Washington State Industry Outlook and Freight Transportation Forecast:

Potato Industry

Prepared for the
Washington State Department of Transportation
Freight Systems Division

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STUDY GOAL

The goal of this report is to offer state and regional transportation planners necessary information regarding future freight flows specific to the potato industry. This is accomplished by providing general industry information regarding the prospects for increased trade and production growth and also estimation of a prediction model for statewide potato production over the next twenty years. This prediction model is estimated using historical production information at the Township, Section, and Range level and is then allocated to truck shipments and highways using information and data collected from a recent survey of the potato industry regarding transportation characteristics of the industry.

INDUSTRY INFORMATION

Washington State's potato production is geographically concentrated in the three areas of the Skagit Valley, Yakima Valley and the Columbia Basin (see Figure 1). Each year approximately 160,000 acres are planted by roughly 300 commercial growers, with harvesting averages of approximately 30 tons per acre, twice as much as the average yield for the United States. Eastern Washington produces the highest yield per acre of potatoes in the world as a result of the volcanic soil, water resources, long growing season and favorable climate [1].

The high quality of Washington potatoes make them popular with both consumers and food processors. Washington State potatoes are packed raw to be used in restaurants, commercial kitchens and by households; raw potato production is also crucial in processing of potatoes for french fires, other frozen potato products, dehydrated products and potato chips. Washington-based potato processing facilities turn nearly 90 percent of the annual Washington potato yield into the value-added products mentioned above, increasing the value of the crop nearly six-fold [2]. The frozen potato products industry in Washington is dependent on raw potato production from within the state, and in terms of sales, is more than twice as large as the raw potato production.

In 2006, Washington growers raised about 156,000 acres of potatoes, with an average yield per acre of 29 tons, making the Washington State potato industry the second largest producer of potatoes in the U.S. Washington State produced over 20 percent of all U.S. potatoes with a total production of 4,495 tons ($539.4 million in farm gate value) [3].

The Washington potato industry also generates significant additional economic and jobs in the state including potato planting, harvesting, packing, processing and transportation. Economists estimate the annual economic impact of Washington potato production, packing and processing to be approximately $3 billion, making potatoes one of the most important value-added agricultural commodities in the state [4].

Further, a regional impact analysis conducted by Washington State University's economists reported that the Washington State Columbia Basin Area exported $1,402 million worth of potatoes and potato products in 2003. The regional effects of these

foreign and domestic exports are measured in terms of output (Sales) at $3,480 million; value added at $1,374 million; and employment at 20,703 jobs. The motor freight and transportation sector was the largest non-potato benefactor; exports were $286 million in sales and 2,359 in jobs [5].

ECONOMIC OUTLOOK

New Market Potential and Emerging Markets

Frozen potatoes comprise 50 percent of total US potato exports. The US Potato Board feels that new growth opportunities for US potatoes can be generated by increasing usage of and creating new channels for US frozen potatoes. The overall goal is to expand market penetration for US frozen potato products into current target markets including Japan, China, South Korea, Singapore, Malaysia, Philippines, Thailand, Vietnam, Indonesia and Mexico [6].

Increased use of the dehydrated potato products in US Government International Food Assistance Programs by the USPB encourages the expansion of potato markets in addition to the current dehydrated markets, such as Korea, Singapore, Indonesia and Malaysia [7].

The potato chip industry is growing around the world and the USPB International Chip-Stock Program is gearing towards educating chip manufacturers and developing an improved understanding of US chipping potato varieties, characteristics and technical requirements. Indonesia, Japan, Korea, Malaysia, Philippines and Thailand constitute the current target markets for the potato chip industry [8].

There is an increasing effort to build international demand and reap the rewards from exporting of US seed potatoes by the participating growers. To educate US growers about the process, export workshops are routinely conducted. The matching funds from USPB can be used to defer the initial costs of penetrating new markets. Current target markets include of Brazil, Dominican Republic, Honduras, Nicaragua, Uruguay, Venezuela and Sri Lanka [9].

Trade Growth Potential

Increasing demand and gaining increased market access underlies continued growth and profitability for the US potato industry. The USPB works cooperatively with the National Potato Council (NPC) and the American Potato Trade Alliance (APTA) to remove or reduce, via bilateral and multilateral trade agreements, market access barriers such as quotas, tariffs or excessive government regulations.

On March 14, 2007 several market access priorities were adopted by USPB. These priorities include:

- A protocol with Mexico to allow the entry of fresh potatoes from all 50 US states
- Establishment of a free, fair and transparent trading relationship between US and Canada on potatoes
- Elimination of the tariff rate quotas for dehydrated potatoes in the Korean market and increased access for US potatoes and products to Korea
- A protocol with China to allow the import of US fresh potatoes
- Penetration into Japan via the protocol allowing the import of US chip-stock for processing in Japan
- Import protocols allowing the access for US seed potatoes into Venezuela and Sri Lanka
- US exiting the Japanese market as a producer of genetically modified potatoes for commercial use
- Increased access of the US fresh potatoes in Taiwan, Korea, Thailand, Philippines and Russia
- Establishment of import protocols allowing full access of US seed potatoes into the Dominican Republic and Thailand
- Improvement of food additive regulations, quality standards and other food safety regulations for potatoes around the globe
- Full access of all potato products including the tariff rate reductions under the Thailand, Korean and Malaysia federal trade agreement
- Elimination of production and export subsidies and reduction of import tariffs to US levels on all potato products [10]

Achievement of the above market access priorities, in addition to the increased international demand for potatoes, the Washington State's potato industry can be expected to improve overall presence and competition in the world potato industry.

Domestic vs. International

World potato production increased at an annual average rate of 4.5 percent over the last 10 years (Table 1). While the consumption rate has increased in the developing world, it has decreased in Europe. Potato production in developed countries, mostly in Europe

and the Commonwealth of Independent States declined on average by one percent over the past 20 years, while developing countries compensated for this decline with an expansion at an average rate of five percent per year. China and India are the main drivers for this growth [11].

