Freight Commodity Flows: Selected Washington State Highways

WA-RD 825.1

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April 2014

Washington State Department of Transportation
Office of Research & Library Services

WSDOT Research Report

Research Report

WA-RD# 825.1

Freight Commodity Flows: Selected Washington State Highways

by

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Prepared for
The State of Washington
Washington State Department of Transportation
Lynn Peterson, Secretary

April 4, 2014

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
WA-RD 825.1		

4. TITLE AND SUBTITLE	5. REPORT DATE
FREIGHT COMMODITY FLOWS:SELECTED WASHINGTON STATE HIGHWAYS	April 2014
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Sage, J., Casavant, K.	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Freight Policy Transportation Institute (FPTI) School of Economic Sciences Washington State University PO Box 646210, Pullman, WA 99164-6210	10. WORK UNIT NO.
	11. CONTRACT OR GRANT NO. Agreement T4120, Task 34
12. SPONSORING AGENCY NAME AND ADDRESS Research Office Washington State Department of Transportation Transportation Building, MS 47372 Olympia, Washington 98504-7372 Project Manager: Doug Brodin, 360.705.7972	13. TYPE OF REPORT AND PERIOD COVERED Research Report
	14. SPONSORING AGENCY CODE
15. SUPPLEMENTARY NOTES	

16. ABSTRACT:

The search for understanding of commodity flows throughout the nation and the State of Washington is a continual process. This understanding is critical at many levels of the transportation industry and to those firms and entities that provide that transportation, or regulate and invest in the needed infrastructure. These data, usually desired at the sub national level, are essential to adequate planning by state, regional and local levels as attempts continue to improve the efficiency, effectiveness and sustainability of the transportation system. State and national travel models require those data, often on a seasonal, commodity/industrial, directional, modal, etc. basis. Determining the importance of a commodity flow on a corridor level leads to the correct prioritization of investments in infrastructure as well as increasing the ability to determine quantitative impacts of congestion, regulation and bottlenecks on a transportation system or supply chain.

Using the FPTI developed Intercept Survey Methodology, the research team conducted a series of seasonal truck surveys at seven locations: on Snoqualmie Pass (2 sites) and in the greater Wenatchee area (5 sites). Survey results aid in the identification of not only volume and commodity movements in the regions, but also bottlenecks or rerouting options identified by the survey respondents.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
Intercept Survey, Snoqualmie Pass, Wenatchee, Truck Freight	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22616

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
None	None		

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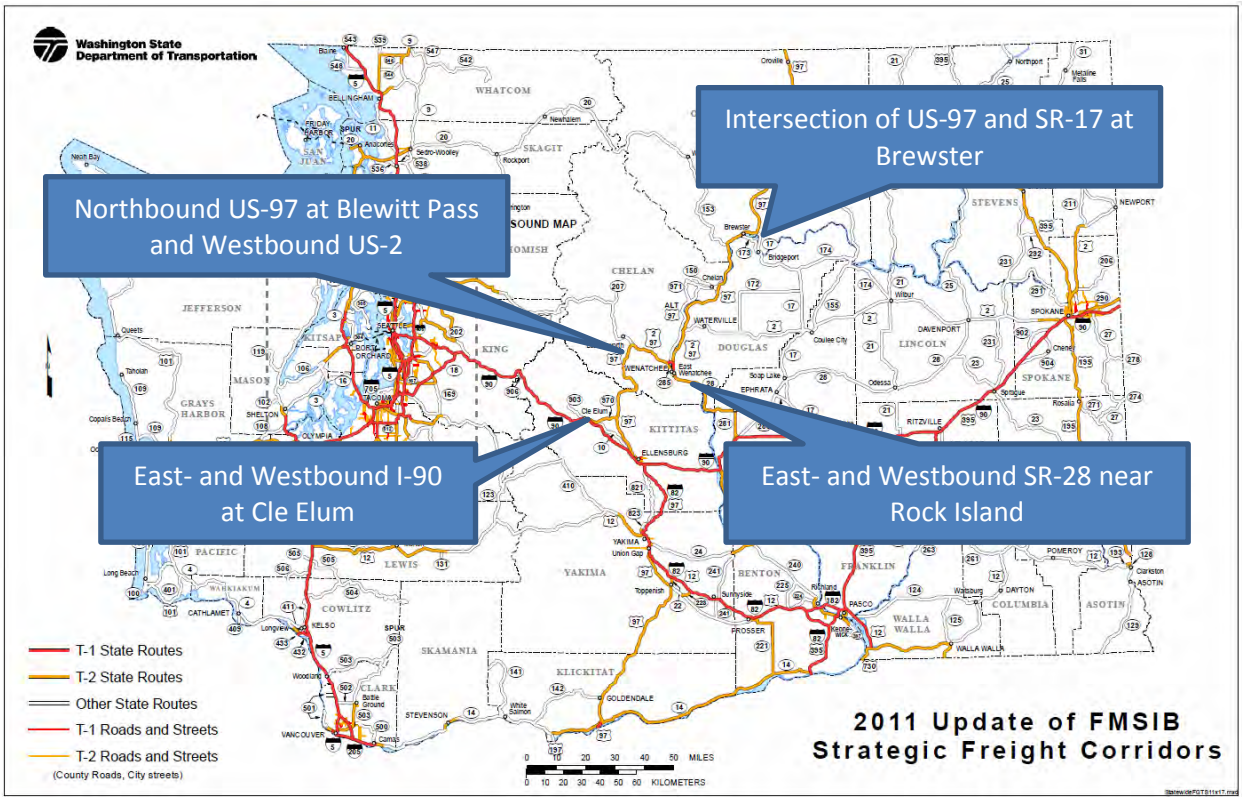
EXECUTIVE SUMMARY

Project Overview

The search for understanding of commodity flows throughout the nation and the state of Washington is a continual process. This understanding is critical at many levels of the transportation industry and to those firms and entities that provide that transportation, or regulate and invest in the needed infrastructure. These data, usually desired at the sub national level, are essential to adequate planning by state, regional and local levels as attempts continue to improve the efficiency, effectiveness and sustainability of the transportation system. State and national travel models require those data, often on a seasonal, commodity/industrial, directional, or modal basis. Determining the importance of a commodity flow on a corridor level leads to improved bases for the prioritization of investments in infrastructure as well as increasing the ability to determine quantitative impacts of congestion, regulation and bottlenecks on a transportation system or supply chain.

Seasonal surveys were collected from seven locations shown below; two on Snoqualmie Pass, and five in the greater Wenatchee region.



Specific survey instruments were developed for each region of consideration in an effort to address regional data needs. Specifically, the Snoqualmie survey instruments were developed to aid the region in answering the following series of questions:

- How much freight is crossing the Snoqualmie Pass both in tonnage and value of freight?
- What types of products are crossing the Pass, on a daily, seasonal, and yearly basis?
- What routes does freight take when Snoqualmie Pass is closed?
- How important is Snoqualmie Pass to the Ports?
- Which Ports benefit most from Snoqualmie Pass?
- Is Snoqualmie Pass used primarily for importing or exporting freight?
- How much does closing the Pass cost the state of Washington's economy?
- How much does it cost freight companies when the Pass is closed?

Similarly, the Wenatchee area survey instruments were designed to again collect information on the volume and commodity movements in the region and with an added interest in the identified bottlenecks for freight throughout the region. Through the compilation and analysis of the results, it becomes readily apparent that many drivers are not pleased with the implementation and effectiveness of the growing trend in round-a-bouts in place of lighted intersections.

VOLUME I: SNOQUALMIE PASS

Section 1: Background

The search for understanding of commodity flows throughout the nation and the state of Washington is a continual process. This understanding is critical at many levels of the transportation industry and to those firms and entities that provide that transportation, or regulate and invest in the needed infrastructure. These data, usually desired at the sub national level, are essential to adequate planning by state, regional and local levels as attempts continue to improve the efficiency, effectiveness and sustainability of the transportation system. State and national travel models require those data, often on a seasonal, commodity/industrial, directional, or modal basis. Determining the importance of a commodity flow on a corridor level leads to improved bases for the prioritization of investments in infrastructure as well as increasing the ability to determine quantitative impacts of congestion, regulation and bottlenecks on a transportation system or supply chain.

The information on the destination of the products carried, their origin, their volume/value, etc. can be useful, even critical, in prioritizing the I-90 corridor over Snoqualmie Pass for future private and public infrastructure investments. Potential needs for corridor enhancement have been placed at around $500 million, but the benefits of such improvements suffer from the lack of precise, enriched data on the actual commodity flows. Such data can be used to prioritize infrastructure investments and policy alternatives dealing with the overall impact of problems in the corridor.

Objectives

The overall goal of this research project is to collect the necessary data to quantify and characterize the movement of commodities through specified freight corridors, or through and around relevant entities/cities/counties, using the intercept methodology (Appendix I.A), when trucks are stopped during the movement itself, as developed in previous studies by the Freight Policy Transportation Institute (FPTI)[1]. Specifically, the survey design and implementation sought to enable WSDOT and contributing agencies to answer the following questions:

- How much freight is crossing the Snoqualmie Pass both in tonnage and value of freight?
- What types of products are crossing the Pass, on a daily, seasonal, and yearly basis?
- What routes does freight take when Snoqualmie Pass is closed?
- How important is Snoqualmie Pass to the Ports?

[1] http://www.sfta.wsu.edu/research/reports/pdf/Rpt_2_Data_Dictionary.pdf

- Which Ports benefit most from Snoqualmie Pass?
- Is Snoqualmie Pass used primarily for importing or exporting freight?
- How much does closing the Pass cost the state of Washington's economy?
- How much does it cost freight companies when the Pass is closed?

Discussions regarding each of the above questions are addressed in the sections that follow.

Section 2: Freight Truck Movements on Washington's Snoqualmie Pass

The efficient movement of goods over Washington's major East-West corridor, Snoqualmie Pass, is vital to the economic vitality of the state and the region. Figure I.2.1 summarizes the survey total for each season and direction, along with the recorded average volumes for the week of the survey (where applicable). As can be seen in the table, each survey session garnered sufficient responses to readily obtain a confidence level of 95% (C.I. 5%). Using the Seasonal weight factor calculations (Appendix A), the average annual daily truck traffic (AADTT) is calculated as 3,114 for eastbound trucks (1,110 empty, and 2,004 loaded), and 2,351 for westbound trucks (400 empty, and 1951 loaded). These figures, multiplied by 312 (assumed 6 days of operation per week), are used to calculate annual volumes and associated values.

Figure I.2.1: Seasonal survey totals.

	Number of Empty Trucks Surveyed	Number of Trucks With Cargo Surveyed	Seasonal Weight Factor	Truck Total Volume[a]	Weighted Value	Percent of Trucks Surveyed	Confidence Level 95% +/- 5%
Eastbound							
Fall	210	303	0.261	2,650	691	19%	√
Winter	213	366	0.294	2,500	736	23%	√
Spring	167	292	0.233	3,636	848	13%	√
Summer	128	289	0.212	3,880	822	11%	√
Westbound							
Fall	112	590	0.269	2,175	585	32%	√
Winter	129	606	0.282	1,031	290	71%	√
Spring	107	511	0.237	3,125	740	20%	√
Summer	96	459	0.213	3,455	735	16%	√

[a] Truck total volumes represent the average of the recorded truck (Summation of Single-, Double-, and Triple-Units) volumes for the week of the survey. Due to instrument error, counts for the winter session are not available. The recorded values represent February 2012 recordings. Truck counts are only used to gauge statistical significance, thus this error does not reduce the integrity of the surveys.

Figure I.2.2 captures the aggregated industry groups transporting goods across the pass, as measured by all surveys collected westbound at the Port of Entry (POE) near Cle Elum, and the eastbound weigh station opposite the POE. Using commodity values ($/ton) generated from the nationally based Commodity Flow Survey (CFS), the value of the surveyed cargo being transported has been estimated. Where available, the values are generated from Washington specific averages of the corresponding industry codes. National averages are used in place of those with insufficient records to generate a state average (Indicated by (*) in Figure I.2.2). The figure relates only the number of occurrences each commodity is found in the surveyed drivers from all eight (four eastbound, and four westbound) survey events. Cargo weight and total tonnage represent the combined cargo weight of all respondents under the associated commodity category, while average cargo weight is a simple average taken based on the number of observations in the category.

Figure I.2.2: I-90 commodity survey totals by volume and associated value.

SCTG	Description	Number of Occurrences	Total Cargo Weight	Average Cargo Weight	Total Tonnage	Total Value ($)
01	Live animals and live fish	6	209,000	34,833	105	$ 179,252
02	Cereal grains	14	504,561	36,040	252	$ 68,256
03	Other agricultural products	334	13,890,050	41,587	6,945	$ 5,276,381
04	Animal feed and animal products*	169	8,111,233	47,995	4,056	$ 6,045,892
05	Meat, fish, seafood	125	4,323,799	34,590	2,162	$ 7,768,038
06	Milled grain and bakery products	34	1,536,810	45,200	768	$ 1,400,269
07	Other prepared foodstuffs, fats, oils	593	24,396,285	41,140	12,198	$ 15,731,934
08	Alcoholic beverages	50	1,903,624	38,072	952	$ 2,020,863
10	Monumental or building stone	3	128,000	42,667	64	$ 41,891
11	Natural sands	7	423,900	60,557	212	$ 5,958
12	Gravel and crushed stone	25	1,250,720	50,029	625	$ 9,288
13	Nonmetallic minerals*	15	736,480	49,099	368	$ 32,578
14	Metallic ores and concentrates	3	179,700	59,900	90	$ 382,561
16	Crude Petroleum*	4	142,830	35,708	71	$ 47,122
17	Gasoline and aviation turbine fuel	30	1,890,499	63,017	945	$ 948,576
18	Fuel oils	20	1,060,800	53,040	530	$ 426,739
20	Basic chemicals	19	749,288	39,436	375	$ 310,445
21	Pharmaceutical products	2	37,000	18,500	19	$ 2,465,818
22	Fertilizers	5	184,000	36,800	92	$ 31,888
23	Chemical products and preparations	9	304,028	33,781	152	$ 820,728
24	Plastics and rubber	66	2,189,178	33,169	1,095	$ 5,070,853
25	Logs and other wood in the rough	8	449,000	56,125	225	$ 24,477
26	Wood products	162	6,376,350	39,360	3,188	$ 1,137,798
27	Pulp, and paper products	119	4,146,167	34,842	2,073	$ 1,693,864
30	Articles of textiles or leather	45	1,172,066	26,046	586	$ 15,646,694
31	Nonmetallic mineral products	62	2,129,022	34,339	1,065	$ 244,643
32	Primary/semi-finished base metal	121	4,776,741	39,477	2,388	$ 4,378,351
33	Articles of base metal	3	93,000	31,000	47	$ 186,919
34	Machinery	79	2,219,995	28,101	1,110	$ 9,940,499
35	Electronic, electrical equipment, components and office equipment	70	1,708,496	24,407	854	$ 35,138,085
36	Motorized and other vehicles, parts	170	4,458,856	26,229	2,229	$ 20,521,445
38	Precision instruments and apparatus	8	147,869	18,484	74	$ 18,520,258
39	Furniture, mattresses, lamps, lighting fittings, and illuminated signs	114	2,683,895	23,543	1,342	$ 13,183,563
40	Miscellaneous manufactured products	93	2,866,250	30,820	1,433	$ 4,494,387
41	Waste and scrap	75	3,105,762	41,410	1,553	$ 844,362
43	Mixed freight	374	12,020,759	32,141	6,010	$ 23,578,985
					Total	**$ 198,619,662**

As can be readily expected, distinct differences exist between east and westbound commodity movement. At the broadest perspective, this difference is manifest in the average weight and value of the cargo. Figure I.2.3 reveals these differences. Westbound trucks, largely originating in Eastern Washington, averaged slightly over 19 tons per truck. The value of these same trucks averaged roughly $3,500 per ton. Eastbound trucks weighed less, just shy of 17 tons per tuck, and are valued higher on average, over $5,000 per ton, than their westbound counterparts. Annualizing the volume and value of cargo crossing the Snoqualmie pass generates in excess of an estimated 10 million tons crossing in either direction and $106 Billion combined in goods moved (Figure I.2.4).

