industries were to stagnate or facilities were to shut down, the level of crossings would be reduced significantly.

Table 16 - SFTA: Laurier (South) Route Usage

Laurier SFTA (south)	
Highway	%AADT
US395	100.00%
US395 (only)	63.57%
I-90	19.66%

Figure 21 - Southbound Crossing at Laurier



Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

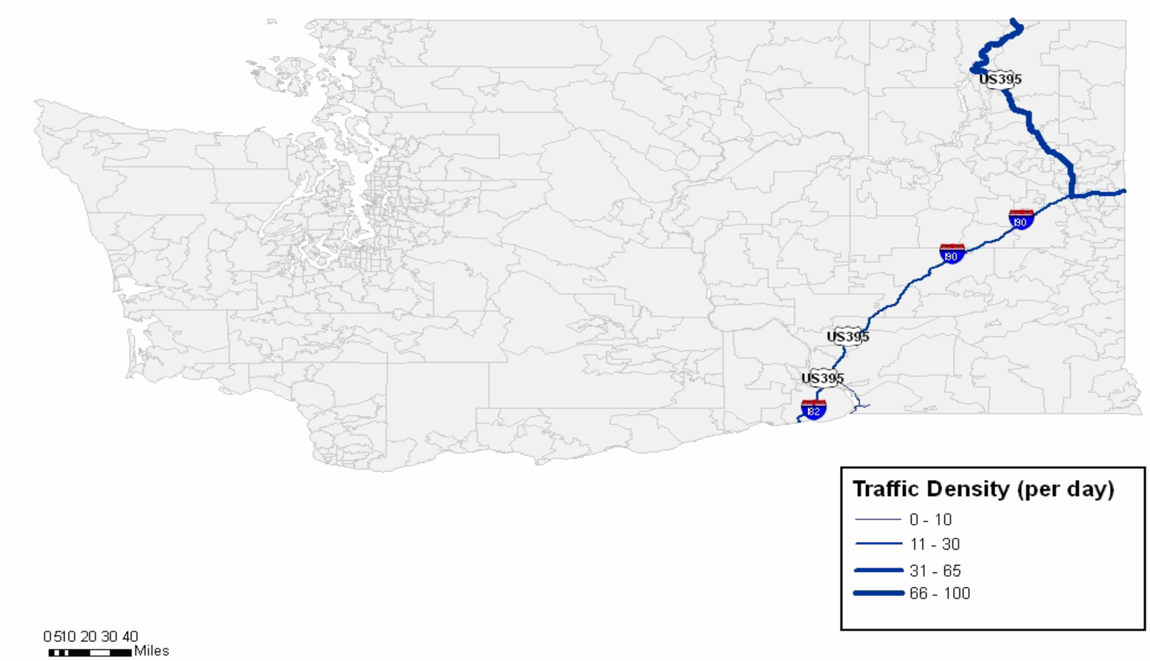
Danville Crossing.--The route breakdown at Danville was the same as the SFTA (north) route breakdown for Danville. The only highway used was SR21.

Frontier Crossing.--The southbound crossings showed heavy use of U.S. 395. Furthermore, roughly 30% of the crossings terminate in Spokane. The major commodities crossing were chemicals and fertilizers, appearing to originate from the Cominco Ltd. mine and refinery in Trail, BC. Of the total Frontier crossings, 38.7% are destined for interstate travel, predominately Idaho. US-97 was not incorporated into Figure 22 because of low volume movements.

Table 17 - SFTA: Frontier (South) Route Usage

Frontier SFTA (south)	
Highway	%AADT
US395	82.77%
I-90	45.30%
US395 (only)	37.18%
US97	7.01%

Figure 22 - Southbound Crossing at Frontier

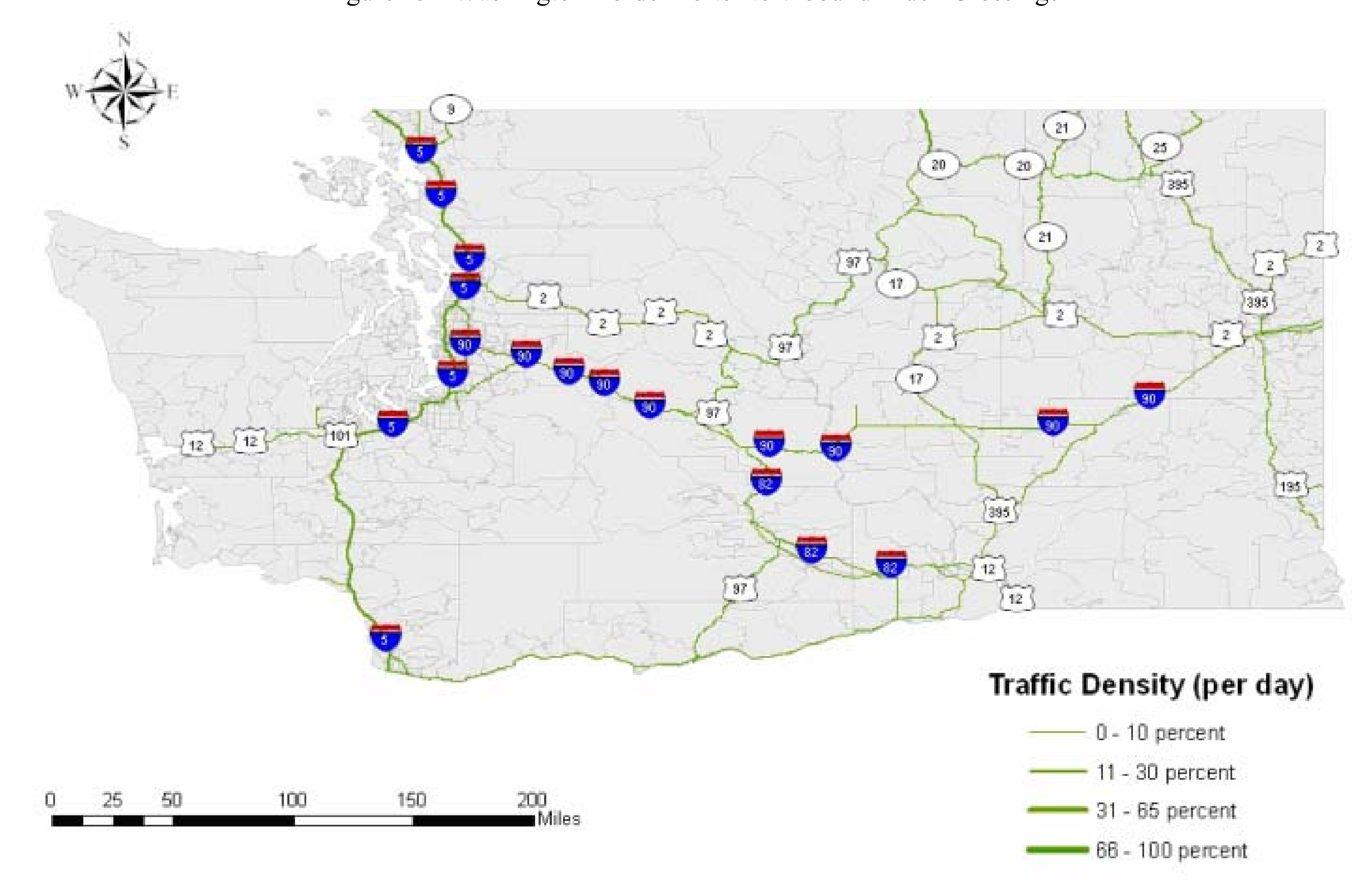


Source: Peunpatom, Tosmai. Custom Map. Jan, 2007.

The final additions in this section (Figures 23 and 24) show route flows for the combined border ports for both northbound and southbound movements.[6] There was extensive use of Washington arterials to distribute the commodities crossing at the various border ports. Upon closer inspection, there was frequent heavy use of I-5 and US97 in the northern portion of the state. I-90 had heavier usage at the western and eastern portions of the state, though there was less usage in central Washington.

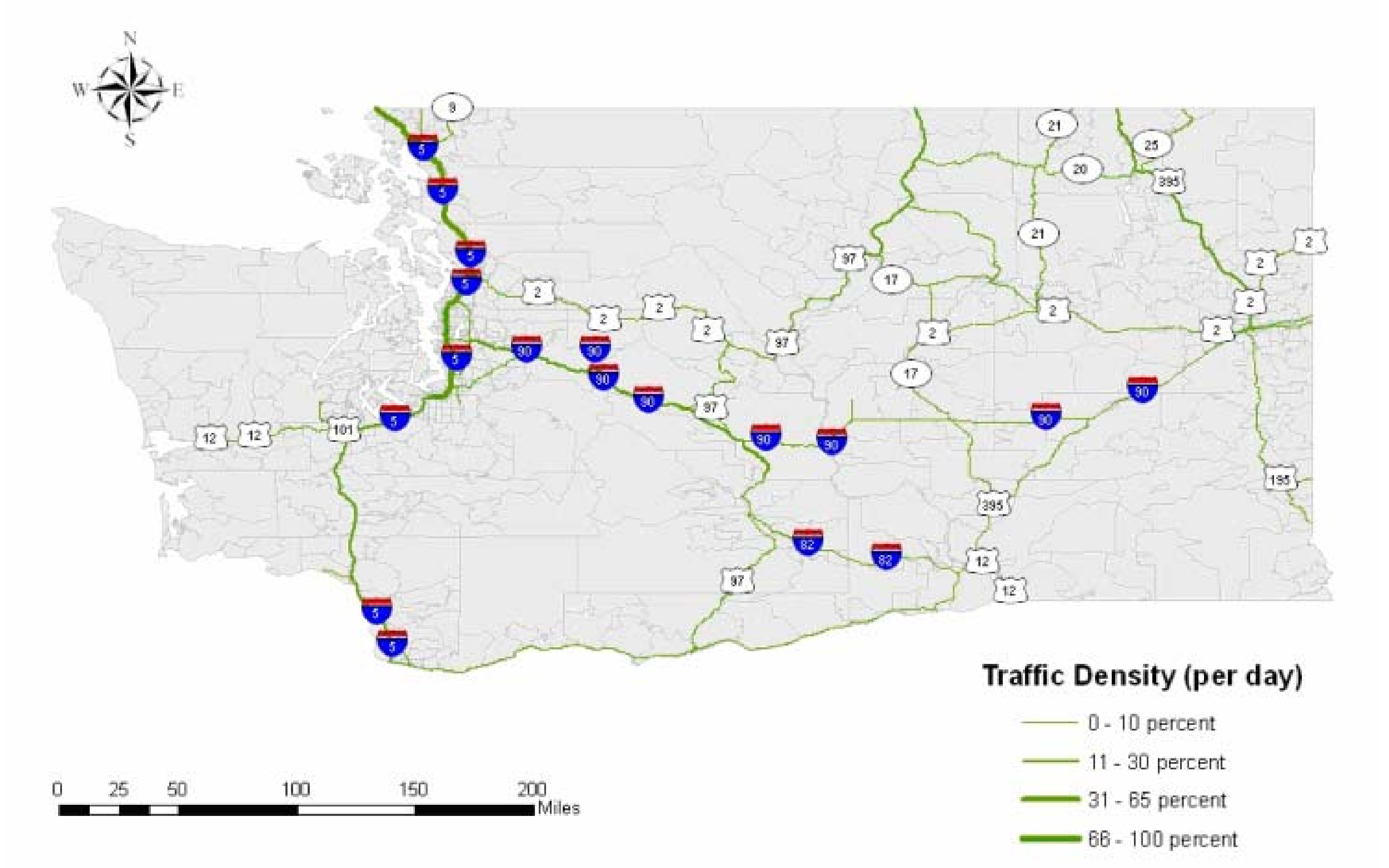
[6] Puenpatom, Tosmai, Jessup, Eric and Casvant, Ken. Applications of Geo-Coded Truck Route Data in Washington State: A GIS Approach. Transportation Research Group. Washington State University. 2006 p. 17-18.

Figure 23 - Washington Border Ports Northbound Truck Crossings



Source: Puenpatom, Tosmai, Jessup, Eric and Casvant, Ken, 2006.

Figure 24 - Washington Border Ports Southbound Truck Crossings



Source: Puenpatom, Tosmai, Jessup, Eric and Casvant, Ken, 2006.

EWITS Survey

An additional analysis of the routes defined in the earlier EWITS analysis lends greater understanding of the changes in transportation flows in the last decade. EWITS, as described above, is similar to the SFTA origin-destination survey. This particular section focuses on the routes utilized to facilitate the transfer of goods. The breakdown of arterials used, when compared to the SFTA survey, shows many similarities as well as many differences, indicating the varying and changing dynamics of arterials used.

Northbound

Blaine Crossing.--As in SFTA, all observed trucks, except those originating internal to Blaine, used I-5 as a part of the Washington highway arterial to move goods to Canada. In the I-5 Only category, almost 70% of the total crossings exclusively used I-5 as an arterial for transport. Of this 70%, approximately 48% originate from the state of Oregon, and therefore use the entire northbound length of I-5. Other significant arterial movements (14%) used I-90. In SFTA the I-90 utilization rate was about 12.1%. I-405 also had a high usage rate, representing about 10.8%, compared to SFTA's 2.1% use of I-405. The remaining routes used were comparable to SFTA's (see Table 18).

Table 18 - EWITS: Blaine (North) Route Usage

Blaine	
EWITS (North)	
Highway	%AADT
I-5	100.00%
I-5 (only)	69.81%
I-90	14.07%
I-405	10.80%
I-82	4.24%

US97	2.25%
US2	1.85%
US12	1.84%
US395	0.67%

Lynden Crossing.--There were only two arterials identified for the Lynden border port. However, the I-5 Only category is similar to the same category in SFTA. The I-405 category showed larger use compared to SFTA.

Table 19 - EWITS: Lynden (North) Route Usage

Lynden	
EWITS (North)	
Highway	%AADT
I-5	100.00%
I-5 (only)	50.00%
I-405	33.33%

Sumas Crossing.--Large degrees of differences are noted between the utilization of routes at the Sumas border port in EWITS and SFTA. First, in SFTA, the arterials identified had included I-5, I-405, U.S. 97, and U.S. 2. Secondly, the level of I-5 Only usage increased from 31% to 85%. One interesting observation from the EWITS findings was only 22% of the crossings at Sumas originated from another state. Compared to the 39% of crossings with "out of state" origins from SFTA, this would indicate that Sumas may have elevated from a local/regional border port to an interstate border crossing over the last decade. This conjecture was based on the interstate truck traffic at the other Western Washington border ports, in which Blaine and Lynden had 41% and 47.5% of interstate traffic, respectively.

Table 20 - EWITS: Sumas (North) Route Usage

Sumas	
EWITS (North)	
Highway	%AADT
I-5	100.00%
I-5 & SR542 (only)	31.23%
I-90	12.80%
I-405	12.80%

Oroville Crossing.--The exclusive use of U.S. 97 was not as high compared to SFTA, which could indicate growth of trade and transportation over the last decade in communities located in Washington on U.S. 97. A low level (9.1%) of interstate transportation from SFTA fell into the U.S. 97 Only category. In EWITS, U.S. 97 Only interstate travel use was significantly higher (19%), suggesting a decline in the usage of U.S. 97 as an exclusive interstate network for trade with British Columbia.

Table 21 - EWITS: Oroville (North) Route Usage

Oroville	
EWITS (North)	
Highway	%AADT
US97	100.00%
I-90	35.13%
US97 (only)	31.81%
US2	19.34%
US395	15.71%
I-5	10.76%
US12	5.03%
I-405	4.59%
I-82	4.44%

Laurier Crossing.--EWITS had more arterial usage for the Laurier border port compared to SFTA.[7] Use of U.S. 395 Only in EWITS was 10.7%, compared to 85.4% utilization rate in SFTA. There are three explanations for this. First, no survey locations were near the border in EWITS (see footnote). Therefore, the route information may be more of a reflection of the survey sites used (especially those not located on U.S. 395). Second, an increase in trade and transportation from communities located on U.S. 395 could also have resulted in a high level of U.S. 395 Only crossings. The third explanation focuses on the high use of I-90 (89%). In EWITS, 48.5% of the border crossings at Laurier had departure origins in another state, suggesting that truck transporters used multiple arterials to move goods through the border port.

Table 22 - EWITS: Laurier (North) Route Usage

Laurier	
EWITS (North)	
Highway	%AADT
US395	100.00%
I-90	89.35%
I-82	12.01%
US395 (only)	10.72%
US12	9.42%

Frontier Crossing.--The Frontier border port crossing arterial breakdown also changed considerably between EWITS and SFTA. In EWITS, 91% of trucks crossing at Frontier utilized I-90, which logically makes sense because I-90 is the largest east-west arterial in the state and SR25 (the highway that runs to the Frontier border port) is connected to I-90

[7] Keep in mind that the survey locations for EWITS (Othello, Plymouth, East Spokane, and Tokio East) used to collect these observations were not located at the border, therefore the observations are a reflection of the locations of the survey site. However, for SFTA, the survey site location was at the border.

through SR 23 and SR 28, and U.S. 395. In SFTA, U.S. 2 constitutes 13.9% of the east-west freight movement.

Table 23 - EWITS: Frontier (North) Route Usage

Frontier	
EWITS (North)	
Highway	%AADT
US395	100.00%
I-90	91.10%
I-82	46.35%
US97	13.17%
I-5	12.81%
I-405	12.81%

Southbound

Comparison of the southbound EWITS and SFTA route profiles suggests more distinct changes in the routes. The only border port crossing that maintained a similar profile was Oroville.

Blaine Crossing.--There are few similarities between the EWITS and SFTA Blaine crossing for southbound truck movements. In SFTA the I-5 Only component made up 71% of the route profile, compared to 47% in EWITS. One similarity was the level of out of state destinations; SFTA (35%) and EWITS (33%) had non-Washington destinations for southbound truck crossings. On other arterials, I-405 decreased by more than half between EWITS (21.2%) and SFTA (9.9%) and I-90, I-82, US12, and US97 remained relatively constant.

Table 24 - EWITS: Blaine (South) Route Usage

Blaine	
EWITS (South)	
Highway	%AADT
I-5	99.81%
I-5 (only)	47.10%
I-405	21.20%
I-90	12.42%
I-82	3.29%
US12	0.98%
US97	0.32%

Lynden Crossing.--Comparing the two freight studies, the level of I-5 Only crossings decreased over ten years from 75% to 26%, the level of I-90 usage increased from 20% to 34%, the level of I-405 usage increased from 7% to 48.5%, and the level of I-82 usage increased from 13% to 24%. One explanation for the increase in the usage level of other Washington State arterials may be the result of the reduction in out of state movements. In 1994, the level of out of state freight movements was roughly 54.4%, whereas in 2003, the level of out of state movement was 48.3%. Since there was an increase in the number of crossings between 1993 and 2002 and a decrease in the level of out of state transport moving through the Lynden border port, then an increase in other Washington State arterial use could follow. Additionally, if trade in other Washington regions, specifically eastern Washington, began to grow as a result of NAFTA or other market factors, then there would be an increase in the use of I-90, I-82, and I-405.

Table 25 - EWITS: Lynden (South) Route Usage

Lynden	
EWITS (South)	
Highway	%AADT
I-5	100.00%
I-5 (only)	74.74%
US395	25.26%
I-90	20.13%
I-82	13.42%
I-405	6.71%

Sumas Crossing.--There has been a significant change in interstate travel crossing at Sumas. In EWITS, the level of interstate travel was roughly 28%, which increased to 42% ten years later. Furthermore, only two main arterials were used in EWITS, whereas in SFTA, I-5, I-405, I-90, I-82, and U.S. 12 were used. I-90 usage decreased from 28% to 15.5% over that time, indicating a broadening of traffic across the state.

Table 26 - EWITS: Sumas (South) Route Usage

Sumas	
EWITS (South)	
Highway	%AADT
I-5	100.00%
I-90	28.04%

Oroville Crossing.--As stated earlier, Oroville is the only border port that stands out as having the most similarities in arterial use. For this case, both EWITS and SFTA flows are shown in Table 27 for easier comparison. One notable difference, though, includes the dramatic increase in the level of crossings from almost 27,500 crossings in 1993 to 41,300 crossings in 2003.

Table 27 - EWITS: Oroville (South) Route Usage

Oroville		
	EWITS (South)	SFTA (South)
Highway	%AADT	%AADT
US97	100.00%	100.00%
I-90	35.58%	29.48%
US97 (only)	31.94%	35.54%
US2	25.97%	22.94%
US395	14.05%	23.40%
I-5	9.00%	5.35%
I-82	7.49%	3.38%
US12	4.99%	1.69%
I-405	2.02%	--

Laurier Crossing.--Laurier's arterial use was more diverse ten years ago than in the SFTA profile. The use of I-90 as an arterial appears to have decreased from 39% to 20% for the study years, though the level of traffic has increased considerably. There was a dramatic increase in the level of U.S. 395 Only usage from 14.4% to 63.6% over the decade. Implications from this would suggest that southbound movements have become more focused on supplying goods to the communities and region located around U.S. 395 in the northeastern part of Washington State (above I-90).

Table 28 - EWITS: Laurier (South) Route Usage

Laurier	
EWITS (South)	
Highway	%AADT
US395	100.00%
I-90	38.76%
US395 (only)	14.45%
I-82	6.37%
US2	3.29%
I-5	3.00%
I-405	3.00%
US12	1.72%
US97	1.65%

<u>Frontier Crossing</u>.--Frontier also has seen some dramatic changes in the usage of arterials. U.S. 395 usage decreased from 95% to 83%. Further investigation into the high level of U.S. 395 usage in EWITS shows that 78% of the total crossings have Spokane or Trentwood (a community east of Spokane) as a destination. However, ten years later, the level of trucks with destinations in the Spokane area was comparatively low (29.6%).

Table 29 - EWITS: Frontier (South) Route Usage

Frontier	
EWITS (South)	
Highway	%AADT
US395	94.93%
I-90	16.91%
I-5	2.54%
US12	2.54%

CHAPTER 3

FORECAST OF FUTURE TRUCK BORDER CROSSINGS: USING TRUCK CROSSING METHOD

Description

A ten-year forecast of the annual truck crossings was conducted, in order to better analyze the changing profiles of the border ports. Using time series data (1990-2005) gathered from the Whatcom County Council of Governments, Statistics Canada, and the United States Department of Transportation, bi-directional forecasts were developed by border port. Due to high variation in some of the border port locations, trend line analysis was used for the truck crossing method as an approximation of the growth or decline in the number of annual crossings. Compounded average annual percentage changes were determined for the forecasted period. These approximations are important because of their implications on safety, congestion and turnover time that may affect smaller border ports or ports that are nearing capacity. In addition, border ports that are not included in the analysis thus far are added in the truck crossing method section to represent an overall picture of future growth of truck transportation between Washington and British Columbia. The estimated annual average percentage increases by border port is located at the end of this section.

The focus of this chapter is to provide a basis to compare two different methods of projecting truck crossings. This first method uses only truck crossing data to create forecasts, whereas in the following sections, projections are made using a commodity trade growth (trade/profile) method. The comparison of the two methods is only conducted with the Blaine, Lynden, Sumas, Oroville, Laurier and Frontier border ports, due to data availability.

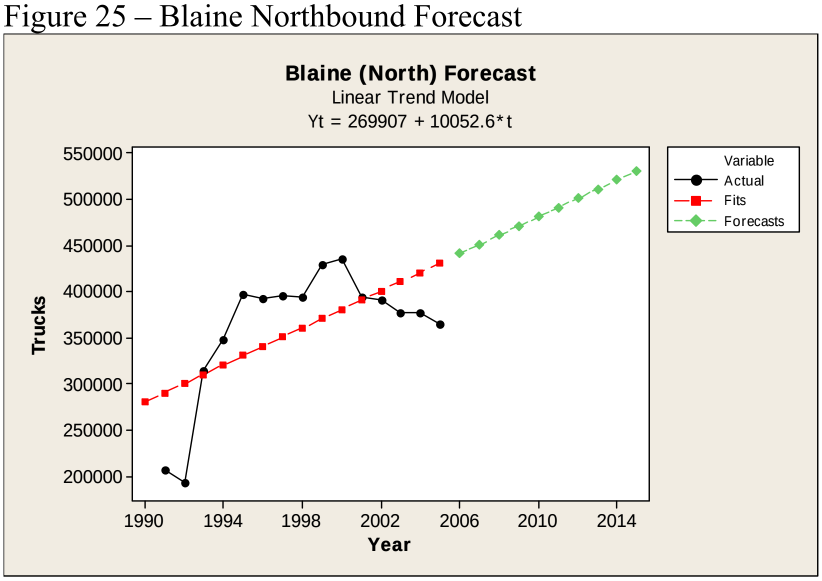
Northbound

Initial trend line analysis indicates only the Danville and the southbound Ferry border ports showed declining truck crossings. All others showed increasing truck crossings over the next ten years, though the variance from year to year differs greatly.

