

A Quantitative Estimate of Eastern Washington Annual Haul Road Needs for Wheat and Barley Movements

**EWITS Research Report Number 6
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by

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EWITS Research Reports: Background and Purpose

This is the sixth of a series of reports prepared from the Eastern Washington Intermodal Transportation Study (EWITS). The reports prepared as a part of this study provide information to help shape the multimodal network necessary for the efficient movement of both freight and people into the next century. This specific analysis was partially funded by the Washington Wheat Commission.

EWITS is a six-year study funded jointly by the Federal government and the Washington State Department of Transportation as a part of the Intermodal Surface Transportation Efficiency Act of 1991. Dr. Ken Casavant of Washington State University is Director of the study. A state-level Steering Committee provides overall direction pertaining to the design and implementation of the project. The Steering Committee includes Jerry Lenzi, Chairperson (WSDOT, Eastern Region); Richard Larson (WSDOT, South Central Region); Don Senn (WSDOT, North Central Region); Charles Howard (WSDOT, Planning Manager), and Jay Weber (Douglas County Commissioner). Linda Tompkins represents the Washington State Transportation Commission on the Steering Committee. An Advisory Committee with representation from a broad range of transportation interest groups also provides guidance to the study. The following are key goals and objectives for the Eastern Washington Intermodal Transportation Study:

- *Facilitate existing regional and state-wide transportation planning efforts.*
- *Forecast future freight and passenger transportation service needs for eastern Washington.*
- *Identify gaps in eastern Washington's current transportation infrastructure.*
- *Pinpoint transportation system improvement options critical to economic competitiveness and mobility within eastern Washington.*

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DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Washington State Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

EWITS PREVIOUS REPORTS NOW AVAILABLE

1. Gillis, William R. and Kenneth L. Casavant. EWITS Research Report Number 1. "Linking Transportation System Improvements to New Business Development in Eastern Washington." February 1994.
2. Gillis, William R. and Kenneth L. Casavant. EWITS Research Report Number 2. "Lessons from Eastern Washington: State Route Mainstreets, Bypass Routes and Economic Development in Small Towns." February 1994.
3. Gillis, William R. and Kenneth L. Casavant. EWITS Research Report Number 3. "Washington State Freight Truck Origin and Destination Study: Methods, Procedures and Data Dictionary." December 1994.
4. Gillis, William R. and Kenneth L. Casavant. EWITS Research Report Number 4. "Major Generators of Traffic on U.S. 395 North of Spokane: Including Freight Trucks and Passenger Vehicles Crossing the International Border." January 1995.
5. Newkirk, Jonathon R., Ken Eriksen and Kenneth L. Casavant. EWITS Research Report Number 5. "Transportation Characteristics of Wheat and Barley Shipments on Haul Roads To and From Elevators in Eastern Washington." March 1995.

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Table of Contents

Introduction	1
Methodology	2
Results	4
Summary	9
Appendix A	11
Appendix B	30

Tables

Table I	The total annual road needs for eastern Washington by movement and road type.	5
Table II	The total annual road needs for eastern Washington by movement and road type, by percentage.	5
Table III	The total amount of road needs to support each county's wheat and barley movements on eastern Washington roads and highways.	6
Table IV	The total amount of road needs to support each county's wheat and barley movements on eastern Washington roads and highways, by percentage. . . .	7
Table V	The total amount of road needs within each county to support wheat and barley movements in Eastern Washington	8
Table VI	The total amount of road needs within each county to support wheat and barley movements in Eastern Washington, by percentage	9
A-I	Adams County	11
Table A-I-1	County road and highway impacts from wheat and barley originating within the county for Elevator to River Port movement.	
Table A-I-2	Road impacts from wheat and barley originating in other counties and passing through the county for Elevator to River Port movement.	
Table A-I-3	County road and highway impacts from wheat and barley originating within the county for Farm to River Port movement.	
Table A-I-4	Road impacts from wheat and barley originating in other counties and passing through the county for Farm to River Port movement.	
Table A-I-5	Road impacts from wheat and barley originating within the county for Elevator to Elevator movement.	
Table A-I-6	Road impacts from wheat and barley originating within the county for Farm to Elevator movement.	
Table A-I-7	Total road needs to support All Wheat and Barley Movement within and through the county.	

Tables

A-II	Benton County	13
	Tables A-II-1 through A-II-7 as described above.	
A-III	Columbia County	15
	Tables A-III-1, A-III-3, A-III-5, A-III-6 and A-III-7 as described above.	
A-IV	Douglas County	16
	Tables A-IV-1, A-IV-3, A-IV-5, A-IV-6 and A-IV-7 as described above.	
A-V	Franklin County	17
	Tables A-V-1 through A-V-7 as described above.	
A-VI	Garfield County	19
	Tables A-VI-1, A-VI-3, A-VI-5, A-VI-6, and A-VI-7 as described above.	
A-VII	Grant County	20
	Tables A-VII-1 through A-VII-7 as described above.	
A-VIII	Lincoln County	22
	Tables A-VIII-1 through A-VIII-7 as described above.	
A-IX	Spokane County	24
	Tables A-IX-1, A-IX-3, A-IX-5, A-IX-6 and A-IX-7 as described above.	
A-X	Stevens County	25
	Tables A-X-1, A-X-3, A-X-5, A-X-6 and A-X-7 as described above.	
A-XI	Walla Walla County	26
	Tables A-XI-1, A-XI-3, A-XI-5, A-XI-6 and A-XI-7 as described above.	
A-XII	Whitman County	27
	Tables A-XII-1 through A-XII-7 as described above.	
A-XIII	Yakima County	29
	Tables A-XIII-1, A-XIII-3, A-XIII-5, A-XIII-6 and A-XIII-7 as described above.	
Appendix B	30
Tonmiles for Elevator to River Port Grain Movement	30