While the potato production in 2007 rose in most North European countries; plantings are expected to decrease for 2008. According the BPC Euro Potato report, the overall production was up 8 % compared to 2006. There was an increase in the production in all continental countries except Britain. Concerns regarding the increasing cost of production for the 2008 crop are being expressed by the Northern European growers. The majority of those growers are expecting an increase of between 15 and 20 % due to the increased costs of energy. Although the largest growers are expected to plant more, total area in Holland is expected to decrease by 5 % in 2008. Belgium has experienced the same trend. In Germany the total potato planting area is expected to decrease by 5 to 8 % due to less investment and high wheat prices [12].

In 2006, the US harvested almost 20 million tons of potatoes. Even though potatoes are grown in every state, Idaho, Washington, Wisconsin, North Dakota, Colorado, Maine, Minnesota, California, Oregon and Michigan produce more than half of the crop. Approximately 30 % of the annual US output is consumed fresh. Around 60 % of annual US output is processed into frozen products.

Table 1: World potato production, 1990-2006

Countries	Million Tons / Year								
	1990	1992	1994	1996	1998	2000	2002	2004	2006
Developed	195.22	184.64	168.69	193.59	169.25	182.04	163.58	171.79	155.25
Developing	84.09	93.44	102.38	117.71	131.41	146.51	152.41	157.77	159.12
WORLD	279.32	278.09	271.07	311.31	300.67	328.55	315.98	329.56	314.37
Source: FAOSTAT									

Washington State Outlook

According to Washington's Potato Estimating Program, in year 2005, Benton, Franklin and Grant counties were the top three potato producing counties in the US. Total value of the 2005 crop for the state was $534.7 million and $499.7 million in sales value. Washington State ranked second behind Idaho in statewide total potato production for the nation. In 2006 potatoes ranked 12th among the top 25 commodities in Washington State based on the export value they generated. Total percentage increase in export value increased from 2005 to 2006 a total of 17.1 percent.

Changing consumer demographics, natural resource management and issues regarding sustainable agriculture are key concerns for the Washington State potato growers. In addition, China's international position in the potato market might have significant impact on Washington's potato market since the state exports half of its crop. If China decides to utilize their full capacity to become a dominant figure in the potato export markets, Washington State may need to reevaluate their potato marketing strategy.

Table 2: Export Value and Share of Potato Production in Washington State

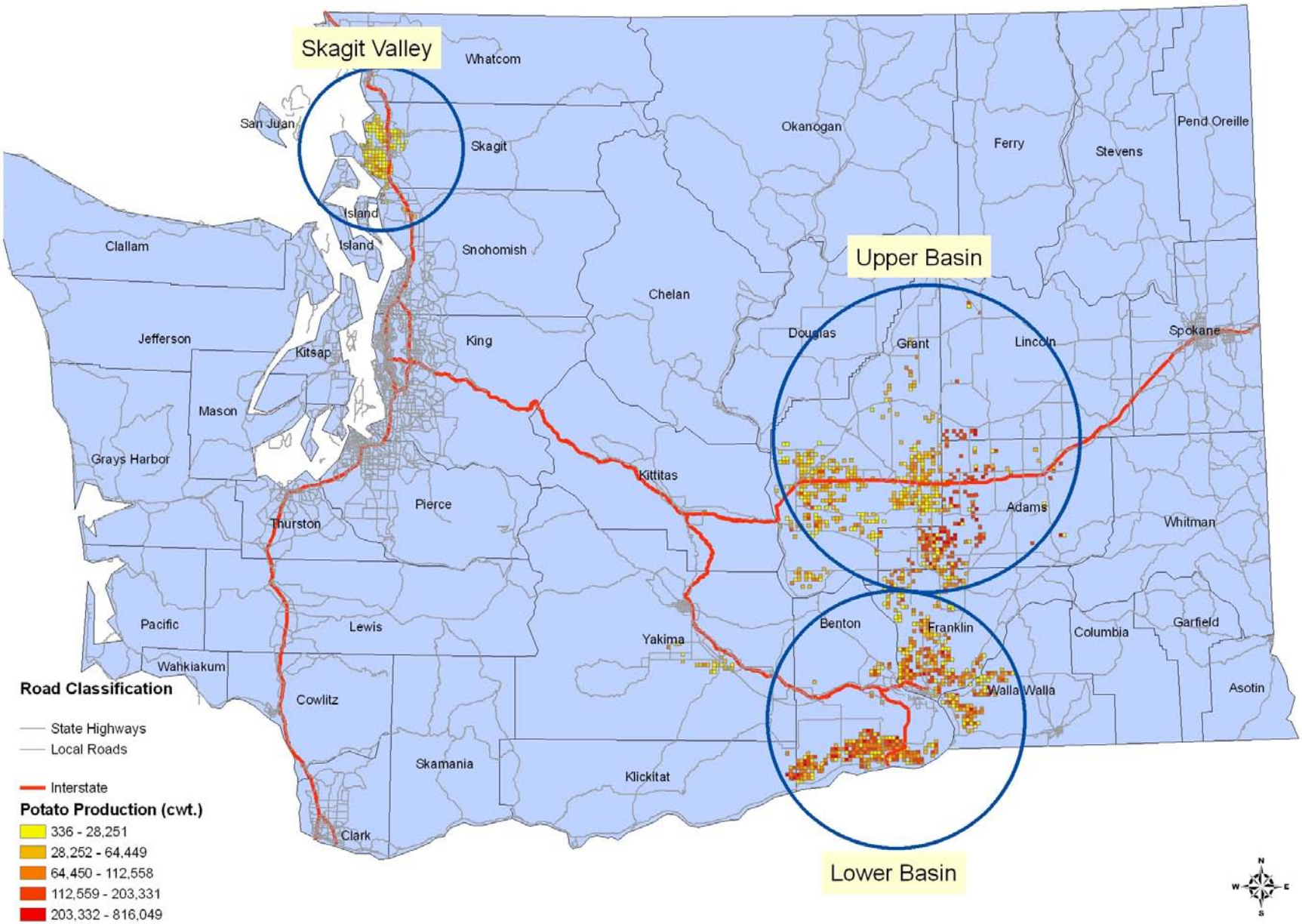
	Year			
	2003	**2004**	**2005**	**2006**
Value of Washington Potato Exports ($ million)	196	234	264	309
Proportion of Total State Exports	0.6%	0.7%	0.7%	0.6%