Blaine Crossing

Though Blaine has shown steady decline in the past 5 years, the overall trend estimates an increase in truck crossings at roughly 10,000 trucks per annum. Based on the trend line projection, by 2015, the level of truck crossings is expected to be in the neighborhood of 531,000 northbound crossings. The variability is discussed in Part III of the report.

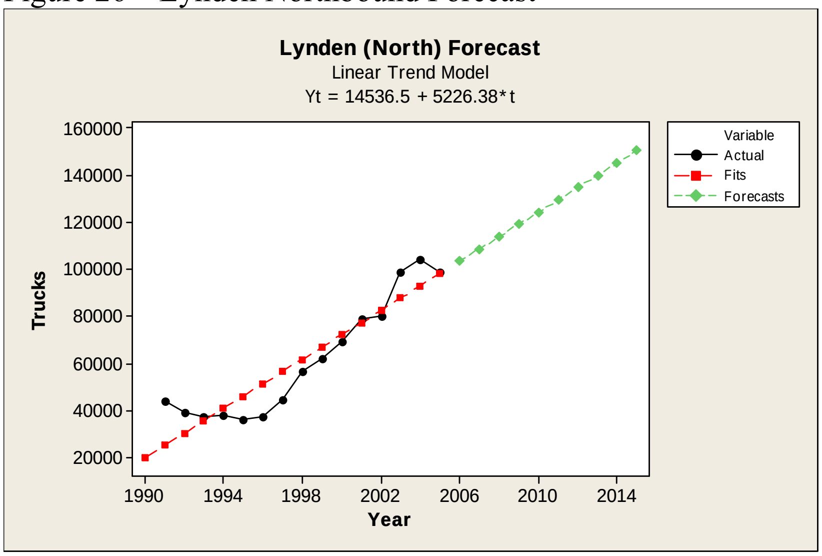
Figure 25 – Blaine Northbound Forecast



Lynden Crossing

The Lynden border port has shown steady increases in northbound truck crossings over the past decade. Based on the current trend, a yearly increase of 5,226 trucks is projected, resulting in 150,420 total yearly crossings by 2015.

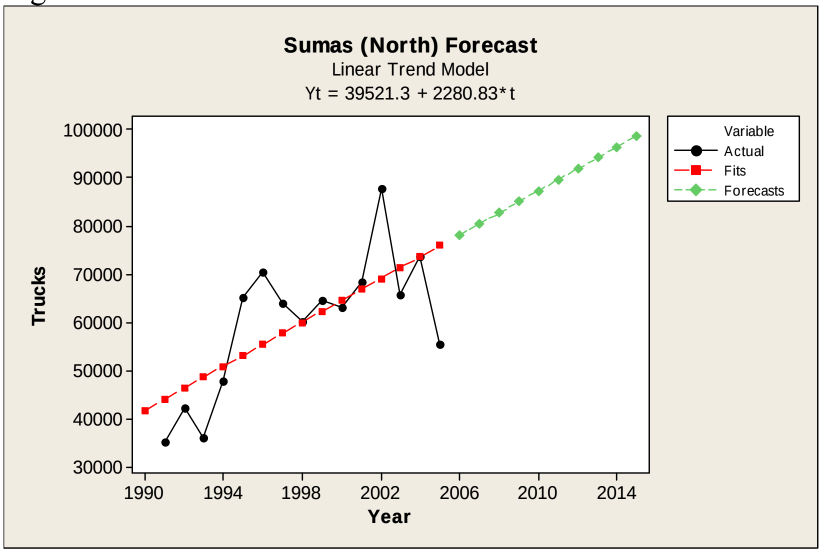
Figure 26 – Lynden Northbound Forecast



Sumas Crossing

Though the Sumas border port has a higher level of variance, there is still an upward trend. The projected level of truck crossings in 2015 is 99,000.

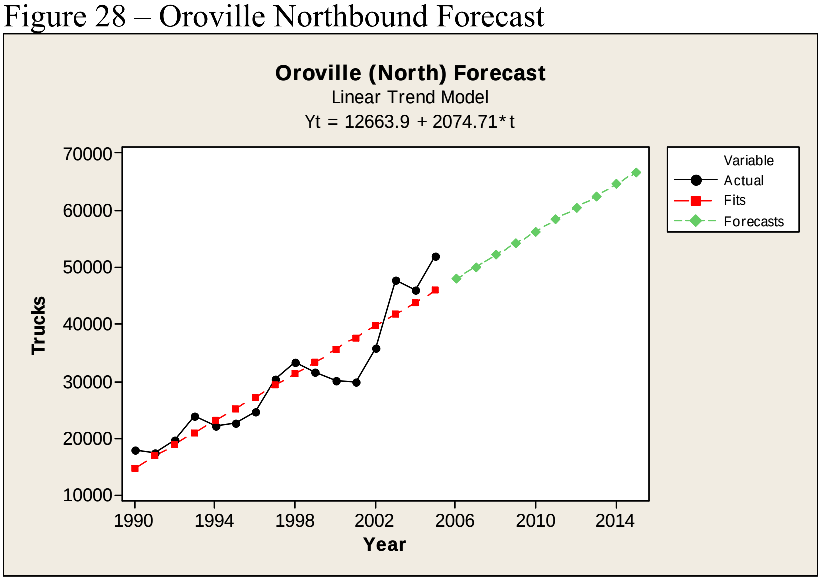
Figure 27 – Sumas Northbound Forecast



Oroville Crossing

Overall, the Oroville crossing shows a strong upward trend of almost 2,075 additional trucks per year. Given the current rate of growth, by 2015 the number of trucks crossing northbound is expected to reach 66,600.

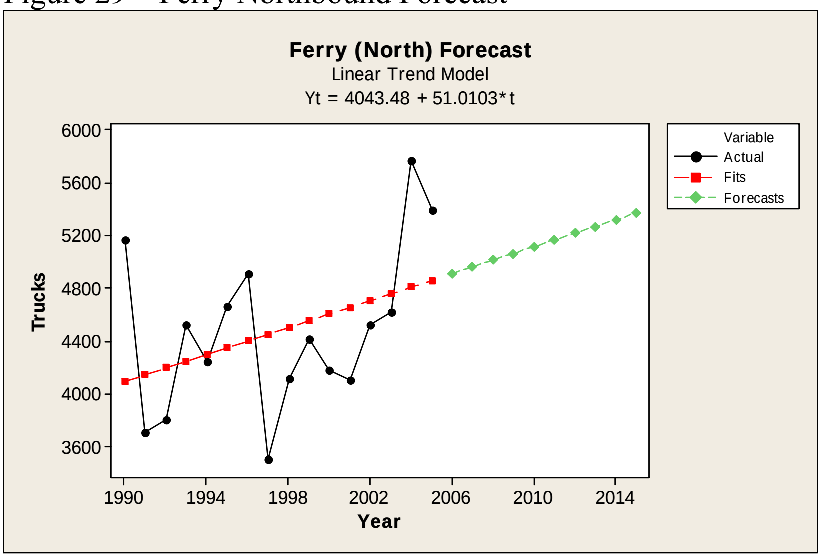
Figure 28 – Oroville Northbound Forecast



Ferry Crossing

Ferry is a small border port by comparison to many of the border ports represented in the analysis. However, with annual truck crossings ranging from 3,500 to 5,800, this constituted a significant enough level of truck traffic to warrant inclusion in the analysis. There is an expected growth rate of 51 trucks per year (noting a high level of variation). The number of crossings is expected to reach 5,370 by 2015.

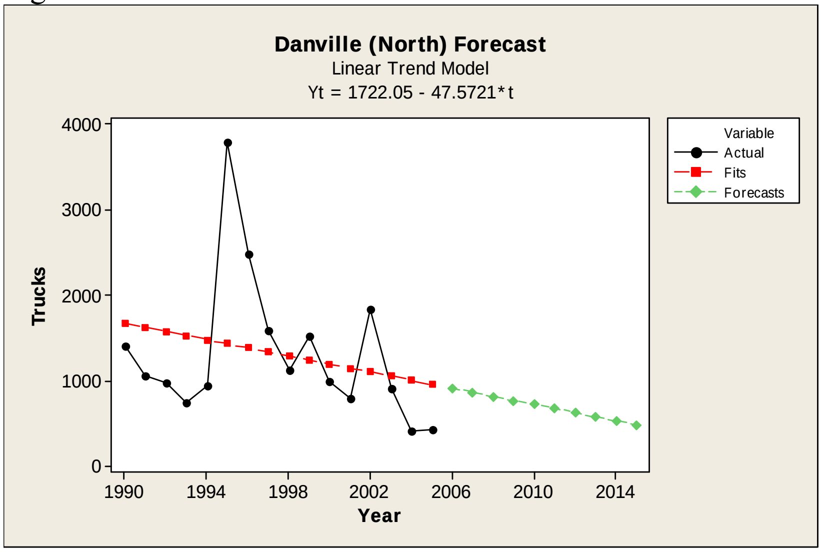
Figure 29 – Ferry Northbound Forecast



Danville Crossing

The Danville border port is the only border port that projects decrease in the number of truck crossings both northbound and southbound. As described in the port profile section, the most frequent commodities crossing at Danville was forestry and wood products. As a result, any changes in the forestry and wood products industry could adversely affect the level of crossings at Danville. There is an expected decrease of 47.5 trucks per year with roughly 485 trucks crossing by 2015.

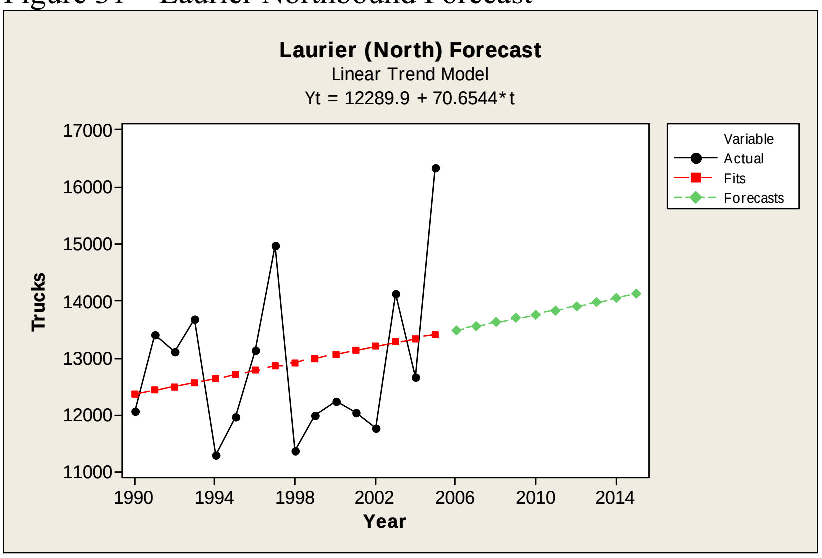
Figure 30 – Danville Northbound Forecast



Laurier Crossing

Though Laurier also has a high level of variation, there is still an expected growth of almost 71 trucks per year. By 2015 the predicted number of crossings is 14,127.

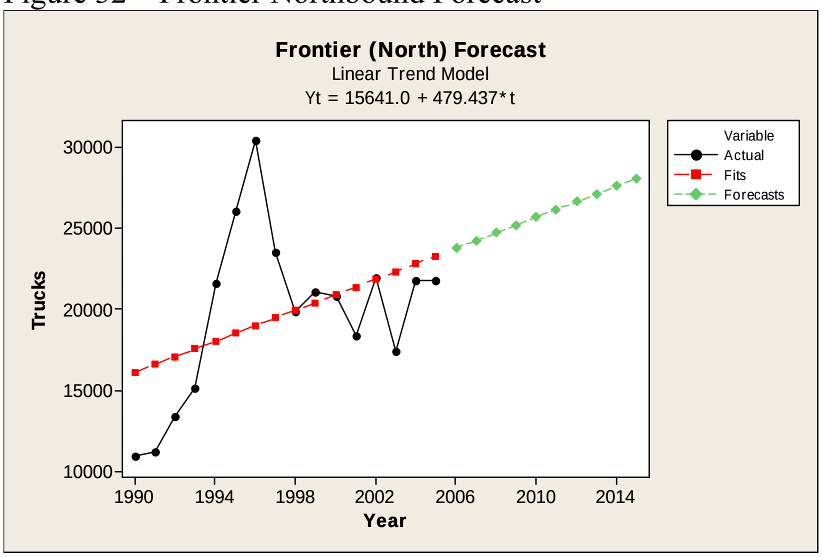
Figure 31 – Laurier Northbound Forecast



Frontier Crossing

Between 1990 and 1996, the Frontier border port experienced a very high level of truck crossing growth, followed by a sharp decline and then relative stagnant growth between 1999 and 2005. However, the over all trend shows growth of around 480 trucks per year with an estimated 28,100 trucks crossing by 2015.

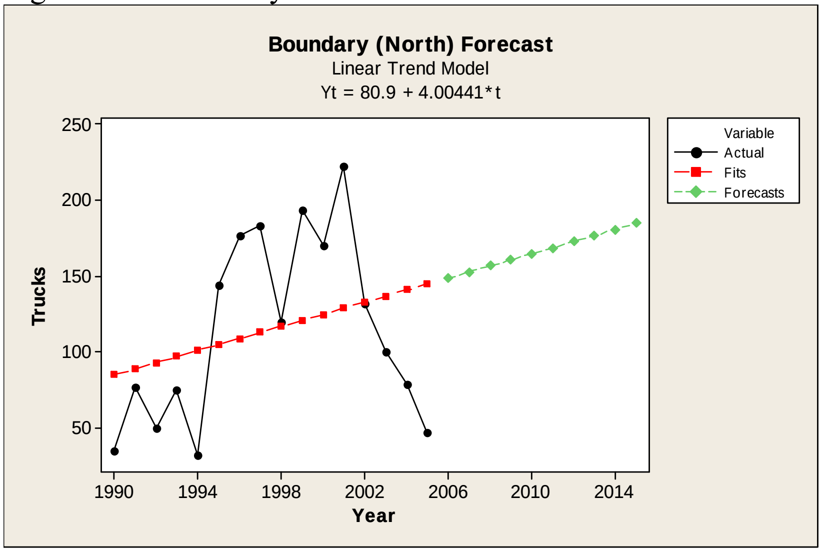
Figure 32 – Frontier Northbound Forecast



Boundary Crossing

Boundary's border port was especially difficult to predict future border crossings. The border port experienced off and on growth from 1990 to 2001. However between 2002 and 2005 the number of truck crossings has decreased back down to 1990 levels. The overall trend still shows growth, but given the trend over the last 4 years, it is difficult to determine if there will be continued growth. Nevertheless, Boundary is the smallest of the border ports analyzed, whose annual average daily number of crossings is less than one truck, yielding a predicted level of growth of 4 trucks per year, with 185 truck crossings by 2015.

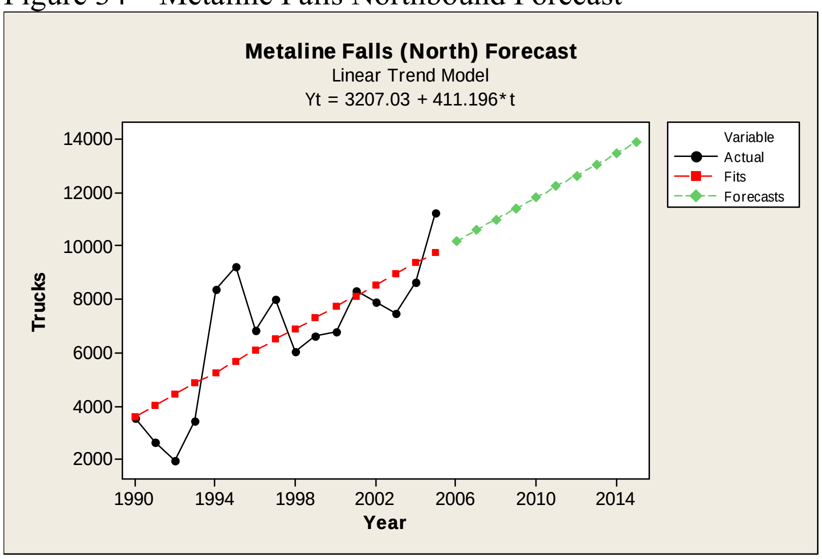
Figure 33 – Boundary Northbound Forecast



Metaline Falls Crossing

Metaline Falls, the last eastern border port in eastern Washington, shows relatively strong growth over the next ten years with a projected growth of 411 trucks per year. The expected number of truck crossings by 2015 is 13,900 trucks.

Figure 34 – Metaline Falls Northbound Forecast

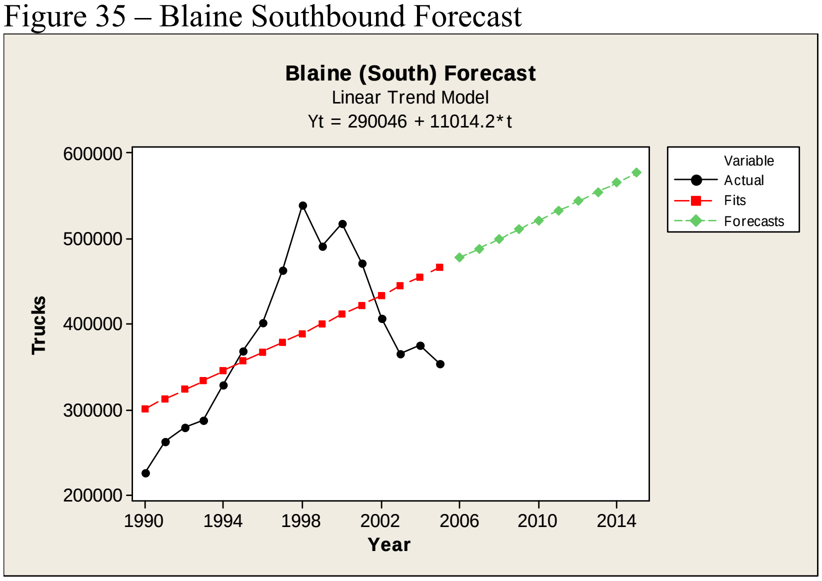


Southbound

Blaine Crossing

The largest border port in Washington has seen significant fluctuation in truck crossings over the past 16 years. In the early days of NAFTA and CAFTA there was an explosion of trade and border crossings, increasing almost 140% from 226,773 truck crossings in 1990 to 539,306 crossings in 1998. However, after 1998 the number of crossings declined to 354,264 by 2005. The overall trend predicts that there will be a yearly increase of 11,014 crossings, though this would require a directional change in the current downward sloping trend. Rationale for the decrease is discussed later.

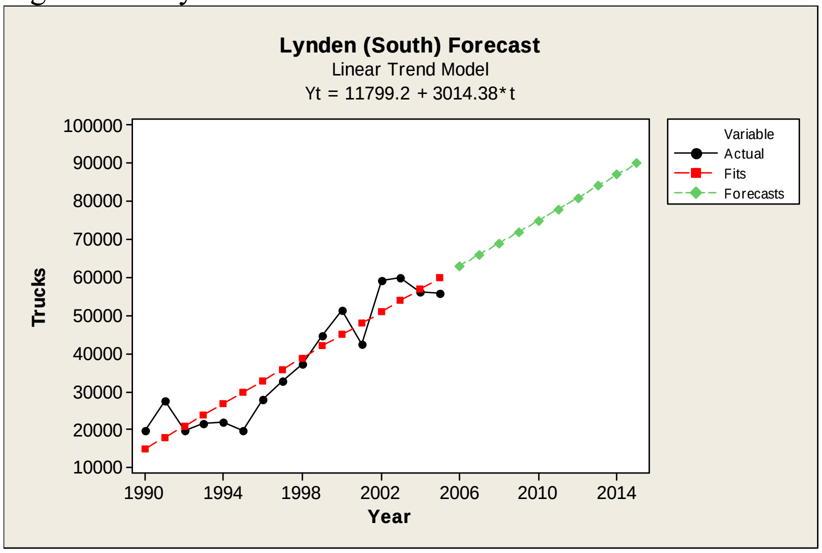
Figure 35 – Blaine Southbound Forecast



Lynden

Lynden has had a steady growth rate for the past 16 years. The predicted number of increased annual truck crossings is 3,014 per year. If Lynden border crossings follow the predicted path, roughly 90,200 crossings are expected by the year 2015.

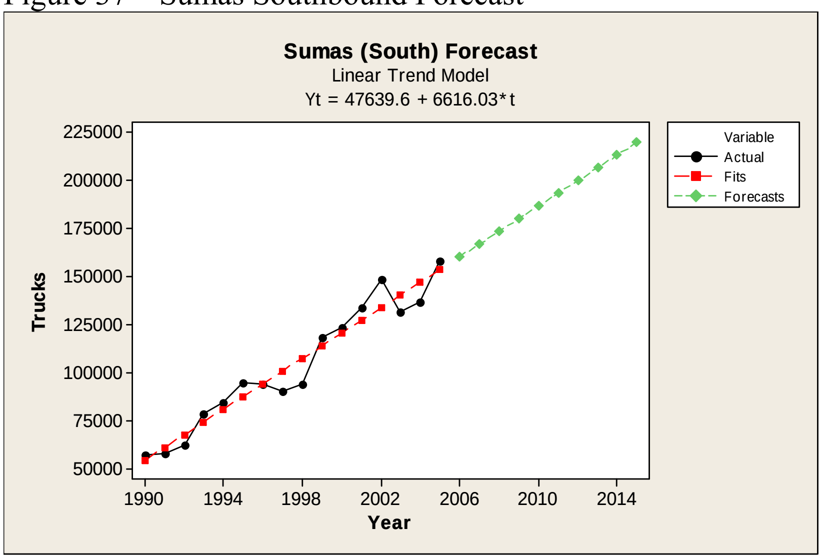
Figure 36 – Lynden Southbound Forecast



Sumas

Sumas has also followed a low variance growth path and is predicted to continue its growth of 6,616 additional truck crossings per year. At this growth rate, the predicted number of crossings is 219,650 by 2015.

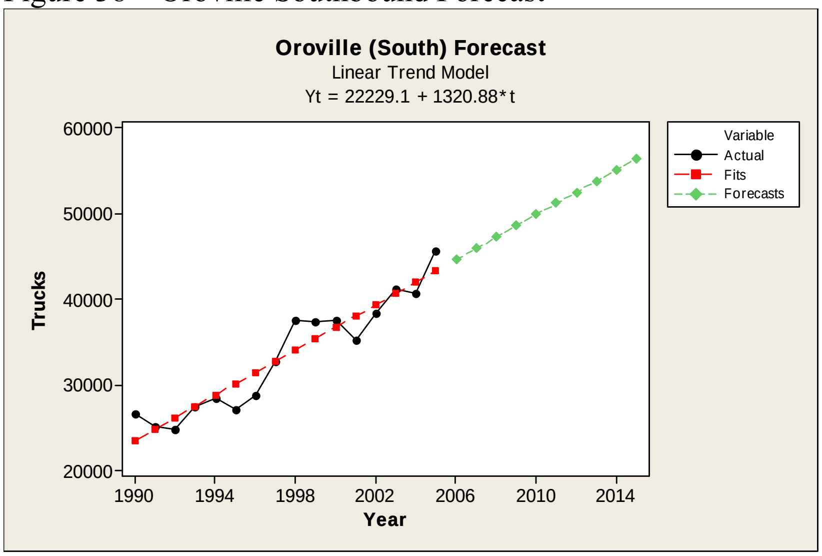
Figure 37 – Sumas Southbound Forecast



Oroville

Oroville also has a low variation growth pattern, predicting a 1,321 yearly increase in the number of truck crossings. The expected number of crossings in 2015 is 56,570.