Figure I.2.3: East and Westbound cargo averages[a].

	Average Cargo Weight (Tons)	Average Cargo Value ($/ton)
Westbound	19.4	$ 3,518.62
Eastbound	17.0	$ 5,033.00

[a] Only those records for which a cargo weight was specified by the respondent, and an identifiable cargo value could be determined are included here.

Figure I.2.4: Annualized volume and value of cargo crossing Snoqualmie Pass.

Direction of Trip	Number of Empty Trucks	Number of Trucks with Cargo	Total Cargo Weight (Million Tons)	Total Cargo Value (Million Dollars)
Eastbound	346,360	625,298	10.62	$ 53,436.81
Westbound	124,711	608,670	11.82	$ 53,394.88

Section 3: Characteristic Profile of Eastbound Trucks on I-90

Brief summaries of the eastbound trucks, empty and loaded, are displayed in the following tables. Major characteristics of consideration include the origin and destination (O-D) states/provinces and cities, as well as their associated O-D facilities. The overwhelming majority of trucks surveyed, loaded and empty, originated within Washington (Figure I.3.1). Few other states or provinces recorded a significant number of observations. The Canadian province of British Columbia (BC) generated more observations that all other US states combined, absent Washington. This observation begins to suggest an important relationship between the U.S.-Canadian border and I-90. Breaking the origins of trips down further, Figure I.3.2 provides indication of the cities from which trucks begin their hauls. The top five origin cities are presented, with Seattle being the primary generator both for loaded and empty trucks. Approximately 65% of eastbound trucks are carrying cargo from more than 130 different cities, while the empty trucks originate from just over 100 cities.

Figure I.3.1: Eastbound-origin State/Province.

Origin State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	1180	94.1%	668	95.3%	1848	94.9%
BC	62	4.9%	17	2.4%	79	4.1%
CA	6	0.5%	3	0.4%	9	0.5%
OR	6	0.5%	6	0.9%	12	0.6%
Other	7	0.6%	7	1.0%	14	0.7%
Total	**1254**	**100%**	**701**	**100%**	**1948**	**100%**

Figure I.3.2: Eastbound-origin city.

Origin City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Seattle	238	19%	164	26%	402	21%
Kent	186	15%	61	10%	247	13%
Tacoma	115	9%	128	20%	243	13%
Sumner	97	8%	36	6%	133	7%
Auburn	95	8%	36	6%	131	7%
Other	526	42%	273	39%	799	39%
Total	**1257**	**100%**	**698**	**100%**	**1955**	**100%**

As should be expected, destination states are more widely dispersed than are the coinciding origins, though still largely dominated by intrastate travel (Figure I.3.3). Unlike the origins for both loaded and empty trucks, whose Washington based originations both exceeded 90%, a difference arises between

loaded and empty when considering their destination. Just fewer than 60% of loaded trucks terminated in Washington, while 87% of empty trucks did so within the state. Additionally, loaded trucks were destined for 53 states or provinces (or some combination thereof), while empty trucks were terminating in fewer than half that number, 21.

Loaded, eastbound trucks are destined for more than 300 cities after crossing Snoqualmie Pass. Spokane ranks as the most frequent destination, with 15%. Of the top destination cities, only one out-of-state city, Hermiston, OR, cracks into the Top-5 for loaded tucks (Figure I.3.4). For those trucks eastbound without cargo, the attraction to Spokane significantly drops off, with only 3% of the destinations. Replacing it as the top destination city is a combination of Yakima and Ellensburg with 13% each. Not shown in Figure I.3.4, but garnering significant attraction by empty eastbound trucks are Pasco (33), Othello (30), and Grandview (29). One Hundred and twenty different cities serve as the destination of eastbound trucks.

Figure I.3.3: Eastbound-destination State/Province.

Destination State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	739	58.8%	609	87.2%	1348	69.0%
ID	95	7.6%	17	2.4%	112	5.7%
OR	70	5.6%	39	5.6%	109	5.6%
MT	48	3.8%	3	0.4%	51	2.6%
UT	44	3.5%	2	0.3%	46	2.4%
Other	260	20.7%	28	4.0%	288	14.7%
Total	**1256**	**100%**	**698**	**100%**	**1954**	**100%**

Figure I.3.4: Eastbound-destination city.

Destination City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Spokane	191	15%	22	3%	213	11%
Yakima	99	8%	89	13%	188	10%
Moses Lake	55	4%	32	5%	87	5%
Wenatchee	47	4%	49	7%	96	5%
Hermiston	48	4%	22	3%	70	4%
Ellensburg	41	3%	88	13%	129	7%
Other	757	61%	393	57%	1150	59%
Total	**1238**	**100%**	**695**	**100%**	**1933**	**100%**

Concentrating now on the facility types that generate eastbound flows on I-90, Figure I.3.5 displays the ten option types that were provided for the respondents. Loaded trucks were most likely (52%) to have originated from a Warehouse or Distribution Center. Perhaps surprisingly was the low percentage of trips associated with the major River and Ocean Ports of western Washington. Despite the low count for port generated cargo, nearly twice as many empty observations (122) were recorded originating at the ports. Similar to loaded trips, the empty trips were also led by Warehouse and Distribution Centers.

While Seattle generates more eastbound (import) trips with cargo originating from the ports, as compared to Tacoma, it produces substantially fewer empty truckloads than that of Tacoma (Figure I.3.6). By truck count, the Port of Seattle generates more than 12,000 more truck trips over Snoqualmie Pass, than does its Tacoma counterpart. By value, the Port of Seattle generates just over $1.3 billion in goods moving over the pass annually, while the Port of Tacoma comes in at nearly $548 million of those trucks carrying cargo eastward from either port, no significant commodity trend is apparent. The cargo however, does contain a handful of several SCTG commodities identified in Table 3.7. Most trucks leaving the ports with cargo have destination cities within Washington; 30 of 42 from Seattle, and 9 of 17 from Tacoma. Additionally, Tacoma annually produces approximately 10,000 more empty loads heading east.

Figure I.3.5 Eastbound-origin facility types.

Facility Origin	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	174	14%	183	27%	357	18%
Railroad Yard	35	3%	4	1%	39	2%
River or Ocean Port	64	5%	122	18%	186	10%
Airport	9	1%	4	1%	13	1%
Industrial Factory/Sawmill	89	7%	14	2%	103	5%
Agriculture Processing Facility	48	4%	22	3%	70	4%
Warehouse/Distribution	656	52%	194	28%	850	44%
Farm or Forest	13	1%	10	1%	23	1%
Retail Store or Gas Station	20	2%	30	4%	50	3%
Job/Construction Site	20	2%	7	1%	27	1%
Other	123	10%	91	13%	214	11%
Total	**1251**	**100%**	**681**	**100%**	**1932**	**100%**

Figure I.3.6: Eastbound-Seattle and Tacoma port origination detail.

	Number of Empty Trucks	Number of Trucks with Cargo	Total Cargo Weight (Tons)	Total Cargo Value (Million Dollars)
Surveyed				
Seattle	47	42	910	$ 2.62
Tacoma	67	17	365	$ 1.10
Annualized				
Seattle	23,902	21,008	454,966	$ 1,310.13
Tacoma	34,073	8,497	182,360	$ 547.72

Figure I.3.7: Eastbound-major commodities generated by the Ports of Seattle and Tacoma.

	SCTG Code	Description	Number of Trucks Surveyed	Annualized Number of Trucks
Seattle	3	Other agricultural products	3	1,501
	5	Meat, fish, seafood, and their preparations	3	1,501
	7	Other prepared foodstuffs and fats and oils	4	2,001
	17	Gasoline and aviation turbine fuel	4	2,001
	18	Fuel oils	3	1,501
	43	Mixed freight	7	3,501
Tacoma	26	Wood products	2	1,000
	36	Motorized and other vehicles (including parts)	5	2,501
	43	Mixed freight	2	1,000

Similar to their origins, destination facilities (Figure I.3.8) for respondent trips were largely attributable to Warehouse or Distribution Centers for both loaded (45%) and empty (36%). Agriculturally related empty trucks making return trips, likely back to eastern Washington, additionally make up a substantial number of observations.

Figure I.3.8: Eastbound-destination facility types.

Facility Destination	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	132	11%	130	20%	262	14%
Railroad Yard	7	1%	2	0%	9	0%
River or Ocean Port	2	0%	8	1%	10	1%
Airport	5	0%	0	0%	5	0%
Industrial Factory/Sawmill	55	5%	29	4%	84	5%
Agriculture Processing Facility	40	3%	115	18%	155	8%
Warehouse/Distribution	550	45%	231	36%	781	42%
Farm or Forest	18	1%	20	3%	38	2%
Retail Store or Gas Station	187	15%	13	2%	200	11%
Job/Construction Site	29	2%	8	1%	37	2%
Other	185	15%	94	14%	279	15%
Total	**1210**	**100%**	**650**	**100%**	**1860**	**100%**

Section 4: Characteristic Profile of Westbound Trucks on I-90

Brief summaries of the westbound trucks, empty and loaded, are displayed in the following tables. Major characteristics of consideration include the origin and destination (O-D) states/provinces and cities, as well as their associated O-D facilities. The slight majority of trucks surveyed, loaded and empty, originated with Washington (Figure I.4.1). Unlike eastbound trucks, several other states recorded a significant number of observations. In addition to the observations shown in the figure, a stark difference in the origination states can be seen between those loaded trucks and those empty. Loaded trucks originated from across 52 states and provinces, while empty trucks were more regional in their starting points with only 15 states or provinces represented. Breaking the origins of trips down further, Figure I.4.2 provides indication of the cities from which trucks begin their hauls. Neither loaded nor empty trucks may be suggested to have a primary origination city. Only Spokane generated in excess of 10% of a category, and that was only for those empty trucks. Loaded trucks began their hauls, from more than 500 different cities throughout the U.S. and Canada.

Figure I.4.1: Westbound-origin State/Province.

Origin State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	1096	50.4%	363	83.1%	1459	55.9%
ID	156	7.2%	29	6.6%	185	7.1%
UT	134	6.2%	4	0.9%	138	5.3%
OR	133	6.1%	14	3.2%	147	5.6%
TX	73	3.4%	0	0.0%	73	2.8%
MT	38	1.7%	12	2.7%	50	1.9%
Other	543	25.0%	15	3.4%	558	21.4%
Total	**2173**	**100%**	**437**	**100%**	**2610**	**100%**

Figure I.4.2: Westbound-origin city.

Origin City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Spokane	164	8%	64	14%	228	9%
Yakima	136	6%	39	9%	175	7%
Ellensburg	88	4%	29	6%	117	5%
Moses Lake	82	4%	17	4%	99	4%
Hermiston	74	3%	11	2%	85	3%
Other	1585	74%	288	64%	1873	73%
Total	**2129**	**100%**	**448**	**100%**	**2577**	**100%**

As should be expected given the origin statistics of the eastbound trucks, the vast majority, in excess of 90%, of westbound trucks are destined for Washington (Figure I.4.3). Only BC generates a significant number of destination responses, nearly 7%. The make-up of loaded vs. empty trucks moving west offers quite a different picture as those moving east. Eighty-three percent of westbound trucks were recorded as hauling cargo, as compared to the 64% of those heading east.

In further consideration of the destinations for loaded eastbound trucks, Seattle leads the greater than 170 cities with 22% of the destinations, followed closely by Tacoma at 17% (Figure I.4.4). Seattle's portion of empty trucks increases slightly to 24%, while Tacoma's considerably drops off to 12%. All of the major destination cities are located on the east side of the Puget Sound; the greater Seattle-Tacoma region.

Figure I.4.3: Westbound-destination State/Province.

Destination State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	1991	91.7%	425	97.3%	2416	92.6%
BC	147	6.8%	5	1.1%	152	5.8%
OR	10	0.5%	1	0.2%	11	0.4%
CA	6	0.3%	0	0.0%	6	0.2%
AK	4	0.2%	0	0.0%	4	0.2%
Other	14	0.6%	6	1.4%	20	0.8%
Total	**2172**	**100%**	**437**	**100%**	**2609**	**100%**

Figure I.4.4: Westbound-destination city.

Destination City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Seattle	476	22%	106	24%	582	22%
Tacoma	361	17%	51	12%	412	16%
Kent	221	10%	46	11%	267	10%
Auburn	138	6%	42	10%	180	7%
Sumner	125	6%	26	6%	151	6%
Other	842	39%	164	38%	1006	39%
Total	**2163**	**100%**	**435**	**100%**	**2598**	**100%**

Concentrating now on the facility types that generate westbound flows on I-90, Figure I.4.5 displays the ten option types that were provided for the respondents. Loaded trucks were most likely to have originated from a Warehouse or Distribution Center (38%) or an Agricultural Facility (18%). Further exploration may be warranted to determine whether any respondents interpreted Warehouse/Distribution center to imply one of an agricultural variety. Similar to loaded trips, the empty trips were also led by Warehouse and Distribution Centers in conjunction with Trucking Yards.

Figure I.4.5 Westbound-origin facility types.

Facility Origin	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	244	12%	113	27%	357	14%
Railroad Yard	7	0%	1	0%	8	0%
River or Ocean Port	9	0%	1	0%	10	0%
Airport	8	0%	1	0%	9	0%
Industrial Factory/Sawmill	298	14%	18	4%	316	13%
Agriculture Processing Facility	377	18%	22	5%	399	16%
Warehouse/Distribution	791	38%	109	26%	900	36%
Farm or Forest	88	4%	8	2%	96	4%
Retail Store or Gas Station	27	1%	55	13%	82	3%
Job/Construction Site	18	1%	15	4%	33	1%
Other	210	10%	69	17%	279	11%
Total	**2077**	**100%**	**412**	**100%**	**2489**	**100%**

Similar to their origins, destination facilities for respondent trips were largely attributable to Warehouse or Distribution Centers for both loaded (40%) and empty (28%). The western Washington Ports become a readily apparent attractant in the destinations of westbound trucks on I-90, attracting 17% of the westbound loaded trucks completing the survey. The ports of Tacoma and Seattle receive similar volumes of westbound trips, 172 and 159 respectively (Figure I.4.7). The major commodities destined for these destinations is comprised of agricultural products, animal feed and products, and prepared foodstuff (Figure I.4.8a). Specifically, the major westbound products to either port are hay, apples, and frozen French Fries (Figure I.4.8b).