Tables

B-I	Adams County	30
	Table B-I-1a Tonmiles for grain originating within the county.	
	Table B-I-2a Tonmiles for grain originating in other Counties and passing through this county.	
B-II	Benton County	30
	Tables B-II-1a and B-II-2a as described above.	
B-III	Columbia County	31
	Table B-III-1a as described above.	
B-IV	Douglas County	31
	Table B-VI-1a as described above.	
B-V	Franklin County	31
	Tables B-V-1a and B-V-2a as described above.	
B-VI	Garfield County	32
	Table B-VI-1a as described above.	
B-VII	Grant County	32
	Tables B-VII-1a and B-VII-2a as described above.	
B-VIII	Lincoln County	32
	Tables B-VIII-1a and B-VIII-2a as described above.	
B-IX	Spokane County	33
	Table B-IX-1a as described above.	
B-X	Stevens County	33
	Table B-X-1a as described above.	
B-XI	Walla Walla County	33
	Table B-XI-1a as described above.	
B-XII	Whitman County	33
	Tables B-XII-1a and B-XII-2a as described above.	
B-XIII	Yakima County	34
	Table B-XIII-1a as described above.	

Tables

Tonmiles for Farm to River Port Grain Movement	35
B-I Adams County	35
Table B-I-1b Tonmiles for grain originating within the county.	
Table B-I-2b Tonmiles for grain originating in other Counties and passing through this county.	
B-II Benton County	35
Tables B-II-1b and B-II-2b as described above.	
B-III Columbia County	36
Table B-III-1b as described above.	
B-IV Douglas County	36
Table B-IV-1b as described above.	
B-V Franklin County	36
Tables B-V-1b and B-V-2b as described above.	
B-VI Garfield County	37
Table B-VI-1b as described above.	
B-VII Grant County	37
Tables B-VII-1b and B-VII-2b as described above.	
B-IIIX Lincoln County	37
Tables B-VIII-1b and B-VIII-2b as described above.	
B-IX Spokane County	38
Table B-IX-1b as described above.	
B-X Stevens County	38
Table B-X-1b as described above.	
B-XI Walla Walla County	38
Table B-XI-1b as described above.	
B-XII Whitman County	38
Tables B-XII-1b and B-XII-2b as described above.	

Tables

B-XIII	Yakima County	39
	Table B-XIII-1b as described above.	
	Tonmiles for Elevator to Elevator Movement	40
	Table B-1c	
	Tonmiles for Farm to Elevator Movement	41
	Table B-1d	

Introduction

The history of Washington as a state, and especially eastern Washington as a region, is a history of the wheat industry. The economic rationale for rural community formation and infrastructure development was the support of and benefits from agricultural activity, particularly wheat production in the Pacific Northwest. The continuing level of state development and sustaining of that level is supported by a mature wheat industry, its associated service purchases and the wheat industry's access to world markets provided by an efficient and dynamic transportation system.

It is known that the wheat industry in Washington is one of the most productive wheat sectors, certainly on a per acre basis, in the U. S. A recent study done for the Washington Wheat Commission looked in great detail at the economic impact of the wheat industry ("Economic Contribution of the Wheat Industry to the Washington Economy", Roger Coupal and David Holland, WSU). The study estimated direct economic impacts from wheat production, transportation and storage, and milling activities.

Total industry production value was \$457 million, with transportation and handling charges adding another direct value of \$50 million in sales. The impact was further enhanced by \$33 million from flour sales and \$54 million in wheat program returns.

Indirect impacts, added to the above direct impacts, resulted in \$1.4 billion annually, indicative of a mature industry. Employment to the state of Washington from the wheat industry was over 27,200 jobs, directly and indirectly, in a year. And, this broad level of activity generated over \$80 million in tax revenues for Washington's local and state governments.

But, the importance of transportation in the wheat industry far transcends the \$50 million in sales. Without the transportation system to support the access to the world markets, the shrinkage of the economic value of the industry would be startling. Support of the transportation system is the same as supporting this wheat industry and its substantial contributions to the state's and region's economies.

This transportation system is under pressure, physically and financially. Railroad abandonment, waterway drawdown and road deterioration all contribute to a sense of urgency in detailing the needs of that system. The overall purpose of this study is to provide a detailed assessment of needs, specifically for the road system in eastern Washington. Although road needs includes redesign, truck lanes, reconfiguration, etc., this study looks solely and directly at the road deterioration from the normal wear and tear associated with movement of grains. Specific objectives were to:

- 1) **Develop a methodology to determine the impacts on roads associated with normal, legal truck movement.**
- 2) **Identify road usage and support needed by county for wheat and barley movements in each county.**
- 3) **Quantify the overall annual road needs and accompanying investment required to support the industry.**

Methodology

The road impact estimates developed in this analysis are derived predominately from information obtained through an in-depth survey of eastern Washington grain elevators (see EWITS report #5). The survey provided information concerning the origin, destination and movement (and volume) of wheat and barley from farm to market and allowed investigation of the resultant road needs for each type of truck movement. This study analyzes four types of grain movement: 1) grain moving from elevator to river ports; 2) grain moving directly from farm to river ports; 3) grain moving from one elevator to another elevator; and 4) grain moving from farm to elevators. These movements should capture the majority of road needs to support grain movement in eastern Washington. It should be noted that any roads passing through a local jurisdiction such as a city are simply assigned to the category of road entering the city, whether it was a county or state roadway.