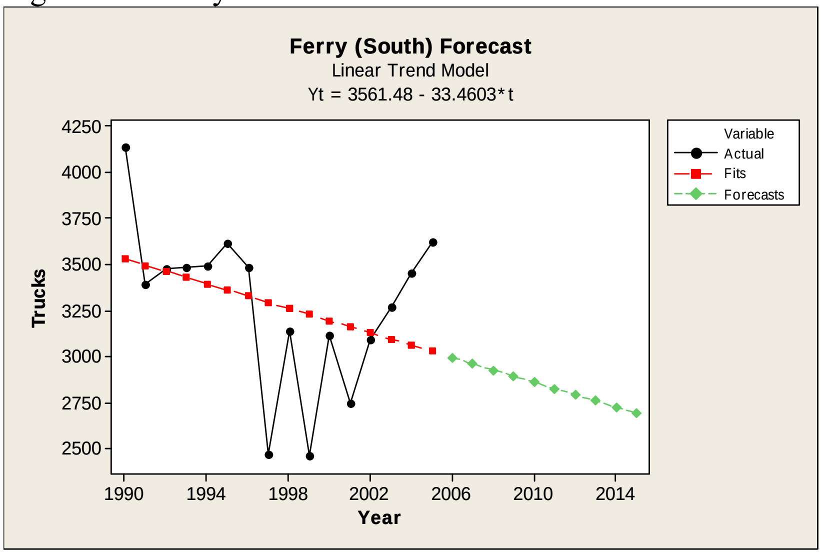
Figure 38 – Oroville Southbound Forecast



Ferry

Ferry traffic appears to be decreasing with bouts of extreme relative variability. The variability is greatest between 1996 and 2002, starting from as high as 3,484 and decreasing to a low of 2,461. Currently, the latest trend appears to be upward sloping, which conflicts with the direction of the overall trend line. However, the predicted trend using this methodology is a 33.5 truck crossing decrease per year.

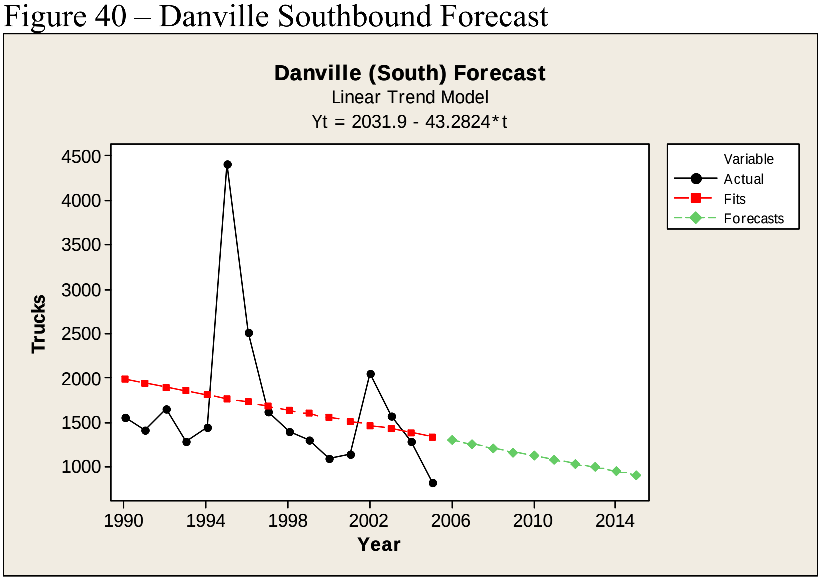
Figure 39 – Ferry Southbound Forecast



<u>Danville</u>

The southbound crossings at the Danville border port are closely related to the northbound crossings. The overall trend is downward sloping, indicating that the future use of the border port by trucks will decrease by 43 trucks per year. The predicted number of crossings in 2015 is 907 trucks.

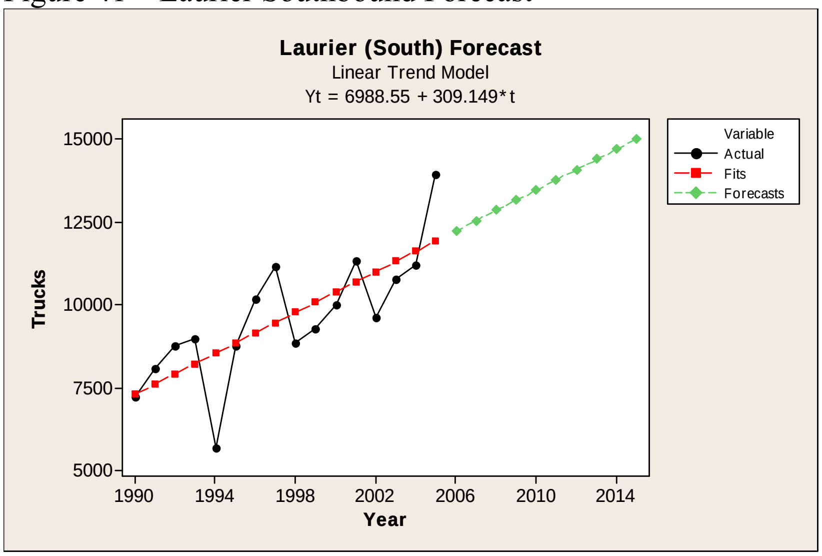
Figure 40 – Danville Southbound Forecast



Laurier

Though the border port has significant variation, the overall trend at Laurier is upward sloping, showing a yearly increase of 309 truck crossings. The predicted number of crossings in 2015 is 15,026 trucks.

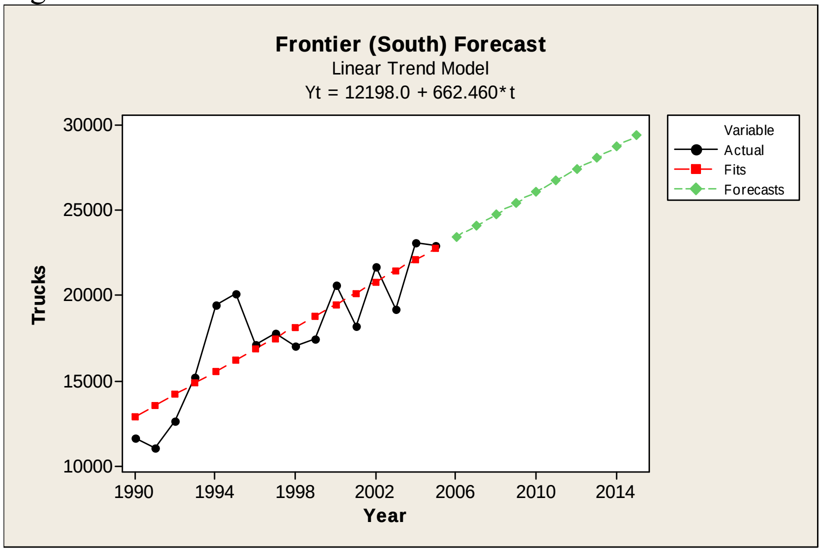
Figure 41 – Laurier Southbound Forecast



Frontier

Frontier has had steady growth in the number of southbound truck crossings. The predicted growth rate of crossings at the Frontier border port is 662 trucks per year. Barring any externalities affecting the chemical fertilizer and the zinc & lead industries, this growth rate is expected to hold.

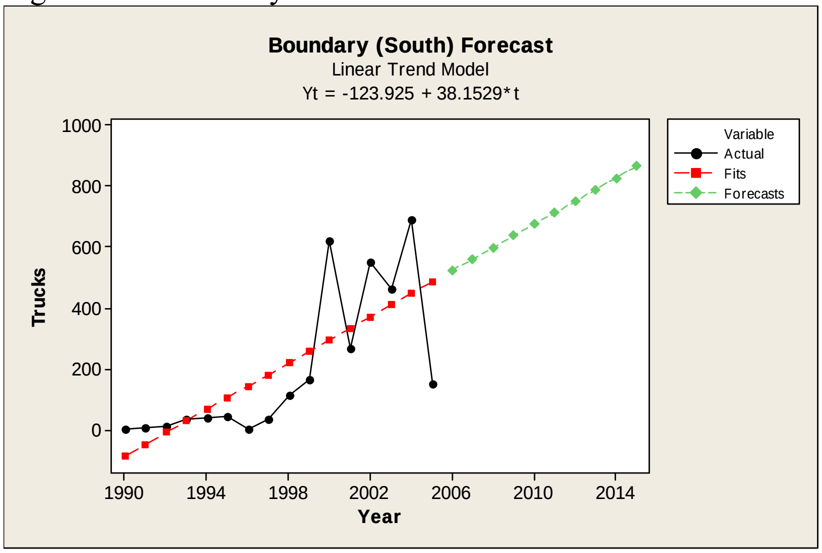
Figure 42 – Frontier Southbound Forecast



<u>Boundary</u>

The number of truck crossings at the Boundary border port also has a high level of variation. Between 1990 and 1999 there was mild annual growth in the number of crossings. Between 2000 and 2005, the number of crossings became highly variable. Overall, the current trend still shows an increasing number of crossings annually. The predicted annual increase in crossings is 38 trucks, with an expected 868 annual truck crossings by 2015.

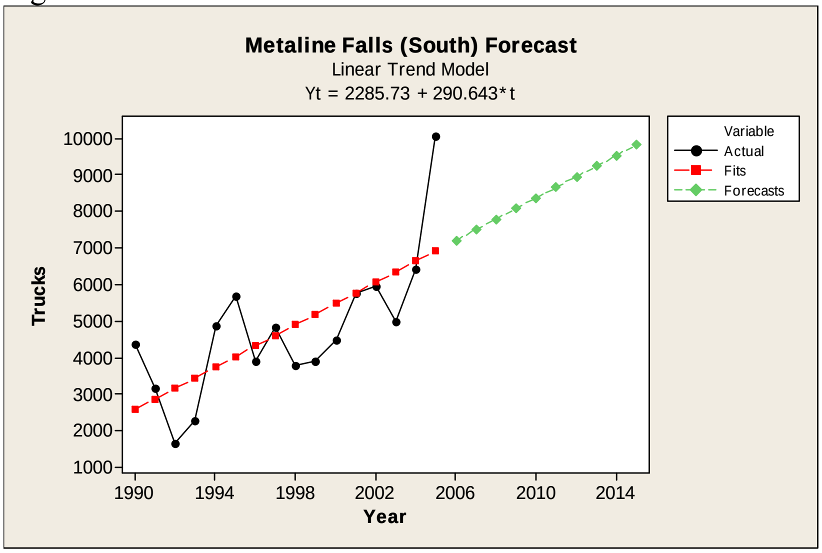
Figure 43 – Boundary Southbound Forecast



Metaline Falls

Metaline Falls also has significant variation; however, the variation still allows for some predictability. The border port has had steady growth overall, and has seen rapid growth in the number of truck crossings over the last 3 years, moving from 4,973 in 2003 to 10,084 in 2005. The predicted growth is 291 trucks per year. The estimated number of crossings by 2015 is 9,842. This value is lower than the 2005 value because currently the number of crossing in 2005 is viewed as an outlier.

Figure 44 – Metaline Falls Southbound Forecast



An overall summary of the growth across all the border ports can be seen in Table 30. As described in the methodology, these growth rate values provide the basis for comparison of the trade/profile method. As stated earlier, only Blaine, Lynden, Sumas, Oroville, Laurier, and Frontier are evaluated for truck crossings due to lack of available data.

Table 30 – Border Port Ten Year Annual Growth Rates

Border Port Growth		
Port	**Northbound**	**Southbound**
Blaine	1.88%	1.90%
Lynden	3.82%	3.64%
Sumas	2.36%	3.21%
Oroville	3.34%	2.39%
Ferry	0.90%	-1.06%
Danville	-6.10%	-3.51%
Laurier	0.46%	2.07%
Frontier	1.68%	2.29%
Boundary	2.19%	5.16%
Metaline Falls	3.14%	3.14%

Implications for Border Ports

Based on the truck crossing model, most border ports are expected to grow over the next decade. With average annual increases ranging from 2,000 to 10,000 trucks per year for major Washington and British Columbia border ports, congestion, security, and safety may become key issues to address in the near to medium future. Furthermore, the small eastern Washington border ports analysis suggest possible declines in future truck crossings. This may be the result of higher volatility in trade occurring through the specific ports. Also, as more efficient routes or means of transportation are utilized, crossings may diminish. In addition, changing market conditions for communities located near the small border ports could affect the level of cross-border trade.

The next sections will take these projections several steps further by analyzing and estimating the future growth in trade by commodity and weighting the trade growth by port profiles to determine differences in the above estimated growth in truck crossings.

CHAPTER 4

TRADE AND INDUSTRY ANALYSIS

Description

Chapter four focuses on the historic trade levels between Washington and Canada and the economy of the industries trading between Washington and British Columbia at a commodity level. More specifically, the focus is on the top industries and top commodities traded in the port crossing profiles that comprise the bulk of the border crossings both northbound and southbound. In Chapter 5, estimates from the trade/profile method on the future growth of truck crossings are presented.

Trade Analysis

Utilizing the northbound and southbound profile description of each border port, an analysis of industry trade and trade growth projections further refined the overall truck crossing expectations for individual ports. In other words, knowing the projected trade of certain industries allowed an additional component to be added to the border crossing projections from Chapter 3, namely growth or decline in traded commodities (weighted by the profile for each port) being transported. For example, the Oroville (northbound) border port has an annual projected border crossing growth rate of 2.4%. The annual trade projection of wood products is 0.81% between Washington and Canada. One could then expect that in the future, the percentage of wood products crossing northbound would decrease relative to the remaining port profile. This next section provides the analysis results for future trade of commodities, focusing on trade moving between Washington and Canada.

Commodities were re-categorized from 3-digit NAICS to HS-2 (Harmonized System Codes) classifications because available trade data was categorized in HS codes. Furthermore, some similar commodities such as raw iron and steel, as well as manufactured iron and steel products are combined together. The goal was to investigate which commodities were increasing rapidly in trade and which were decreasing or remaining stagnant.

From the border port descriptions above, and based on the top five listings for each border port, nine commodity categories were selected to project future trade in U.S. dollars. The categories and the set of HS codes used were:

Food Products (HS01-24)
Chemical Products (HS28-38)
Plastics & Rubber (HS39-40)
Wood Products (HS44-47)
Paper Products (HS48)
Metals (HS72-83)
Non-Metallic Mineral (HS25-27 & 68-71)
Transportation Equipment (HS86-89)
Machinery / Electrical (HS84-85)

Northbound Washington to Canada

An analysis of Washington to Canada trade determined the expected growth of truck crossings. The source for trade data used was STAT-USA, a part of USA Trade Online. The source compiles data from the U.S. Census Bureau's Foreign Trade Division.[8] The trade data includes all modes of transportation; however, growth in trade

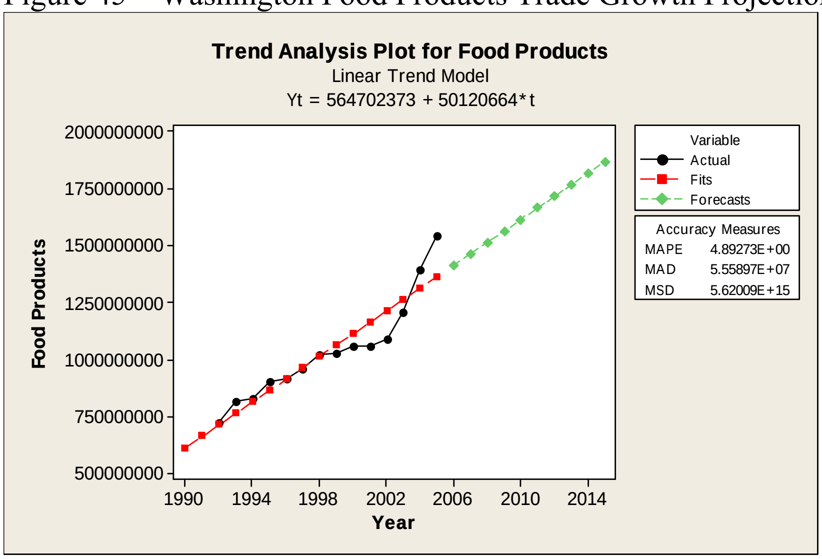
[8] The trade values are in fixed-weighted constant dollars from 1990-2003, and then in April 2003 the Census Bureau began publishing values in a chained-dollar series.

by commodity, regardless of mode can be translated into truck crossing growth. This is based on the assumption that the percentage growth in trade is equal to the percentage growth in truck crossings.

Some commodities have high variation in the year to year changes of trade amounts. As a result, the level of confidence in the future projections changes, based on the products.

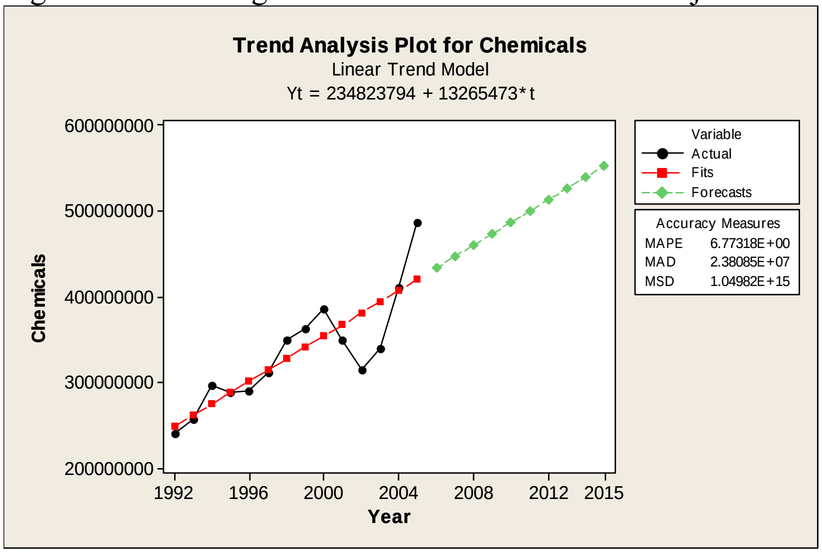
For the food products there is relatively stable growth in northbound trade. In Figure 45, the 10-year compounded annual average trade growth rate was estimated at 2.89%

Figure 45 – Washington Food Products Trade Growth Projection



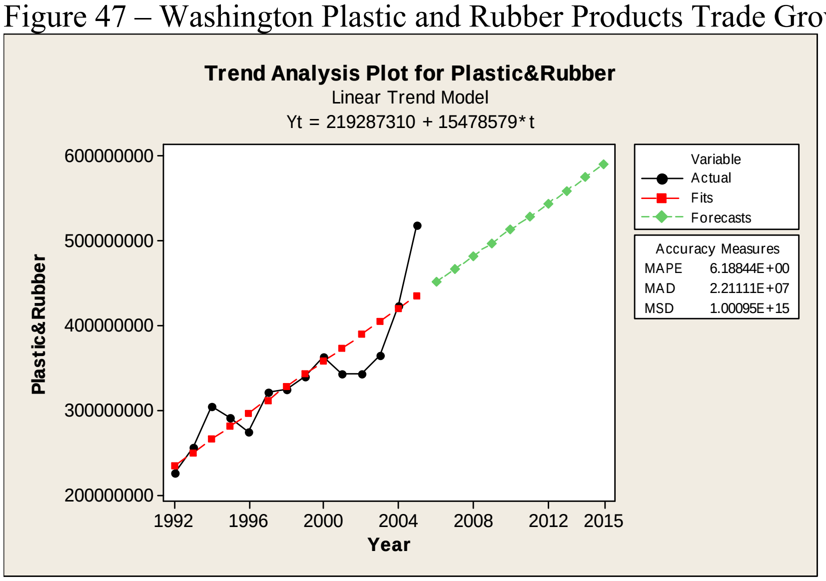
The current trend for chemical products in Figure 46 shows consistent growth between 1990 and 2005. The current rate of growth over the next 10 years was estimated at 2.46%

Figure 46 - Washington Chemicals Trade Growth Projection



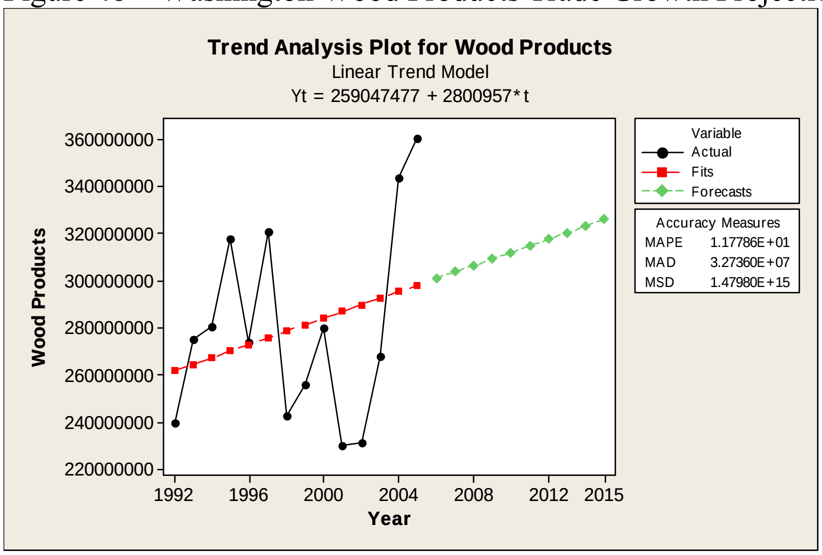
Though there has been consistent growth in the plastic and rubber trade, as seen in Figure 47, the last three years have seen a high level of growth. Nevertheless, the estimated rate of growth in trade for the next 10 years was 2.73%.

Figure 47 – Washington Plastic and Rubber Products Trade Growth Projection



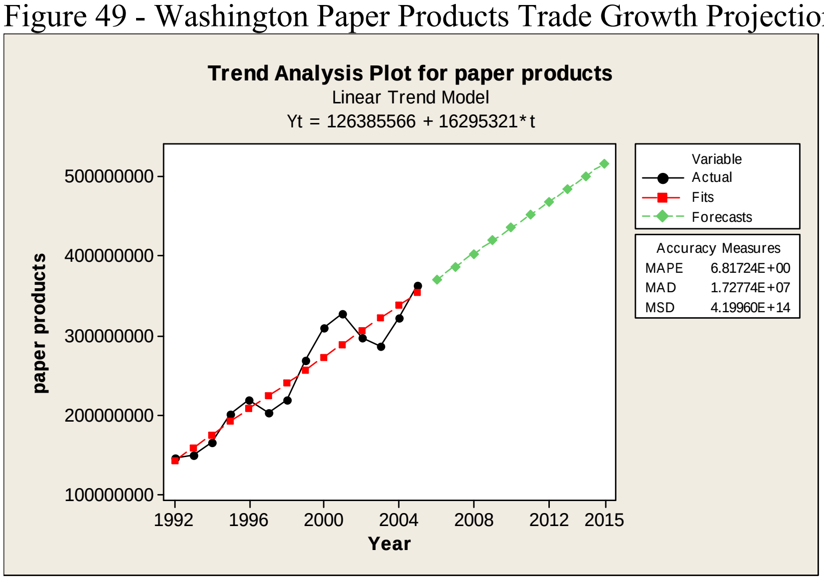
Market and policy changes can have significant impacts on the level of trade. This is evident by the strong increases and decreases in the level of wood products trade between Washington and Canada seen in Figure 48. Based on the data the predicted annual rate of growth was 0.81%.

Figure 48 – Washington Wood Products Trade Growth Projection



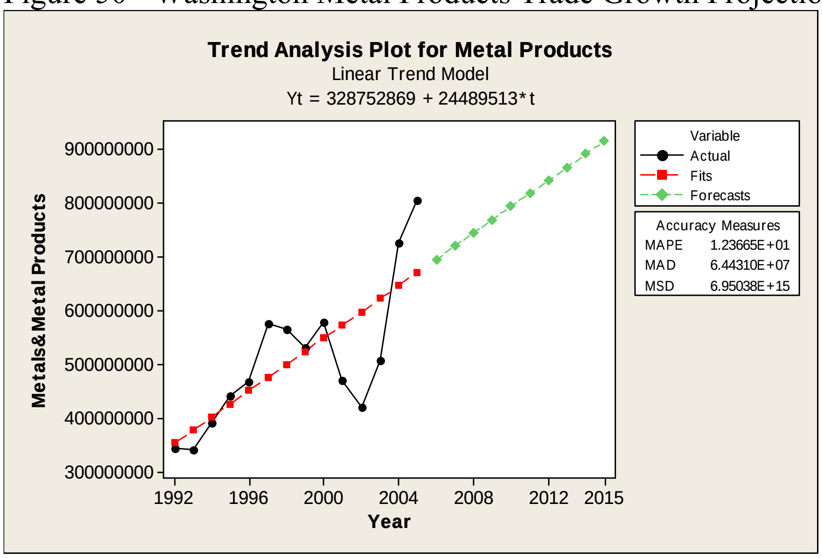
The paper products industry has seen consistent growth in trade. The predicted rate of annual growth in Figure 49 was 3.39%.