In 2012, nearly $4.3 billion in agricultural products (e.g. hay, vegetables, fruit, meat) were exported through the port of Seattle, in addition to another $5.8 billion in non-agricultural products (e.g. forest products, seafood, paper)[2]. Survey estimates of the total value of commodities crossing Snoqualmie Pass and heading to the Port of Seattle total slightly more than $2.5 billion, thus contributing significantly to the total exports from the port. Note, that the survey period is somewhat offset from the 2012 total export value from the Port.

Similarly, the Port of Tacoma processed $11.2 billion in international exports in 2013 in addition to additional domestic shipments[3]. Truck trips destined for the Port of Tacoma over the survey period are

[2] http://www.portseattle.org/Cargo/SeaCargo/Pages/Exports.aspx
[3] http://portoftacoma.com/about/statistics

estimated to total $4.1 billion, making the Pass a significant contributing passageway for products destined for the Port.

Figure I.4.6: Westbound-destination facility types.

Facility Destination	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking yard	170	8%	145	36%	315	13%
Railroad yard	24	1%	7	2%	31	1%
River or Ocean Port	339	17%	34	9%	373	15%
Airport	14	1%	1	0%	15	1%
Industrial factory/sawmill	127	6%	21	5%	148	6%
Agriculture processing facility	71	3%	8	2%	79	3%
Warehouse/distribution	823	40%	110	28%	933	38%
Farm of forest	34	2%	6	2%	40	2%
Retail store or gas station	176	9%	7	2%	183	8%
Job/construction site	36	2%	7	2%	43	2%
Other	223	11%	54	14%	277	11%
Total	**2037**	**100%**	**400**	**100%**	**2437**	**100%**

Figure I.4.7: Westbound-Seattle and Tacoma port destination detail.

	Number of Empty Trucks	Number of Trucks with Cargo	Total Cargo Weight (Tons)		Total Cargo Value (Million Dollars)
Surveyed					
Seattle	17	159	3,734	$	8.26
Tacoma	16	172	4,163	$	13.36
Annualized					
Seattle	4,855	48,804	1,146,124	$	2,535.52
Tacoma	4,569	52,795	1,277,928	$	4,100.07

Figure I.4.8a: Westbound-major commodity groups destined for the Ports of Seattle and Tacoma.

	SCTG Code	Description	Number of Trucks Surveyed	Annualized Number of Trucks
Seattle	3	Other agricultural products	42	11,765
	4	Animal feed and products of animal origin	43	12,045
	7	Other prepared foodstuffs and fats and oils	32	8,964
	32	Base metal in primary or semi-finished forms and finished basic shapes	8	2,241
Tacoma	3	Other agricultural products	34	9,524
	4	Animal feed and products of animal origin	48	13,446
	7	Other prepared foodstuffs and fats and oils	49	13,726
	26	Wood products	9	2,521
	43	Mixed freight	7	1,961

Figure I.4.8b: Westbound-major commodities destined for the Ports of Seattle and Tacoma.

	Commodity	Number of Trucks Surveyed	Annualized Number of Trucks
Seattle	Apples	25	7,003
	Hay	39	10,925
	French Fries	25	7,003
	Potatoes	9	2,521
	Lumber	1	280
Tacoma	Apples	23	6,443
	Hay	41	11,485
	French Fries	24	6,723
	Potatoes	3	840
	Onions	5	1,401
	Lumber	7	1,961

Section 5: Reroute Characteristics of East and Westbound Truck Movement

Of significant concern in the formulation of this intercept survey, is the understanding of the tendencies of freight movement in the face of a potentially long term closure of the pass. Drivers were asked "*In the event of a weather related closure on Snoqualmie Pass, how long are you willing to wait before taking an alternative route?"* Drivers were provided the opportunity to select from five responses ranging from a decision to reroute immediately, up to waiting in excess of five hours. Figure I.5.1 summarize the responses garnered from all respondents who provided an answer to the rerouting question. Independent of direction, 43% of drivers indicate that they will wait in excess of five hours before rerouting. Nearly a quarter of each was not able to provide a firm answer to the question. Likely justifications for not knowing stem from two main sources: 1) Decisions about rerouting are not made by the driver, rather they are made by a logistics managers (dispatch); and 2) unfamiliarity with the route if not using this route very often.

Further examination of two of the more prominent commodities, in each direction, moving over Snoqualmie pass reveals subtle differences taking shape in regards to the willingness to wait for reopening of the pass. Two primary reroutes constitute movement around a potential closure. These include White and Stevens passes, followed by a larger reroute utilizing I-84. None of these options are considered 'good' options as they add many miles/hours and/or additional closure potential. For eastbound flows, food manufacturers appear much less likely (33%) to wait more than five hours as compared to the average truck (43%), and more likely to reroute 20% versus 12%. Moving in the opposite direction, westbound, drivers involved with commodities related to crop production are more likely (49%) to wait in excess of five hours as compared to the average truck (43%) and less likely to reroute. The observations suggest a variation in the valuation of time for the associated freight, reflective of the perishability of the product and/or the necessity to adhere to just in time delivery.

Figure I.5.1: Timing of reroute decisions by drivers.

	N	Immediately		Less Than 1 Hour		Less than 3 hours		Less Than 5 Hours		More than 5 hours		Don't Know	
Eastbound													
All	1803	224	**12%**	111	**6%**	182	**10%**	73	**4%**	776	**43%**	437	**24%**
311	146	29	**20%**	12	**8%**	13	**9%**	16	**11%**	48	**33%**	28	**19%**
339	196	30	**15%**	15	**8%**	24	**12%**	3	**2%**	69	**35%**	55	**28%**
Westbound													
All	2451	276	**11%**	157	**6%**	275	**11%**	109	**4%**	1052	**43%**	582	**24%**
111	354	31	**9%**	20	**6%**	33	**9%**	26	**7%**	175	**49%**	69	**19%**
311	447	49	**11%**	36	**8%**	46	**10%**	14	**3%**	190	**43%**	112	**25%**

111: Crop Production 311: Food Manufacturing 339: Miscellaneous Manufacturing

The decision to either wait out the closure, or immediately reroute is of course not a costless one. In a 2011 survey of freight dependent businesses conducted by Washington State University's Social and Economic Sciences Research Center (SESRC) for the FPTI, and WSDOT, respondents on average estimated their truck (mixed between heavy and light) operating costs to be $71 per hour[4]. Approximately 35% of this cost can be attributed to driver wages and benefits, while another 20% is attributable to fuel costs. Applying this reported value to the trucks along the Snoqualmie pass, we can estimate the direct delay costs associated with closures. Figure I.5.2 displays the estimated cost to waiting trucks for a 1-, 3-, and 5-hour closure of the pass in either direction. Proportions of trucks willing to wait the specified times are identified in Figure I.5.1. Truck volumes assumed to be experiencing the delay are generated based on the assumption that the closure occurs at peak flow in which approximately 8% of the AADTT crosses the pass in an hour; 188 trucks for westbound movement, and 249 eastbound. For example, in a closure that is expected to last more than one hour, but less than three hours, we expect 142 eastbound trucks (~57%) to wait for the reopening. At $71 per hour, this wait generates a cost of $10,109. Moving into longer closures, the calculation becomes somewhat more cumbersome, as we consider those trucks not only arriving in the first hour and waiting out the entire closure, but also those trucks arriving in the second, third, and so on hours of the closure. Subsequently, a 5-hour closure of the eastbound lanes of I-90 over the pass generates a direct cost to firms that choose to wait out the closure of more than $125,000. It is important to note that even with an expected closure of 1-hour, nearly 20% of trucks will reroute. With no short and timely reroutes

[4] http://www.wsdot.wa.gov/NR/rdonlyres/4D53B6C5-D1DF-4A3C-9B67-FD90D4847A66/0/June2012_Impact_Freight_Congestion.pdf

available, this adds considerably to the cost of a closure. Refer to WA-RD 708.1[5] for detailed explanation of the economic impacts of extended closures to Washington's economy.

Figure I.5.2: Direct costs accrued to trucks/firms for closures of 1-, 3-, and 5-hours.

	Westbound	Eastbound
1 Hour Closure	$ 7,820	$ 10,109
3 Hour Closure	$ 42,429	$ 55,302
5 Hour Closure	$ 96,366	$ 126,646

Section 6: Conclusion

The preceding sections highlight several of the major themes of the data collected in the 2012-2013 intercept survey over Snoqualmie pass. The survey instrument is available in Appendix B to gauge the full detail of information collected from the drivers. The survey effort successfully completed in excess of 90% of attempted interviews with drivers. This result is indicative of the excellent work provided by the volunteer crew of Service Club members and the eagerness of the drivers themselves to contribute to a better understanding of roadway conditions.

Accompanying this report is the full data set generated from the survey effort. The first several tabs include pivot tables allowing the formulation of many differing aggregations of the data beyond what is included in this report. These pivot tables may be used to generate tables relating to any number of potential questions related to differing characteristics of the network, drivers, or commodity being transported.

[5] http://www.wsdot.wa.gov/research/reports/fullreports/708.1.pdf

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Appendix I.A

Methodology

Data Collection Methods and Issues

The FPTI origin and destination (O-D) survey was designed to provide a statistically reliable and comprehensive database of freight truck movements on select highway corridors in the state of Washington. A varied set of truck trip and shipment characteristics were determined and incorporated into the survey. Examples of such information include the carrier, truck type, unloaded truck weight, payload weight, commodity type, and the origin and destination facility type(s) (See Appendix B for Instrument). Detailed information on the highways and routes used by the drivers was also collected as an aid in identifying the major and minor freight corridors within and through Washington.

Ten interview sites at permanent weigh stations (6), ports of entry (1), and other sites (3) deemed safe by the Washington State Patrol's Commercial Vehicle Enforcement Officers (CVEOs) were utilized to implement the driver survey. Unlike previous FPTI O-D surveys that broadly covered the entire state, the 2012-2013 surveys targeted WSDOT identified corridors of interest.

Data was collected during a four-week period in each season (Fall (Oct-Nov 2012), Winter (Jan-Feb 2013), Spring (Apr-May 2013), Summer (Jul-Aug 2013), Fall (Oct-Nov 2013)) (Figure I.A-1). The sequential surveys were conducted to allow seasonal traffic flow comparisons to be made. Data collection was conducted on the same day of the week for the specified sites to allow continuity between seasons. As a rule of thumb, surveys were not conducted on holidays or on Mondays and Fridays so as to avoid any generated unusual flow patterns. Surveys on I-90 were conducted over 24-hr periods (2pm-2pm). All other sites began operation in the early morning hours, 5, 6, or 7am dependent upon historic truck counts. To best capture the highest volume of traffic, all effort was made to capture the time period in which greater than 80% of the truck traffic could be reasonably expected to pass the survey sites. Evening shutdown of the survey operations was dependent upon the density of truck flow and was typically halted when volumes reached fewer than five trucks per hour.

Figure I.A-1: Survey Schedule

DATE	LOCATION	HOURS
October 23, 2012	I-90 W of Cle Elum WESTBOUND	24hr beginning 2:00pm
October 24, 2012	I-90 W of Cle Elum EASTBOUND	24hr beginning 2:00pm
October 30, 2012	US-2 W of Wenatchee EASTBOUND	5:00am –
November 1, 2012	US-2 W of Wenatchee WESTBOUND	5:00am –
November 6, 2012	SR-28 E of Wenatchee EASTBOUND	5:00am –
November 8, 2012	SR-28 E of Wenatchee WESTBOUND	5:00am –
January 29, 2013	US-2 W of Wenatchee EASTBOUND	5:00 am –
January 29, 2013	US-395 Kettle Falls SOUTHBOUND	7:00 am -
January 31, 2013	US-2 W of Wenatchee WESTBOUND	5:00 am –
February 5, 2013	SR-28 E of Wenatchee EASTBOUND	5:00 am –
February 5, 2013	US-395 Chewelah NORTHBOUND	7:00 am -
February 7, 2013	SR-28 E of Wenatchee WESTBOUND	5:00 am –
February 12, 2013	US-395 Deer Park SOUTHBOUND	7:00 am -
February 13, 2013	US-97 N of Brewster at US-97/SR-17	7:00 am -
February 19, 2013	I-90 W of Cle Elum WESTBOUND	24hr beginning 2:00pm
February 20, 2013	I-90 W of Cle Elum EASTBOUND	24hr beginning 2:00pm
April 23, 2013	I-90 W of Cle Elum WESTBOUND	24hr beginning 2:00pm
April 24, 2013	I-90 W of Cle Elum EASTBOUND	24hr beginning 2:00pm
April 30, 2013	US-2 W of Wenatchee EASTBOUND	5:00 am –
April 30, 2013	US-395 Kettle Falls SOUTHBOUND	7:00 am -
May 2, 2013	US-2 W of Wenatchee WESTBOUND	5:00 am –
May 7, 2013	SR-28 E of Wenatchee EASTBOUND	5:00 am –
May 7, 2013	US-395 Chewelah NORTHBOUND	7:00 am -
May 9, 2013	SR-28 E of Wenatchee WESTBOUND	5:00 am –
May 14, 2013	US-395 Deer Park SOUTHBOUND	7:00 am -
May 15, 2013	US-97 N of Brewster at US-97/SR-17	7:00 am -
July 23, 2013	I-90 W of Cle Elum WESTBOUND	24hr beginning 2:00pm
July 24, 2013	I-90 W of Cle Elum EASTBOUND	24hr beginning 2:00pm
July 30, 2013	US-2 W of Wenatchee EASTBOUND	5:00 am –
July 30, 2013	US-395 Kettle Falls SOUTHBOUND	7:00 am -
August 1, 2013	US-2 W of Wenatchee WESTBOUND	5:00 am –
August 6, 2013	SR-28 E of Wenatchee EASTBOUND	5:00 am –
August 6, 2013	US-395 Chewelah NORTHBOUND	7:00 am -
August 8, 2013	SR-28 E of Wenatchee WESTBOUND	5:00 am –
August 13, 2013	US-395 Deer Park SOUTHBOUND	7:00 am -
August 14, 2014	US-97 N of Brewster at US-97/SR-17	7:00 am -
October 29, 2013	US-395 Kettle Falls SOUTHBOUND	7:00 am -
November 5, 2013	US-395 Chewelah NORTHBOUND	7:00 am -
November 12, 2013	US-395 Deer Park SOUTHBOUND	7:00 am -
November 13, 2012	US-97 N of Brewster at US-97/SR-17	7:00 am -

Approximately 9,000 driver interviews were collected (roughly equivalent per season) to complete the entire origin and destination survey. Refer to Section 1 for I-90 specific counts. Additionally, estimates of the number and direction of non-sampled trucks were made during the interview periods. Estimates are based on either actual truck counts established during the collection period or on historic counts under similar conditions. Actual counts were taken where feasible. These counts were then used to construct weighted estimates of total truck volumes at each location by season. The results presented in this study are derived from these weighted truck trip estimates.