Source: Total U.S. Exports (Origin of Movement) via Washington State, Foreign Trade Statistics

Total value of the Washington State potato exports has increased from 196 million dollars in 2003 to 309 million dollars in 2006, while the total value percentage share of the potato exports stayed about the same at 0.6 % (Table 2).

As indicated earlier the intensity of potato production is concentrated in three primary areas in Washington State: (Figure 1) the Skagit Valley, Lower Basin and Upper Basin potato production regions. The 2006 hundred-weight (cwt) production is provided at the Township, Section and Range level and varies substantially across the three regions.

Figure 1: Intensity of Washington State Potato Production, 2006



Almost all of the 36 potato packing and shipping facilities in the state are located in or near the potato producing regions. In addition, there are dehydrated and frozen potato processors throughout the region that provide a market for much of the potato production. These processing facilities include:

Dehydrated Potato Processor Locations:

- Walnut Creek, California
- Quincy, Washington
- Boardman, Oregon

Frozen Potato Processor Locations:

- Boise, Idaho (2 firms)
- Tri-Cities, Washington
- Boardman, Washington
- Oakbrook, Illinois
- Beaverton, Oregon
- Prosser, Washington

Source: Washington State Potato Commission

STATEWIDE TRANSPORTATION AND LOGISTICS

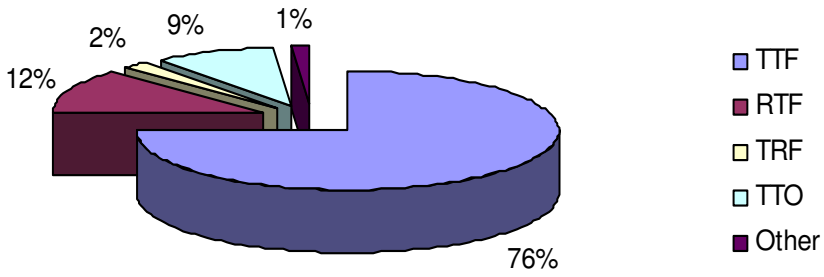
Information collected from a statewide 2007 Potato Survey conducted by the Transportation Research Group (TRG) at Washington State University. This allows depiction of industry transportation activities statewide, including freight shipments by specific highways for both existing potato production and production in future years.

Mode of Transportation Shipments

The common modal choices for Washington potato shipments include truck to final destination (TTF), rail to final destination (RTF), truck repacked to railcar to final destination (TRF), and container truck to ocean port (TTO). Truck to final destination is by far the most common, with about 76 percent of potatoes being shipped via this mode (see Figure 2). Rail shipping accounts for 12 percent of total potato shipments, and over

9 percent of potato volume is shipped to ports by container trucks. A relatively small percentage (2 percent) of potatoes is moved via intermodal movements (TRF).

Figure 2: Share of transportation modes

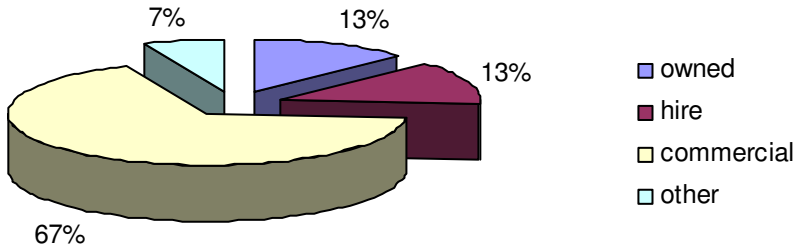


Source: SFTA 2007-survey respondents

Types of shipping services and truck configuration

Commercial truck companies are the main shipping service provider for Washington potato movements. More than 67 percent of total potato shipments are shipped on this type of service provider. Private for-hire and shipper-owned fleets each account for about 13 percent of potato shipments (see Figure 3). The remaining 7 percent of shipments uses other types of services, generally some combination of the other categories.

Figure 3: Shipping services chosen by respondents



Source: SFTA 2007-survey respondents

STATEWIDE FREIGHT PROJECTIONS

Potato acreage and production information for the state was obtained from the Washington State Department of Agriculture in order to forecast future potato production quantities. The township-range-section (TRS) level acreage data used in this study are the compilation of the results from a continuum of surveys conducted by the Department of Agriculture between 1999 and 2007. The potato production figures for each county were allocated to the TRS level by using yield and acreage information calculated for each county. The 2006 potato production data for Washington State were reflected on the TRS level.