Figure 49 - Washington Paper Products Trade Growth Projection



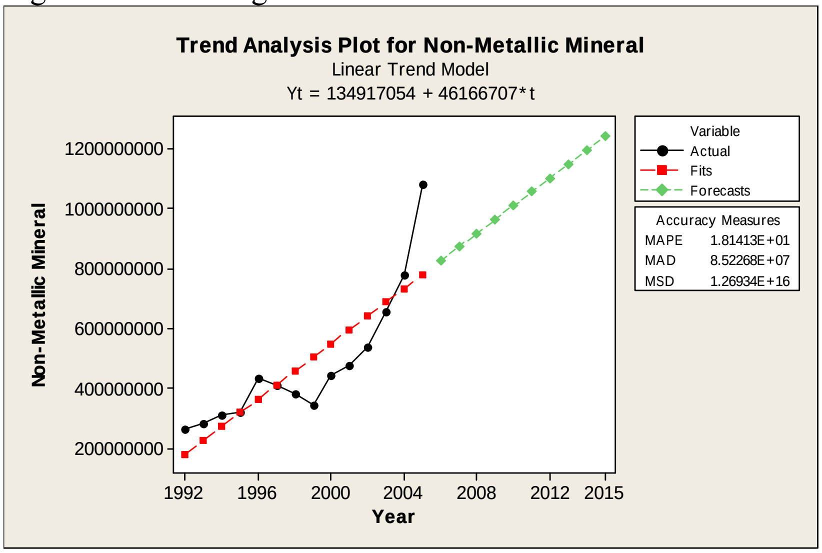
The metals and metal products industry combines HS categories 72-83. From part one this is the equivalent to the combination of the primary and fabricated metal categories. There was a strong drop in northbound trade between 2000 and 2002 as seen in Figure 50. That decline aside, there has been a steady increase in trade in the metals category. The estimated average annual growth is 2.78%.

Figure 50 - Washington Metal Products Trade Growth Projection



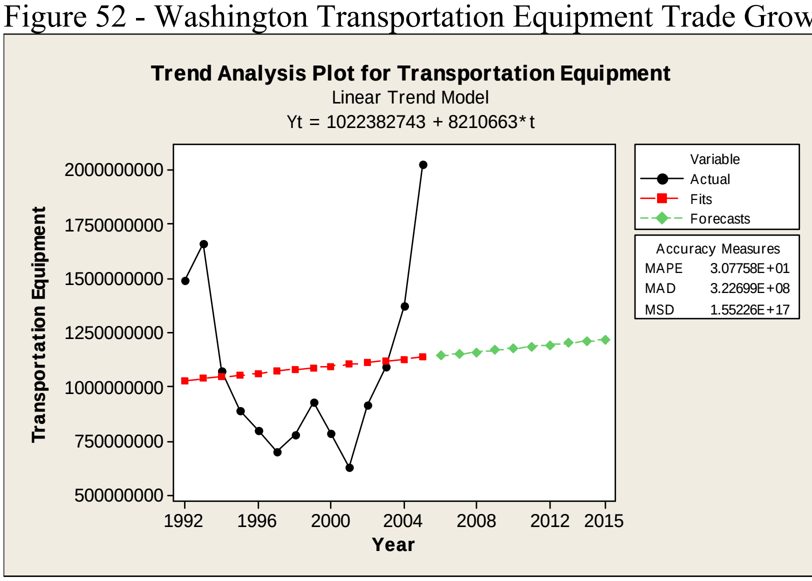
Non-Metallic mineral products (Figure 51) have seen the largest growth in northbound trade. The predicted average annual growth rate is 4.15%.

Figure 51 - Washington Non-Metallic Mineral Products Trade Growth Projection



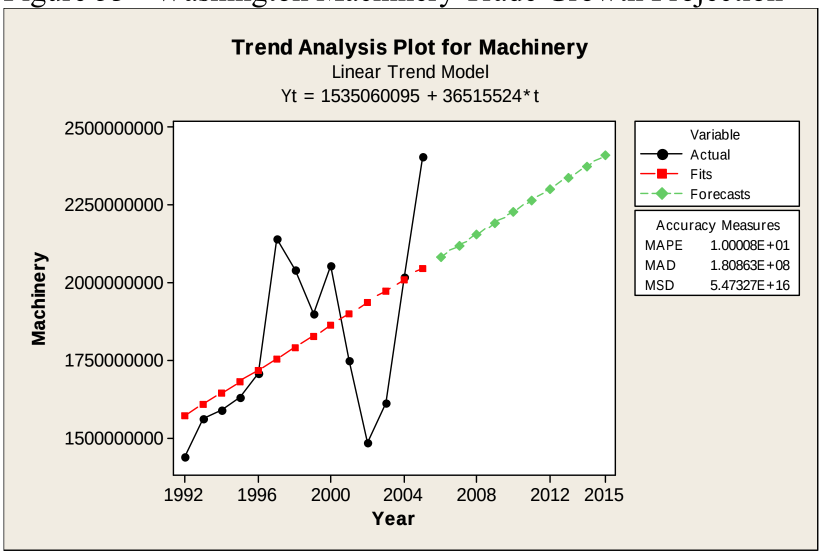
Transportation equipment experienced a large decrease in the level of trade between 1993 and 2001 (see Figure 52). This decrease averaged 10.2% per year until 2001. However, between the interval 2001 and 2005 there has been an explosive average increase of 26.4% per year. Given this data and the observably high degree of variation over the past 13 years of transportation equipment trade, future predictions are difficult to make, but an average annual increase of at least 0.62% until 2015 is expected.

Figure 52 - Washington Transportation Equipment Trade Growth Projection



Machinery also had a lot of volatility in trade over the past 14 years (see Figure 53). Over the past four years, trade in machinery increased on average 12.8% per annum. However, given sharp declines between 1997 and 2002, the overall predicted annual average increase is 1.47%.

Figure 53 - Washington Machinery Trade Growth Projection

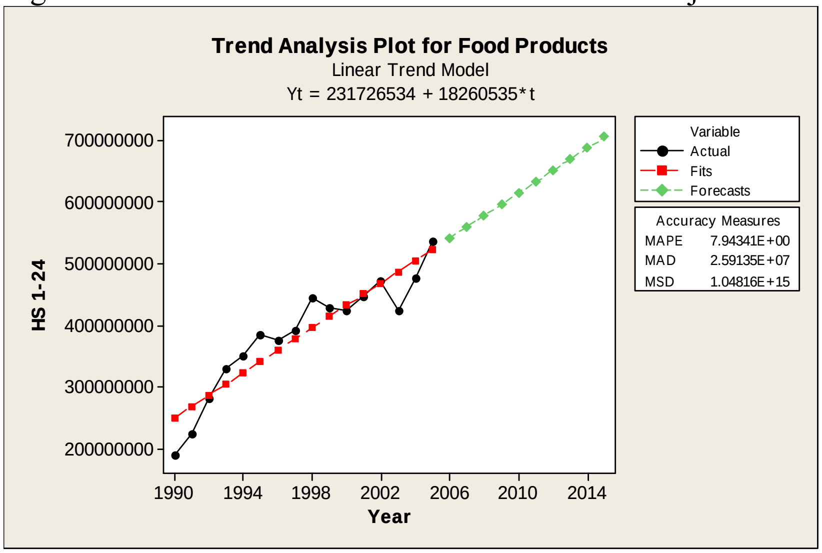


<u>Southbound Canada to Washington</u>

Southbound trade data was also collected from STAT-USA. Values are in constant dollars. As with the Washington to Canada data, some commodities have high year to year variation, thereby changing the level of confidence in future projections.

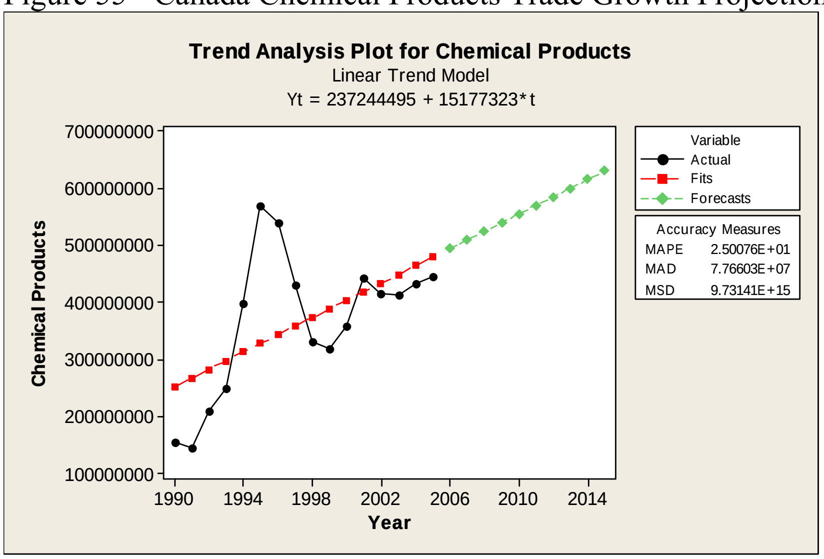
Food products had a steady increase in trade of roughly $18,260,535 per year and a projected average annual growth rate of 2.68%. Given the consistent growth of the overall food products industry, which includes agriculture raw products, processed food, fats, oils, and beverage products, there is an expectation of continued growth (see Figure 54).

Figure 54 – Canada Food Products Trade Growth Projection



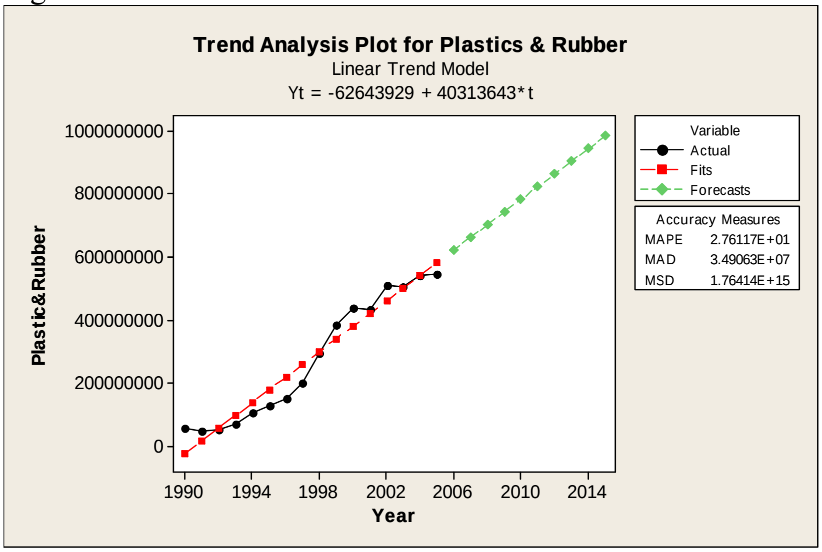
Chemical products have had steady overall growth, except for the four periods of rapid increased growth and decline from 1994-1999. The average annual increase in trade is estimated at 2.46% (see Figure 55).

Figure 55 - Canada Chemical Products Trade Growth Projection



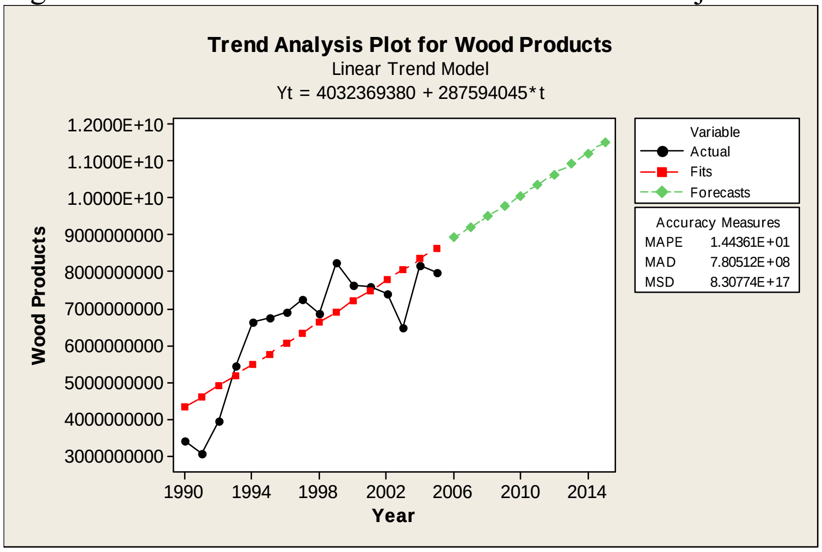
Plastic and rubber products have seen very consistent increases in trade over the past sixteen years, as seen in Figure 56. An expectation of 4.70% average annual growth over the next decade is indicated.

Figure 56 - Canada Plastic and Rubber Products Trade Growth Projection



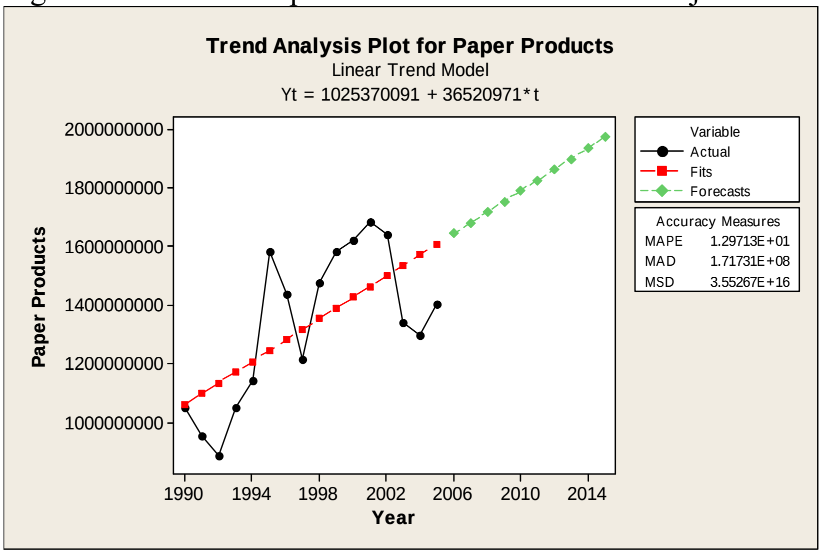
Though the level of trade in wood products has had recent variation increases, an overall trend of 2.58% is projected from Figure 57.

Figure 57 - Canada Wood Products Trade Growth Projection



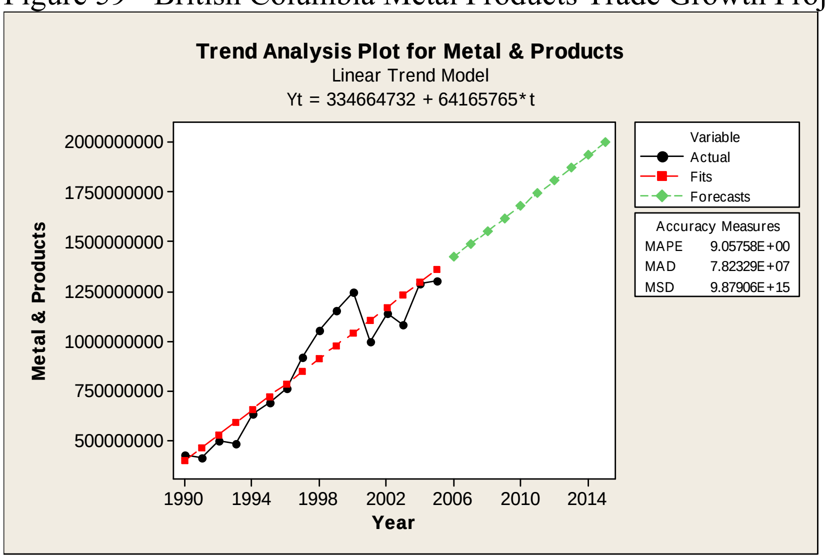
Paper products trade also appears to be volatile (see Figure 58); possibly stemming from timber prices, exchange rates, and/or market changes. However, an average annual increase of 1.84% is expected over the next ten years.

Figure 58 - Canada Paper Products Trade Growth Projection



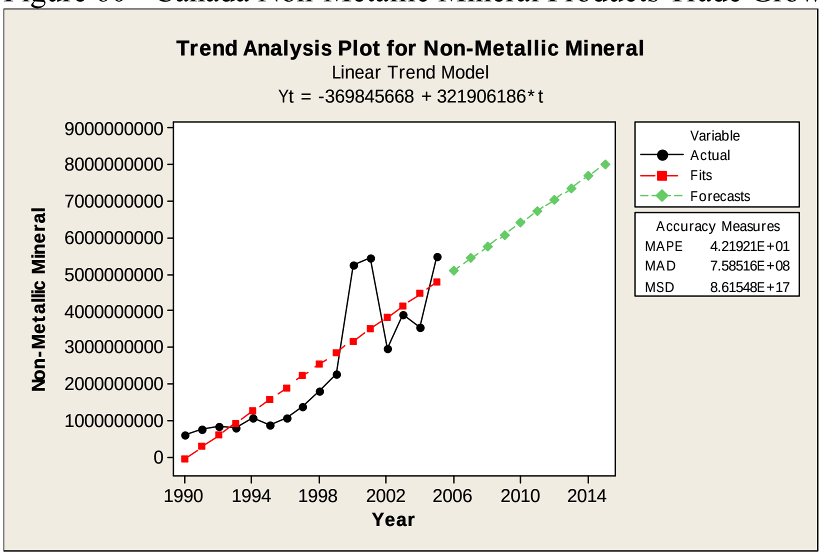
Southbound trade in metal products has seen steady increases over the past sixteen years (Figure 59). The average annual growth in trade is expected to be 3.46%.

Figure 59 - British Columbia Metal Products Trade Growth Projection



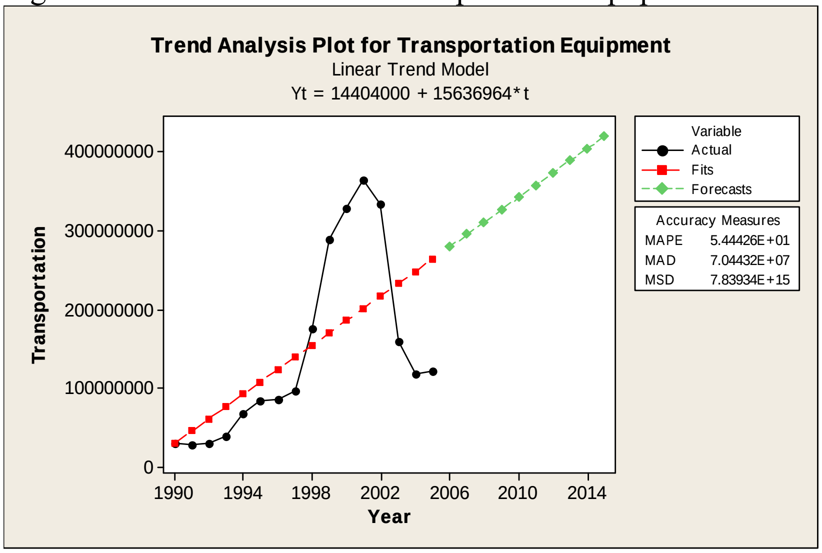
Though there appears to be increased variation in the latter years (see Figure 60), non-metallic minerals is expected to have a relatively high growth rate. The average annual rate of growth is projected at 4.60%

Figure 60 - Canada Non-Metallic Mineral Products Trade Growth Projection



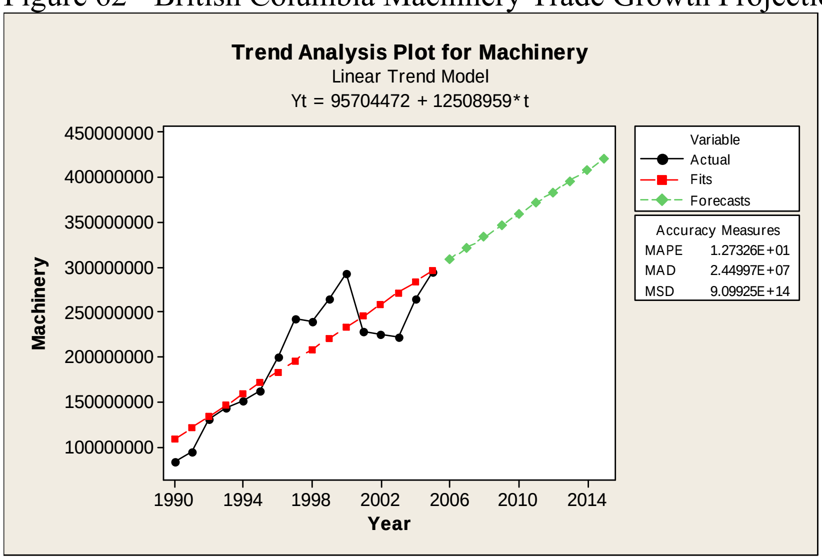
The overall growth rate of transportation equipment is strongly upward sloping (Figure 61). However, given the trend over the past five years and the high variability, this overall trend may be overstated. The projected and utilized trend is 4.15%. The reasoning is based on the growth of the Canadian transportation equipment industry as seen in the next section.

Figure 61 - British Columbia Transportation Equipment Trade Growth Projection



The projected rate of trade growth for machinery and electrical equipment is 3.16%, though there is more variation in trade in the latter years (see Figure 62).

Figure 62 - British Columbia Machinery Trade Growth Projection



Due to a low response rate, the interviews with industry personnel provided little insight for long-run trade projections of commodities. However, basic conclusions for two of the evaluated commodities were made. First, chemical products, including fertilizers, pesticides, adhesives, resins, paints, soaps and detergents, and other miscellaneous chemicals, appear to be on a steady trade growth path, which supports the projected trade growth. Second, the wood products industry and southbound trade which include lumber, plywood, manufactured homes, trusses, wood containers, pallets and other miscellaneous wood products, may be slightly overestimated based on historical data. Current market conditions are expected to decline in the short to medium run. However, no adjustments to trade growth have been made because of lack of information for long-run projections.

Industry Analysis

With the above future aggregate commodity trade, an analysis of the representative trading industries will provide evidence and support for the use of the trade projections. In other words, the industry analysis investigates and projects future output growth within the trading industries. The argument for this investigation was based on the premise that if industry output is not increasing, then the likelihood of trade growth diminishes. Furthermore, the industry analysis creates more understanding and insight for the traded commodities.

U.S. Industry

The U.S. industry analysis used data provided by the Bureau of Economic Analysis (BEA). Industry output time series data (in chain type quantity index for gross output)[9] was collected from 1987 to 2005. Industries showed relatively consistent output growth based on the trend analysis, except paper products and electric products (BEA,

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[9] For methodology used by BEA, see Appendix B.

2006). However, the paper and electronic product industries comprised a low level of truck crossings in the port profiles, thereby creating less of an impact on overall trade and traffic growth. Food products, transportation equipment, chemicals, and plastic and rubber products show strong growth and relative stability (BEA, 2006). Table 31 shows the ten year average compounded output growth rates for the evaluated industries.[10]

Table 31 – Compounded Annual Growth Rates for U.S. Industries

Commodity Group	United States
Food	1.72%
Chemicals	2.45%
Plastics & Rubber	2.64%
Wood	2.59%
Paper	1.54%
Metal	1.86%
Non-Metallic Mineral	2.35%
Transportation Equipment	2.22%
Machinery/Appliance	1.95%

Figures (63-71) provide a visual of the consistencies in output growth for the cited industries.

[10] The growth rates in the table are gross output growth rates, and not chain-type quantity output growth rates.