The driver interviews were conducted by a team of Washington State University personnel assisted by members of local Lions clubs throughout the survey regions. Survey locations were typically staffed by 4 to 6 individuals, resulting in 60-150 personnel hours accrued conducting driver interviews each survey day. Driver participation in the survey was high, with locations reporting 95 to 100 percent response rates. A copy of the survey questionnaire is included as Appendix I.B of this report.

Data Management, Analysis and Modeling Procedures

This section briefly highlights key procedures used within this data framework. More detailed information can be found in Strategic Freight Transportation Analysis Report Number 2, "*Freight Truck Origin and Destination Study: Methods, Procedures and Data Dictionary*."[6]

Data Management

It is important to maintain effective management of data during collection, entry into a database, and during all subsequent analyses. Following and implementing appropriate management techniques helps ensure that the compiled database accurately reflects the statewide freight movements in Washington. There are three possible sources of error that can be attributed to on-site data collection issues. Systemic problems arise from poorly worded questions, incorrect interview procedures and/or problems stemming from sub-optimal site selection. Data problems may come from drivers who provide inaccurate information in response to the survey questions. Finally, interview personnel may fill out the survey incorrectly, providing inaccurate data regarding vehicle information or driver responses.

Errors stemming from improper data collection technique were minimized through a constant monitoring of the survey and data entry personnel. On-site monitoring allowed specific problems to be

[6] http://www.sfta.wsu.edu/research/reports/pdf/Rpt_2_Data_Dictionary.pdf

immediately addressed with the interviewer. Problems identified during data entry were addressed during the following survey season.

One persistent entry error occurred relative to the weight of cargo. Respondents occasionally indicated their gross vehicle weight (GVW) rather than their cargo only weight (payload). Where this event was readily identifiable (e.g. where the combined answers of the empty and cargo weights of the truck grossly exceeded 105,500 pounds), the data entry was adjusted such that the empty truck weight was subtracted from the identified GVW to obtain a payload weight. Surveys that were identified as not being able to be reliably adjusted, were not included in any calculation of the respective variable.

Data Analysis and Modeling

The data obtained in the driver interviews was entered into a MS Excel database in table format. Additional information from various sources was systematically added to the database in order to provide greater depth of analysis. For example, traffic counts from the WSDOT Traffic Data Office were used when and where feasible to verify and correct the sample weights obtained during the survey period.

The use of the MS Excel platform also allows for the incorporation of database information from such sources as the US Census Bureau, the USDOT Bureau of Transportation Statistics and other federal, state and local transportation databases. Linkage of these various databases was and is accomplished by the use of the Standard Classification of Transported Goods (SCTG) code. This code was identified using information obtained during the driver interview about the primary commodity content of the cargo being transported. This information is critical to identifying commodity flows and volumes moving on state highways.

In order to best present the survey data in a meaningful manner, site specific seasonal weight factors based upon the total number of trucks passing each survey site during the day of the survey was calculated. Where feasible, truck counters, either tube or permanent, were used to estimate the total volume. To calculate the seasonal weight factor for each site/season, the total number of trucks in a 24-hour period was divided by the total number of surveys collected at each site. The seasonal weight factor is used to expand the collected data characteristics to represent the entire population of trucks at each

survey location. This expanded information was a representation based upon the total number of daily truck trips.

Appendix I.B

SAMPLE ONLY

CONFIDENTIAL

Washington State Department of Transportation and
Washington State University
Truck Traffic Survey

[Please Fill Questions 1-7 prior to or as approaching the Truck]

Interviewer and Site Information:

1) Station location:_____
2) Initials of interviewer:_____
3) Time of interview:_____
4) Date of interview:_____

Basic Truck Characteristics:

5) Truck Configuration
[Check only *one* truck configuration]
[See Quality Control Notes for definitions]

a. ☐ Straight truck
b. ☐ Truck and trailer
c. ☐ Tractor only
d. ☐ Tractor and trailer
e. ☐ Tractor with two trailers
f. ☐ Other (specify) _____

6) Total number of axles on the ground _____

7) Is a hazardous material placard displayed? 1. ☐ Yes ID #_____ 2. ☐ No

[Please ask the driver the following questions]

Basic Truck/Company Information

8) Trucking company name:_____
9) Trucking company home base: City_____ State/Province_____
10) What is the **unloaded** weight of this vehicle? _____ lbs.

Cargo Information

11) Is this vehicle carrying cargo, or is it empty? ☐ Carrying Cargo (Ask Q12-19) ☐ Empty (Ask Q20-25)
12) What is the major commodity on board:_____
13) How much does the cargo you are carrying today weigh?_____

Complete only the one column that applies to this trip. No round-trip information, please!

Trucks CARRYING cargo:	Trucks WITHOUT cargo:
Where did you pick-up this cargo?	Where did this trip without cargo begin?
14) City _____	20) City _____
15) State/Province_____	21) State/Province_____
16) Facility: **[see Quality Control Notes]**	22) Facility: **[see Quality Control Notes]**
a. ☐ Trucking yard	a. ☐ Trucking yard
b. ☐ Railroad yard	b. ☐ Railroad yard
c. ☐ River or ocean port	c. ☐ River or ocean port
d. ☐ Airport	d. ☐ Airport
e. ☐ Industrial factory or sawmill	e. ☐ Industrial factory or sawmill
f. ☐ Agricultural processing facility	f. ☐ Agricultural processing facility
g. ☐ Warehouse/distribution center or post office	g. ☐ Warehouse/distribution center or post office
h. ☐ Farm or forest	h. ☐ Farm or forest
i. ☐ Retail store or gas station	i. ☐ Retail store or gas station
j. ☐ Job or construction site	j. ☐ Job or construction site
k. ☐ Other _____	k. ☐ Other _____
Where is the destination of your cargo?	Where will your trip without cargo end?
17) City: _____	23) City: _____
18) State/Province_____	24) State/Province_____
19) Facility: **[See Quality Control Notes]**	25) Facility: **[See Quality Control Notes]**
a. ☐ Trucking yard	a. ☐ Trucking yard
b. ☐ Railroad yard	b. ☐ Railroad yard
c. ☐ River or ocean port	c. ☐ River or ocean port
d. ☐ Airport	d. ☐ Airport
e. ☐ Industrial factory or sawmill	e. ☐ Industrial factory or sawmill
f. ☐ Agricultural processing facility	f. ☐ Agricultural processing facility
g. ☐ Warehouse/distribution center or post office	g. ☐ Warehouse/distribution center or post office
h. ☐ Farm or forest	h. ☐ Farm or forest
i. ☐ Retail store or gas station	i. ☐ Retail store or gas station
j. ☐ Job or construction site	j. ☐ Job or construction site
k. ☐ Other _____	k. ☐ Other _____

26) What Washington highways were used to travel between the two locations identified above?

_____ (Remember, **accurately** highlight [in yellow] attached map!)

Write out the highways used to get between the two locations identified above

27) With what frequency does this truck travel the above route?

a. ☐ Daily
b. ☐ Once a Week
c. ☐ Several Times a week
d. ☐ Occasionally (1-3 times/mo.)
e. ☐ Rarely (<1 time/mo.)
f. ☐ Don't Know

28) In the event of a weather related closure on Snoqualmie Pass, how long are you willing to wait before taking an alternative route?

a. ☐ Will reroute immediately
b. ☐ Will to wait up to 1 hr
c. ☐ Will wait up to 3 hrs
d. ☐ Will wait up to 5 hrs
e. ☐ Will wait over 5 hrs
f. ☐ Don't Know

29) When you decide to reroute, what alternative route would you most likely use?

_____ (Remember, **accurately** highlight [in Pink] attached map!)

Write out the highways used to get between the two locations identified above

THANK YOU!!

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VOLUME II: WENATCHEE REGION

Section 1: Background

The search for understanding of commodity flows throughout the nation and the state of Washington is a continual process. This understanding is critical at many levels of the transportation industry and to those firms and entities that provide that transportation, or regulate and invest in the needed infrastructure. These data, usually desired at the sub national level, are essential to adequate planning by state, regional and local levels as attempts continue to improve the efficiency, effectiveness and sustainability of the transportation system. State and national travel models require those data, often on a seasonal, commodity/industrial, directional, or modal basis. Determining the importance of a commodity flow on a corridor level leads to improved bases for the prioritization of investments in infrastructure as well as increasing the ability to determine quantitative impacts of congestion, regulation and bottlenecks on a transportation system or supply chain.

Objectives

The overall goal of this research project is to collect the necessary data to quantify and characterize the movement of commodities through specified freight corridors, or through and around relevant entities/cities/counties, using the intercept methodology (Appendix II.A), when trucks are stopped during the movement itself, as developed in previous studies by the Freight Policy Transportation Institute (FPTI)[7].

Section 2: Freight Truck Movements in the Wenatchee Region (SR-28)

The efficient movement of goods in and over the Wenatchee Region is vital to the economic vitality of the state and the region. Figure II.2.1 summarizes the survey total for each season, along with the recorded average volumes for the week of the survey (where applicable). As can be seen in the table, each survey session garnered sufficient responses to readily obtain a confidence level of 95% (C.I. 5%). Using the Seasonal weight factor calculations (Appendix II.A), the average annual daily truck traffic (AADTT) is calculated as 538 for eastbound trucks (175 empty and 363 loaded), and 617 for westbound trucks (237 empty and 380 loaded). These figures, multiplied by 312, are used to calculate annual volumes and associated values.

[7] http://www.sfta.wsu.edu/research/reports/pdf/Rpt_2_Data_Dictionary.pdf

Figure II.2.1: Seasonal survey totals.

	Number of Empty Trucks Surveyed	Number of Trucks With Cargo Surveyed	Truck Total Volume	Seasonal Weight Factor	Weighted Value	Percent of Trucks Surveyed[a]	Confidence Level 95% +/- 5%
Eastbound							
Fall	60	107	461	0.22	103	36%	√
Winter	38	131	467	0.23	105	36%	√
Spring	83	160	671	0.32	217	36%	√
Summer	55	116	472	0.23	108	36%	√
Westbound							
Fall	63	112	545	0.23	123	32%	√
Winter	88	102	592	0.24	145	32%	√
Spring	82	149	719	0.30	214	32%	√
Summer	65	115	561	0.23	130	32%	√

[a] Percent of trucks surveyed for winter, spring, summer is established using the counter information obtained in the fall season. The assumption is made that survey rates are equal across dates.

Figure II.2.2 captures the aggregated industry groups transporting goods on SR-28, as measured by all surveys collected. Using commodity values ($/ton) generated from the nationally based Commodity Flow Survey (CFS), the value of the cargo being transported has been estimated. Where available, the values are generated from Washington specific averages of the corresponding industry codes. National averages are used in place of those with insufficient records to generate a state average.

Figure II.2.2: Wenatchee Region (SR-28) industry survey totals by volume and associated value.

SCTG	Description	Number of Occurrences	Total Cargo Weight	Average Cargo Weight	Total Tonnage	Total Value
1	Live animals and live fish	1	44,000	44,000	22	$ 37,737
3	Other agricultural products	367	14,232,977	38,782	7,116	$ 5,406,648
4	Animal feed and animal products	13	382,612	29,432	191	$ 285,189
5	Meat, fish, seafood	3	99,000	33,000	50	$ 177,861
6	Milled grain and bakery products	4	23,500	5,875	12	$ 21,412
7	Other prepared foodstuffs, fats, oils	62	1,945,464	31,378	973	$ 1,254,532
8	Alcoholic beverages	5	74,000	14,800	37	$ 78,557
11	Natural sands	5	326,960	65,392	163	$ 4,596
12	Gravel and crushed stone	8	400,720	50,090	200	$ 2,976
13	Nonmetallic minerals	2	78,500	39,250	39	$ 3,472
17	Gasoline and aviation turbine fuel	17	958,275	56,369	479	$ 480,824
18	Fuel oils	3	153,000	51,000	77	$ 61,549
19	Coal and petroleum product	4	119,160	29,790	60	$ 46,255
20	Basic chemicals	8	316,626	39,578	158	$ 131,185
22	Fertilizers	12	466,300	38,858	233	$ 80,811
23	Chemical products and preparations	3	72,700	24,233	36	$ 196,255
24	Plastics and rubber	15	219,180	14,612	110	$ 507,693
25	Logs and other wood in the rough	12	456,100	38,008	228	$ 24,864
26	Wood products	33	876,943	26,574	438	$ 156,482
27	Pulp and paper products	2	90,600	45,300	45	$ 37,013
28	Paper or paperboard articles	51	1,667,499	32,696	834	$ 1,483,293
29	Printed products	1	40,000	40,000	20	$ 72,995
30	Articles of textiles or leather	12	260,550	21,713	130	$ 3,478,256
31	Nonmetallic mineral products	6	135,084	22,514	68	$ 15,522
32	Primary/semi-finished base metal	15	505,335	33,689	253	$ 463,189
33	Articles of base metal	14	285,000	20,357	143	$ 572,818
34	Machinery	43	1,247,795	29,018	624	$ 5,587,267
35	Electronic, electrical equipment, components and office equipment	12	152,770	12,731	76	$ 3,141,971
36	Motorized and other vehicles, parts	32	439,900	13,747	220	$ 2,024,596
37	Transportation equipment	2	65,705	32,853	33	$ 913,663
38	Precision instruments and apparatus	2	35,000	17,500	18	$ 4,383,671
39	Furniture, mattresses, lamps, lighting fittings, and illuminated signs	8	146,460	18,308	73	$ 719,426
40	Miscellaneous manufactured products	4	162,200	40,550	81	$ 254,336
41	Waste and scrap	16	635,860	39,741	318	$ 172,871
43	Mixed freight	33	858,109	26,003	429	$ 1,683,200
					Total	**$ $33,962,985**

As can be readily expected, distinct differences exist between east and westbound commodity movement. At the broadest perspective, this difference is manifest in the average weight and value of the cargo. Figure II.2.3 reveals these differences. Westbound trucks, largely originating in Eastern Washington, averaged over 17.5 tons per truck. The value of these same trucks averaged roughly $4,100 per ton. Eastbound trucks weighed less, just over of 16 tons per tuck, and are valued $1,000 at roughly $3,100 per ton on average, than their westbound counterparts. Annualizing the volume and value of the cargo generates an estimated 2 million tons in either direction and $14.3 billion combined in goods moved (Figure II.2.4).

Figure II.2.3: Cargo averages[a] (SR-28).

	Average Cargo Weight (Tons)	Average Cargo Value ($/ton)
Eastbound	16.03	$ 3,146.66
Westbound	17.73	$ 4,121.97

[a] Only those records for which a cargo weight was specified by the respondent, and an identifiable cargo value could be determined are included here.