Road impact from the first type of grain movement from elevator to river port was calculated in the following manner. All elevators surveyed indicated the river port location to which they shipped wheat and barley and the amount of each that was shipped. They also were asked to indicate the route used to reach the river port; the majority of respondents provided detailed route information. Thus, to determine the amount of road need, each elevator was located on a map and the distance in miles was measured from the elevator to the river port, by county and road type, and the volume of wheat and barley was multiplied times the miles traversed to arrive at a tonmile estimate for county roads and state highways in each county. The tonmiles also included the weight of the trucks, assumed to weigh 12 tons and have a payload of 28 tons. The trucks were also assumed to return empty, thus making the effective truck weight on roads 24 tons.

These tonmiles estimates were then multiplied by a road damage coefficient of \$.071 per tonmile for state highways and \$.1065 per tonmile for county roads in 1995. These coefficients were obtained from a previous research study by Ken Casavant and Jerry Lenzi titled "Procedure for Predicting and Estimating the Impact of Rail Line Abandonments on Washington Roads" in the WSDOT final report 1989. Denver Tolliver updated and calibrated these estimates for WSDOT and, with Casavant, these last coefficients were updated to 1995

("Washington Rail Impact Analysis: Executive Summary", Denver Tolliver, Kevin Andres and Brian Lindamood, WSDOT, December 1994). In the event that no route was provided by the elevator, the shortest and most direct route was chosen.

The road impacts from farm to river port movement were more challenging to obtain. The volume produced and the route taken to the river port were approximated by taking the average miles of county road and state highway used by elevators within each county transporting grain to river ports. The volume of wheat and barley moved from farm to river port was obtained by subtracting the amount handled by elevators within a county from the five year average production for that given county. The volume (including truck weights as before) was then multiplied by the average county miles to arrive at a tonmile estimate, similar to previous road type and county estimates. The assumption that miles of road traveled for farm to river port movement will be on average the same as elevator to river port movement is not too limiting since elevators are usually located in direct proportion to the intensity of grain production of a given region. However, the estimate of the volume of grain moved this way may not be entirely accurate since it abstracts from any grain that may move across county lines to be handled at elevators in adjoining counties.

Grain moving from elevator to elevator is typically being moved from an elevator which doesn't have access to rail or to a multi-car train loading facility to an elevator which does. Thus to arrive at the number of miles traveled for elevator to elevator movement, all elevator locations were identified on a map within each county as either having or not having a multi-car train loading facility and the distance in miles was measured between a sample of those elevators which did not, and those which did have multi-car loading facilities. The average miles of county road and state highway traveled by the sample of those elevators without loading facilities to those elevators which do was multiplied by the volume of grain (including truck weight) reported shipped to other elevators by those without multi-car loading facilities; this allowed a tonmile estimate by road type and county to be derived. Once again this method abstracts from any movement between elevators across county lines.

The farm to elevator movement was calculated by first identifying all on-farm storage locations in eastern Washington, on a map, along with the elevators. The location of the on-farm storage facilities was obtained from county Agricultural Soil and Conservation Service offices and county assessor offices. Then, for each elevator it was determined which on-farm storage facilities would ship their grain to that elevator, assuming they ship to the closest elevator. Once which elevators each on-farm storage facility shipped their grain to were determined, the average miles of county road and state highway traversed by farmers transporting grain to the elevator was calculated. The average distances were determined by selecting a sample of on-farm storage locations for each elevator, measuring the distance between the on-farm storage location and the elevator and then taking the average. In the event where there were only a few on-farm storage locations shipping to an elevator, each were included in the average mileage estimates. The volume of grain handled at each elevator, and the weight of the trucks used for transporting the grain, were multiplied by the

average mileage from the farms to the elevators to arrive at a tonmile estimate. These tonmiles were then multiplied by the road damage coefficients for county roads and state highways previously mentioned to determine a dollar value for highway need. Grain shipments from farm to elevator were assumed to move to the closest elevator within the county. Therefore, no grain moved across county boundaries en route to the elevators. While this may seem somewhat unrealistic, overall the highway impact from grain which would cross county lines to reach the closest elevator will be off-setting since grain could reasonably be expected to move in both directions across the county line.

Results

Results of this analysis are presented in this section. What is quickly evident is the significant variation among the counties in magnitude of road impacts by type of movement. As detailed in the methodology discussion the four general possible movement types are: farm to river port, farm to elevator, elevator to river port and elevator to elevator. These types of movements are summarized by type of road and total impact in Tables I and II.

Investment needs of about \$27.5 million a year will be required to maintain the haul road system needed to support the wheat and barley industry. Of this, the vast majority of the impact, \$16.5 million or 60%, occurred in farm to river port movement. Elevator to river port movement caused over \$8.1 million or 29.5% of the total impact. Elevator to elevator movements were associated with less than 2% of the wear and tear; farm to elevator caused about \$2.5 million or 8.8% of the total investment need.