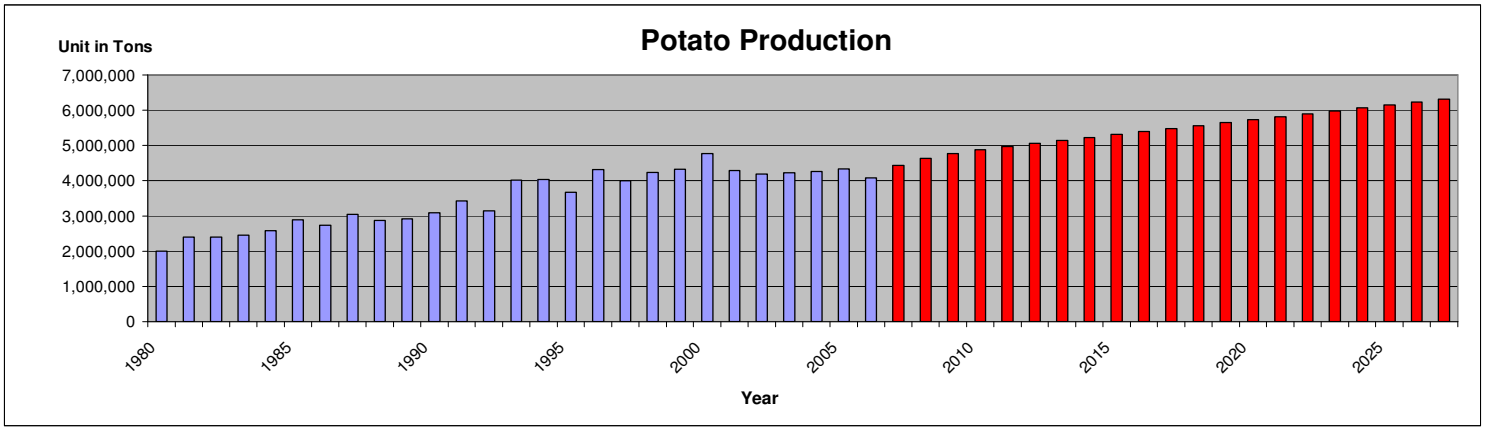
A regression model was estimated to forecast future potato production. Based on the forecast results, the average annual growth rate between 2007 and 2027 is expected to be 1.6 %. The production levels for the years 2007, 2012, 2017 and 2027 were also projected at the TRS level. This forecast, while developed from historical production information, may be considered somewhat aggressive, given the availability of additional land to be devoted to potato production. However, it does provide a basis for understanding future freight traffic needs.

The forecasted statewide potato production for the years 2007 through 2027 are provided in Table 3, along with the growth rates for each time period. Historical and projected statewide production is also demonstrated below in Figure 4. The blue bars indicate the historical production volumes and the red represents forecasted figures.

Table 3: Base year and forecasted years Production

Years	Growth Rate	Year	Production in Tons
2006-2007	0.09	2007	4,433,476
2006-2012	0.24	2012	5,054,989
2006-2017	0.34	2017	5,475,691
2006-2027	0.55	2027	6,311,001

Figure 4: Historical and Projected Statewide Potato Production



The forecasted potato production for each region is provided in Figure 5. The lower basin and upper basin regions dominate the statewide production, whereas the Skagit valley production is substantially smaller.

Figure 5: Projected Potato Production, by Region

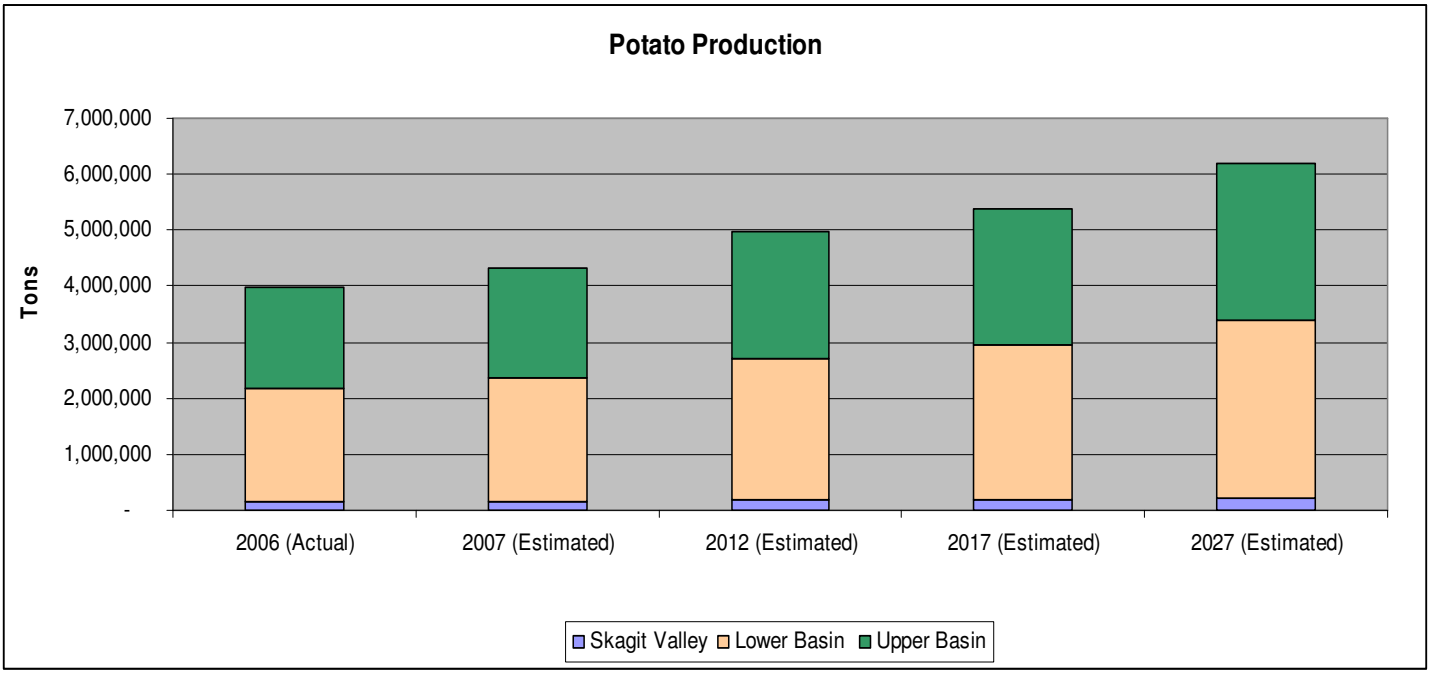


Table 4: Potato Production (in Tons) for the State, by Region

Year	Washington State	Skagit Valley	Lower Basin	Upper Basin
2006	4,077,864	149,688	2,020,788	1,814,400
2007 (Forecast)	4,433,476	162,742	2,197,012	1,972,626
2012 (Forecast)	5,054,989	185,556	2,534,804	2,249,161
2017 (Forecast)	5,475,691	200,999	2,745,764	2,436,348
2027 (Forecast)	6,311,001	231,661	3,164,627	2,808,009