Figure II.2.4: Annualized volume and value of cargo in the Wenatchee Region (SR-28).

	Number of Empty Trucks	Number of Trucks with Cargo	Total Cargo Weight (Million Tons)	Total Cargo Value (Million Dollars)
Eastbound	54,588	113,383	1.82	$ 5,719.27
Westbound	73,892	118,660	2.10	$ 8,674.26

Section 3: Characteristic Profile of Eastbound Trucks in the Wenatchee Region (SR-28)

Brief summaries of the eastbound trucks, empty and loaded, are displayed in the following tables. Major characteristics of consideration include the origin and destination (O-D) states/provinces and cities, as well as their associated O-D facilities. The overwhelming majority of trucks surveyed, loaded and empty, originated within Washington (Figure II.3.1). Few other states or provinces recorded a significant number of observations. Breaking the origins of trips down further, Figure II.3.2 provides indication of the cities from which trucks begin their hauls. The top five origin cities are presented, with Wenatchee being the primary generator both for loaded and empty trucks (above 40% each). Approximately 68% of eastbound trucks are carrying cargo, having originated from just over 75 cities, while the empty trucks originate from over 50 cities.

Figure II.3.1: Origin State/Province.

Origin State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	489	96.1%	225	93.0%	714	95.1%
OR	9	1.8%	6	2.5%	15	2.0%
CA	4	0.8%	0	0.0%	4	0.5%
ID	3	0.6%	1	0.4%	4	0.5%
Other	4	0.8%	10	4.1%	14	1.9%
Total	**509**	**100%**	**242**	**100%**	**751**	**100%**

Figure II.3.2: Origin city.

Origin City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Wenatchee	250	49.1%	98	40.5%	348	46.3%
East Wenatchee	23	4.5%	23	9.5%	46	6.1%
Chelan	22	4.3%	7	2.9%	29	3.9%
Brewster	20	3.9%	1	0.4%	21	2.8%
Cashmere	19	3.7%	11	4.5%	30	4.0%
Other	175	34.4%	102	42.1%	277	36.9%
Total	**509**	**100%**	**242**	**100%**	**751**	**100%**

Similar to the origin state, Washington is the top destination for both loaded and empty trucks heading east. The overwhelming majority (above 90%) of empty trucks originate and end their routes in Washington. However, only half of loaded trucks are destined in Washington even though more than 95% originate in WA. As should be expected, destination states are more dispersed than are the coinciding origins, though still somewhat dominated by intrastate travel (Figure II.3.3). Loaded trucks originate from six states and are destined to over forty.

Loaded, eastbound trucks are destined for more than 180 cities. Quincy ranks as the most frequent destination, with 10%. None of the top origin cities are in the Top-5 destination cities for loaded trucks (Figure II.3.4). Wenatchee only accounts for 3% of loaded trucks and 6% of empty. This is a far cry from the 49% of loaded trucks and 40% of empty trucks originating in Wenatchee. Replacing Wenatchee as the top destination city for both loaded an empty trucks is Quincy with 10% and 16% respectively.

Figure II.3.3: Destination State/Province.

Destination State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	277	54.6%	220	93.6%	497	67.0%
CA	28	5.5%	0	0.0%	28	3.8%
TX	15	3.0%	0	0.0%	15	2.0%
OR	14	2.8%	3	1.3%	17	2.3%
AZ	14	2.8%	0	0.0%	14	1.9%
Other	159	31.4%	12	5.1%	171	23.0%
Total	**507**	**100%**	**235**	**100%**	**742**	**100%**

Figure II.3.4: Destination city.

Destination City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Quincy	49	10.1%	37	15.7%	86	11.9%
Moses Lake	34	7.0%	23	9.8%	57	7.9%
Pasco	27	5.6%	8	3.4%	35	4.9%
Spokane	26	5.4%	13	5.5%	39	5.4%
Yakima	25	5.2%	19	8.1%	44	6.1%
Other	324	66.8%	135	57.4%	459	63.8%
Total	**485**	**100%**	**235**	**100%**	**720**	**100%**

Concentrating now on the facility types that generate flows on SR-28, Figure II.3.5 displays the ten option types that were provided for the respondents. Loaded trucks were most likely (48%) to have originated from a Warehouse or Distribution Center (26% for empty trucks). As can be expected, a significant number of loaded (and empty), eastbound trucks originate from an Agriculture Processing Facility (24%). More than 60% of empty trucks originated from a Trucking Yard, an Agriculture Processing Facility, or a Warehouse or Distribution Center.

Figure II.3.5 Origin facility types.

Facility Origin	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	25	5.1%	47	20.9%	72	10.0%
Railroad Yard	0	0.0%	0	0.0%	0	0.0%
River or Ocean Port	0	0.0%	0	0.0%	0	0.0%
Airport	1	0.2%	1	0.4%	2	0.3%
Industrial Factory/Sawmill	48	9.7%	15	6.7%	63	8.8%
Agriculture Processing Facility	120	24.2%	36	16.0%	156	21.7%
Warehouse/Distribution	241	48.7%	58	25.8%	299	41.5%
Farm or Forest	12	2.4%	6	2.7%	18	2.5%
Retail Store or Gas Station	13	2.6%	24	10.7%	37	5.1%
Job/Construction Site	8	1.6%	19	8.4%	27	3.8%
Other	27	5.5%	19	8.4%	46	6.4%
Total	**495**	**100%**	**225**	**100%**	**720**	**100%**

Similar to their origins, destination facilities (Figure II.3.6) for respondent trips were largely attributable to Warehouse or Distribution Centers for both loaded (42%) and empty (30%). Agriculture Processing Facilities, also, accounted for a significant portion of destination facilities (17% for loaded and 16% for empty trucks). Most other destination facilities do not account for any significant amount of traffic, except for Retail Store or Gas Station with 14% for loaded trucks.

Figure II.3.6: Destination facility types.

Facility Destination	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	11	2.3%	28	12.6%	39	5.5%
Railroad Yard	10	2.1%	0	0.0%	10	1.4%
River or Ocean Port	1	0.2%	0	0.0%	1	0.1%
Airport	0	0.0%	1	0.5%	1	0.1%
Industrial Factory/Sawmill	33	6.9%	20	9.0%	53	7.5%
Agriculture Processing Facility	83	17.3%	35	15.8%	118	16.8%
Warehouse/Distribution	204	42.4%	67	30.2%	271	38.5%
Farm or Forest	10	2.1%	19	8.6%	29	4.1%
Retail Store or Gas Station	69	14.3%	9	4.1%	78	11.1%
Job/Construction Site	17	3.5%	14	6.3%	31	4.4%
Other	43	8.9%	29	13.1%	72	10.2%
Total	**481**	**100%**	**222**	**100%**	**703**	**100%**

Section 4: Characteristic Profile of Westbound Trucks in the Wenatchee Region (SR-28)

Brief summaries of the westbound trucks, empty and loaded, are displayed in the following tables. Major characteristics of consideration include the origin and destination (O-D) states/provinces and cities, as well as their associated O-D facilities. The overwhelming majority of trucks surveyed, both loaded and empty, originated within Washington (Figure II.4.1). Few other states or provinces recorded a significant number of observations. Breaking the origins of trips down further, Figure II.4.2 provides indication of the cities from which trucks begin their hauls. Neither loaded nor empty trucks may be suggested to have a primary origination city. However, Quincy, Moses Lake, and Spokane combined generated about a third for loaded and empty trucks heading west. Most trucks are originating in Eastern Washington. Also of note, but not pictured below, is that Wenatchee accounts for 10% of unloaded trucks. Approximately 62% of westbound trucks are carrying cargo, having originated from just over 105 cities, while the empty trucks originate from 50 cities.

Figure II.4.1: Origin State/Province.

Origin State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	421	88.3%	268	90.2%	689	89.0%
OR	19	4.0%	13	4.4%	32	4.1%
CA	8	1.7%	1	0.3%	9	1.2%
ID	6	1.3%	10	3.4%	16	2.1%
Alberta	5	1.0%	1	0.3%	6	0.8%
Other	18	3.8%	4	1.3%	22	2.8%
Total	**477**	**100%**	**297**	**100%**	**774**	**100%**

Figure II.4.2: Origin city.

Origin City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Quincy	62	13.1%	45	15.3%	107	13.9%
Moses Lake	52	10.9%	24	8.1%	76	9.9%
Spokane	48	10.1%	27	9.2%	75	9.7%
Yakima	31	6.5%	7	2.4%	38	4.9%
Wallula	23	4.8%	1	0.3%	24	3.1%
Other	259	54.5%	191	64.7%	450	58.4%
Total	**475**	**100%**	**295**	**100%**	**770**	**100%**

As should be expected, the vast majority, in excess of 96%, of westbound trucks are destined for Washington (Figure II.4.3). No other states or provinces recorded a significant number of observations. The make-up of loaded vs. empty trucks moving west is similar as those moving east (61% vs. 68%).

None of the top origin cities are in the Top-5 destination cities for loaded trucks (Figure II.4.4), while only Quincy takes the 5th spot for empty trucks. The destination cities of choice are Wenatchee and East Wenatchee. Together they account for 70% of all trucks heading west on SR-28.

Figure II.4.3: Destination State/Province.

Destination State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	459	96.84%	291	98.0%	750	97.3%
British Columbia	5	1.05%	2	0.7%	7	0.9%
OR	2	0.42%	1	0.3%	3	0.4%
FL	2	0.42%	0	0.0%	2	0.3%
Other	6	1.3%	3	1.0%	9	1.2%
Total	**474**	**100%**	**297**	**100%**	**771**	**100%**

Figure II.4.4: Destination city.

Destination City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Wenatchee	304	64.4%	177	59.4%	481	62.5%
East Wenatchee	40	8.5%	26	8.7%	66	8.6%
Chelan	17	3.6%	5	1.7%	22	2.9%
Cashmere	10	2.1%	8	2.7%	18	2.3%
Orondo	10	2.1%	5	1.7%	15	1.9%
Other	91	19.3%	77	25.8%	168	21.8%
Total	**472**	**100%**	**298**	**100%**	**770**	**100%**

Concentrating now on the facility types that generate westbound flows SR-28, Figure II.4.5 displays the ten option types that were provided for the respondents. Loaded trucks were most likely to have originated from a Warehouse or Distribution Center (42%) or an Agricultural Facility (12%). These percentages are slightly lower than origin facilities for eastbound trucks. Also of note is that Farms of Forests make up 10% of loaded trucks. Similar to loaded trips, the empty trips were also led by Warehouse and Distribution Centers and Trucking Yards and Agriculture Processing Facilities follow slightly behind.

Figure II.4.5 Origin facility types.

Facility Origin	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	33	7.3%	54	20.8%	87	12.2%
Railroad Yard	3	0.7%	6	2.3%	9	1.3%
River or Ocean Port	0	0.0%	2	0.8%	2	0.3%
Airport	2	0.4%	2	0.8%	4	0.6%
Industrial Factory/Sawmill	27	6.0%	11	4.2%	38	5.3%
Agriculture Processing Facility	57	12.6%	43	16.5%	100	14.0%
Warehouse/Distribution	189	41.8%	69	26.5%	258	36.2%
Farm or Forest	47	10.4%	12	4.6%	59	8.3%
Retail Store or Gas Station	14	3.1%	11	4.2%	25	3.5%
Job/Construction Site	17	3.8%	12	4.6%	29	4.1%
Other	63	13.9%	38	14.6%	101	14.2%
Total	**452**	**100%**	**260**	**100%**	**712**	**100%**

Similar to their origins, destination facilities for respondent trips were largely attributable to Warehouse or Distribution Centers for both loaded (34%) and empty (31%). Retail Stores or Gas Stations and Agriculture Processing Facilities also make up a significant percent of loaded trucks; however, only a few empty trucks are destined for Retail Stores or Gas Stations, which is not surprising.

Figure II.4.6: Destination facility types.

Facility Destination	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking yard	19	4.3%	42	16.0%	61	8.6%
Railroad yard	2	0.5%	4	1.5%	6	0.8%
River or Ocean Port	2	0.5%	0	0.0%	2	0.3%
Airport	5	1.1%	0	0.0%	5	0.7%
Industrial factory/sawmill	13	2.9%	14	5.3%	27	3.8%
Agriculture processing facility	79	17.8%	67	25.5%	146	20.7%
Warehouse/distribution	153	34.5%	82	31.2%	235	33.2%
Farm of forest	7	1.6%	3	1.1%	10	1.4%
Retail store or gas station	91	20.5%	7	2.7%	98	13.9%
Job/construction site	27	6.1%	8	3.0%	35	5.0%
Other	46	10.4%	36	13.7%	82	11.6%
Total	**444**	**100%**	**263**	**100%**	**707**	**100%**

Section 5: Freight Truck Movements in the Wenatchee Region (US-97/2)

The efficient movement of goods in and over the Wenatchee Region is vital to the economic vitality of the state and the region. Figure II.5.1 summarizes the survey total for each season, along with the recorded average volumes for the week of the survey (where applicable). As can be seen in the table, each survey session garnered sufficient responses to readily obtain a confidence level of 95% (C.I. 5%). Using the Seasonal weight factor calculations (Appendix A), the average annual daily truck traffic (AADTT) is calculated as 583 for northbound trucks (274 empty and 308 loaded), and 456 for westbound trucks (164 empty and 291 loaded). These figures, multiplied by 312, are used to calculate annual volumes and associated values.

Figure II.5.1: Seasonal survey totals.

	Number of Empty Trucks Surveyed	Number of Trucks With Cargo Surveyed	Truck Total Volume	Seasonal Weight Factor	Weighted Value	Percent of Trucks Surveyed	Confidence Level 95% +/- 5%
Northbound							
Fall	95	93	631	0.25	160	30%	√
Winter	92	78	504	0.23	116	34%	√
Spring	100	105	542	0.28	150	38%	√
Summer	66	112	616	0.24	148	29%	√
Westbound							
Fall	37	80	529	0.19	101	22%	√
Winter	41	93	395	0.22	87	34%	√
Spring	67	111	395	0.29	115	45%	√
Summer	73	109	502	0.30	150	36%	√

Figure II.5.2 captures the aggregated industry groups transporting goods on US-97/2, as measured by all surveys collected westbound at the weight station near the intersection of US-2 and US-97 and northbound over Blewett Pass on US-97. Using commodity values ($/ton) generated from the nationally based Commodity Flow Survey (CFS), the value of the cargo being transported has been estimated. Where available, the values are generated from Washington specific averages of the corresponding industry codes. National averages are used in place of those with insufficient records to generate a state average.

Figure II.5.2: Wenatchee Region (US-97/2) industry survey totals by volume and associated value.