The incidence of these road needs offers information for investment strategies by local and state decision makers. Almost 81 percent or \$22.2 million of the impact is felt by state highways. County roads receive the other 19.3 percent or \$5.3 million of impact.

The incidence of impact does vary significantly by type of movement (Tables I and II). Any movement to the river port, whether from elevator or farm, has a heavy impact on state highways (83% and 89.2%, respectively). Elevator to elevator movements are the most even in distribution across county road and state highway. Grain movements from farm to elevator occur almost 79% of the time on county roads, with only 21.3% on state highways. This overall distribution reflects the longer haul movements to river ports being on state highways and the shorter haul movements occurring on collector county roads.

An in-depth examination of the above aggregate road needs for each county was also done for each of the thirteen counties in eastern Washington which reported elevator movements. The specific data on road needs for each county's movement are detailed in Appendices A and B. The share of each county in total road investment needs is indicated in Tables III and IV. These tables detail the amount of road needs caused by the grain produced in each county,

whether it occurs in that home county or in counties it crosses as it moves to market. Lincoln and Whitman counties, 26 and 19 percent or \$7 and \$5.2 million respectively, cause the largest amount of required road investment, followed by Grant and Adams. The southeastern counties, along with Benton and Stevens counties, are the source of least impact on roads.

Table I. Annual Road needs for All 13 Eastern Washington Counties from Wheat and Barley by Movement and Road Type, in dollars.

Movement	County Road	State Highway	Total
Elevator to River Port	1,382,331	6,733,075	8,115,406
Farm to River Port	1,788,020	14,712,395	16,500,415
Elevator to Elevator	229,113	252,914	482,026
Farm to Elevator	1,931,388	525,714	2,457,103
Total	5,330,852	22,224,098	27,554,950

Table II. Annual Road needs for All 13 Eastern Washington Counties from Wheat and Barley by Movement and Road Type, by percentage.

Movement	County Road	State Highway	Total
Elevator to River Port	17.0	83	29.5
Farm to River Port	10.8	89.2	59.9
Elevator to Elevator	47.5	52.5	1.7
Farm to Elevator	78.6	21.3	8.8
Total	19.3	80.7	100

Table III. Total Road Needs in Eastern Washington to support Each Counties Production of Wheat and Barley, in dollars.

County	County Road	State Highway	Total
Adams	613,990	2,294,031	2,908,021
Benton	36,213	622,727	658,940
Columbia	248,062	408,833	656,896
Douglas	241,928	2,280,652	2,522,580
Franklin	127,822	816,031	943,853
Garfield	294,243	132,190	426,433
Grant	358,846	2,709,518	3,068,364
Lincoln	1,036,216	6,042,124	7,078,340
Spokane	460,652	1,063,315	1,523,967
Stevens	4,364	124,555	128,917
Walla Walla	570,371	1,552,510	2,122,881
Whitman	1,265,690	3,888,210	5,153,900
Yakima	72,455	289,404	361,858
Total	5,330,852	22,224,098	27,554,950

Table IV. Total Road Needs in Eastern Washington to support Each Counties Production of Wheat and Barley, by Percentage.

County	County Road	State Highway	Total
Adams	21.1	78.9	10.6
Benton	5.5	94.5	2.4
Columbia	37.8	62.2	2.4
Douglas	9.6	90.4	9.2
Franklin	13.6	86.4	3.4
Garfield	69.0	31.0	1.6
Grant	11.7	88.3	11.1
Lincoln	14.6	85.4	25.7
Spokane	30.3	69.7	5.5
Stevens	3.0	96.0	.5
Walla Walla	26.9	73.1	7.7
Whitman	24.6	75.4	18.7
Yakima	19.9	80.1	1.2
Total	19.3	80.7	100

County and state planners developing road investment strategies are faced with differing needs. As detailed in Tables III and IV, counties range from having 69% of their impact caused by their grain production occurring on county roads (Garfield) to 3% in Stevens county. Stevens county's movements are almost entirely (96%) on state highways while 86.4% of road impacts for Franklin county are on those state highways. The largest total dollar impact arose in Lincoln and Whitman county. Benton, Douglas and Stevens all saw over 90% of their road impact occur on state highways. Each county's configuration, location and road system determines the use, and magnitude of that use, of alternative road systems.

The above analysis detailed the road impacts and resulting investment needs caused by the grain produced in that county. The amount of road impacts occurring in each county, no matter the source of the grain itself, is summarized in Tables V and VI. In this approach those roads that receive and move grain across a county, usually state highways, require more investment than the roads simply originating that grain volume; such roads can be expected to be located in counties with or on the routes to river ports.

The above hypothesis is supported by the results of the analysis. Lincoln, Adams, Grant and Whitman counties do have that characteristic and a large amount of internal production. These four counties account for over 60 percent (\$16.6 million) of the road needs to support wheat and barley movement in eastern Washington. Those counties with low production and no cross shipments have a small share of the impacts eg. Stevens, Garfield and Spokane. This is supported by comparing Tables IV and VI. The larger amounts in Table VI reflect the volume of cross shipments; Adams, Franklin, Grant and Garfield significantly increased their road investment needs by hauling other counties' products to the market. Most of that increase occurred on state highways.

Table V. Total Road Needs Occurring in Each County, in dollars.