Based on the SFTA 2007 Potato Survey, 45 % of the production from Lower Basin is utilized as fresh and the remainder of the production is processed. Fourteen percent of the Skagit potato production is processed, while the rest, 86 %, is transported fresh. Only 24 % of the potato production from Upper Basin is transported fresh. Overall, 43.4 % of the Washington potato production is transported fresh, while 56.4 % is transported processed. These proportions between processed and fresh are provided below in Table 5.

HIGHWAY ASSIGNMENTS

In order to convert tons of potato production into truck load equivalents, the truck capacity for fresh potatoes was estimated to be 22 tons, and the truck capacity for the processed potatoes was 20 tons. These truck volume capacities were obtained from a weighted average of truck observations from the 2003 SFTA Origin-Destination Survey for trucks carrying fresh and processed potato products. The figures for processed production represent the volume of processed/packed potato products shipped out. Average recovery rate of Washington Potatoes during processing was assumed as 80 percent. Also, each potato production region is forecasted separately and converted into truck equivalents leaving each region. The information of how shipments leave and which highways are traversed to each destination were obtained from the industry survey.

Table 5: Proportion of Fresh and Processed Potato Production, by Region

Region	Fresh	Processed In	Processed Out
Lower Basin	45%	55%	44%
Skagit Valley	86%	14%	0%
Upper Basin	24%	76%	60%

According to these survey results, 86 percent of the total potato production in Skagit Valley is utilized fresh, while most of the Upper Basin potato is processed. However, since there are no processing facilities in the Skagit Valley, the outbound shipments from this area will be treated as entirely fresh, as the processing must occur in other locations. The production utilization percentages for the three main production regions are also provided in Table 5's second and third columns. The "fresh" and "processed in" columns were obtained from the survey data, whereas the "processed out" column is the percentage leaving each region after applying the 80% recovery rate to that volume which is processed, with the only exception being the Skagit Valley (due to no processing facilities). Tables 6 through 8 below present the total volumes of production for each production region and the total number of truck loads required to transport fresh and processed potatoes to their final destinations.

Table 6: Potato Volumes (in Tons) and Total Truck Loads for Skagit Valley

Skagit Valley	Volume (Tons)	Unique Truck Loads		
		Fresh	Processed	Total
2007 (Forecast)	162,742	7,322	0	7,322
2012 (Forecast)	185,556	8,349	0	8,349
2017 (Forecast)	200,999	9,043	0	9,043
2027 (Forecast)	231,661	10,423	0	10,423

Table 7: Potato Volumes (in Tons) and Total Truck Loads for Lower Basin

Lower Basin	Volume (Tons)	Unique Truck Loads		
		Fresh	Processed	Total
2007 (Forecast)	2,197,012	44,482	47,359	91,841
2012 (Forecast)	2,534,804	51,321	54,641	105,962
2017 (Forecast)	2,745,764	55,592	59,189	114,781
2027 (Forecast)	3,164,627	64,073	68,218	132,290

Table 8: Potato Volumes (in Tons) and Total Truck Loads for Upper Basin

Upper Basin	Volume (Tons)	Unique Truck Loads		
		Fresh	Processed	Total
2007 (Forecast)	1,972,626	21,301	58,758	80,059
2012 (Forecast)	2,249,161	24,287	66,996	91,282
2017 (Forecast)	2,436,348	26,308	72,571	98,879
2027 (Forecast)	2,808,009	30,321	83,642	113,963

Among the three potato production regions in Washington State, the Lower Basin requires the most total number of truck loads to transport the fresh and processed potatoes to their final destinations. This is consistent with the region producing the largest volume of potatoes.

Table 9: Percentage of Shipments to Major Destinations by Region

Major destinations	Lower Basin	Skagit Valley	Upper Basin
Eastern Washington	12.48%	2.03%	6.22%
Western Washington	14.29%	6.81%	6.40%
Oregon	2.31%	4.35%	1.25%
California	14.58%	40.72%	11.85%
Idaho	0.00%	0.00%	34.33%
States west of Mississippi	22.01%	13.30%	12.76%
States east of Mississippi	24.26%	23.58%	11.99%
Canada	8.85%	7.04%	2.91%
Mexico	0.14%	1.96%	0.25%
Other international	1.09%	0.20%	12.03%

Source: 2007 Potato Survey

The shares of the production shipped from the Lower Basin, Skagit Valley and Upper Basin to their final destinations are provided in Table 9, and are geographically presented for each region in Figures 6, 7 and 8. Forty-one percent of the potato shipments in the Skagit Valley are sent to California. Forty-six percent of the shipments in the Lower Basin go to the States west and east of Mississippi, whereas thirty-four percent of shipments from the Upper Basin go to Idaho. Among the main production regions, Upper Basin is the sole provider of fresh potatoes and potato products to Idaho.