SCTG	Description	Number of Occurrences	Total Cargo Weight	Average Cargo Weight	Total Tonnage	Total Value
1	Live animals and live fish	1	13,000	13,000	7	$ 11,150
3	Other agricultural products	261	8,783,050	33,652	4,392	$ 3,336,397
4	Animal feed and animal products	9	195,700	21,744	98	$ 145,869
5	Meat, fish, seafood	4	98,500	24,625	49	$ 176,963
6	Milled grain and bakery products	3	92,000	30,667	46	$ 83,826
7	Other prepared foodstuffs, fats, oils	69	2,041,566	29,588	1,021	$ 1,316,503
8	Alcoholic beverages	11	239,334	21,758	120	$ 254,074
11	Natural sands	10	608,700	60,870	304	$ 8,556
12	Gravel and crushed stone	30	1,096,900	36,563	548	$ 8,145
13	Nonmetallic minerals	4	273,420	68,355	137	$ 12,095
17	Gasoline and aviation turbine fuel	18	1,019,285	56,627	510	$ 511,436
18	Fuel oils	8	384,700	48,088	192	$ 154,757
19	Coal and petroleum product	3	25,040	8,347	13	$ 9,720
20	Basic chemicals	4	160,000	40,000	80	$ 66,291
22	Fertilizers	2	129,100	64,550	65	$ 22,373
23	Chemical products and preparations	2	52,800	26,400	26	$ 142,534
24	Plastics and rubber	18	329,859	18,326	165	$ 764,062
25	Logs and other wood in the rough	7	340,400	48,629	170	$ 18,557
26	Wood products	21	665,540	31,692	333	$ 118,759
27	Pulp and paper products	4	239,000	59,750	120	$ 97,640
28	Paper or paperboard articles	19	363,792	19,147	182	$ 323,604
30	Articles of textiles or leather	4	39,258	9,815	20	$ 524,081
31	Nonmetallic mineral products	13	365,556	28,120	183	$ 42,006
32	Primary/semi-finished base metal	15	479,360	31,957	240	$ 439,380
33	Articles of base metal	11	314,800	28,618	157	$ 632,712
34	Machinery	25	633,090	25,324	317	$ 2,834,795
35	Electronic, electrical equipment, components and office equipment	25	301,327	12,053	151	$ 6,197,295
36	Motorized and other vehicles, parts	14	229,700	16,407	115	$ 1,057,172
37	Transportation equipment	12	341,325	28,444	171	$ 4,746,307
38	Precision instruments and apparatus	2	39,000	19,500	20	$ 4,884,662
39	Furniture, mattresses, lamps, lighting fittings, and illuminated signs	8	51,130	6,391	26	$ 251,156
40	Miscellaneous manufactured products	8	169,400	21,175	85	$ 265,625
41	Waste and scrap	23	892,020	38,783	446	$ 242,513
43	Mixed freight	40	817,041	20,426	409	$ 1,602,644
					Total	**$ $31,303,661**

As can be readily expected, distinct differences exist between north and westbound commodity movement. At the broadest perspective, this difference is manifest in the average weight and value of the cargo. Figure II.5.3 reveals these differences. Westbound trucks, largely originating in Eastern Washington, averaged slightly under 14 tons per truck. The value of these same trucks averaged roughly $3,300 per ton. Westbound trucks weighed more, just shy of 17 tons per truck, and are valued higher on average, over $5,600 per ton, than their eastbound counterparts. Annualizing the volume and value of the cargo generates just under 2.9 million tons and $13.5 billion combined in goods moved (Figure II.5.4).

Figure II.5.3: North and Westbound cargo averages[a].

	Average Cargo Weight (Tons)	Average Cargo Value ($/ton)
Northbound	16.96	$ 5,678.82
Westbound	13.88	$ 3,338.53

[a] Only those records for which a cargo weight was specified by the respondent, and an identifiable cargo value could be determined are included here.

Figure II.5.4: Annualized volume and value of cargo crossing Snoqualmie Pass.

	Number of Empty Trucks	Number of Trucks with Cargo	Total Cargo Weight (Million Tons)	Total Cargo Value (Million Dollars)
Northbound	85,644	96,194	1.63	$ 9,266.92
Westbound	51,244	90,936	1.26	$ 4,213.64

Section 6: Characteristic Profile of Northbound Trucks in the Wenatchee Region (US-97)

Brief summaries of the northbound trucks, empty and loaded, are displayed in the following tables. Major characteristics of consideration include the origin and destination (O-D) states/provinces and cities, as well as their associated O-D facilities. The overwhelming majority of trucks surveyed, both loaded and empty, originated within Washington (Figure II.6.1). Oregon is the only other state to have a significant number of observations, averaging about 8% for loaded and empty trucks. Breaking the origins of trips down further, Figure II.6.2 provides indication of the cities from which trucks begin their hauls. The top five origin cities are presented, with Yakima being the primary generator for loaded trucks; however, Seattle is the primary generator overall. Well over 25% of loaded trucks are originating in the Puget Sound region. Approximately 52% of northbound trucks are carrying cargo from just under 100 different cities, while the empty trucks originate from just over 80 cities.

Figure II.6.1: Origin State/Province.

Origin State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	345	89.1%	312	88.6%	657	88.9%
OR	28	7.2%	30	8.5%	58	7.8%
CA	5	1.3%	4	1.1%	9	1.2%
UT	2	0.5%	0	0.0%	2	0.3%
Other	7	1.8%	6	1.7%	13	1.8%
Total	**387**	**100%**	**352**	**100%**	**739**	**100%**

Figure II.6.2: Origin city.

Origin City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Yakima	69	18.0%	19	5.4%	88	12.0%
Seattle	64	16.7%	55	15.7%	119	16.2%
Tacoma	20	5.2%	22	6.3%	42	5.7%
Ellensburg	14	3.6%	22	6.3%	36	4.9%
Sumner	11	2.9%	28	8.0%	39	5.3%
Other	206	53.6%	204	58.3%	410	55.9%
Total	**384**	**100%**	**350**	**100%**	**734**	**100%**

Similar to the origin state, Washington is the top destination for both loaded and empty trucks heading east (above 92%). British Columbia has the next highest observation count among loaded trucks at 2.6% (Figure II.6.3). Over 50% of loaded and empty, northbound trucks are destined for Wenatchee (including East Wenatchee). A large portion of both empty and loaded trucks end their routes in the Wenatchee region. The Top-5 destination cities for loaded tucks (Figure II.6.4) and destination cities in general are very different than origin cities. Trucks originate from the south and west of the state and, for the most part, end somewhere along US-97 and up into Canada. Since most trucks end their routes in Wenatchee, it isn't surprising that loaded and empty trucks are destined to far fewer cities than where they originated (under 85 for loaded and 40 for empty trucks).

Figure II.6.3: Destination State/Province.

Destination State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	359	92.1%	344	97.7%	703	94.7%
British Columbia	10	2.6%	0	0.0%	10	1.3%
FL	4	1.0%	1	0.3%	5	0.7%
GA	2	0.5%	0	0.0%	2	0.3%
Other	15	3.8%	7	2.0%	22	3.0%
Total	**390**	**100%**	**352**	**100%**	**742**	**100%**

Figure II.6.4: Destination city.

Destination City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Wenatchee	183	46.9%	172	49.0%	355	47.9%
East Wenatchee	25	6.4%	10	2.8%	35	4.7%
Cashmere	16	4.1%	26	7.4%	42	5.7%
Chelan	13	3.3%	45	12.8%	58	7.8%
Leavenworth	11	2.8%	6	1.7%	17	2.3%
Other	142	36.4%	92	26.2%	234	31.6%
Total	**390**	**100%**	**351**	**100%**	**741**	**100%**

Concentrating now on the facility types that generate northbound flows on US-97, Figure II.6.5 displays the ten option types that were provided for the respondents. Loaded trucks were most likely (45%) to have originated from a Warehouse or Distribution Center (27% empty trucks). As can be expected, a high percentage (37) of empty trucks originate at a Trucking Yard. Besides these two facilities, Agriculture Processing Facilities and, to a smaller extent, Industrial Factories also have a significant number of observations.

Figure II.6.5 Origin facility types.

Facility Origin	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	41	10.7%	129	37.7%	170	23.4%
Railroad Yard	4	1.0%	1	0.3%	5	0.7%
River or Ocean Port	10	2.6%	19	5.6%	29	4.0%
Airport	5	1.3%	1	0.3%	6	0.8%
Industrial Factory/Sawmill	37	9.6%	15	4.4%	52	7.2%
Agriculture Processing Facility	54	14.1%	30	8.8%	84	11.6%
Warehouse/Distribution	173	45.1%	93	27.2%	266	36.6%
Farm or Forest	4	1.0%	0	0.0%	4	0.6%
Retail Store or Gas Station	8	2.1%	25	7.3%	33	4.5%
Job/Construction Site	10	2.6%	0	0.0%	10	1.4%
Other	38	9.9%	29	8.5%	67	9.2%
Total	**384**	**100%**	**342**	**100%**	**726**	**100%**

Differing from their origins, destination facilities (Figure II.6.6) for respondent trips were largely attributable to a combination of Warehouse or Distribution Centers and Retail Stores or Gas Stations for loaded trucks (29% and 28%, respectively). Agriculture Processing Facilities remained the same for loaded trucks at 15%. The big change for empty trucks revolves around Agriculture Processing Facilities. Only 9% of empty trucks originated from an Agriculture Processing Facility while 53% were destined to one. The next highest percentage (28) of empty trucks were destined for Warehouse or Distribution Centers.

Figure II.6.6: Destination facility types.

Facility Destination	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	6	1.6%	19	5.7%	25	3.5%
Railroad Yard	0	0.0%	1	0.3%	1	0.1%
River or Ocean Port	1	0.3%	1	0.3%	2	0.3%
Airport	0	0.0%	0	0.0%	0	0.0%
Industrial Factory/Sawmill	21	5.6%	15	4.5%	36	5.0%
Agriculture Processing Facility	63	16.7%	177	52.7%	240	33.7%
Warehouse/Distribution	109	28.9%	95	28.3%	204	28.6%
Farm or Forest	12	3.2%	3	0.9%	15	2.1%
Retail Store or Gas Station	104	27.6%	6	1.8%	110	15.4%
Job/Construction Site	27	7.2%	4	1.2%	31	4.3%
Other	34	9.0%	15	4.5%	49	6.9%
Total	**377**	**100%**	**336**	**100%**	**713**	**100%**

Section 7: Characteristic Profile of Westbound Trucks in the Wenatchee Region (US-2)

Brief summaries of the westbound trucks, empty and loaded, are displayed in the following tables. Major characteristics of consideration include the origin and destination (O-D) states/provinces and cities, as well as their associated O-D facilities. The overwhelming majority (95%) of trucks surveyed, loaded and empty, originated with Washington (Figure II.7.1). Breaking the origins of trips down further, Figure II.7.2 provides indication of the cities from which trucks begin their hauls. Wenatchee takes the top spot for both loaded and trucks at over 45% and the majority of trucks seem to originate in the Wenatchee region. Approximately 65% of westbound trucks are carrying cargo.

Figure II.7.1: Origin State/Province.

Origin State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	377	95.4%	205	94.9%	582	95.3%
British Columbia	4	1.0%	4	1.9%	8	1.3%
OR	3	0.8%	4	1.9%	7	1.1%
ID	2	0.5%	2	0.9%	4	0.7%
Other	9	2.3%	1	0.5%	10	1.6%
Total	**395**	**100%**	**216**	**100%**	**611**	**100%**

Figure II.7.2: Origin city.

Origin City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Wenatchee	183	46.6%	82	38.1%	265	43.6%
Cashmere	35	8.9%	16	7.4%	51	8.4%
East Wenatchee	25	6.4%	17	7.9%	42	6.9%
Brewster	15	3.8%	4	1.9%	19	3.1%
Spokane	13	3.3%	2	0.9%	15	2.5%
Other	122	31.0%	94	43.7%	216	35.5%
Total	**393**	**100%**	**215**	**100%**	**608**	**100%**

Even though Washington is overwhelmingly the destination state of choice, it accounts for 20 percentage points less (Figure II.7.3) than the percentage of loaded trucks originating in Washington (75% vs. 95%). California also generates a significant number of destination responses, with over 7%. For trucks without cargo, Washington still account for about 95% of observations. As should be expected, most destination cities are along US-2 or end in the Puget Sound region (Figure II.7.4). Leavenworth takes the top spot at 12% for loaded trucks, with Seattle at 10% and 12% for empty trucks.

Figure II.7.3: Destination State/Province.

Destination State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	296	75.7%	204	94.4%	500	82.4%
CA	28	7.2%	1	0.5%	29	4.8%
OR	13	3.3%	8	3.7%	21	3.5%
AZ	8	2.0%	0	0.0%	8	1.3%
Other	46	11.8%	3	1.4%	49	8.1%
Total	**391**	**100%**	**216**	**100%**	**607**	**100%**

Figure II.7.4: Destination city.

Destination City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Leavenworth	47	12.0%	19	8.9%	66	10.9%
Seattle	41	10.5%	26	12.1%	67	11.1%
Yakima	31	7.9%	18	8.4%	49	8.1%
Tacoma	23	5.9%	14	6.5%	37	6.1%
Peshastin	22	5.6%	21	9.8%	43	7.1%
Other	228	58.2%	116	54.2%	344	56.8%
Total	**392**	**100%**	**214**	**100%**	**606**	**100%**

Concentrating now on the facility types that generate westbound flows on US-2, Figure II.7.5 displays the ten option types that were provided for the respondents. Loaded trucks were most likely to have originated from a Warehouse or Distribution Center (46%) or an Agriculture Processing Facility (27%). For empty trips, Trucking Yards make up 24% of the observations with Warehouse or Distribution Centers (20%), and Retail Stores or Gas Stations (14%) following close behind.

Figure II.7.5 Origin facility types.

Facility Origin	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	16	4.2%	50	24.2%	66	11.1%
Railroad Yard	3	0.8%	1	0.5%	4	0.7%
River or Ocean Port	1	0.3%	1	0.5%	2	0.3%
Airport	1	0.3%	0	0.0%	1	0.2%
Industrial Factory/Sawmill	29	7.5%	12	5.8%	41	6.9%
Agriculture Processing Facility	105	27.3%	19	9.2%	124	20.9%
Warehouse/Distribution	177	46.0%	41	19.8%	218	36.8%
Farm or Forest	8	2.1%	7	3.4%	15	2.5%
Retail Store or Gas Station	19	4.9%	29	14.0%	48	8.1%
Job/Construction Site	8	2.1%	12	5.8%	20	3.4%
Other	18	4.7%	35	16.9%	53	9.0%
Total	**385**	**100%**	**207**	**100%**	**592**	**100%**

Similar to their origins, destination facilities for respondent trips were largely attributable to Warehouse or Distribution Centers for both loaded (40%) and empty (23%). The western Washington ports become a readily apparent attractant in the destinations of westbound trucks on US-2, attracting 9% of the westbound loaded trucks completing the survey. Similar to origination facilities for empty trucks, the top destinations facilities are similar in make-up and percentages except that Retail Stores and Gas Stations are replaced with Industrial Factories and Sawmills.

Figure II.7.6: Destination facility types.