County	County Road	State Highway	Total
Adams	838,086	4,721,542	5,559,628
Benton	36,213	608,749	644,962
Columbia	248,063	408,833	656,896
Douglas	241,928	427,316	669,244
Franklin	127,822	5,596,347	5,724,169
Garfield	294,243	132,168	426,411
Grant	555,518	4,381,475	4,936,993
Lincoln	615,448	958,520	1,573,970
Spokane	396,474	72,014	468,488
Stevens	4,360	52,246	56,606
Walla Walla	570,371	1,552,510	2,122,881
Whitman	1,329,869	3,261,475	4,591,344
Yakima	72,454	50,902	123,357
Total	5,330,849	22,224,098	27,554,950

Table VI. Total Road Needs Occurring in Each County, by Percentage.

County	County Road	State Highway	Total
Adams	15.1	84.9	20.2
Benton	5.6	94.4	2.3
Columbia	37.8	62.2	2.4
Douglas	36.2	63.8	2.4
Franklin	2.2	97.8	20.8
Garfield	69.0	31.0	21.6
Grant	11.3	88.7	17.9
Lincoln	39.1	55.9	5.7
Spokane	84.6	15.4	1.7
Stevens	7.7	92.3	0.2
Walla Walla	26.9	73.1	7.7
Whitman	29.0	71.0	16.6
Yakima	58.7	41.3	.5
Total	19.3	80.7	100

Summary

The wheat industry in Washington is one of the most productive wheat sectors in the U. S. Its economic impact on the state's economy is substantial to say the least: production value of \$457 million; \$50 million in transportation and handling; \$1.4 billion total direct and indirect value; 27,200 jobs in the economy. The industry requires a solid transportation system, road - rail - water, to access the critical international markets.

This analysis indicated annual road investment in eastern Washington of \$27.5 million is necessary to replace normal wear and tear on the road system. Almost \$22.2 million (81%) occurred on state highways and county roads received the other 19 percent of impact.

Most of the road needs occurs on movements to river ports; especially noticeable is that 89.2 percent of the impact on state highways occurs from farm to river port movement. However, farm to elevator movement generates 79 percent of its impacts on county roads.

Finally, it is evident that those counties serving as passage routes for other counties grain have a need for road investment far above that caused by their own production. This impact is felt directly by those counties near the river.

Appendix A

Adams County

Movement I Elevator to River Port

Table A-I-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Adams	197,851	575,959	773,810

Table A-I-2 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Adams County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Grant	0	176,030	176,030
Lincoln	58,886	410,983	469,869
Douglas	0	29,290	29,290
Whitman	0	200,222	200,222
Total	58,886	816,525	875,412

Movement II Farm to River Port

Table A-I-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Adams	113,512	416,194	529,706

Table A-I-4 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Adams County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Grant	0	304,026	304,026
Lincoln	165,210	1,512,076	1,677,286
Douglas	0	220,424	220,424
Whitman	0	811,071	811,070
Total	165,210	2,847,596	3,012,806

Adams County

(continued)

Movement III Elevator to Elevator

Table A-I-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Adams	59,213	34,114	93,327

Movement IV Farm to Elevator

Table A-I-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Adams	243,414	31,153	274,567

All Movements

Table A-I-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Adams	838,086	4,721,542	5,559,628

Benton County

Movement I Elevator to River Port

Table A-II-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Benton	0	29,312	29,312

Table A-II-2 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Benton County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Yakima	0	24,526	24,525

Movement II Farm to River Port

Table A-II-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Benton	0	382,417	382,417

Table A-II-4 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Benton County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Yakima	0	151,526	151,526

Movement III Elevator to Elevator

Table A-II-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Benton	0	0	0

Benton County

(continued)

Movement IV Farm to Elevator

Table A-II-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Benton	36,213	20,969	57,182

All Movements

Table A-II-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Benton	36,213	608,749	644,962

Columbia County

Movement I Elevator to River Port

Table A-III-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Columbia	93,794	328,735	422,529

Movement II Farm to River Port

Table A-III-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Columbia	35,144	63,267	98,410

Movement III Elevator to Elevator

Table A-III-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Columbia	17,321	2,816	20,138

Movement IV Farm to Elevator

Table A-III-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Columbia	101,803	14,016	115,819

All Movements

Table A-III-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Columbia	248,063	408,833	656,896

Douglas County

Movement I Elevator to River Port

Table A-IV-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Douglas	11,212	48,001	59,214

Movement II Farm to River Port

Table A-IV-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Douglas	165,318	336,934	502,252

Movement III Elevator to Elevator

Table A-IV-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Douglas	0	0	0

Movement IV Farm to Elevator

Table A-IV-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Douglas	65,398	42,381	107,778

All Movements

Table A-IV-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Douglas	241,928	427,316	669,244

Franklin County

Movement I Elevator to River Port

Table A-V-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Franklin	14,855	120,228	135,083

Table A-V-2 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Franklin County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Adams	0	718,672	718,672
Benton	0	13,529	13,529
Douglas	0	75,318	75,318
Grant	0	476,404	476,404
Lincoln	0	187,565	187,565
Whitman	0	92,896	92,896
Yakima	0	8,703	8,703
Total	0	1,573,087	1,573,086

Movement II Farm to River Port

Table A-V-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Franklin	81,028	686,271	767,300

Franklin County

(continued)