Figure 63 – U.S. Food Products Growth

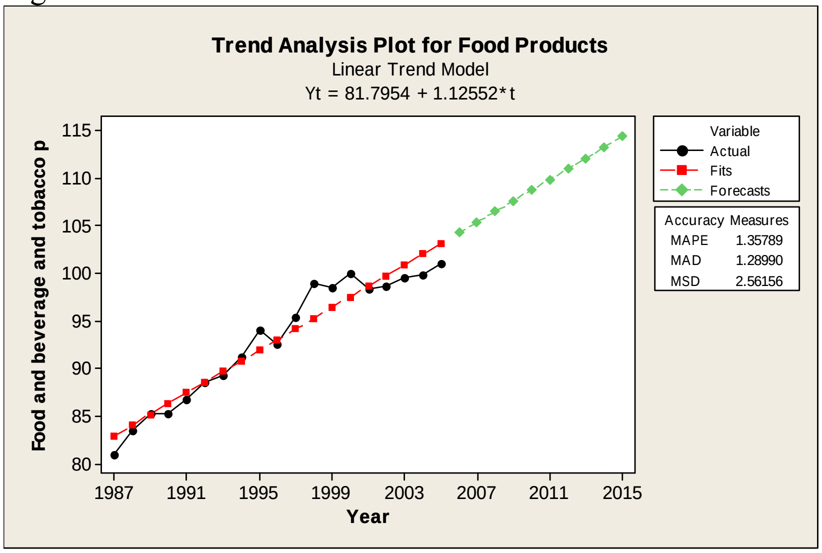


Figure 64 – U.S. Wood Products Growth

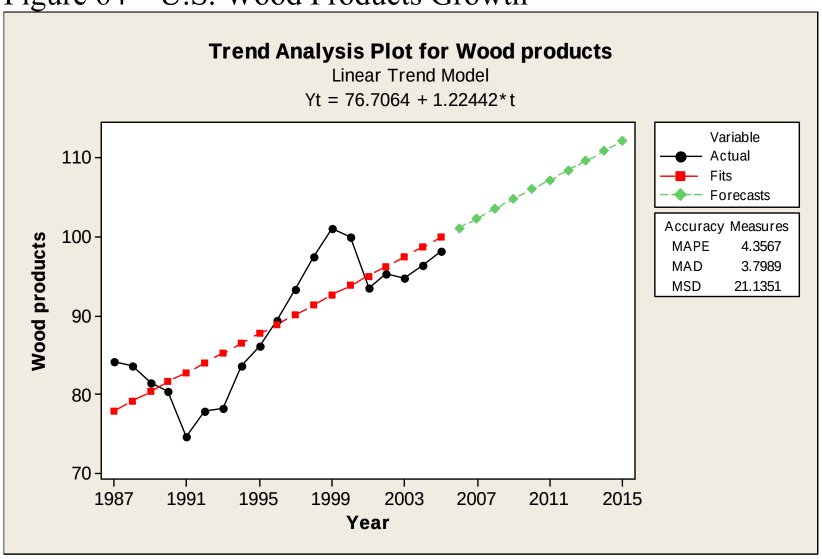


Figure 65 – U.S. Non-metallic Mineral Products Growth

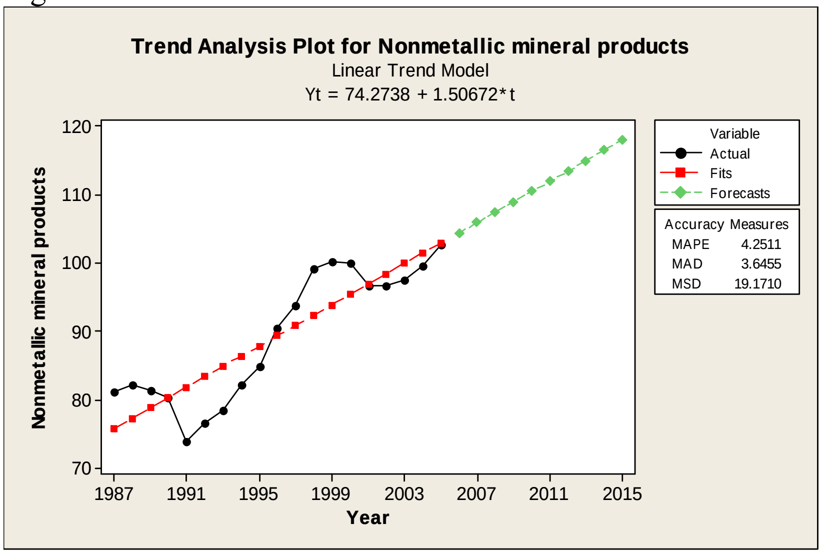


Figure 66 – U.S. Metal Products Growth

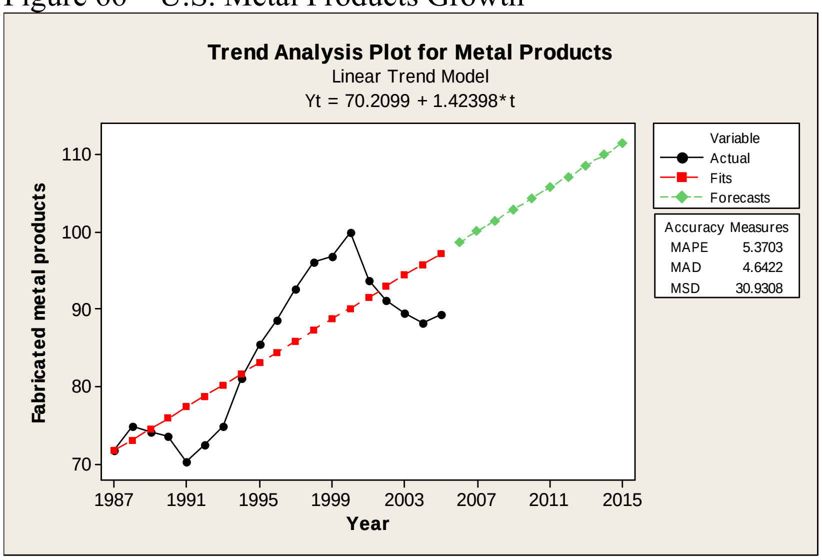


Figure 67 – U.S. Paper Products Growth

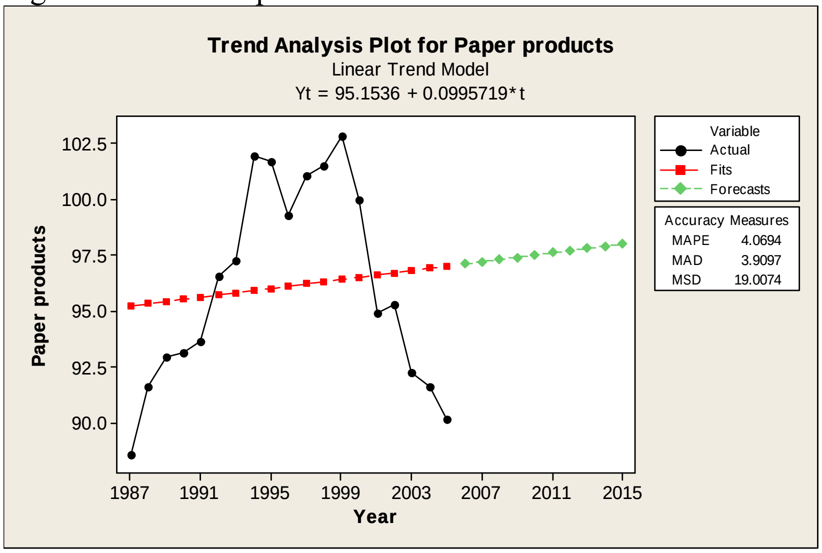


Figure 68 – U.S. Chemical Products Growth

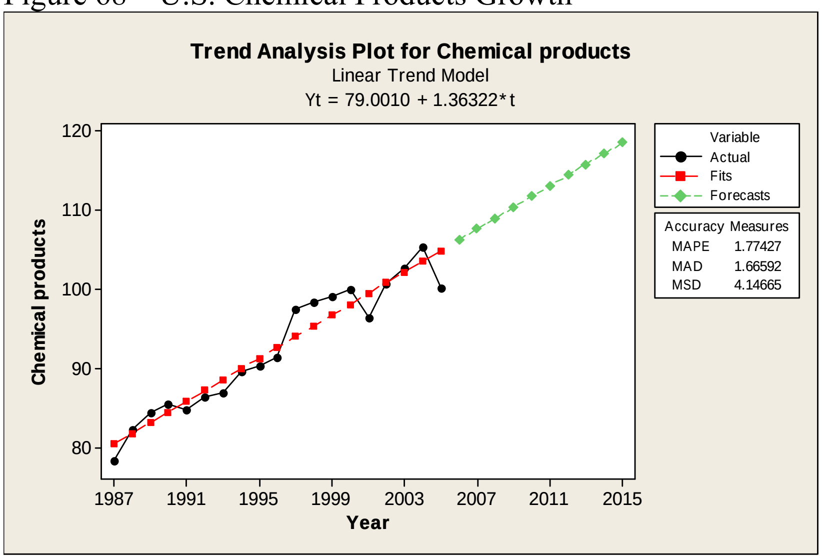


Figure 69 – U.S. Plastics and Rubber Products Growth

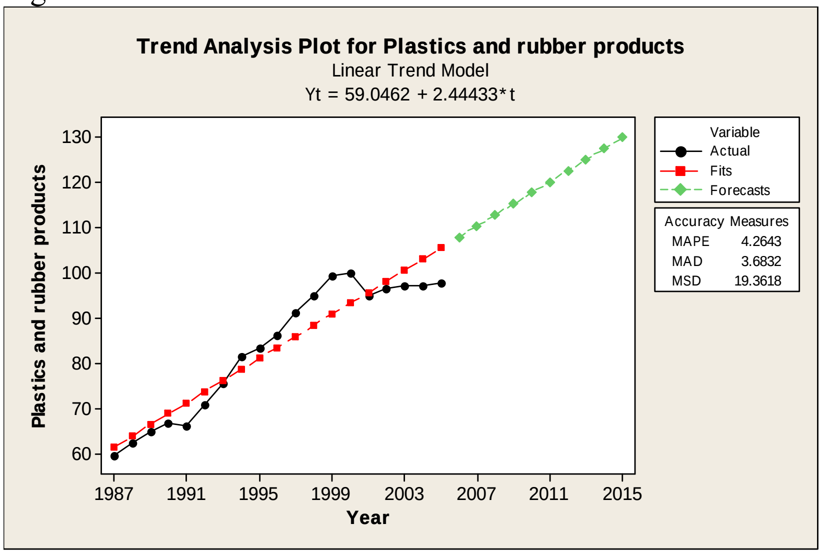


Figure 70 – U.S. Transportation Equipment Growth

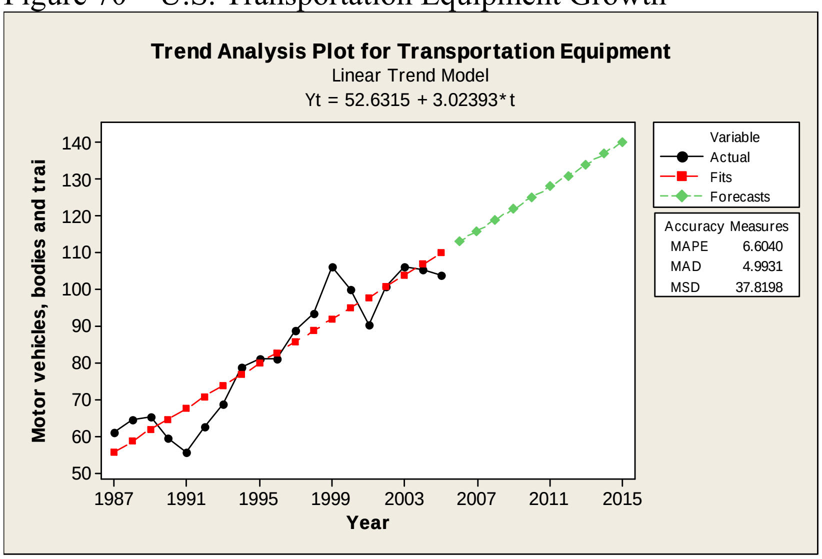
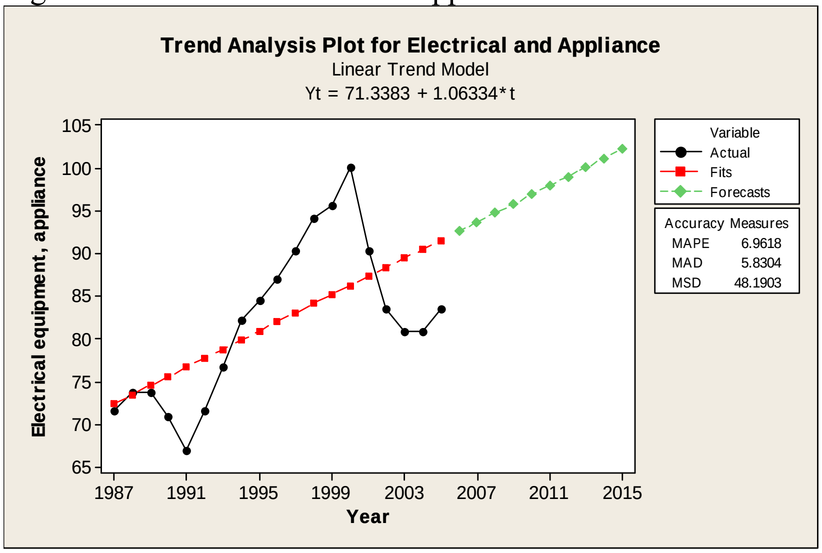


Figure 71 – U.S. Electrical and Appliance Products Growth



Canada Industry

Canadian industry data, collected through Statistics Canada[11] (Canada's national statistics agency), indicated relatively consistent growth for all industries, except non-metallic minerals. The average ten year compounded annual growth rate for the nine industries evaluated are displayed in Table 32.

Table 32 – Compounded Annual Growth Rates for Canadian Industry

Commodity Group	Canada
Food	1.34%
Chemicals	2.03%
Plastics and Rubber	3.05%
Wood	2.10%
Paper	1.07%
Metal	2.56%
Non-Metallic Mineral	3.44%
Transportation Equipment	2.32%
Machinery/Appliance	1.99%

[11] Canada's industry data is based on gross output in 1997 constant millions of U.S. dollars. The time series runs from 1985 to 2004. The forecasts are from 2005-2015.

For visual reference trend line and forecast graphs for the individual industries are displayed in Figures 72-79 below.

Figure 72 – Canadian Food Products Growth

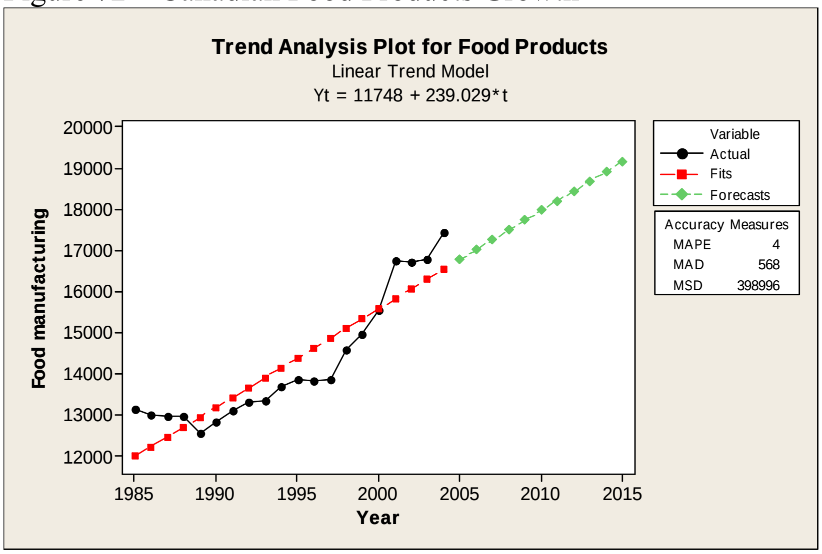


Figure 73 – Canadian Wood Products Growth

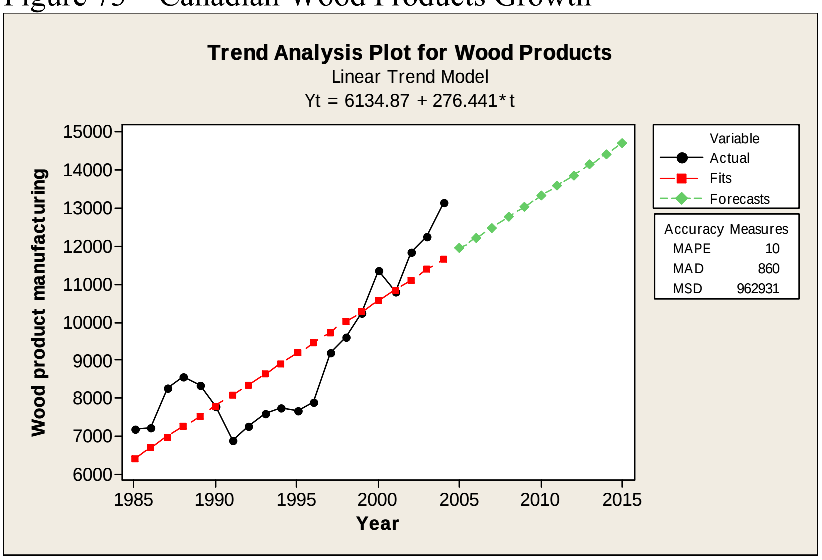


Figure 74 – Canadian Paper Products Growth

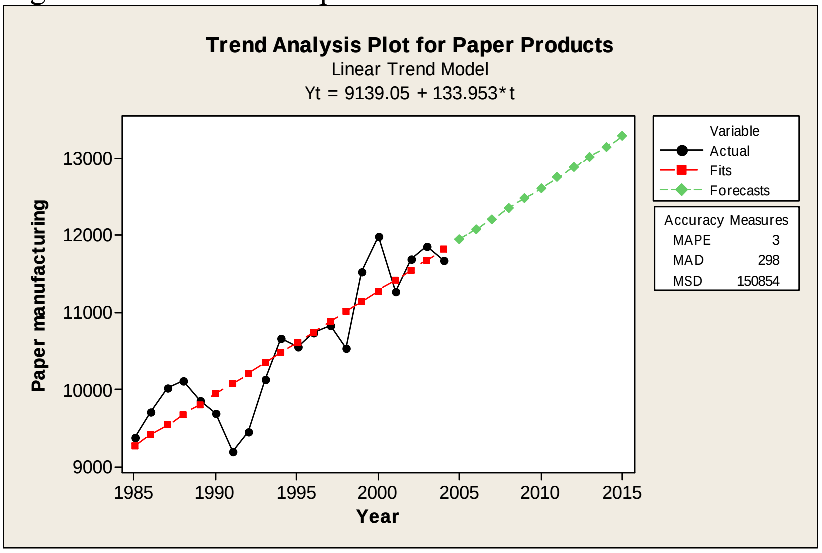


Figure 75 – Canadian Chemical Products Growth

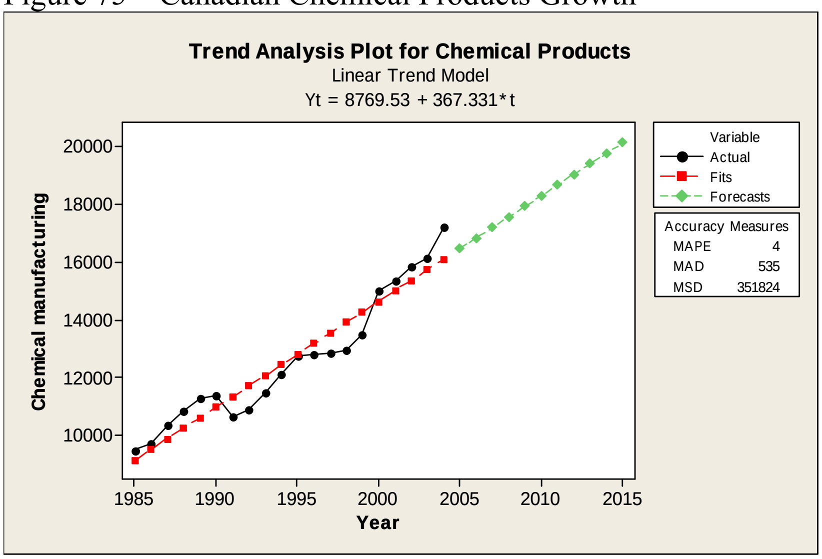


Figure 76 – Canadian Plastic and Rubber Products Growth

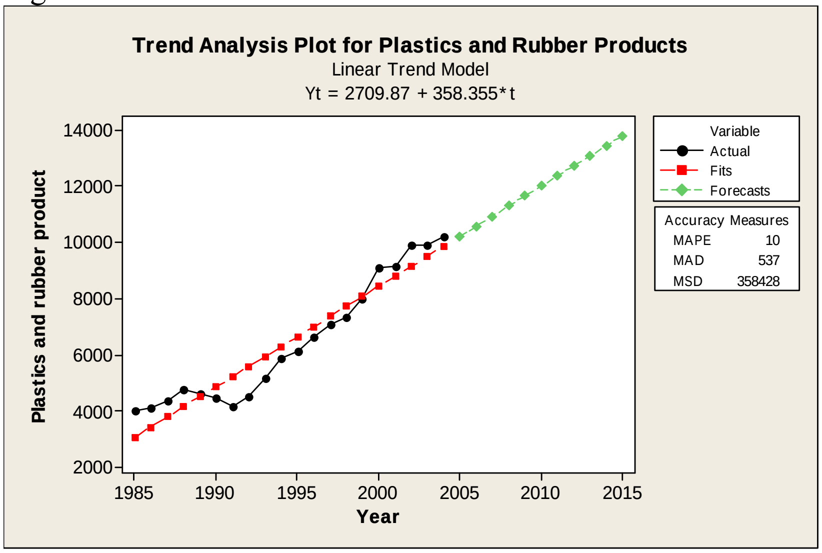


Figure 77 – Canadian Metal Products Growth

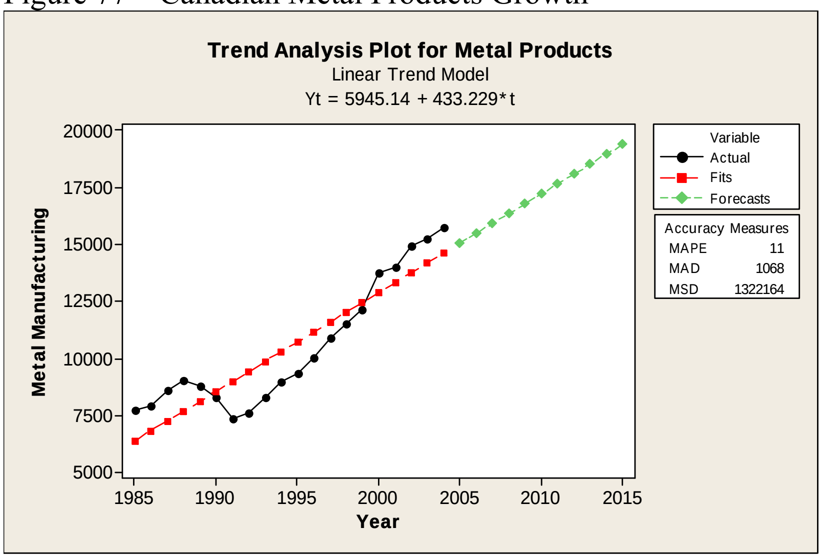


Figure 78 – Canadian Transportation Equipment Growth

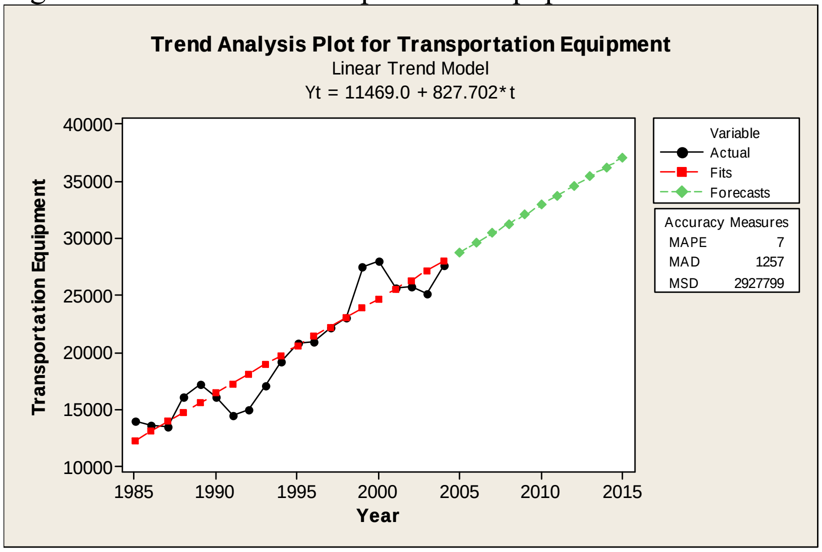
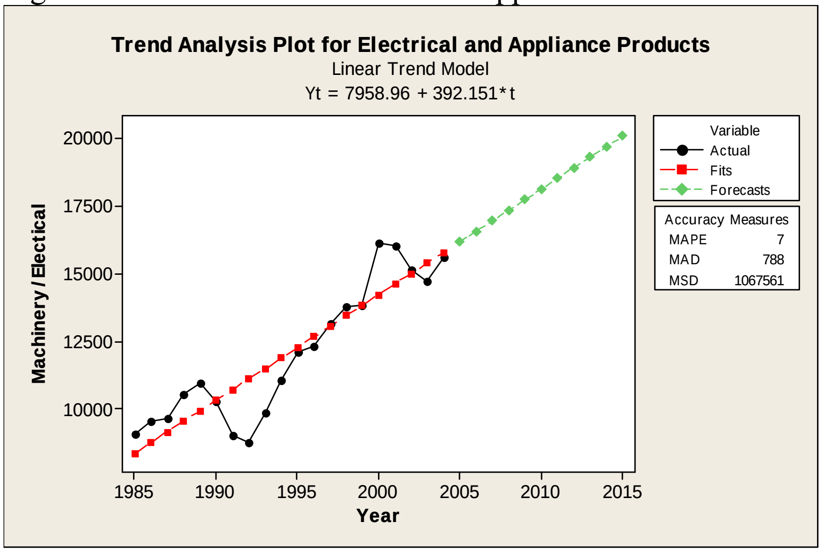


Figure 79 – Canadian Electrical and Appliance Products Growth



Non-Metallic mineral products showed a high level of inconsistent output in the earlier years of the time series. However, in latter years there appears to be stronger growth and consistency in the industry. An additional time series was developed to determine growth from 1992 to 2004 (Figure 78). This time period showed a higher level of industry output growth with a mean average percentage error (MAPE) of only 3.4% versus the MAPE of 14% for the original time series (Figure 77). The main conclusion to draw from this is that overall the industry appears to be more consistent given the last thirteen years of data collected.