Facility Destination	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking yard	12	3.2%	47	23.0%	59	10.2%
Railroad yard	3	0.8%	4	2.0%	7	1.2%
River or Ocean Port	33	8.8%	2	1.0%	35	6.0%
Airport	1	0.3%	0	0.0%	1	0.2%
Industrial factory/sawmill	11	2.9%	22	10.8%	33	5.7%
Agriculture processing facility	42	11.2%	23	11.3%	65	11.2%
Warehouse/distribution	148	39.4%	47	23.0%	195	33.6%
Farm of forest	4	1.1%	5	2.5%	9	1.6%
Retail store or gas station	70	18.6%	9	4.4%	79	13.6%
Job/construction site	27	7.2%	19	9.3%	46	7.9%
Other	25	6.6%	26	12.7%	51	8.8%
Total	**376**	**100%**	**204**	**100%**	**580**	**100%**

Section 8: Freight Truck Movements in the Wenatchee Region (Brewster)

The efficient movement of goods in and over the Wenatchee Region is vital to the economic vitality of the state and the region. Figure II.8.1 summarizes the survey total for each season, along with the recorded average volumes for the week of the survey (where applicable). As can be seen in the table, each survey session garnered sufficient responses to readily obtain a confidence level of 95% (C.I. 5%). Using the Seasonal weight factor calculations (Appendix A), the average annual daily truck traffic (AADTT) is calculated as 637 (201 empty, and 437 loaded). These figures, multiplied by 312, are used to calculate annual volumes and associated values.

Figure II.8.1: Seasonal survey totals.

	Number of Empty Trucks Surveyed	Number of Trucks With Cargo Surveyed	Truck Total Volume	Seasonal Weight Factor	Weighted Value	Percent of Trucks Surveyed	Confidence Level 95% +/- 5%
Fall	67	156	726	0.29	210	31%	√
Winter	56	102	558	0.21	114	28%	√
Spring	63	144	674	0.27	181	31%	√
Summer	59	123	550	0.24	130	33%	√

Figure II.8.2 captures the aggregated industry groups transporting goods around Brewster, as measured by all surveys collected at the weigh station just north of Brewster. Using commodity values ($/ton) generated from the nationally based Commodity Flow Survey (CFS), the value of the cargo being transported has been estimated. Where available, the values are generated from Washington specific averages of the corresponding industry codes. National averages are used in place of those with insufficient records to generate a state average.

Figure II.8.2: Wenatchee Region (Brewster) industry survey totals by volume and associated value.

SCTG	Description	Number of Occurrences	Total Cargo Weight	Average Cargo Weight	Total Tonnage	Total Value
1	Live animals and live fish	21	1,211,555	57,693	606	$ 1,039,107
3	Other agricultural products	130	5,117,463	39,365	2,559	$ 1,943,959
4	Animal feed and animal products	11	252,564	22,960	126	$ 188,254
7	Other prepared foodstuffs, fats, oils	37	755,733	20,425	378	$ 487,334
8	Alcoholic beverages	5	95,500	19,100	48	$ 101,382
11	Natural sands	1	56,000	56,000	28	$ 787
12	Gravel and crushed stone	13	445,240	34,249	223	$ 3,306
13	Nonmetallic minerals	9	449,364	49,929	225	$ 19,877
17	Gasoline and aviation turbine fuel	10	520,600	52,060	260	$ 261,216
18	Fuel oils	6	306,000	51,000	153	$ 123,098
19	Coal and petroleum product	1	45,000	45,000	23	$ 17,468
20	Basic chemicals	4	122,600	30,650	61	$ 50,796
22	Fertilizers	11	327,581	29,780	164	$ 56,771
23	Chemical products and preparations	4	154,040	38,510	77	$ 415,833
24	Plastics and rubber	12	229,772	19,148	115	$ 532,227
25	Logs and other wood in the rough	14	762,250	54,446	381	$ 41,554
26	Wood products	33	1,594,560	48,320	797	$ 284,534
27	Pulp and paper products	1	2,000	2,000	1	$ 817
28	Paper or paperboard articles	30	851,232	28,374	426	$ 757,198
30	Articles of textiles or leather	6	22,800	3,800	11	$ 304,372
31	Nonmetallic mineral products	13	401,595	30,892	201	$ 46,147
32	Primary/semi-finished base metal	4	206,087	51,522	103	$ 188,899
33	Articles of base metal	5	170,500	34,100	85	$ 342,686
34	Machinery	10	184,900	18,490	92	$ 827,929
35	Electronic, electrical equipment, components and office equipment	15	324,000	21,600	162	$ 6,663,603
36	Motorized and other vehicles, parts	25	352,637	14,105	176	$ 1,622,977
37	Transportation equipment	4	112,500	28,125	56	$ 1,564,373
38	Precision instruments and apparatus	1	5,000	5,000	3	$ 626,239
39	Furniture, mattresses, lamps, lighting fittings, and illuminated signs	8	96,400	12,050	48	$ 473,527
40	Miscellaneous manufactured products	5	74,000	14,800	37	$ 116,035
41	Waste and scrap	10	314,255	31,426	157	$ 85,436
43	Mixed freight	23	497,682	21,638	249	$ 976,214
					Total	**$ $20,163,955**

Taking a broad perspective is helpful in analyzing the data. Figure II.8.3 (and Figure II.8.4) reveals important information. These trucks, largely originating in Washington, averaged over 16 tons per truck. The value of these same trucks averaged roughly $4,300 per ton. Annualizing the volume and value of the cargo generates in excess of an estimated 2 million tons and $9.7 billion combined in goods moved (Figure II.8.4).

Figure II.8.3: Cargo averages[a] (Brewster)

	Average Cargo Weight (Tons)	Average Cargo Value ($/ton)
Brewster	16.66	$ 4,267.54

[a] Only those records for which a cargo weight was specified by the respondent, and an identifiable cargo value could be determined are included here.

Figure II.8.4: Annualized volume and value of cargo in the Wenatchee Region (Brewster)

	Number of Empty Trucks	Number of Trucks with Cargo	Total Cargo Weight (Million Tons)	Total Cargo Value (Million Dollars)
Brewster	62,581	136,247	2.27	$ 9,687.50

Section 9: Characteristic Profile of Wenatchee Region (Brewster) Trucks

Brief summaries of the Brewster trucks, empty and loaded, are displayed in the following tables. Major characteristics of consideration include the origin and destination (O-D) states/provinces and cities, as well as their associated O-D facilities. The overwhelming majority of trucks surveyed, both loaded and empty, originated within Washington (Figure II.9.1). The Canadian province of British Columbia (BC) also generated a significant amount of observations, more than all other US states combined, absent Washington. This begins to suggest an important relationship between the U.S.-Canadian border and Highway 97. Breaking the origins of trips down further, Figure II.9.2 provides indication of the cities from which trucks begin their hauls. The top five origin cities are presented, with Wenatchee and Brewster being the primary generators both for loaded and empty trucks (about 20%). The trucks, which are carrying cargo, originate from more than 145 different cities, while the empty trucks originate from just over 70 cities.

Figure II.9.1: Origin State/Province.

Origin State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	370	70.1%	192	80.0%	562	73.2%
British Columbia	84	15.9%	32	13.3%	116	15.1%
OR	27	5.1%	3	1.3%	30	3.9%
CA	14	2.7%	1	0.4%	15	2.0%
NV	8	1.5%	0	0.0%	8	1.0%
Other	25	4.7%	12	5.0%	37	4.8%
Total	**528**	**100%**	**240**	**100%**	**768**	**100%**

Figure II.9.2: Origin city.

Origin City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Wenatchee	54	10.3%	24	10.1%	78	10.2%
Brewster	43	8.2%	26	10.9%	69	9.0%
Spokane	38	7.2%	12	5.0%	50	6.5%
Chelan	22	4.2%	4	1.7%	26	3.4%
Okanogan	20	3.8%	12	5.0%	32	4.2%
Other	349	66.3%	160	67.2%	509	66.6%
Total	**526**	**100%**	**238**	**100%**	**764**	**100%**

Washington and British Columbia account for greater than 80% of origin and destination states for loaded trucks and greater than 90% for empty trucks. As should be expected, destination states are slightly more dispersed than are the coinciding origins, though still largely dominated by intrastate travel (Figure II.9.3). Even though Washington and British Columbia make up the same percentage of destination states as origin states, the number of destination states for loaded trucks exceeds that of origin states by more than 50%.

Of the top destination cities, only one out-of-state city, Kelowna, British Columbia, cracks into the Top-5 for loaded tucks (Figure II.9.4). For those trucks with and without cargo, the attraction to Wenatchee significantly drops off, with just under 2% of the destinations. Replacing it as the top destination city for loaded trucks is Omak with 13%. Brewster maintains the top spot for empty trucks for both origin and destination cities. Okanogan and Brewster are the only cities in the top 5 for both origin and destination.

Figure II.9.3: Destination State/Province.

Destination State/Province	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
WA	342	64.9%	188	79.0%	530	69.3%
British Columbia	87	16.5%	30	12.6%	117	15.3%
CA	20	3.8%	7	2.9%	27	3.5%
OR	18	3.4%	6	2.5%	24	3.1%
NY	6	1.1%	0	0.0%	6	0.8%
Other	54	10.2%	7	2.9%	61	8.0%
Total	**527**	**100%**	**238**	**100%**	**765**	**100%**

Figure II.9.4: Destination city.

Destination City	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Omak	69	13.2%	16	6.7%	85	11.2%
Oroville	32	6.1%	16	6.7%	48	6.3%
Kelowna	31	6.0%	8	3.4%	39	5.1%
Brewster	27	5.2%	25	10.5%	52	6.9%
Okanogan	23	4.4%	18	7.6%	41	5.4%
Other	339	65.1%	155	65.1%	494	65.1%
Total	**521**	**100%**	**238**	**100%**	**759**	**100%**

Concentrating now on the facility types that generate flows near Brewster, Figure II.9.5 displays the ten option types that were provided for the respondents. Loaded trucks were most likely (35%) to have originated from a Warehouse or Distribution Center (15% for empty trucks). Industrial Factories or Sawmills and Agriculture Processing Facilities account for another 20% each for loaded trucks. Combined, these 3 origin facilities account for over 70% of loaded trucks. Overwhelmingly, most trucks without cargo originated from a trucking yard (42%).

Figure II.9.5 Origin facility types.

Facility Origin	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	49	9.4%	95	42.2%	144	19.3%
Railroad Yard	1	0.2%	0	0.0%	1	0.1%
River or Ocean Port	1	0.2%	0	0.0%	1	0.1%
Airport	1	0.2%	0	0.0%	1	0.1%
Industrial Factory/Sawmill	89	17.0%	15	6.7%	104	13.9%
Agriculture Processing Facility	100	19.2%	20	8.9%	120	16.1%
Warehouse/Distribution	186	35.6%	32	14.2%	218	29.2%
Farm or Forest	33	6.3%	7	3.1%	40	5.4%
Retail Store or Gas Station	12	2.3%	10	4.4%	22	2.9%
Job/Construction Site	5	1.0%	3	1.3%	8	1.1%
Other	45	8.6%	43	19.1%	88	11.8%
Total	**522**	**100%**	**225**	**100%**	**747**	**100%**

Similar to their origins, destination facilities (Figure II.9.6) for respondent trips were largely attributable to Warehouse or Distribution Centers (30%) for loaded trucks. Agriculture Processing Facilities accounted for roughly the same percentage as origin facilities. Not surprisingly, Retail Stores and Gas Stations make up a large percentage (20) of destination facilities for loaded trucks. Upwards of 50% of empty trucks seem to end their route at one of the top 3 origin facilities (Industrial, Agriculture, and Warehouse).

Figure II.9.6: Destination facility types.

Facility Destination	Trucks Carrying Cargo		Trucks Without Cargo		All Trucks	
	Count	Frequency	Count	Frequency	Count	Frequency
Trucking Yard	25	4.9%	48	22.6%	73	10.1%
Railroad Yard	1	0.2%	1	0.5%	2	0.3%
River or Ocean Port	0	0.0%	0	0.0%	0	0.0%
Airport	1	0.2%	0	0.0%	1	0.1%
Industrial Factory/Sawmill	44	8.6%	26	12.3%	70	9.6%
Agriculture Processing Facility	73	14.2%	46	21.7%	119	16.4%
Warehouse/Distribution	154	30.0%	38	17.9%	192	26.4%
Farm or Forest	36	7.0%	15	7.1%	51	7.0%
Retail Store or Gas Station	105	20.4%	7	3.3%	112	15.4%
Job/Construction Site	17	3.3%	8	3.8%	25	3.4%
Other	58	11.3%	23	10.8%	81	11.2%
Total	**514**	**100%**	**212**	**100%**	**726**	**100%**

Section 10: Roadway Usage and Major Bottlenecks

Given the survey locations sites selected for consideration, only a segment of the truck-freight traffic has been captured. However, the segments captured do collect the major ingress and egress means from the Wenatchee area. Figure II.10.1 below summarizes the major roadway segments used within the region by those trucks captured in the survey. Substantial values obviously occur on the roadways being surveyed. It is important to note in the table below that double counting does occur when a particular truck trip use the same highway on two different segments. For example, US 97 would be counted twice if the respondent indicated that they began in Brewster, heading south on US-97 then travelled west on US-2 and then again south on US-97. An additional important note lies in few respondents indicating that they travelled on the Sunset Hwy; most simply identified it as SR-28. However, numerous respondents did indicate the Sunset Highway as a major source of bottlenecks (Figure II.10.2).

Bridges (116 comments) and Round-A-Bouts (84 comments) were often cited by respondents as their major cause of concern on roadways within their trip (Figure II.10.2). The George Sellar Bridge was of particular concern to SR-28 travelling respondents. Of the roadways specifically identified that can be related to Wenatchee specifically, the Sunset Hwy and Wenatchee Avenue drew particular ire.

Figure II.10.1 Segment occurrences of major highways and streets.

Roadway Name or Number	Survey Location				
	US-2 Westbound	US-97 Northbound	SR-28 East	SR-28 West	Brewster
2	539	481	591	703	270
12	9	15	13	38	36
17	18	5	90	173	313
28	75	27	410	358	18
90	282	508	464	477	200
97	415	587	191	117	646
153	4	4	1	0	11
172	2	2	0	0	0
173	0	0	0	1	4
174	1	1	1	0	61
281	13	7	244	347	12
283	1	0	0	8	16
285	3	0	12	11	1
395	8	4	55	74	86
97a	1	10	0	3	5
Chumstick	3	1	0	0	0
Grant	3	4	1	0	0
Main	4	1	0	0	0
Miller	2	1	0	0	0
Sunset	1	0	2	0	1
Walla Walla	3	2	0	0	0
Wenatchee	16	4	4	1	0

Figure II.10.2 Major bottlenecks.