Table A-V-4 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Franklin County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Adams	0	517,939	517,938
Benton	0	176,500	176,500
Douglas	0	566,804	566,804
Grant	0	838,038	838,037
Lincoln	0	540,333	540,333
Whitman	0	513,849	513,849
Yakima	0	53,767	53,767
Total	0	3,207,229	3,207,229

Movement III Elevator to Elevator

Table A-V-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Franklin	0	0	0

Movement IV Farm to Elevator

Table A-V-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Franklin	31,939	9,532	41,471

All Movements

Table A-V-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Franklin	127,822	5,596,347	5,724,169

Garfield County

Movement I Elevator to River Port

Table A-VI-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Garfield	0	49,446	49,446

Movement II Farm to River Port

Table A-VI-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Garfield	0	6,740	6,740

Movement III Elevator to Elevator

Table A-VI-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Garfield	5,168	56,275	61,443

Movement IV Farm to Elevator

Table A-VI-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Garfield	289,075	19,707	308,782

All Movements

Table A-VI-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Garfield	294,243	132,168	426,411

Grant County

Movement I Elevator to River Port

Table A-VII-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Grant	58,339	305,398	363,737

Table A-VII-2 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Grant County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Douglas	0	120,741	120,741
Lincoln	11,570	94,518	106,088
Total	11,570	215,260	226,830

Movement II Farm to River Port

Table A-VII-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Grant	51,095	513,122	564,217

Table A-VII-4 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Grant County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Douglas	0	840,759	840,759
Lincoln	185,102	2,410,437	2,595,539
Total	185,102	3,251,196	3,436,298

Grant County

(continued)

Movement III Elevator to Elevator

Table A-VII-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Grant	25,168	62,322	87,489

Movement IV Farm to Elevator

Table A-VII-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Grant	224,244	34,178	258,422

All Movements

Table A-VII-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Grant	555,518	4,381,475	4,936,993

Lincoln County

Movement I Elevator to River Port

Table A-IIX-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Lincoln	107,192	189,504	296,696

Table A-IIX-2 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Lincoln County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Stevens	0	3,461	3,461

Movement II Farm to River Port

Table A-IIX-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Lincoln	233,919	501,831	735,751

Table A-IIX-4 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Lincoln County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Stevens	0	68,847	68,847

Movement III Elevator to Elevator

Table A-IIX-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Lincoln	46,545	19,678	66,223

Lincoln County

(continued)

Movement IV Farm to Elevator

Table A-IIX-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Lincoln	227,792	175,199	402,992

All Movements

Table A-IIX-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Lincoln	615,448	958,520	1,573,970

Spokane County

Movement I Elevator to River Port

Table A-IX-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Spokane	8,869	1,856	10,725

Movement II Farm to River Port

Table A-IX-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Spokane	275,985	47,701	323,686

Movement III Elevator to Elevator

Table A-IX-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Spokane	27,892	18,595	46,487

Movement IV Farm to Elevator

Table A-IX-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Spokane	83,728	3,861	87,588

All Movements

Table A-IX-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Spokane	396,474	72,013	468,487

Stevens County

Movement I Elevator to River Port

Table A-X-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Stevens	0	2,354	2,354

Movement II Farm to River Port

Table A-X-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Stevens	0	46,816	46,816

Movement III Elevator to Elevator

Table A-X-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Stevens	0	0	0

Movement IV Farm to Elevator

Table A-X-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Stevens	4,360	3,077	7,437

All Movements

Table A-X-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Stevens	4,360	52,246	56,606

Walla Walla County

Movement I Elevator to River Port

Table A-XI-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Walla Walla	209,726	1,045,698	1,255,424

Movement II Farm to River Port

Table A-XI-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Walla Walla	112,069	397,975	510,043

Movement III Elevator to Elevator

Table A-XI-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Walla Walla	14,791	24,204	38,996

Movement IV Farm to Elevator

Table A-XI-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Walla Walla	233,785	84,633	318,418

All Movements

Table A-XI-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Walla Walla	570,371	1,552,510	2,122,881

Whitman County

Movement I Elevator to River Port

Table A-XII-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Whitman	607,188	1,365,105	1,972,293

Table A-XII-2 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Whitman County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Spokane	2,848	33,873	36,722

Movement II Farm to River Port

Table A-XII-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Whitman	308,307	799,977	1,108,284

Table A-XII-4 Road impacts from Wheat and Barley Originating in Other Counties and Passing Through Whitman County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Spokane	61,330	957,429	1,018,759

Movement III Elevator to Elevator

Table A-XII-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Whitman	33,013	34,910	67,924

Whitman County

(continued)

Movement IV Farm to Elevator

Table A-XII-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Whitman	317,182	70,181	387,363

All Movements

Table A-XII-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Whitman	1,329,869	3,261,475	4,591,344

Yakima County

Movement I Elevator to River Port

Table A-XIII-1 County Road and highway impacts from Wheat and Barley Originating within the County for Elevator to River Port Movement, in dollars.

County	County Road	State Highway	Total
Yakima	0	4,747	4,747

Movement II Farm to River Port

Table A-XIII-3 County Road and highway impacts from Wheat and Barley Originating within the County for Farm to River Port Movement, in dollars.

County	County Road	State Highway	Total
Yakima	0	29,328	29,328

Movement III Elevator to Elevator

Table A-XIII-5 Road impacts from Wheat and Barley Originating within the County for Elevator to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Yakima	0	0	0

Movement IV Farm to Elevator

Table A-XIII-6 Road impacts from Wheat and Barley Originating within the County for Farm to Elevator Movement, in dollars.