Table 10: Major Routes Used, by Region

Major Destinations	Lower Basin	Skagit Valley	Upper Basin
Eastern Washington	I-90, I-82,	I-5, I-90,	I-90, I-82,
	Hwy 12, 14	Hwy 2, 405	Hwy 17
Western Washington	I-90, I-82, I-5,	I-5,	I-90,
	240, 395	405, 167	Hwy 17
Oregon	I-90, I-82, I-84, Hwy 97, 395, 597	I-5	I-90, I-82, I-84
California	I-90, I-82, I-5, Hwy 97, 395	I-5	I-90, I-82, I-5, Hwy 17, 395
Idaho			I-90, I-82, I-84, SR 17, 395
States west of Mississippi	I-90, I-82, 395	I-90, I-80, I-5, I-84, 405	I-90, I-82, I-5, I-84, SR 17, 395
States east of Mississippi	I-90, I-82,	I-90, I-80, I-5,	I-90, I-82, I-5, I-84,
	395	405	SR 17, 395
Canada	I-90, I-82, I-5	I-5, I-90	I-5, I-90
Mexico	I-82, I-5, Hwy 97	I-5	

Source: 2007 Potato Survey

The most commonly used routes for shippers from Lower Basin are I-90, I-82, I-5 and 395; from Skagit Valley they are I-5, I-90, I-80 and 405; from Upper Basin they are I-82, I-84, I-90, I-5, Hwy 17 and 395 (Table 10). These routes reflect the flow of potatoes to markets as discussed above.

Table 11: Number of Truck Shipments, by Highway for Lower Basin Production Region

Highways	2007		2012		2017		2027	
	Fresh	Processed	Fresh	Processed	Fresh	Processed	Fresh	Processed
I-90	39,104	46,365	45,117	53,494	48,871	57,946	56,327	66,785
I-82	39,158	46,429	45,179	53,567	48,939	58,026	56,404	66,877
I-5	14,986	17,768	17,290	20,500	18,729	22,206	21,586	25,594
I-84	916	1,086	1,057	1,253	1,145	1,358	1,320	1,565
Hwy 12	4,939	5,857	5,699	6,757	6,173	7,319	7,115	8,436
14	4,939	5,857	5,699	6,757	6,173	7,319	7,115	8,436
240	5,657	6,708	6,527	7,739	7,070	8,383	8,149	9,662
395	30,663	36,356	35,377	41,946	38,322	45,437	44,167	52,368
Hwy 97	6,743	7,995	7,779	9,224	8,427	9,992	9,712	11,516
597	5,773	6,845	6,660	7,897	7,215	8,554	8,315	9,859
Total	44,482	47,359	51,321	54,641	55,592	59,189	64,073	68,218

Figure 6: Shipment Destinations for Lower Basin Potato Production

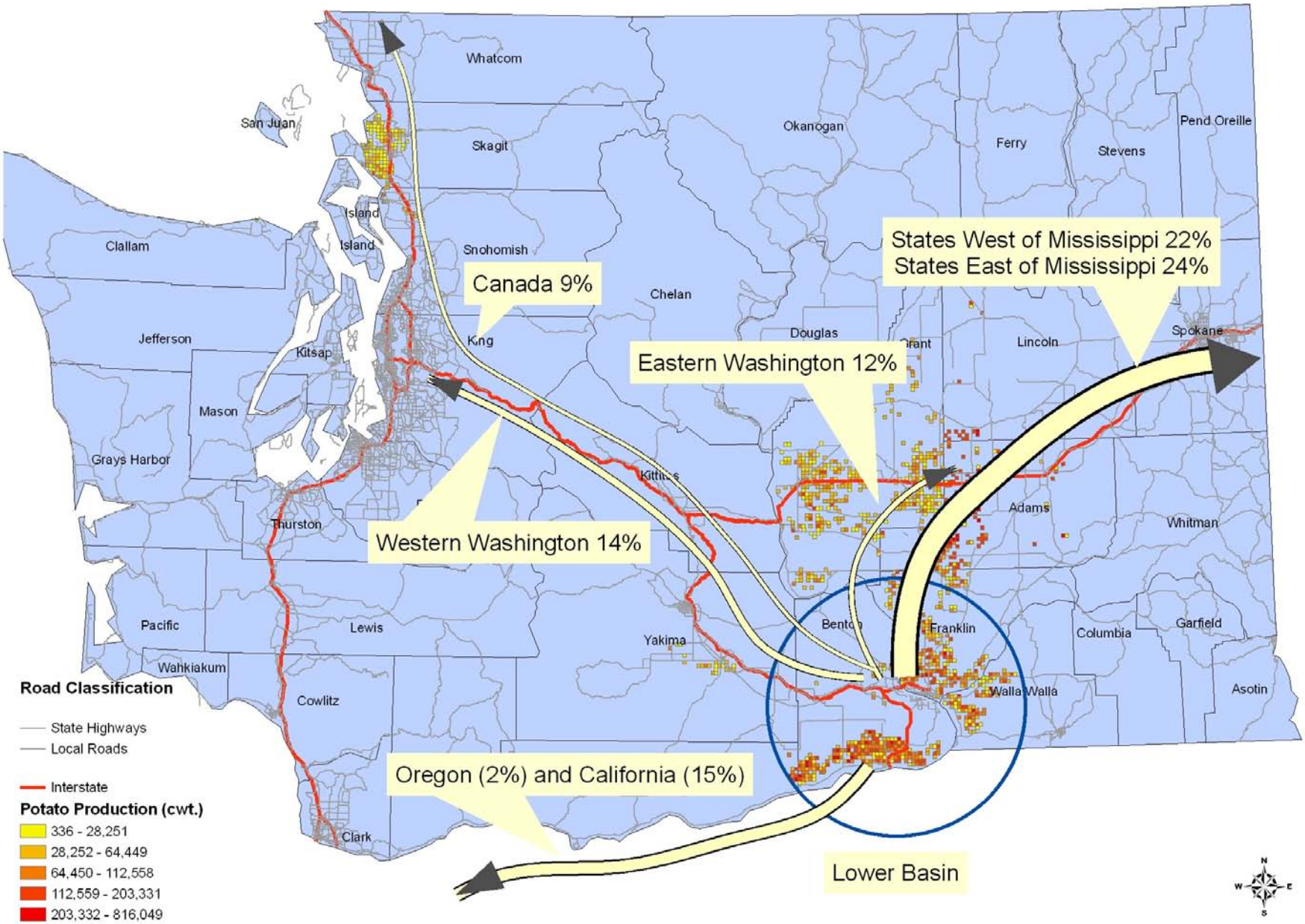


Table 12: Number of Truck Shipments, by Highway for Skagit Valley Production Region