	Survey Location					
	Brewster	US-97 NB	US-2 WB	SR-28 EB	SR-28 WB	Total
Specific Highways Indicated						
2	4	18	10	9	2	43
17	13	1	1	1	5	21
28	5	10	6	38	45	104
97	13	19	15	10	9	66
285	0	8	6	4	14	32
I-90	2	20	11	2	7	42
I-90 (Snoqualmie Specific)	1	8	4	0	1	14
Other Roads Mentioned						
Baker Flats	4	0	0	2	1	7
Grant Road	6	3	3	25	19	56
Sunset Hwy	4	2	0	29	34	69
Wenatchee Ave	2	12	9	19	11	53
Bridges Indicated						
Bridges (any mention)	3	6	16	46	45	116
George Sellar Bridge	0	0	0	19	17	36
Peshastin Bridge	0	3	6	0	2	11
Other Road Features						
Lights	7	2	6	9	9	33
Passing Lanes	13	0	1	0	4	18
Round-A-Bouts	18	13	13	17	23	84
Construction	6	8	8	20	27	69
Rough Roads	13	10	5	0	5	33

Section 11: Conclusion

The preceding sections highlight several of the major themes of the data collected in the 2012-2013 intercept survey in the greater Wenatchee region. The survey instrument is available in Appendix II.B to gauge the full detail of information collected from the drivers. The survey effort successfully completed in excess of 90% of attempted interviews with drivers. This result is indicative of the excellent work provided by the volunteer crew of Service Club members and the eagerness of the drivers themselves to contribute to a better understanding of roadway conditions.

Accompanying this report is the full data set generated from the survey effort. The first several tabs include pivot tables allowing the formulation of many differing aggregations of the data beyond what is included in this report. These pivot tables may be used to generate tables relating to any number of potential questions related to differing characteristics of the network, drivers, or commodity being transported.

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Appendix II.A

Methodology

Data Collection Methods and Issues

The FPTI origin and destination (O-D) survey was designed to provide a statistically reliable and comprehensive database of freight truck movements on select highway corridors in the state of Washington. A varied set of truck trip and shipment characteristics were determined and incorporated into the survey. Examples of such information include the carrier, truck type, unloaded truck weight, payload weight, commodity type, and the origin and destination facility type(s) (See Appendix B for Instrument). Detailed information on the highways and routes used by the drivers was also collected as an aid in identifying the major and minor freight corridors within and through Washington.

Ten interview sites at permanent weigh stations (6), ports of entry (1), and other sites (3) deemed safe by the Washington State Patrol's Commercial Vehicle Enforcement Officers (CVEOs) were utilized to implement the driver survey. Unlike previous FPTI O-D surveys that broadly covered the entire state, the 2012-2013 surveys targeted WSDOT identified corridors of interest.

Data was collected during a four-week period in each season (Fall (Oct-Nov 2012), Winter (Jan-Feb 2013), Spring (Apr-May 2013), Summer (Jul-Aug 2013), Fall (Oct-Nov 2013)) (Figure II.A-1). The sequential surveys were conducted to allow seasonal traffic flow comparisons to be made. Data collection was conducted on the same day of the week for the specified sites to allow continuity between seasons. As a rule of thumb, surveys were not conducted on holidays or on Mondays and Fridays so as to avoid any generated unusual flow patterns. Surveys on I-90 were conducted over 24-hr periods (2pm-2pm). All other sites began operation in the early morning hours, 5, 6, or 7am dependent upon historic truck counts. To best capture the highest volume of traffic, all effort was made to capture the time period in which greater than 80% of the truck traffic could be reasonably expected to pass the survey sites. Evening shutdown of the survey operations was dependent upon the density of truck flow and was typically halted when volumes reached fewer than five trucks per hour.

Figure II.A-1: Survey Schedule

DATE	LOCATION	HOURS
October 23, 2012	I-90 W of Cle Elum WESTBOUND	24hr beginning 2:00pm
October 24, 2012	I-90 W of Cle Elum EASTBOUND	24hr beginning 2:00pm
October 30, 2012	US-2 W of Wenatchee EASTBOUND	5:00am –
November 1, 2012	US-2 W of Wenatchee WESTBOUND	5:00am –
November 6, 2012	SR-28 E of Wenatchee EASTBOUND	5:00am –
November 8, 2012	SR-28 E of Wenatchee WESTBOUND	5:00am –
January 29, 2013	US-2 W of Wenatchee EASTBOUND	5:00 am –
January 29, 2013	US-395 Kettle Falls SOUTHBOUND	7:00 am -
January 31, 2013	US-2 W of Wenatchee WESTBOUND	5:00 am –
February 5, 2013	SR-28 E of Wenatchee EASTBOUND	5:00 am –
February 5, 2013	US-395 Chewelah NORTHBOUND	7:00 am -
February 7, 2013	SR-28 E of Wenatchee WESTBOUND	5:00 am –
February 12, 2013	US-395 Deer Park SOUTHBOUND	7:00 am -
February 13, 2013	US-97 N of Brewster at US-97/SR-17	7:00 am -
February 19, 2013	I-90 W of Cle Elum WESTBOUND	24hr beginning 2:00pm
February 20, 2013	I-90 W of Cle Elum EASTBOUND	24hr beginning 2:00pm
April 23, 2013	I-90 W of Cle Elum WESTBOUND	24hr beginning 2:00pm
April 24, 2013	I-90 W of Cle Elum EASTBOUND	24hr beginning 2:00pm
April 30, 2013	US-2 W of Wenatchee EASTBOUND	5:00 am –
April 30, 2013	US-395 Kettle Falls SOUTHBOUND	7:00 am -
May 2, 2013	US-2 W of Wenatchee WESTBOUND	5:00 am –
May 7, 2013	SR-28 E of Wenatchee EASTBOUND	5:00 am –
May 7, 2013	US-395 Chewelah NORTHBOUND	7:00 am -
May 9, 2013	SR-28 E of Wenatchee WESTBOUND	5:00 am –
May 14, 2013	US-395 Deer Park SOUTHBOUND	7:00 am -
May 15, 2013	US-97 N of Brewster at US-97/SR-17	7:00 am -
July 23, 2013	I-90 W of Cle Elum WESTBOUND	24hr beginning 2:00pm
July 24, 2013	I-90 W of Cle Elum EASTBOUND	24hr beginning 2:00pm
July 30, 2013	US-2 W of Wenatchee EASTBOUND	5:00 am –
July 30, 2013	US-395 Kettle Falls SOUTHBOUND	7:00 am -
August 1, 2013	US-2 W of Wenatchee WESTBOUND	5:00 am –
August 6, 2013	SR-28 E of Wenatchee EASTBOUND	5:00 am –
August 6, 2013	US-395 Chewelah NORTHBOUND	7:00 am -
August 8, 2013	SR-28 E of Wenatchee WESTBOUND	5:00 am –
August 13, 2013	US-395 Deer Park SOUTHBOUND	7:00 am -
August 14, 2014	US-97 N of Brewster at US-97/SR-17	7:00 am -
October 29, 2013	US-395 Kettle Falls SOUTHBOUND	7:00 am -
November 5, 2013	US-395 Chewelah NORTHBOUND	7:00 am -
November 12, 2013	US-395 Deer Park SOUTHBOUND	7:00 am -
November 13, 2012	US-97 N of Brewster at US-97/SR-17	7:00 am -

Approximately 9,000 driver interviews were collected (roughly equivalent per season) to complete the entire origin and destination survey. Refer to Section 1 for Wenatchee area specific counts. Additionally, estimates of the number and direction of non-sampled trucks were made during the interview periods. Estimates are based on either actual truck counts established during the collection period or on historic counts under similar conditions. Actual counts were taken where feasible. These counts were then used to construct weighted estimates of total truck volumes at each location by season. The results presented in this study are derived from these weighted truck trip estimates.

The driver interviews were conducted by a team of Washington State University personnel assisted by members of local Lions clubs throughout the survey regions. Survey locations were typically staffed by 4 to 6 individuals, resulting in 60-150 personnel hours accrued conducting driver interviews each survey day. Driver participation in the survey was high, with locations reporting 95 to 100 percent response rates. A copy of the survey questionnaire is included as Appendix B of this report.

Data Management, Analysis and Modeling Procedures

This section briefly highlights key procedures used within this data framework. More detailed information can be found in Strategic Freight Transportation Analysis Report Number 2, "*Freight Truck Origin and Destination Study: Methods, Procedures and Data Dictionary*."[8]

Data Management

It is important to maintain effective management of data during collection, entry into a database, and during all subsequent analyses. Following and implementing appropriate management techniques helps ensure that the compiled database accurately reflects the statewide freight movements in Washington. There are three possible sources of error that can be attributed to on-site data collection issues. Systemic problems arise from poorly worded questions, incorrect interview procedures and/or problems stemming from sub-optimal site selection. Data problems may come from drivers who provide inaccurate information in response to the survey questions. Finally, interview personnel may fill out the survey incorrectly, providing inaccurate data regarding vehicle information or driver responses.

Errors stemming from improper data collection technique were minimized through a constant monitoring of the survey and data entry personnel. On-site monitoring allowed specific problems to be

[8] http://www.sfta.wsu.edu/research/reports/pdf/Rpt_2_Data_Dictionary.pdf

immediately addressed with the interviewer. Problems identified during data entry were addressed during the following survey season.

One persistent entry error occurred relative to the weight of cargo. Respondents occasionally indicated their gross vehicle weight (GVW) rather than their cargo only weight (payload). Where this event was readily identifiable (e.g. where the combined answers of the empty and cargo weights of the truck grossly exceeded 105,500 pounds), the data entry was adjusted such that the empty truck weight was subtracted from the identified GVW to obtain a payload weight. Surveys that were identified as not being able to be reliably adjusted, were not included in any calculation of the respective variable.

Data Analysis and Modeling

The data obtained in the driver interviews was entered into a MS Excel database in table format. Additional information from various sources was systematically added to the database in order to provide greater depth of analysis. For example, traffic counts from the WSDOT Traffic Data Office were used when and where feasible to verify and correct the sample weights obtained during the survey period.

The use of the MS Excel platform also allows for the incorporation of database information from such sources as the US Census Bureau, the USDOT Bureau of Transportation Statistics and other federal, state and local transportation databases. Linkage of these various databases was and is accomplished by the use of the Standard Classification of Transported Goods (SCTG) code. This code was identified using information obtained during the driver interview about the primary commodity content of the cargo being transported. This information is critical to identifying commodity flows and volumes moving on state highways.

In order to best present the survey data in a meaningful manner, site specific seasonal weight factors based upon the total number of trucks passing each survey site during the day of the survey was calculated. Where feasible, truck counters, either tube or permanent, were used to estimate the total volume. To calculate the seasonal weight factor for each site/season, the total number of trucks in a 24-hour period was divided by the total number of surveys collected at each site. The seasonal weight factor is used to expand the collected data characteristics to represent the entire population of trucks at each

survey location. This expanded information was a representation based upon the total number of daily truck trips.

Appendix II.B

SURVEY QUESTIONNAIRE

SR-28 / US-2 **CONFIDENTIAL**

Washington State Department of Transportation and
Washington State University
Truck Traffic Survey

[Please Fill Questions 1-7 prior to or as approaching the Truck]

Interviewer and Site Information:

1) Station location:_____
2) Initials of interviewer:_____
3) Time of interview:_____
4) Date of interview:_____

Basic Truck Characteristics:

5) Truck Configuration
[Check only *one* truck configuration]
[See Quality Control Notes for definitions]

1. ☐ Straight truck
2. ☐ Truck and trailer
3. ☐ Tractor only
4. ☐ Tractor and trailer
5. ☐ Tractor with two trailers
6. ☐ Other (specify) _____

6) Total number of axles on the ground _____

7) Is a hazardous material placard displayed? 1. ☐ Yes ID #_____ 2. ☐ No

[Please ask the driver the following questions]

Basic Truck/Company Information

8) Trucking company name:_____
9) Trucking company home base: City_____ State/Province_____
10) What is the unloaded weight of this vehicle? _____ lbs.

Cargo Information

11) Is this vehicle carrying cargo, or is it empty? ☐ Carrying Cargo (Ask Q12-19) ☐ Empty (Ask Q20-25)
12) What is the major commodity on board:_____
13) How much does the cargo you are carrying today weigh?_____

Complete only the **one** column that applies to **this** trip. No round-trip information, please!

Trucks CARRYING cargo:	**Trucks WITHOUT cargo:**
Where did you pick-up this cargo?	Where did this trip without cargo begin?
14) City _____	20) City _____
15) State/Province_____	21) State/Province_____
16) Facility: **[see Quality Control Notes]**	22) Facility: **[see Quality Control Notes]**
a. ☐ Trucking yard	a. ☐ Trucking yard
b. ☐ Railroad yard	b. ☐ Railroad yard
c. ☐ River or ocean port	c. ☐ River or ocean port
d. ☐ Airport	d. ☐ Airport
e. ☐ Industrial factory or sawmill	e. ☐ Industrial factory or sawmill
f. ☐ Agricultural processing facility	f. ☐ Agricultural processing facility
g. ☐ Warehouse/distribution center or post office	g. ☐ Warehouse/distribution center or post office
h. ☐ Farm or forest	h. ☐ Farm or forest
i. ☐ Retail store or gas station	i. ☐ Retail store or gas station
j. ☐ Job or construction site	j. ☐ Job or construction site
k. ☐ Other _____	k. ☐ Other _____
Where is the destination of your cargo?	Where will your trip without cargo end?
17) City: _____	23) City: _____
18) State/Province_____	24) State/Province_____
19) Facility: **[See Quality Control Notes]**	25) Facility: **[See Quality Control Notes]**
a. ☐ Trucking yard	a. ☐ Trucking yard
b. ☐ Railroad yard	b. ☐ Railroad yard
c. ☐ River or ocean port	c. ☐ River or ocean port
d. ☐ Airport	d. ☐ Airport
e. ☐ Industrial factory or sawmill	e. ☐ Industrial factory or sawmill
f. ☐ Agricultural processing facility	f. ☐ Agricultural processing facility
g. ☐ Warehouse/distribution center or post office	g. ☐ Warehouse/distribution center or post office
h. ☐ Farm or forest	h. ☐ Farm or forest
i. ☐ Retail store or gas station	i. ☐ Retail store or gas station
j. ☐ Job or construction site	j. ☐ Job or construction site
k. ☐ Other _____	k. ☐ Other _____

26) What Washington highways and Wenatchee streets were used to travel between the two locations identified above?

_____ (Remember, **accurately** highlight [yellow] attached maps!)
Write out the highways used to get between the two locations identified above

27) With what frequency does this truck travel the above route?

a. ☐ Daily
b. ☐ Once a Week
c. ☐ Several Times a week
d. ☐ Occasionally (1-3 times/mo.)
e. ☐ Rarely (<1 time/mo.)
f. ☐ Don't Know

28) In your opinion, where is the worst bottleneck in the area shown on the Wenatchee map? (Please indicate [in pink highlight] the section where the bottleneck occurs.) What is the suspected typical cause?

_____

29) With what frequency does the indicated bottleneck significantly affect your travel time?

a. ☐ Daily
b. ☐ Once a Week
c. ☐ Several Times a week
d. ☐ Occasionally (1-3 times/mo.)
e. ☐ Rarely (<1 time/mo.)
f. ☐ Don't Know