County	County Road	State Highway	Total
Yakima	72,454	16,828	89,283

All Movements

Table A-XIII-7 Total Road needs to support All Wheat and Barley Movement within and Through the County, in dollars.

County	County Road	State Highway	Total
Yakima	72,454	50,902	123,357

Appendix B

Ton Miles for Elevator to River Port Grain Movement

Adams County

Table B-I-1a For Grain Originating within Adams County

	Tonmiles		
County	County Road	State Highway	Total
Adams	1,546,033	8,502,793	10,048,826

Table B-I-2a For Grain Originating in Other Counties and Passing Through Adams County

	Tonmiles		
County	County Road	State Highway	Total
Grant	0	2,546,628	2,546,628
Lincoln	489,412	6,718,993	7,208,405
Douglas	0	412,538	412,538
Whitman	0	2,065,202	2,065,201
Total	489,412	11,743,361	12,232,772
County Total	2,035,444	20,246,153	22,281,598

Benton County

Table B-II-1a For Grain Originating within Benton County

	Tonmiles		
County	County Road	State Highway	Total
Benton	0	412,854	412,854

Table B-II-2a For Grain Originating in Other Counties and Passing Through Benton County

	Tonmiles		
County	County Road	State Highway	Total
Yakima	0	345,433	345,433
County Total	0	758,287	758,287

Columbia County

Table B-III-1a For Grain Originating within Columbia County

	Tonmiles		
County	County Road	State Highway	Total
Columbia	1,611,581	4,351,768	5,963,349

Douglas County

Table B-IV-1a For Grain Originating within Douglas County

	Tonmiles		
County	County Road	State Highway	Total
Douglas	206,269	630,594	836,863

Franklin County

Table B-V-1a For Grain Originating within Franklin County

	Tonmiles		
County	County Road	State Highway	Total
Franklin	135,873	1,726,173	1,862,046

Table B-V-2a For Grain Originating in Other Counties and Passing Through Franklin County

	Tonmiles		
County	County Road	State Highway	Total
Adams	0	10,581,430	10,581,430
Benton	0	190,548	190,548
Douglas	0	1,060,812	1,060,812
Grant	0	7,019,684	7,019,685
Lincoln	0	2,710,220	2,710,220
Whitman	0	1,308,397	1,308,397
Yakima	0	122,573	122,573
Total	0	22,993,664	22,993,664
County Total	135,873	24,719,837	24,855,710

Garfield County

Table B-VI-1a For Grain Originating within Garfield County

County	Tonmiles		
	County Road	State Highway	Total
Garfield	0	696,428	696,428

Grant County

Table B-VII-1a For Grain Originating within Grant County

County	Tonmiles		
	County Road	State Highway	Total
Grant	285,326	4,298,085	4,583,411

Table B-VII-2a For Grain Originating in Other Counties and Passing Through Grant County

County	Tonmiles		
	County Road	State Highway	Total
Douglas	0	1,573,538	1,573,538
Lincoln	70,620	1,379,444	1,450,064
Total	70,620	2,952,982	3,023,602
County Total	355,946	7,251,066	7,607,012

Lincoln County

Table B-IIX-1a For Grain Originating within Lincoln County

County	Tonmiles		
	County Road	State Highway	Total
Lincoln	782,200	2,517,104	3,299,304

Table B-IIX-2a For Grain Originating in Other Counties and Passing Through Lincoln County

County	Tonmiles		
	County Road	State Highway	Total
Stevens	0	48,750	48,750
County Total	782,200	2,565,854	3,348,054

Spokane County

Table B-IX-1a For Grain Originating within Spokane County

	Tonmiles		
County	County Road	State Highway	Total
Spokane	93,042	24,122	117,164

Stevens County

Table B-X-1a For Grain Originating within Stevens County

	Tonmiles		
County	County Road	State Highway	Total
Stevens	0	33,150	33,150

Walla Walla County

Table B-XI-1a For Grain Originating within Walla Walla County

	Tonmiles		
County	County Road	State Highway	Total
Walla Walla	3,739,843	19,921,224	23,661,068

Whitman County

Table B-XII-1a For Grain Originating within Whitman County

	Tonmiles		
County	County Road	State Highway	Total
Whitman	15,634,659	60,851,739	76,486,399

Table B-XII-2a For Grain Originating in Other Counties and Passing Through Whitman County

	Tonmiles		
County	County Road	State Highway	Total
Spokane	20,676	484,163	504,839
County Total	15,655,335	61,335,902	76,991,238

Yakima County

Table B-XIII-1a

For Grain Originating within Yakima County

County	Tonmiles		
	County Road	State Highway	Total
Yakima	0	66,858	66,858

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Ton Miles for Farm to River Port Grain Movement

Adams County

Table B-I-1b For Grain Originating within Adams County

County	Tonmiles		
	County Road	State Highway	Total
Adams	1,065,844	5,861,875	6,927,720

Table B-I-2b For Grain Originating in Other Counties and Passing Through Adams County

County	Tonmiles		
	County Road	State Highway	Total
Grant	0	4,282,060	4,282,060
Lincoln	1,551,263	21,296,850	22,848,114
Douglas	0	3,104,556	3,104,556
Whitman	0	11,423,525	11,423,525
Total	1,551,263	40,106,991	41,658,254
County Total	2,617,107	45,968,867	48,585,974