Figure 80 – Canadian Non-Metallic Mineral Products (1985-2004)

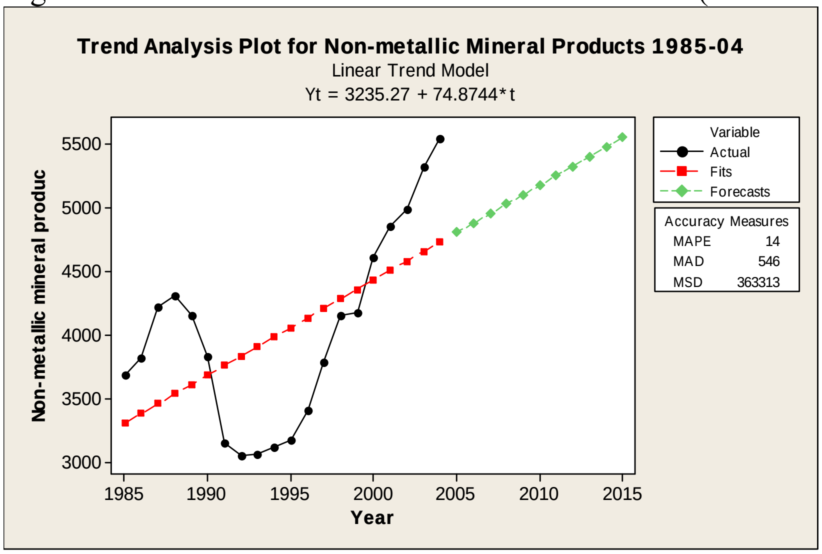
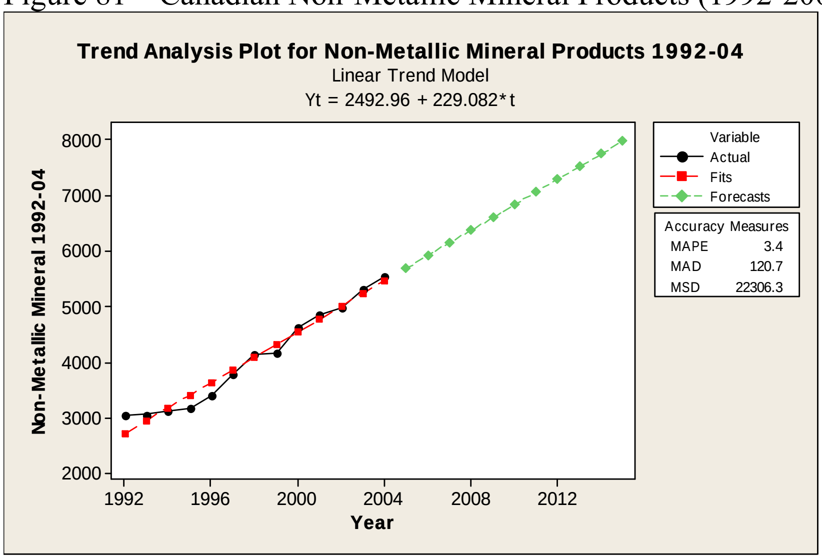


Figure 81 – Canadian Non-Metallic Mineral Products (1992-2004)



CHAPTER 5

NEW TRUCK CROSSING PROJECTIONS

Trade Growth and Truck Crossings: Comparison Projections of Truck Crossings based on Trade Growth and Port Commodity Profiles

To increase the level of accuracy to the trade/profile method of projecting truck crossing, trade in all remaining commodities was projected to 2015. Output growth consistency for these smaller industries was assumed. Furthermore, empty, mixed and unknown truck crossings are also projected. Growth in empty truck crossings is calculated using the weighted average of trade and border specific commodity profiles for trucks traveling in the opposite direction. This was based on the assumption that empty trucks were returning through the same border port from which they originally crossed carrying goods. Mixed and unknown truck crossings were calculated using the weighted average of trade and border port profiles for trucks traveling in the same direction (TSi Consultants, 2002).[12]

Incorporating empty, mixed and unknown trucks allowed a larger percentage of the border port crossings to be incorporated into the analysis. Since empty trucks made up a large portion of crossings as seen in previous sections, a look at the effect of growth in these movements was necessary.

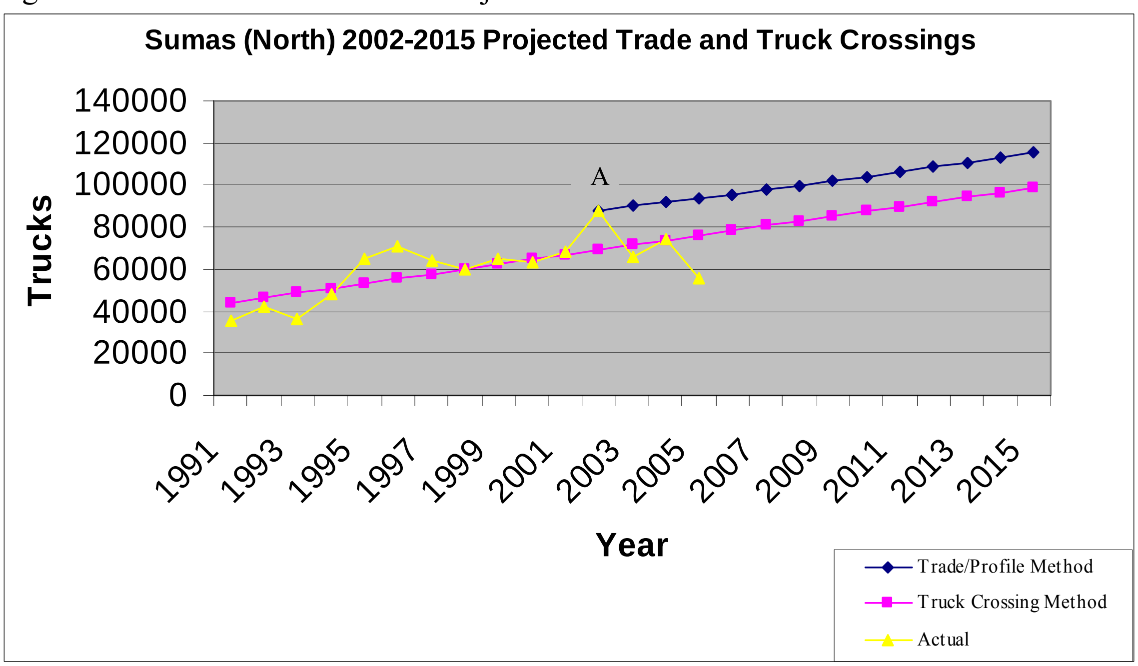
In the figures below, the "trade/profile" line is the projection of border crossings using the trade/profile method (estimations of truck crossings based on trade growth and port commodity profiles). The "truck crossing" line represents the fitted regression line

[12] This same methodology for estimating empty, mixed, and unknown trucks was used in "Lower Mainland Border Crossing Commercial and Passenger Vehicle Forecasts" by TSi Consultants in February 2002.

and projection based on the truck crossings method at the respective border port. The "actual" line represents the historical data of the actual number of truck crossings at the port.

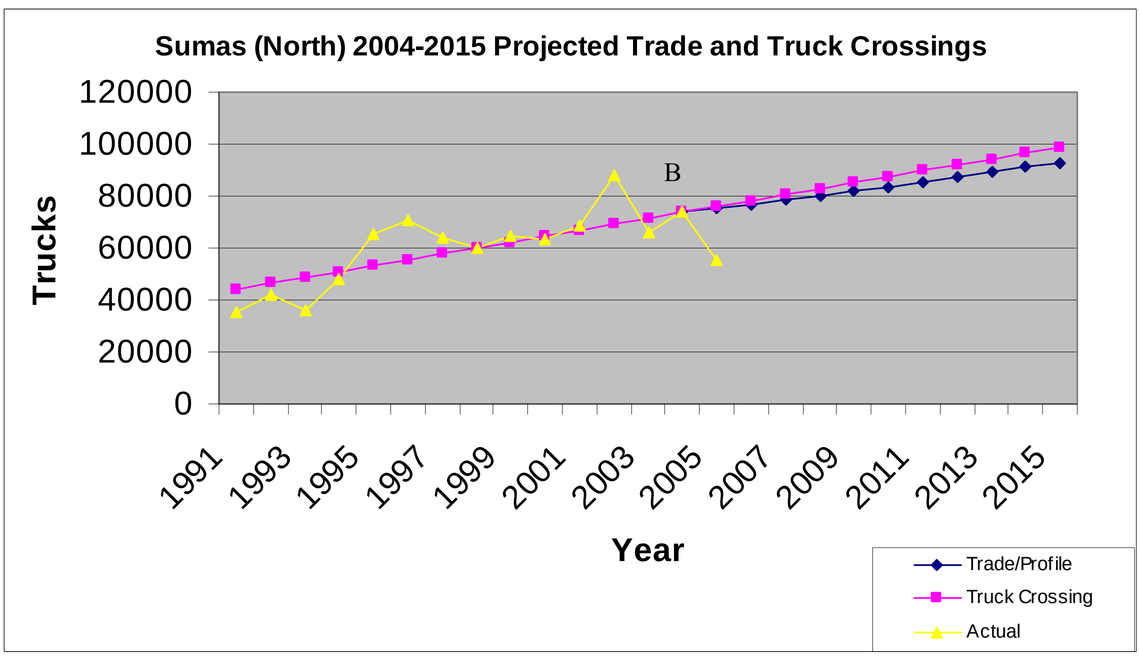
Due to deviation from the trend line in year-to-year crossings, starting dates for calculating growth and profile changes differed. The starting dates used are those closest to the truck crossing line, based on the assumption that the growth in truck crossings is closely related to the growth in trade. If there is significant deviation from the truck crossing line in the base year for calculating growth, then as trade growth is translated into truck crossing growth, a new growth line is created that will not reflect the projected number of truck crossings. Figure 82 depicts this error. Point A reflects the year for which the SFTA survey was completed and the corresponding growth trade/profile projection.

Figure 82 – Trade/Profile Model: Projection Error



As a result, a year in which the number of actual truck crossings has a small deviation from the truck crossing regression line for the number of truck crossings was used. Additionally, the compounded annual trade growth rate was adjusted in order to reflect the year used for trade/profile projections. When this was done, the two projections emulated each other with a smaller level of deviation. In the figure above, the number of actual truck crossings in 2004 was closely related to the truck crossing regression line. When the trade/profile growth projections begin in 2004, the projection line closely fits the truck crossing line. Figure 83 depicts this relationship. Point B reflects the year closest to the truck crossing line and the corresponding trade/profile projection. Note that there is less than 7% difference between the truck crossing method and trade/profile method.

Figure 83 – Trade/Profile Model: Error Correction



To address the difference in years used to project crossings and insure higher accuracy in projections, adjustments to compound trade growth rates in all commodities traded were made. The trade growth values for the commodities were used according to the year the projection began and are shown in Table 33 and 34.

Table 33 – Compounded Commodity Trade Growth Adjustment Table (Northbound)

Compound Trade Growth Table by Year					
Northbound					
	Year				
Commodity	2002	2003	2004	2005	2006
Food Product	3.11%	3.03%	2.96%	2.88%	2.80%
Wood Product	0.85%	0.84%	0.83%	0.82%	0.81%
Paper Product	3.83%	3.72%	3.60%	3.50%	3.39%
Chemical Product	2.70%	2.64%	2.58%	2.52%	2.46%
Plastics & Rubber	3.00%	2.95%	2.87%	2.80%	2.73%
Non-Metallic Mineral	4.82%	4.64%	4.47%	4.31%	4.15%
Metal	3.10%	3.02%	2.94%	2.87%	2.79%
Machinery	1.58%	1.55%	1.53%	1.50%	1.47%
Transportation Equipment	0.66%	0.65%	0.64%	0.64%	0.62%
Furniture	-0.72%	-0.71%	-0.71%	-0.71%	-0.70%
Apparel	2.15%	2.11%	2.07%	2.03%	1.98%
Textile	0.00%	0.00%	0.00%	0.00%	0.00%
Printed Material	0.54%	0.55%	0.56%	0.56%	0.57%
Electronic	2.40%	2.35%	2.30%	2.25%	2.20%
Coal/Petroleum	5.30%	5.09%	4.88%	4.69%	4.51%

Table 34 - Compounded Commodity Trade Growth Adjustment Table (Southbound)

Compound Trade Growth Table by Year Southbound					
	Year				
Commodity	2002	2003	2004	2005	2006
Food Product	2.96%	2.90%	2.82%	2.75%	2.68%
Wood Product	2.84%	2.77%	2.71%	2.64%	2.58%
Paper Product	1.98%	1.95%	1.91%	1.87%	1.84%
Chemical Product	2.71%	2.65%	2.59%	2.53%	2.46%
Plastics & Rubber	5.56%	5.33%	5.10%	4.90%	4.70%
Non-Metallic Mineral	5.43%	5.20%	4.99%	4.79%	4.70%
Metal	3.92%	3.80%	3.69%	3.57%	3.46%
Machinery	3.55%	3.45%	3.35%	3.26%	3.16%
Transportation Equipment	4.82%	4.64%	4.47%	4.31%	4.15%
Furniture	4.96%	4.77%	4.59%	4.42%	4.26%
Apparel	3.93%	3.81%	3.70%	3.58%	3.47%
Textile	5.84%	5.58%	5.34%	5.11%	4.89%
Printed Material	4.82%	4.64%	4.47%	4.31%	4.15%
Electronic	4.02%	3.90%	3.78%	3.66%	3.54%
Coal/Petroleum	5.16%	4.95%	4.76%	4.58%	4.40%

The ten year change in number of trucks reflects the total difference between the 2006 and 2015 projected number of truck crossings (all are positive values). Though a specific commodity at a specific port may decline in terms of the port's overall profile, growth in trade for that commodity can still be positive, resulting in increased truck crossings. For many of the border port commodity profiles, there was significant trade growth in one or more of the commodities relative to the other commodities in the profile. As a result, some significant drops in the percentage composition of commodities for smaller ports such as Oroville, Laurier, and Frontier were evident.

Blaine

Recent time series data for the Blaine/Douglas border port has shown a decline in the number of truck crossings since 2001. This decline runs contrary to the projected growth in trade. Figures 67 and 68 depict the decline. Since Blaine is the largest Canadian border port in the Western United States, this required further research and explanation. There are four main explanations for this occurrence. First, based on current trends there appears to be a slight increase in cross border rail movements, especially for southbound flows (Goodchild, 2006). This small change from truck to rail helps to relieve congestion pressures at the border, especially for time insensitive, low value and high volume goods. Secondly, wait times at the border, especially southbound, average between 20-30 minutes (Goodchild, 2006). The costs associated with these wait times, especially at peak hours, may lead to alternative methods of transportation, or alternative routes, such as Lynden. This was based upon the assumption that the carriers have brokers at multiple border ports to facilitate the crossing, or the carriers are operating under Free and Secure Trade (FAST) program, or a form of Electron Data Interchange (EDI) system. The third and most plausible argument stems from the September 11, 2001 attacks on the World Trade Center. The resulting heightened security and full inspections at border ports would have created severe congestion and ultimately reduced the number of crossings (Federal Highway Administration, 2006). Given these arguments, there are still expectations of increases in the number of bi-directional truck crossings as the North American economy continues to grow and programs are developed to help facilitate the border crossing procedure, while still maintaining security.

Figure 84 – Blaine Northbound Trade Projected Truck Crossings

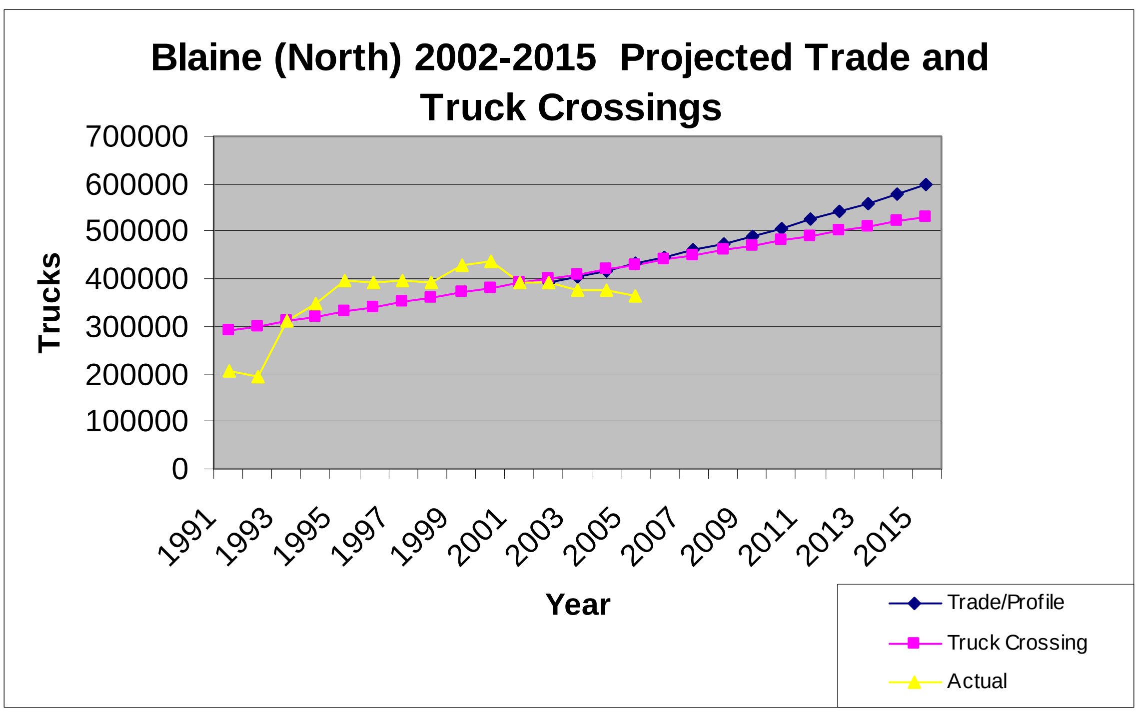
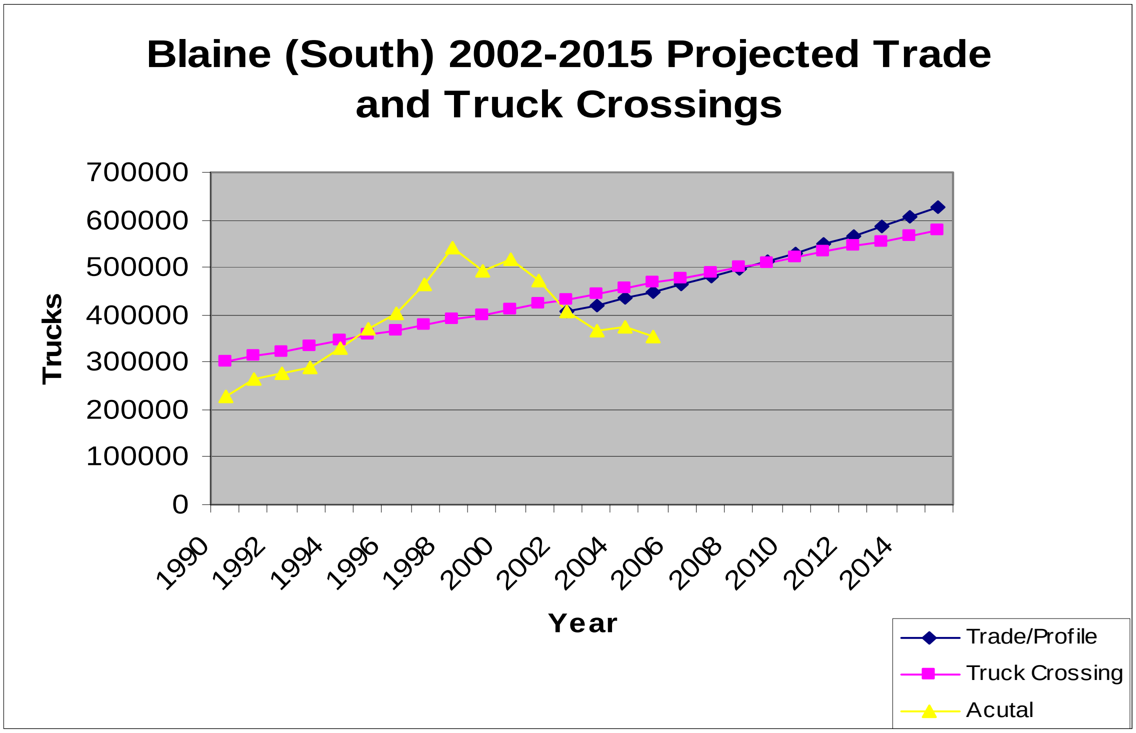


Figure 85 - Blaine Southbound Trade Projected Truck Crossings



Lynden

The trade/profile method shows a slower rate of northbound and southbound truck crossing growth than the truck crossing method (see Figures 86 and 87). One explanation for this is partially displayed in the actual number of truck crossings between the years 2003 and 2005. The number of truck crossings has slowed significantly from previous year's growth rates. An assumption made in the methodology section states that the growth in trade is direct reflection of the growth of truck crossings. This assumption can also work in reverse, meaning growth (or in this case reduction in growth) in truck crossings is mirrored by a reduction in trade growth. The trade/profile line more accurately depicts the recent trend.