Highways	2007		2012		2017		2027	
	Fresh	Processed	Fresh	Processed	Fresh	Processed	Fresh	Processed
I-90	3,365	0	3,836	0	4,156	0	4,790	0
I-5	7,307	0	8,332	0	9,025	0	10,402	0
I-84	974	0	1,110	0	1,203	0	1,386	0
Hwy 2	149	0	170	0	184	0	212	0
405	3,348	0	3,817	0	4,135	0	4,766	0
167	499	0	568	0	616	0	710	0
I-80	2,701	0	3,079	0	3,335	0	3,844	0
Total	7,322	0	8,349	0	9,043	0	10,423	0

Table 13: Number of Truck Shipments, by Highway for Upper Basin Production Region

Highways	2007		2012		2017		2027	
	Fresh	Processed	Fresh	Processed	Fresh	Processed	Fresh	Processed
I-90	15,845	51,759	18,066	59,015	19,569	63,927	22,555	73,679
I-82	14,162	46,263	16,147	52,748	17,491	57,138	20,160	65,855
I-5	7,138	23,317	8,138	26,585	8,816	28,798	10,161	33,191
I-84	10,898	35,599	12,425	40,590	13,460	43,968	15,513	50,675
Hwy 171	4,420	14,440	5,040	16,464	5,459	17,834	6,292	20,555
395	12,813	41,855	14,609	47,722	15,825	51,694	18,239	59,580
SR 17	10,672	34,863	12,168	39,750	13,181	43,058	15,192	49,627
Total	21,301	58,758	24,287	66,996	26,308	72,571	30,321	83,642