Benton County

Table B-II-1b For Grain Originating within Benton County

County	Tonmiles		
	County Road	State Highway	Total
Benton	0	5,386,156	5,386,156

Table B-II-2b For Grain Originating in Other Counties and Passing Through Benton County

County	Tonmiles		
	County Road	State Highway	Total
Yakima	0	2,134,168	2,134,168
County Total	0	7,520,323	7,520,323

Columbia County

Table B-III-1b For Grain Originating within Columbia County

	Tonmiles		
County	County Road	State Highway	Total
Columbia	329,990	891,075	1,221,065

Douglas County

Table B-IV-1b For Grain Originating within Douglas County

	Tonmiles		
County	County Road	State Highway	Total
Douglas	1,552,282	4,745,548	6,297,829

Franklin County

Table B-V-1b For Grain Originating within Franklin County

	Tonmiles		
County	County Road	State Highway	Total
Franklin	760,830	9,665,793	10,426,623

Table B-V-2b For Grain Originating in Other Counties and Passing Through Franklin County

	Tonmiles		
County	County Road	State Highway	Total
Adams	0	7,294,903	7,294,903
Benton	0	2,485,918	2,485,918
Douglas	0	7,983,144	7,983,144
Grant	0	11,803,337	11,803,337
Lincoln	0	7,610,321	7,610,322
Whitman	0	7,237,312	7,237,312
Yakima	0	757,285	757,285
Total	0	45,172,220	45,172,220
County Total	760,830	54,838,014	55,598,844

Garfield County

Table B-VI-1b For Grain Originating within Garfield County

County	Tonmiles		
	County Road	State Highway	Total
Garfield	0	94,924	94,924

Grant County

Table B-VII-1b For Grain Originating within Grant County

County	Tonmiles		
	County Road	State Highway	Total
Grant	479,765	7,227,068	7,706,833

Table B-VII-2b For Grain Originating in Other Counties and Passing Through Grant County

County	Tonmiles		
	County Road	State Highway	Total
Douglas	0	11,841,664	11,841,664
Lincoln	1,738,045	33,949,821	35,687,866
Total	1,738,045	45,791,485	47,529,530
County Total	2,217,811	53,018,552	55,236,363

Lincoln County

Table B-IIX-1b For Grain Originating within Lincoln County

County	Tonmiles		
	County Road	State Highway	Total
Lincoln	2,196,426	7,068,051	9,264,477

Table B-IIX-2b For Grain Originating in Other Counties and Passing Through Lincoln County

County	Tonmiles		
	County Road	State Highway	Total
Stevens	0	969,674	969,674
County Total	2,196,426	8,037,725	10,234,151

Spokane County

Table B-IX-1b For Grain Originating within Spokane County

	Tonmiles		
County	County Road	State Highway	Total
Spokane	2,591,409	671,846	3,263,256

Stevens County

Table B-X-1b For Grain Originating within Stevens County

	Tonmiles		
County	County Road	State Highway	Total
Stevens	0	659,378	659,378

Walla Walla County

Table B-XI-1b For Grain Originating within Walla Walla County

	Tonmiles		
County	County Road	State Highway	Total
Walla Walla	1,052,288	5,605,278	6,657,566

Whitman County

Table B-XII-1b For Grain Originating within Whitman County

	Tonmiles		
County	County Road	State Highway	Total
Whitman	2,894,882	11,267,187	14,162,069

Table B-XII-2b For Grain Originating in Other Counties and Passing Through Whitman County

	Tonmiles		
County	County Road	State Highway	Total
Spokane	575,867	13,484,893	14,060,760
County Total	3,470,750	24,752,080	28,222,829

Yakima County

Table B-XIII-1b

For Grain Originating within Yakima County

County	Tonmiles		
	County Road	State Highway	Total
Yakima	0	413,065	413,065

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Tonmiles for Elevator to Elevator Grain Movement

Table B-1c

County	Tonmiles		
	County Road	State Highway	Total
Adams	555,988	480,484	1,036,472
Benton	0	0	0
Columbia	162,643	39,669	202,312
Douglas	0	0	0
Franklin	0	0	0
Garfield	48,527	792,601	841,128
Grant	236,321	877,765	1,114,086
Lincoln	437,042	277,149	714,191
Spokane	261,901	261,901	523,803
Stevens	0	0	0
Walla Walla	138,887	340,904	479,790
Whitman	309,983	491,697	801,679
Yakima	0	0	0
Total	2,151,291	3,562,169	5,713,460

Tonmiles for Farm to Elevator Grain Movement

Table B-1d

County	Tonmiles		
	County Road	State Highway	Total
Adams	2,133,013	505,552	2,638,565
Benton	312,266	277,569	589,835
Columbia	1,060,870	155,249	1,216,119
Douglas	602,233	356,649	958,882
Franklin	259,852	162,824	422,676
Garfield	1,752,254	518,492	2,270,747
Grant	1,912,269	855,940	2,768,209
Lincoln	4,867,122	2,178,546	7,045,668
Spokane	1,025,277	191,221	1,216,498
Stevens	39,905	44,727	84,631
Walla Walla	2,389,849	599,062	2,988,910
Whitman	2,917,634	917,545	3,835,179
Yakima	699,911	429,279	1,129,189
Total	19,972,455	7,192,654	27,165,109