Figure 86 – Lynden Northbound Trade Projected Truck Crossings

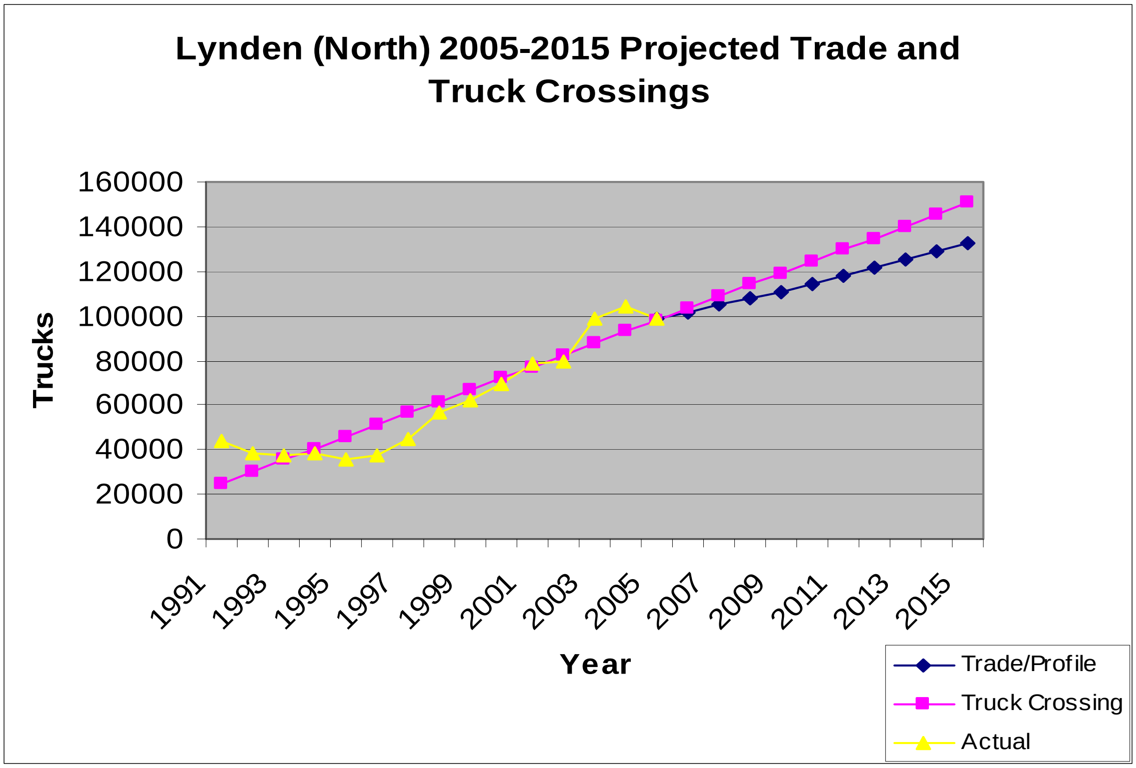
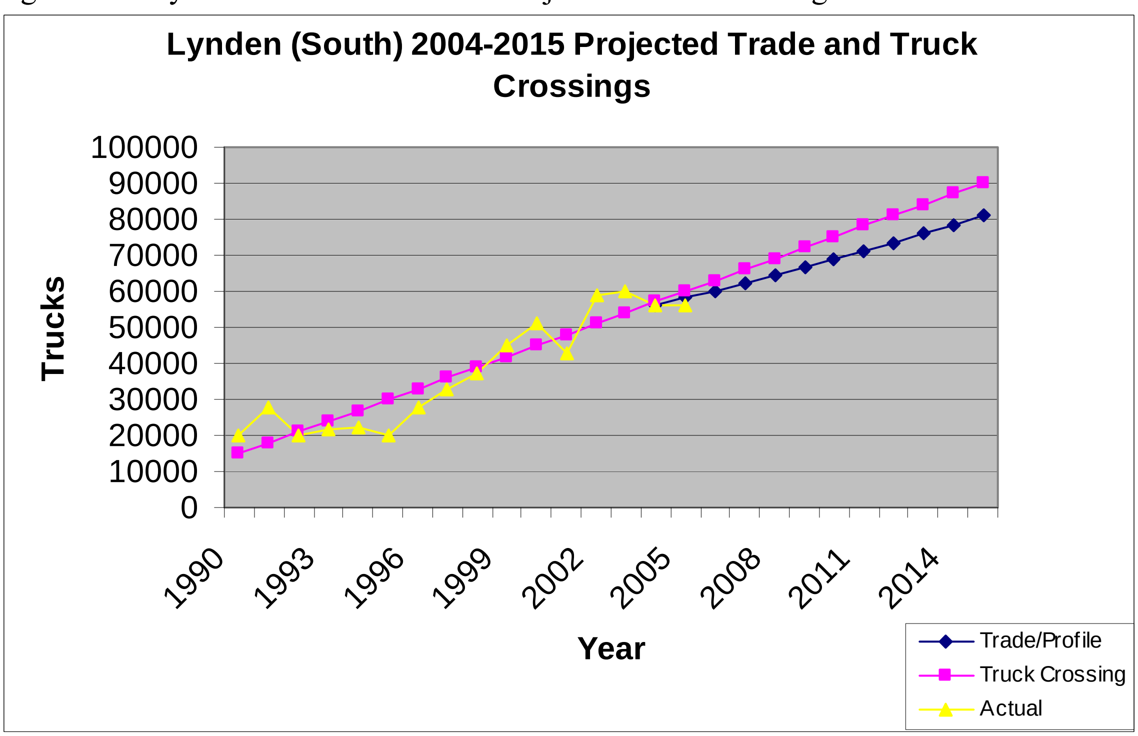


Figure 87 – Lynden Southbound Trade Projected Truck Crossings



<u>Sumas</u>

There is an expectation of continued steady growth in the number of truck crossings at Sumas, based on both methods. Both methods of projecting crossings show, with little difference, that there is an expected increase of roughly 67,000 trucks (both directions).

Figure 88 – Sumas Northbound Trade Projected Truck Crossings

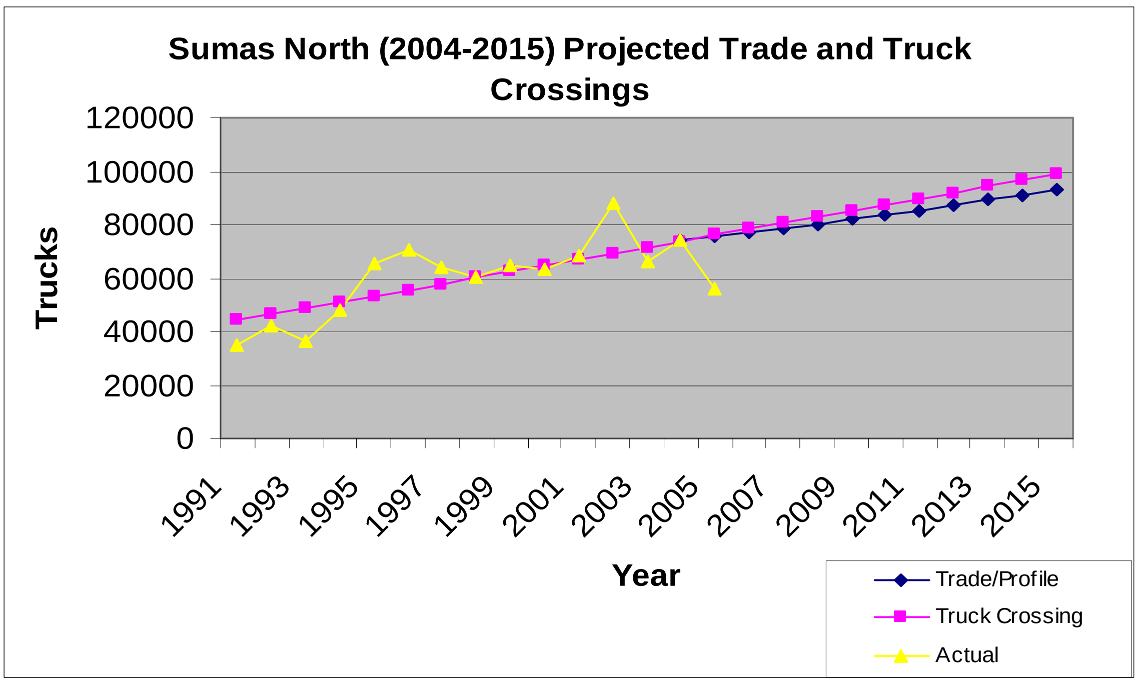
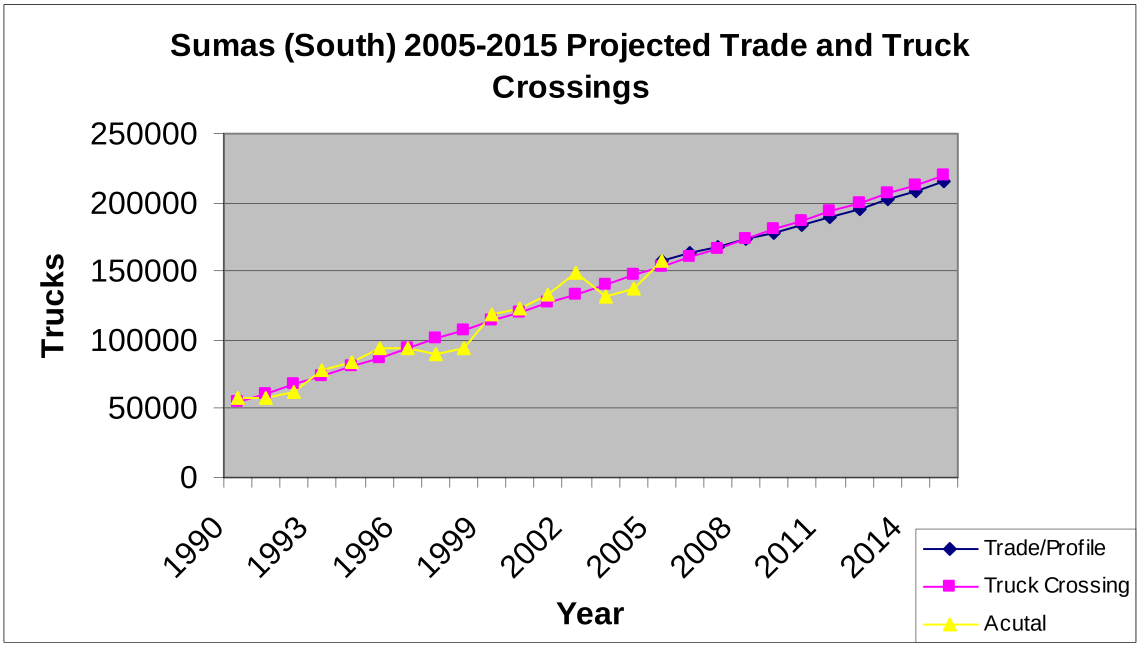


Figure 89 – Sumas Southbound Trade Projected Truck Crossings



Oroville

Like Sumas, the projections for northbound and southbound crossings at Oroville are very similar for both methods. However, these projections are highly dependent on future trade of lumber and soft-wood products, which comprise 35% of southbound crossings and a significant portion of northbound empty truck movements.

Figure 90 – Oroville Northbound Trade Projected Truck Crossings

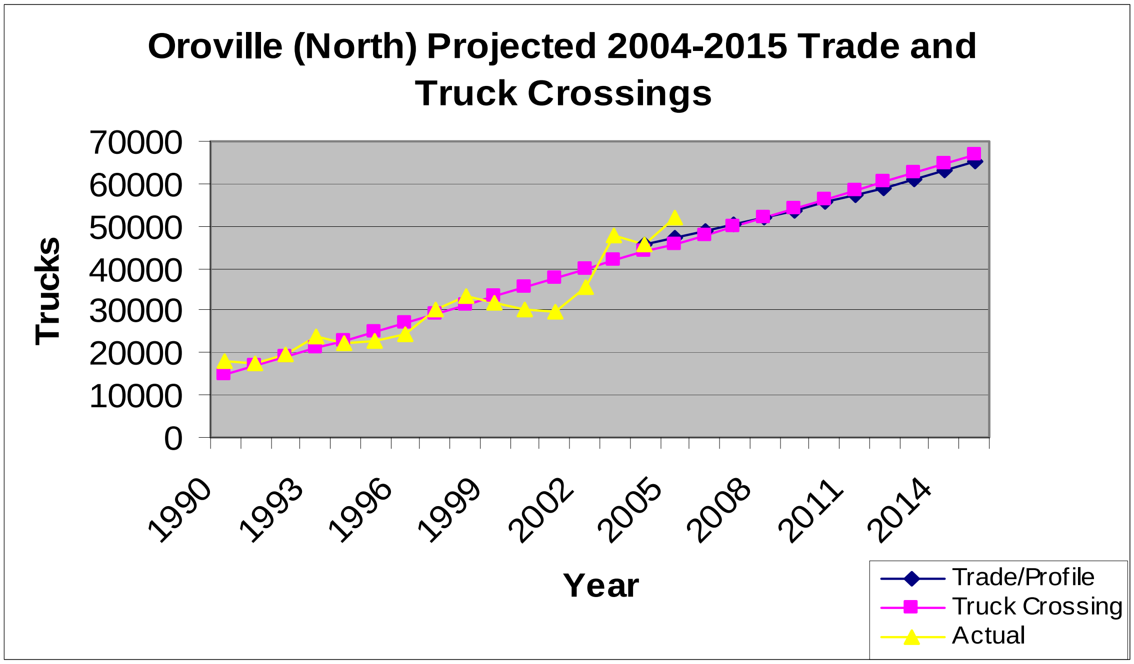
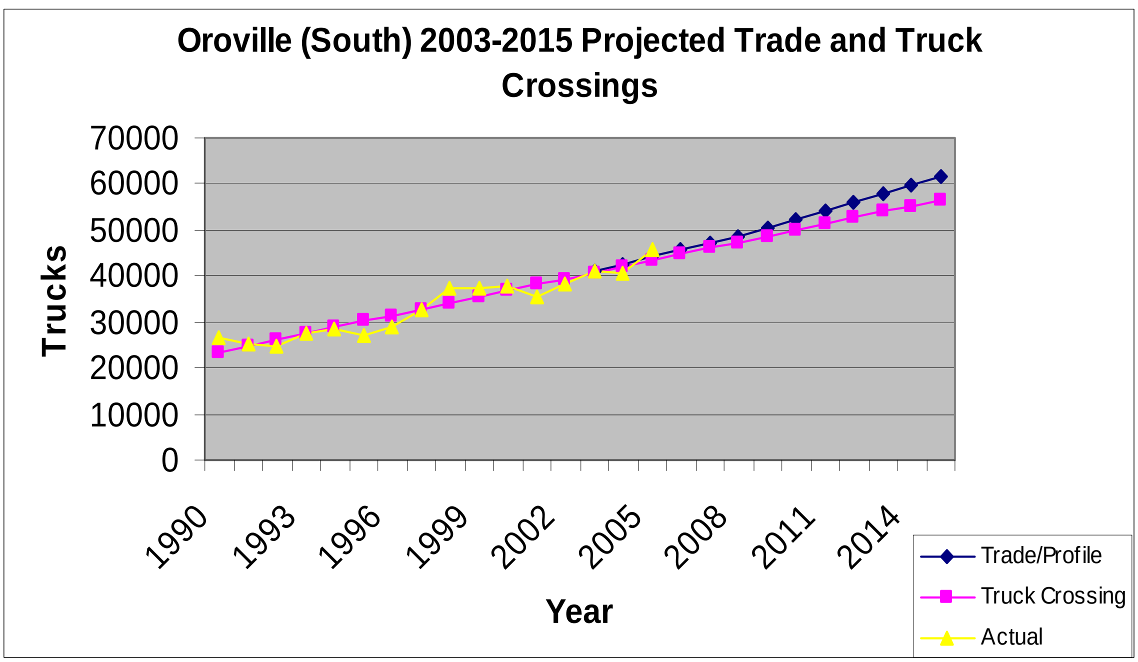


Figure 91 - Oroville Southbound Trade Projected Truck Crossings



Laurier

The differences between the two projection methods for northbound Laurier are high. One explanation focuses on the truck crossing time series data. Recent data shows a higher level of growth in truck crossings at the port location. As a result, and backed by the assumptions made in the model, there is an expected higher growth in the number of projected truck crossings based on trade data. As for southbound Laurier, the projected crossings from both methods are closely related.

Figure 92 – Laurier Northbound Trade Projected Truck Crossings

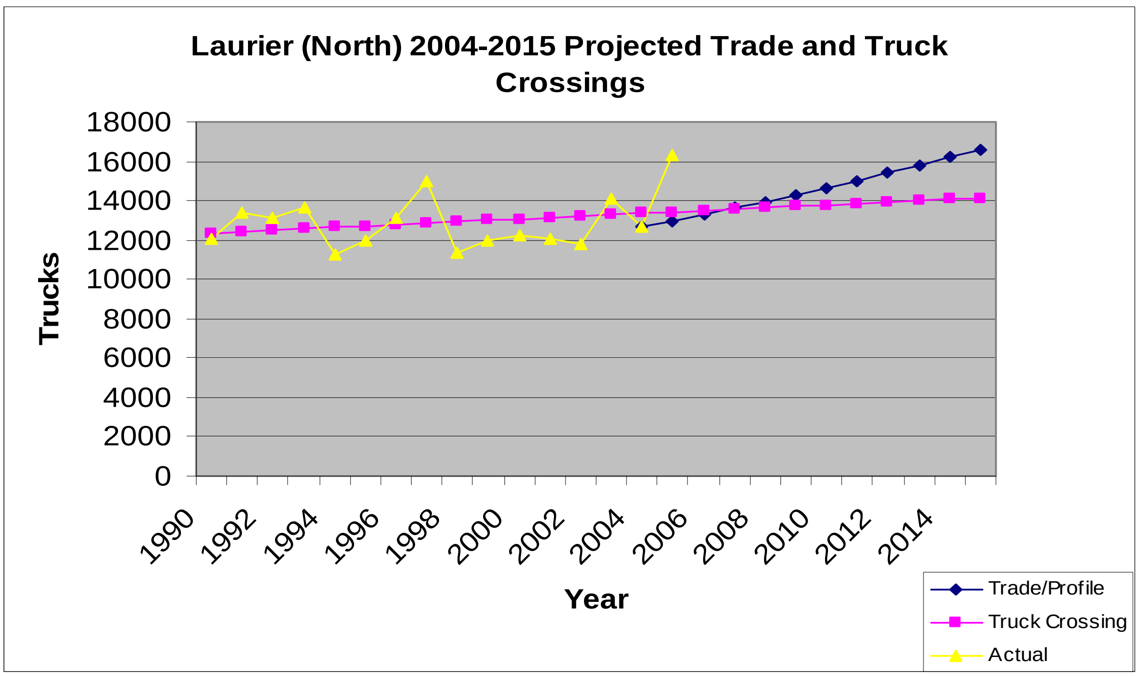
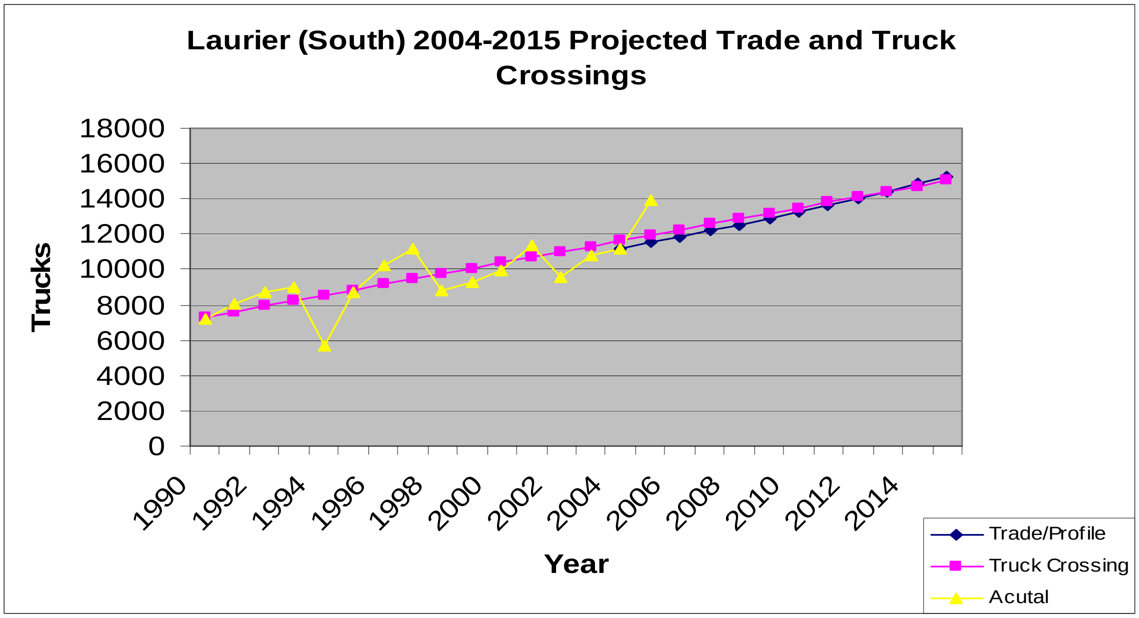


Figure 93 – Laurier Southbound Trade Projected Truck Crossings



<u>Frontier</u>

There were significant differences in bi-directional crossings at Frontier between both projections. The northbound and southbound differences between the trade/profile method and the truck crossing method were 25% and 17%, respectively. Explanations for this difference revolved around trade growth in chemical products. As discussed earlier, Frontier southbound crossings were predominately chemical products (about 75%), which were shipped from the Cominco, Ltd. mine in Trail, BC. The differences between the two projections stem from the projected growth rates of truck crossings vs. the projected trade/profile growth rate (in chemical products). The growth rate of chemical trade was significantly higher than the truck crossing method growth rate.[13]

[13] This also applies to northbound crossings because the majority of empty trucks crossing at Frontier terminated in Trail, BC, indicating that the growth of empty northbound crossings will grow at the same rate of chemical products shipped southbound.

Figure 94 – Frontier Northbound Trade Projected Truck Crossings

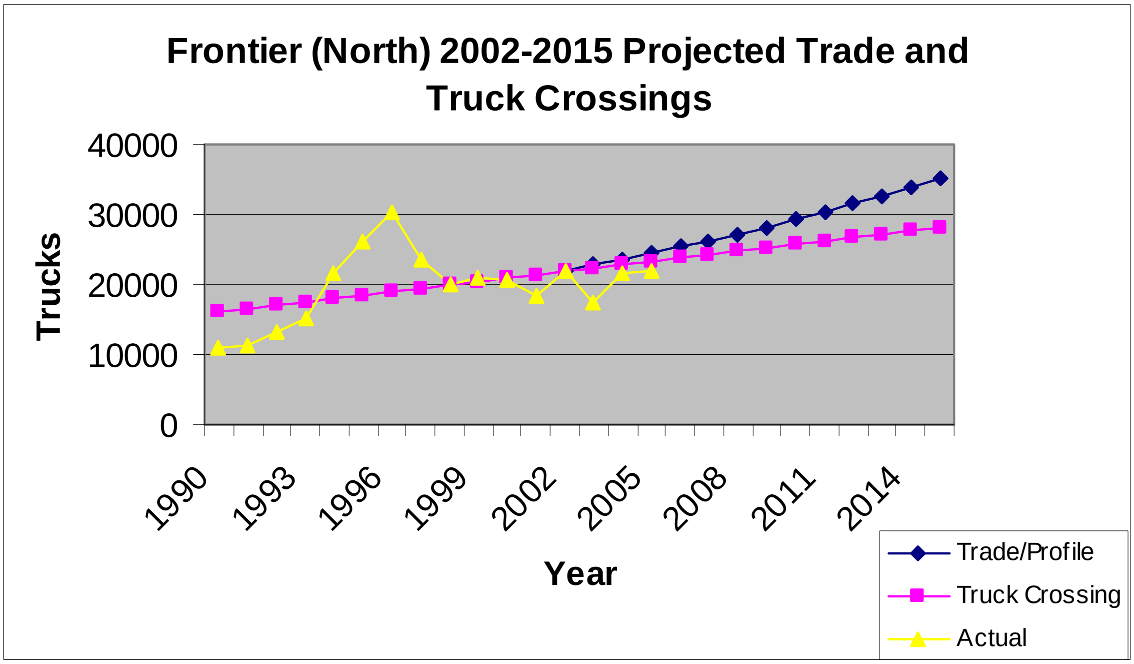


Figure 95 – Frontier Northbound Trade Projected Truck Crossings

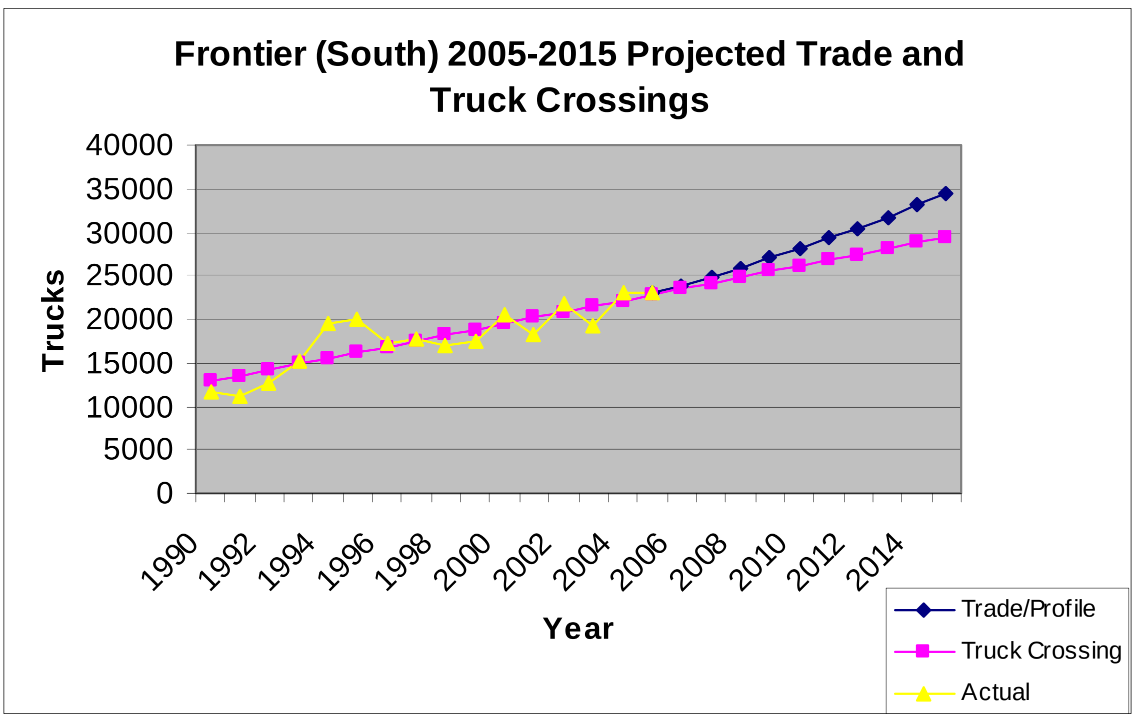


Table 35 summarizes the level of variation between the two types of projected growth levels. The truck crossing method is the basis for comparison.

Table 35 – Percent Difference in Trade Projections

Percent Difference from Trade Projections and Fitted Regression Line Projections		
Port	Northbound	Southbound
Blaine	12.65%	8.63%
Lynden	-11.92%	-9.90%
Sumas	-6.28%	-2.20%
Oroville	-2.33%	9.11%
Laurier	17.86%	1.64%
Frontier	25.04%	17.21%

*Positive sign shows the trade/profile projection is greater than the truck crossing method and negative sign shows the trade/profile projection is less than the truck crossing method.