Figure 7: Shipment Destinations for Skagit Valley Potato Production

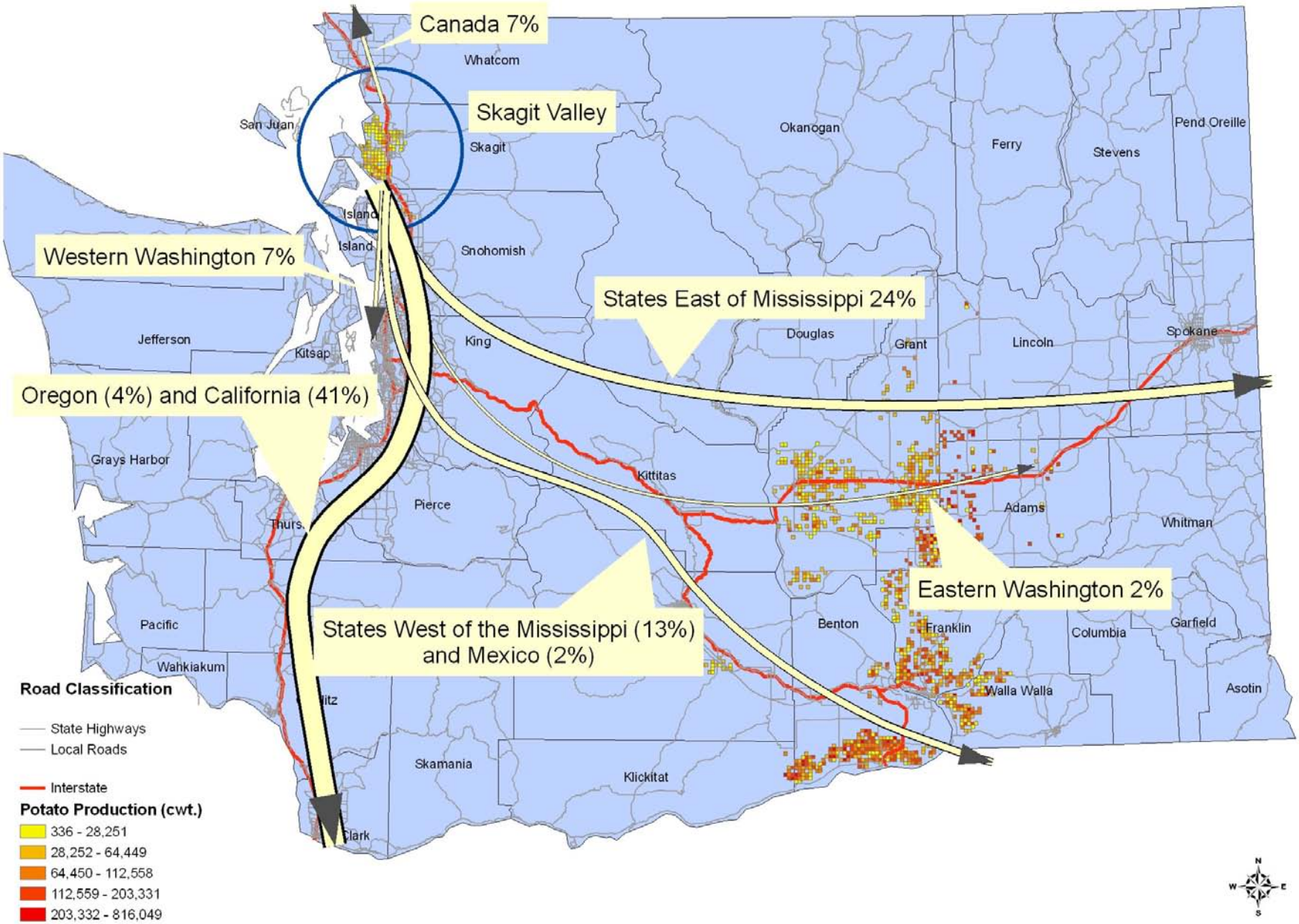
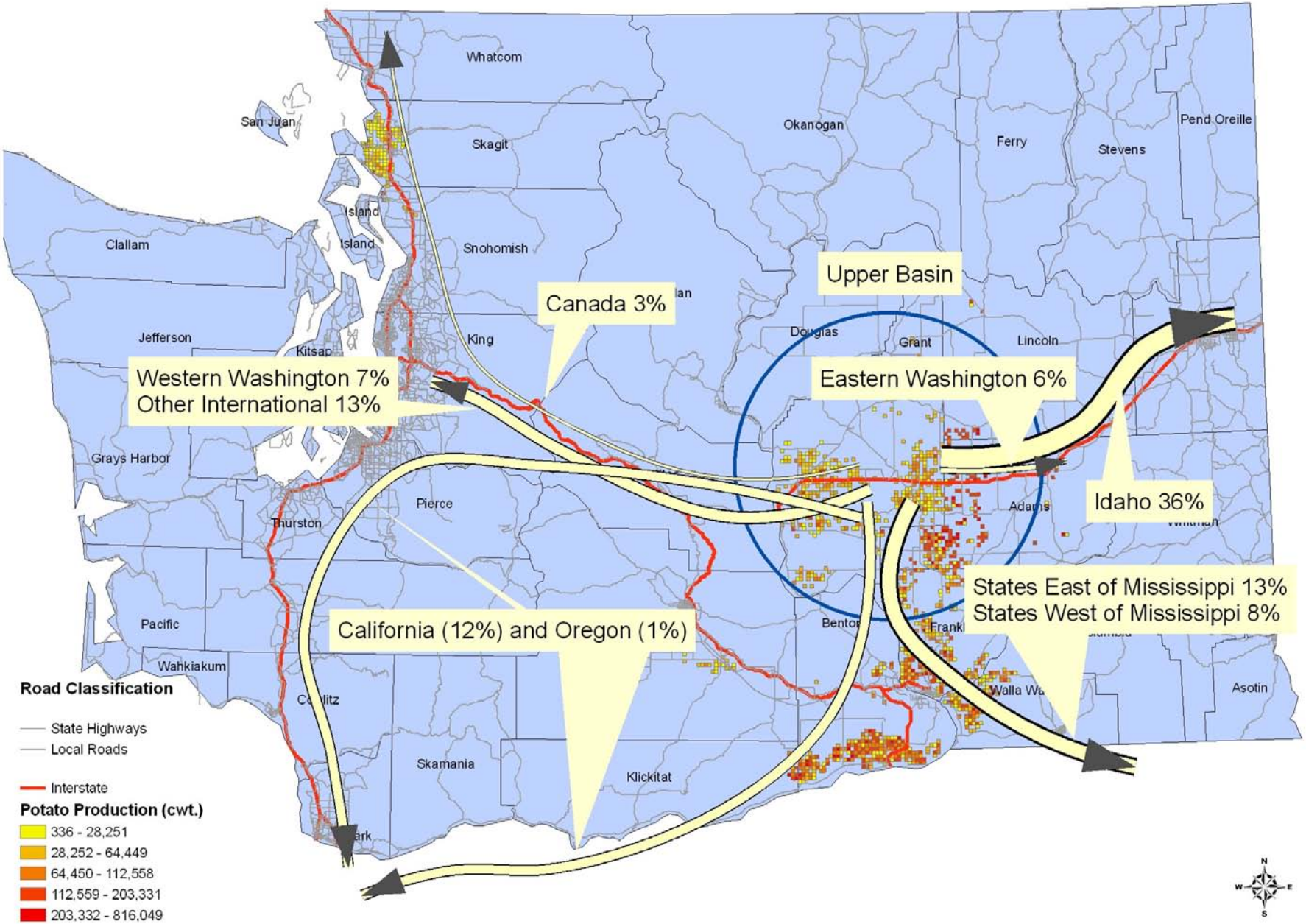


Figure 8: Shipment Destinations for Upper Basin Potato Production



The forecast of truck traffic by production region and by highway is presented in Tables 11, 12 and 13 for the Lower Basin, Skagit Valley and Upper Basin regions, respectively. The total value in the bottom row of each table represents the total unique truck trips for each year (fresh and processed). Given that many of truck trip routes are common to several different highways, summation of trucks on all highways results in exceeding the total unique truck trips due to the fact that each truck trip is not unique to one and only one highway. The most heavily used routes for transporting fresh and processed potatoes to the final destinations are I-90, I-82, 395, I-5, I-84 and SR17. On almost all the major routes except 405, I-80, 167 and Hwy 2, there are more trucks carrying processed potatoes than carrying fresh potatoes to the final destinations.

CONCLUSION

The 2007 SFTA Potato Survey results and the further analysis on future potato production and future total truck trips required to ship the potatoes to their final destinations allow conclusions to be drawn regarding the transportation characteristics of Washington potatoes, logistic uses and needs of the Washington State potato industry, as follows:

- Generally, Washington potatoes are transported in several product forms, but mainly as fresh product.
- Truck to final destination is the most commonly used transportation mode in all three potato-growing regions. Commercial truck companies are the main shipping service provider for Washington potato shipments.
- Major domestic destinations of Washington potatoes outside the State are California, Idaho, and States east and west of Mississippi. While Canada is an important international market for Washington potato growers in the Lower Basin, East and Southeast Asian countries are important international markets for those in the Upper Basin. Targeted markets of the Lower Basin are States east and west of Mississippi; for Skagit Valley they were California and States east of Mississippi; and Upper Basin shipments went heavily to Idaho and international markets.
- The most heavily used routes during the transportation of fresh and processed potatoes are I-90, I-82, 395, I-5, I-84 and SR17 and the density of these truck shipments are forecasted to grow over time.

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