Furthermore, Table 36 summarizes the annual growth rate of truck crossings for both the truck crossing method and trade/profile method. This allows for a stronger evaluation of the relationship between the two growth models. From the table, two distinct conclusions can be drawn. First, the growth rate in the number of southbound crossings from the trade/profile method is greater than the northbound. On average, the trade growth rate for commodities traveling from Canada to Washington was higher than the same commodities traveling north, which could explain this occurrence. Second, a majority of the projections based on the trade/profile method had a higher collective growth rate than the growth rates based on the truck crossing method. This could suggest that there will be a greater number of overall truck crossings, based on current trade trends, than previously determined by the truck crossing method.

Table 36 – Border Port Growth Rate Comparison

Border Port Growth				
	Truck Crossing Method		Trade/Profile Method	
Port	Northbound	Southbound	Northbound	Southbound
Blaine	1.88%	1.90%	2.99%	3.05%
Lynden	3.82%	3.64%	2.68%	3.06%
Sumas	2.36%	3.21%	1.91%	2.81%
Oroville	3.34%	2.39%	2.91%	3.08%
Laurier	0.46%	2.07%	2.25%	2.57%
Frontier	1.68%	2.29%	3.33%	3.75%

Tables 37 and 38 demonstrate commodity profile changes, resulting from trade growth, and the corresponding growth or decline in the number of truck crossings.

Table 37 – Northbound Commodity Profile Changes and Number of Truck Crossing Increase

Northbound Changes in Commodity Profile and Number of Truck Crossings				
Port	Commodity	Percent of Total (North) 2003	Percent of Total (North) 2015	Ten Year Change in Number of Trucks
Blaine	Empty	37.40%	41.44%	75,779
2002	Crop Production	10.07%	9.58%	13,086
	Other	7.41%	6.97%	9,261
	Paper Products	4.92%	5.18%	8,678
	Unknown	6.09%	5.72%	7,608
	Processed Food	6.86%	6.21%	7,484
	Metal	0.75%	4.34%	6,105
	Non-Metallic Mineral	2.52%	2.98%	5,972
	Petroleum & Coal	1.72%	2.20%	4,894
	Chemical	3.73%	3.42%	4,283
	Plastics & Rubber	3.26%	3.10%	4,237
	Beverage	1.21%	1.09%	1,315
	Machinery	1.95%	1.56%	1,207
	Computer & Electronics	0.61%	0.54%	623
	Appliances	0.59%	0.53%	606
	Wood Products	1.60%	1.16%	505
	Transportation Equip	1.95%	1.39%	471
	Animal Production	0.22%	0.21%	298
	Apparel	0.29%	0.25%	261
	Printed Material	0.59%	0.41%	117

	Textile	1.45%	0.95%	-
	Furniture	0.75%	0.45%	-179
			Total Growth	153,083
Lynden 2005	Empty	33.64%	36.10%	13,377
	Crop Production	19.01%	18.90%	5,713
	Other	9.46%	9.29%	2,699
	Plastics & Rubber	9.50%	9.27%	2,645
	Non-Metallic Mineral	4.71%	5.27%	2,141
	Fabricated Metal	4.71%	4.62%	1,338
	Machinery	9.46%	8.16%	1,331
	Processed Food	4.75%	4.55%	1,213
	Wood Products	4.75%	3.84%	356
			Total Growth	30,813
Sumas 2004	Empty	11.51%	14.03%	3,853
	Unknown	21.21%	20.96%	3,180
	Fabricated Metal	11.61%	12.69%	2,709
	Other	15.70%	15.52%	2,355
	Crop Production	5.70%	6.22%	1,320
	Chemical	5.76%	6.05%	1,153
	Forestry/Logging	16.99%	14.79%	986
	Printed Material	11.51%	9.73%	443
			Total Growth	16,001
Oroville 2004	Empty	57.64%	60.69%	11,059
	Crop Production	14.21%	13.75%	2,041
	Non-Metallic Mineral	3.57%	3.94%	785
	Beverage	4.15%	3.85%	504
	Processed Food	2.10%	1.94%	255
	Plastics & Rubber	1.68%	1.59%	223
	Metal	1.53%	1.46%	208
	Paper Products	1.19%	1.21%	204
	Wood Products	5.73%	4.41%	201
	Other	1.17%	1.18%	193
	Petroleum & Coal	0.48%	0.57%	129
	Chemical	1.07%	0.99%	126
	Transportation Equip	3.45%	2.60%	92
	Unknown	0.48%	0.48%	78
	Computer & Electronics	0.70%	0.63%	76
	Machinery	0.85%	0.70%	56
			Total Growth	16,230
Laurier 2004	Empty	50.53%	54.01%	2,161
	Non-Metallic Mineral	9.70%	11.98%	647

	Wood Products	34.91%	29.18%	347
	Unknown	4.85%	4.84%	158
			Total Growth	3,314
Frontier 2002	Empty	64.43%	71.25%	8,158
	Chemical	22.64%	19.73%	1,420
	Wood Products	12.96%	9.03%	227
			Total Growth	9,806

Table 38 - Southbound Commodity Profile Changes and Number of Truck Crossing Increase

Southbound Changes in Commodity Profile and Number of Truck Crossings				
Port	Commodity	Percent of Total (South)	Percent of Total (South) 2015	Ten Year Change in Number of Trucks
Blaine 2002	Wood Products	20.18%	19.91%	31,350
	Empty	24.48%	21.74%	26,535
	Food Products	7.11%	7.95%	15,617
	Metal Products	7.17%	7.80%	14,668
	Non-Metallic Mineral	6.21%	6.18%	9,911
	Other	5.33%	5.50%	9,433
	Paper Products	8.50%	7.25%	7,815
	Unknown	4.39%	4.53%	7,769
	Beverage	3.13%	3.50%	6,874
	Plastics & Rubber	2.09%	2.71%	6,453
	Chemical	2.24%	2.81%	6,408
	Printed Material	1.41%	1.82%	4,326
	Machinery	2.47%	2.34%	3,386
	Agricultural Production	1.41%	1.58%	3,103
	Furniture	0.87%	1.17%	2,864
	Computer & Electronics	0.54%	0.65%	1,431
	Apparel	0.42%	0.49%	1,051
	Transportation Equip	0.54%	0.56%	963
	Forestry/Logging	0.46%	0.45%	713
			Total Growth	162,382
Lynden 2004	Wood Products	39.89%	38.60%	7,532
	Unknown	25.73%	25.71%	5,432
	Beverage	11.83%	12.60%	3,043
	Fabricated Metal	11.83%	12.34%	2,857
	Transportation Equip	10.72%	10.75%	2,291
			Total Growth	21,155

Sumas 2005	Chemical	17.45%	20.10%	14,349
	Wood Products	23.59%	23.36%	11,789
	Empty	38.15%	33.72%	11,036
	Plastics & Rubber	8.72%	10.27%	7,622
	Processed Food	6.04%	6.50%	4,040
			Total Growth	51,980
Oroville 2004	Wood Products	36.41%	34.47%	5,393
	Plastics & Rubber	6.71%	8.04%	1,882
	Crop Production	5.73%	6.05%	1,174
	Non-Metallic Mineral	7.29%	6.96%	1,109
	Processed Food	4.95%	5.22%	1,013
	Empty	11.87%	10.77%	988
	Transportation Equip	5.33%	5.25%	897
	Unknown	5.11%	5.70%	875
	Animal Production	3.19%	3.41%	484
	Other	2.76%	3.08%	473
	Chemical	1.57%	1.82%	409
	Petroleum & Coal	1.38%	1.75%	325
	Forestry/Logging	2.10%	2.23%	311
	Fabricated Metal	1.57%	1.61%	301
	Machinery	1.82%	1.66%	239
	Paper Products	1.41%	1.17%	126
			Total Growth	16,130
Laurier 2004	Wood Products	69.91%	71.79%	2,634
	Non-Metallic Mineral	7.17%	7.42%	278
	Empty	16.72%	14.05%	225
	Chemical	1.67%	2.05%	107
	Foresty&Logging	1.67%	1.71%	63
	Processed Food	1.18%	1.33%	61
	Unknown	1.67%	1.64%	53
			Total Growth	3,421
Frontier 2005	Chemical	73.39%	76.39%	8,754
	Empty	16.81%	14.34%	995
	Unknown	4.90%	4.89%	516
	Wood Products	4.90%	4.39%	355
			Total Growth	10,620

For evaluation and comparison purposes, one further projection of truck crossings using the trade/profile method was conducted. This additional projection removes the empty, mixed and unknown truck estimation component. When compared, there was not a significant change in the number of overall crossings when growth in empty, unknown, and mixed truck crossings were incorporated versus projections based only on commodity trade growth. The significance in comparing the two trade/profile methods lies in the direction of movement of the forecasts. In most cases, incorporating the empty, mixed and unknown trucks for northbound crossings increased the projection values because the aggregate projected southbound trade growth direction was higher than the aggregate projected northbound trade growth.[14] The exact opposite applies to southbound crossings, where the projection values decrease when empty, mixed and unknown trucks are incorporated. Therefore, it is sensible to know and incorporate not just commodities crossing, but also empty, mixed, and unknown truck crossings. A comparison between the three methods used to project crossings can be found in Table 39.

[14] Refer to method for projecting empty trucks and the larger percentage empty trucks movements at the border ports.

Table 39 – Northbound and Southbound 2015 Projected Annual Truck Crossings

Northbound			
Border Port	Truck Crossing Method	Trade/ Profile Commodity only Method	Trade/Profile Empty Trucks Included
Blaine	531,274	558,760	598,455
Lynden	150,422	127,165	133,607
Sumas	98,823	89,227	92,316
Oroville	66,606	60,158	65,304
Laurier	14,127	15,322	16,703
Frontier	28,106	28,388	35,144
Danville	485*	-	-
Metaline Falls	13,898	-	-
Ferry	5,369	-	-
Boundary	185*	-	-
Southbound			
Border Port	Truck Crossing Method	Trade/Profile Commodity only Method	Trade/Profile Empty Trucks Included
Blaine	576,415	639,768	621,837
Lynden	90,173	80,324	80,281
Sumas	219,656	214,360	204,410
Oroville	56,572	63,726	61,092
Laurier	15,026	15,433	14,986
Frontier	29,422	29,240	34,487
Danville	906*	-	-
Metaline Falls	9,842	-	-
Ferry	2691*	-	-
Boundary	868	-	-

* Indicates difficulty in prediction due to high annual variation

Comparison to "Lower Mainland Border Crossing Commercial and Passenger Vehicle Forecasts"

As mentioned previously in the text, TSi Consultants conducted a similar forecasting study in 2002 called the "Lower Mainland Border Crossing Commercial and Passenger Vehicle Forecasts" (LMBC). The goal of their research was to forecast the level of annual and average daily border crossing traffic flows across the Cascade

Gateway. The border ports investigated were: Blaine, Lynden, and Sumas. The forecasts were estimated to 2006 and 2011. Though there are many similarities between the studies, there are also some very significant differences and modifications between TSi's work and this project. The first and most pronounced difference is the number of border ports evaluated. TSi evaluated three border ports. This project encompasses ten border ports with a detailed analysis on six of the ten. A secondary goal of this project also was to provide scope to border crossings in Washington, and not just simply focus on the three western Washington border ports. TSi's research produced one forecast method, with nothing to compare against. This project utilizes three methods of forecasting border crossings and provides a comparison between the three. TSi used two horizon years (2006 and 2011). Only one horizon year was reported in this project, though all horizon years were estimated to the year 2015. LMBC estimates crossings during various peak seasons, including: summer average daily traffic (SADT), winter average daily traffic (WADT), and annual average daily traffic (AADT). This research effort analyzed crossings based solely on AADT. There is an understanding that during peak hours and peak seasons, there will be an expectation of high daily traffic flows. This research was designed to estimate yearly flows and AADT flow, though the methodology easily translates flows into seasons. TSi makes further assumptions about industry stability. This research conducts an industry growth and output consistency investigation, which is outlined in the Industry Analysis section. LMBC estimates trade growth using broader commodity groups (seven commodities, plus mixed, unknown, and empty trucks). This research identifies and estimates trade growth for fifteen commodity groups, plus mixed, unknown, and empty trucks. Lastly, TSi conducts an origin destination study of their own, but only incorporate starting and ending regions (ie:

Puget Sound, Eastern Washington, Alberta, West USA, etc). Through the use of SFTA, exact origin and destination cities are identified as well as the Washington State routes that are utilized in transport. When these differences are incorporated in addition to the updated change in port level border crossings and trade between 2002 and 2005, the end results are very different. Table 40 highlights the AADT results between LMBC and this report ("New").

Table 40 – Lower Mainland Border Crossing Comparison

Lower Mainland Border Crossing Comparison					
Port	Direction	LMBC 2006	New 2006	LMBC 2011	New 2011
Blaine	Northbound	1890	1177	2350	1420
	Southbound	2140	1267	2650	1492
Lynden	Northbound	230	279	290	324
	Southbound	260	164	330	193
Sumas	Northbound	210	211	260	233
	Southbound	510	444	640	504

Based on the comparison of these estimates, one main conclusion is drawn. This report's forecast appears very conservative to the LMBC report, except for Sumas Northbound and Lynden Northbound. One explanation for this is based on the time differential between the reports. In the LMBC time frame, most time series data showed relatively high annual growth in trade and truck crossings, which is revealed by TSi's estimated port truck crossing annual growth rate ranging between 5.0% and 5.5%. After 2001, trade and moreover truck crossings began to slow, which is reflected by this reports range of 2.35% to 3.0% annual growth rate for the Cascade Gateway border ports.

CONCLUSIONS AND IMPLICATIONS

From the onset of this research, the authors' perspective of border crossings encompassed more than just a point of entry to another market. The viewpoint taken conceptualized border crossings/ports as dynamic facilitators of commodity trade, through which transport of goods for consumption, manufacturing, or further market export would be achieved in an efficient manner. This study shows ports are not just physical and geographic locations. Ports have commodity and trade profiles that affect their efficiency, usage, and need for changing infrastructure, operations and the road networks to support them. In other words, transportation efficiency provides a crucial component to market efficiency and knowing the various components contributing to trade and transportation allows a decision maker to maximize cross-border trade efficiency in order to remain competitive in the global market.

This project draws on the detailed information available through SFTA. The reasoning for profile development was to utilize trade growth of commodities to estimate truck flows. This was based on the argument that trade growth is a more reliable predictor of international truck crossings than historical truck crossing data. Profiles were also developed to increase understanding of what and where commodities were crossing the Washington-British Columbia border. This knowledge can benefit cross-border shippers if port profiles indicate significant levels of certain commodities at specific ports (i.e. border port facilities may be able to better accommodate the shippers of the commodities) and also provide policy makers detailed information about future truck crossings and trade expectations. The methodology chosen follows in line with the available resources, data, and information, whereby projections of crossings and border port profiles can be modified based on expected trade growth changes. Furthermore, given the current data and methodology used, projections can be easily adapted in the short run and long run to adjust for exogenous market changes or improved information.

Given the data and analysis, there is an expectation of increased flows for Washington's major border ports. Increases in bi-directional flows have implications ranging from crossing times, road deterioration, security, supply chain management, and border port processing capacity. A major question is: Are the border ports adequate to process the projected growth in truck crossings?

The purpose of this paper was to provide data and information to help the policy process related to improving border ports and roads. The information presented will help in prioritizing investment and infrastructure improvement projects critical to Washington State's efficiency and international competitiveness on the world market.

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APPENDIX

A. BORDER PORT COMMODITY PROFILE

	Northbound				Southbound		
Border Port	**3-Digit NAICS**	**Commodity**			**3-Digit NAICS**	**Commodity**	
Blaine	…	Empty	37.4%		…	Empty	24.5%
	111	Crop Production	10.1%		321	Wood Products	19.7%
	…	Other	7.4%		322	Paper Products	8.5%
	311	Processed Food	6.9%		311	Processed Food	7.1%
	…	Unknown	6.1%		327	Non-Metallic Mineral	6.2%
	322	Paper Products	4.9%		332	Fabricated Metal	5.8%
	325	Chemical	3.7%		…	Other	5.3%
	326	Plastics & Rubber	3.3%		…	Unknown	4.4%
	332	Fabricated Metal	2.9%		312	Beverage	3.1%
	327	Non-Metallic Mineral	2.5%		333	Machinery	2.5%
	336	Transportation Equip	2.0%		325	Chemical	2.2%
	333	Machinery	2.0%		326	Plastics & Rubber	2.1%
	324	Petroleum & Coal	1.7%		323	Printed Material	1.4%
	321	Wood Products	1.6%		111	Crop Production	1.4%
	331	Primary Metal	1.6%		331	Primary Metal	1.4%
	313	Textile	1.4%		212	Mining	1.1%
	312	Beverage	1.2%		337	Furniture	0.9%
	337	Furniture	0.8%		336	Transportation Equip	0.5%
	334	Computer & Electronics	0.6%		334	Computer & Electronics	0.5%
	335	Appliances	0.6%		113	Forestry/Logging	0.5%
	323	Printed Material	0.6%		339	Miscellaneous	0.4%
	339	Miscellaneous	0.3%		315	Apparel	0.4%
	315	Apparel	0.3%				
	112	Animal Production	0.2%				
Lynden	…	Empty	33.6%		321	Wood Products	39.9%
	111	Crop Production	19.0%		…	Unknown	25.7%
	326	Plastics & Rubber	9.5%		332	Fabricated Metal	11.8%
	333	Machinery	9.5%		312	Beverage	11.8%
	321	Wood Products	4.8%		336	Transportation Equip	10.7%
	311	Processed Food	4.8%				
	…	Other	9.5%				
	327	Non-Metallic Mineral	4.7%				
	332	Fabricated Metal	4.7%				
Sumas	…	Unknown	21.2%		…	Empty	38.1%
	113	Forestry/Logging	17.0%		321	Wood Products	23.6%
	…	Other	15.7%		325	Chemical	17.4%
	332	Fabricated Metal	11.6%		326	Plastics & Rubber	8.7%
	…	Empty	11.5%		339	Miscellaneous	6.0%
	323	Printed Material	11.5%		311	Processed Food	6.0%
	325	Chemical	5.8%				
	111	Crop Production	5.7%				

Oroville	…	Empty	57.6%		321	Wood Products	36.4%
	111	Crop Production	14.2%		…	Empty	11.9%
	321	Wood Products	5.7%		327	Non-Metallic Mineral	7.3%
	312	Beverage	4.2%		326	Plastics & Rubber	6.7%
	327	Non-Metallic Mineral	3.6%		111	Crop Production	5.7%
	336	Transportation Equip	3.5%		336	Transportation Equip	5.3%
	311	Processed Food	2.1%		…	Unknown	5.1%
	326	Plastics & Rubber	1.7%		311	Processed Food	4.9%
	322	Paper Products	1.2%		112	Animal Production	3.2%
	…	Other	1.2%		…	Other	2.8%
	331	Primary Metal	1.2%		113	Forestry/Logging	2.1%
	325	Chemical	1.1%		333	Machinery	1.8%
	333	Machinery	0.8%		339	Miscellaneous	1.6%
	334	Computer & Electronics	0.7%		325	Chemical	1.6%
	324	Petroleum & Coal	0.5%		332	Fabricated Metal	1.6%
	…	Unknown	0.5%		322	Paper Products	1.4%
	332	Fabricated Metal	0.4%		324	Petroleum & Coal	1.4%
Danville	321	Wood Products	80.0%		…	Empty	57.1%
	…	Empty	20.0%		321	Wood Products	35.7%
					…	Unknown	7.1%
Laurier	…	Empty	50.5%		321	Wood Products	69.9%
	321	Wood Products	34.9%		…	Empty	16.7%
	327	Non-Metallic Mineral	9.7%		327	Non-Metallic Mineral	7.2%
	…	Unknown	4.9%		113	Foresty&Logging	1.7%
					325	Chemical	1.7%
					…	Unknown	1.7%
					311	Processed Food	1.2%
Frontier	…	Empty	64.4%		325	Chemical	73.4%
	325	Chemical	22.6%		…	Empty	16.8%
	321	Wood Products	13.0%		…	Unknown	4.9%
					321	Wood Products	4.9%

B. ANNUAL INDUSTRY ACCOUNTS METHODOLOGY[15]

The annual input-output (I-O) accounts and the GDP-by-Industry accounts are created using an integrated methodology that makes the annual estimates of gross output, intermediate inputs, and value added by industry more timely and consistent than previously possible.[1] Industry estimates are published for 65 detailed industries, as defined by the 1997 North American Industry Classification System (NAICS). Commodity estimates are published at the same level of detail plus four unique commodities.[2] Extensive estimates of final uses and value added are also included in the annual publication. Compared to previous methodologies, the integrated methodology is applied at a finer level of industry and commodity detail to enhance the accuracy of aggregate level estimates.

The integrated annual I-O accounts and GDP-by-industry accounts are prepared in five steps.

Step one. Industry estimates of current-dollar value added are extrapolated forward by the percentage changes in the annual estimates of gross domestic income (GDI) from the NIPAs. The GDI-by-industry estimates consist of compensation of employees, taxes on production and imports less subsidies, and gross operating surplus. Additionally, BEA uses data on employment to convert the corporate data on profits before tax, net interest, and capital consumption allowances from an enterprise basis to an establishment basis. Finally, the statistical discrepancy, the difference between GDI and GDP from the NIPAs, is distributed among the industries. In general, annual revisions to the industry estimates of value added largely reflect revisions to the components of GDI and to the statistical discrepancy from the annual NIPA revision.

Step two. Industry estimates of gross domestic output. The extrapolators for these estimates are prepared using a wide array of source data, which include surveys from the Bureau of the Census and the Bureau of Labor Statistics, 2002 Economic Census data for manufacturing, and other data.[3] Annual revisions to industry estimates of gross output are due to revisions in these source data.

Step three. The initial commodity composition of intermediate inputs is calculated for each industry by a process that uses the previous year's direct requirements coefficients. First, the industry's gross output for a given year is revalued in the commodity prices of the previous year. Next, the revalued gross output is multiplied by the industry's direct requirements coefficients from the previous year.[4] Finally, the

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[15] Methodology provided by: Bureau of Economic Analysis. Gross-Domestic-Product-by-Industry-Accounts: Annual Industry Accounts Methodology. May 2007. http://www.bea.gov/industry/gpotables/Methodology.cfm?anon=626

resulting commodity estimates of intermediate inputs for the industry are revalued in the commodity prices of the current year.

Step four. The domestic supply of each commodity and the commodity composition of each GDP expenditure component are estimated. The initial commodity compositions for these expenditure components are estimated using commodity-flow relationships from the revised 1997 benchmark I-O accounts. The annual I-O use tables are then balanced using a bi-proportional adjustment procedure to ensure that intermediate and final use of commodities is consistent with domestic supply, that intermediate use is consistent with gross output and value added, and that final use is consistent with the final expenditure components from the NIPAs. The measures of gross output, intermediate inputs, and value added are then incorporated into the GDP-by-industry accounts.

Step five. Price and quantity indexes for the GDP-by industry accounts are prepared in three steps. First, indexes are derived for gross output by separately deflating each commodity produced by an industry that is included as part of its gross output. Next, indexes for intermediate inputs are derived by deflating all commodities that are consumed by an industry as intermediate inputs in the annual I-O use tables.[5] Finally, indexes for valued added by industry are calculated using the double-deflation method in which real value added is computed as the difference between real gross output and real intermediate inputs.[6]

[1] For more information pertaining to the integrated annual industry accounts, see Brian C. Moyer, Mark A. Planting, Mahnaz Fahim-Nader, and Sherlene K.S. Lum, "Preview of the Comprehensive Revision of the Annual Industry Accounts," Survey of Current Business 84 (March 2004): 38-51. http://www.bea.gov/bea/pub/0304cont.htm

[2] These special commodities consist of noncomparable imports; scrap, used and secondhand goods; rest of the world adjustment to final uses; and inventory valuation adjustment.

[3] The estimates of the commodity composition of extrapolated industry gross output are largely consistent with the 1997 benchmark I-O relationships for nonmanufacturing industries and with current survey data for manufacturing industries.

[4] Direct requirements coefficients specify the amount of each commodity required by the industry to produce a dollar of output.

[5] Source data used to prepare the commodity price indexes for deflation can be found in Moyer et al. 48-49.

[6] Separate estimates of gross output and intermediate inputs are combined in a Fisher index-number formula in order to generate the indexes for value added by industry. This method is preferred because it requires the fewest assumptions about the relationships among gross output by industry and intermediate inputs by industry.