Oregon Department of Transportation – Rail Division

# Oregon Rail Study Appendix E
# Oregon Commodity Flow Forecast


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**October 2009**

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# Introduction

As part of the planning effort leading up to the development of a statewide Freight Plan as a component of the Oregon Transportation Plan, the Oregon Department of Transportation (ODOT) has invested in an update to the statewide commodity flow forecast. This forecast will meet the needs of ODOT's first multi-modal Statewide Freight Plan with guidance from the Economic and Freight Working Group, and it will support modeling and analysis done by the ODOT Transportation Planning Analysis Unit (TPAU) and other future ODOT freight planning activities.

This report provides an overview of the methodology used to create this Oregon Commodity Flow Forecast (Oregon CFF), which aims to address the limitations of existing forecasts – inconsistent and separate databases for different modes, lack of transparency in data and assumptions, and data gaps – in a consistent methodology based on national and local data sources.

The Oregon CFF is a county level commodity flow forecast in tons and vehicles (where applicable) for truck, rail, marine, air, and pipeline modes from 2002 to 2035. Factors to convert the results to dollar value are also provided. The approach builds on the Federal Highway Administration (FHWA) Freight Analysis Framework (FAF2) national commodity flow forecast, which disaggregates the data to the sub-state level using local data and expertise on historical and forecast economic and modal trends. Local data is included to either verify that the national forecast provides accurate data for Oregon, or to modify or supplement the national data, as well as to disaggregate the data to the county level.

The report compares the results to other forecasts, including the prior commodity flow forecast used in the 2006 Oregon Transportation Plan (OTP), and summarizes general findings. The report first discusses the general methodology and assumptions used in the development of the Oregon CFF. That is followed by a summary of results by mode and across all modes. The report closes with a discussion about how the forecast can be modified to reflect alternative scenarios. A detailed methodology and descriptive items are contained in the appendices.

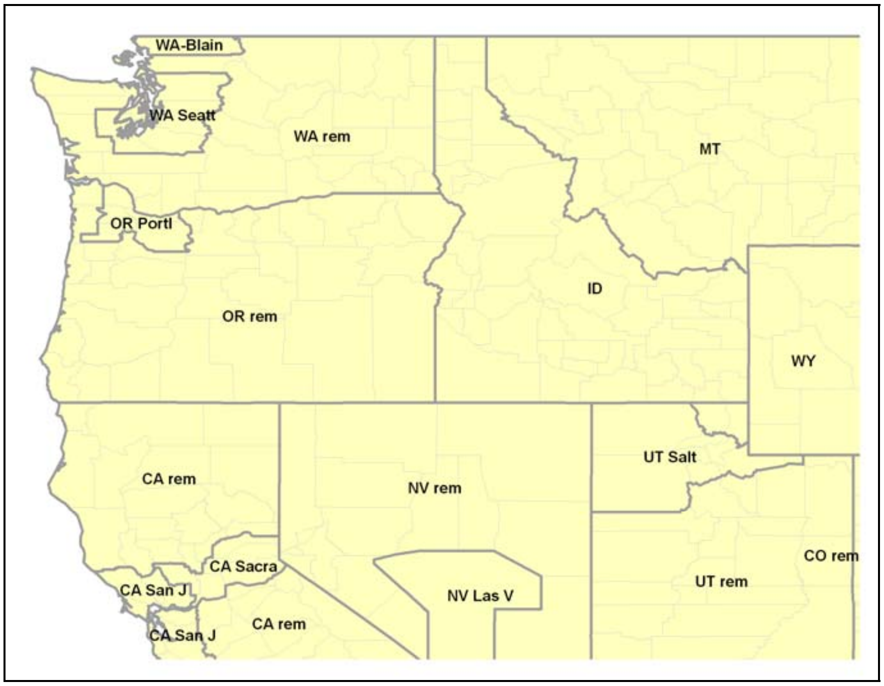
# Methodology

A detailed methodology describing the data sources and processing used in the Oregon CFF is contained in Appendix A, and summarized here. The key data source for the Oregon CFF is the 2002 Freight Analysis Framework (FAF2), a national commodity flow forecast dataset published by the Federal Highway Administration (FHWA). The FHWA FAF2 commodity flow forecast was chosen because FAF2 is national in scope, highly regarded in terms of capturing interstate and international flows, uses a relatively recent base year (2002), and provides a quick way to complete a forecast in time for the Oregon Freight Plan work anticipated for Fall 2009.

FAF2 provides freight flows in tons or dollar values between 130 FAF2 regions encompassing the US for the year 2002 as well as forecasts from 2010 to 2035 in five year increments. The data is split by mode as well as by 43 commodities classified by Standard Classification Transported Goods (SCTG) codes. FAF2 regional zones are relatively coarse, as shown in Exhibit 1. Oregon is covered by two zones: Oregon

Portland and Oregon Remainder. The Oregon Portland zone includes the Oregon portion of the Portland-Vancouver region covering Multnomah, Washington, Clackamas, and Yamhill Counties. The remaining 32 Oregon counties are included in the Oregon Remainder zone.

**Exhibit 1. FAF2 Zones and Counties**




For the Oregon CFF, the commodities were converted from SCTG classification into the Standard Transportation Commodity Code (STCC) classification to enable the use of local data sources, such as the Surface Transportation Board's Rail Waybill data.

In order to transform the coarse FAF2 zone flows into smaller geographic regions within Oregon, the data had to be disaggregated. Since the FAF2 dataset contains the whole United States, flows with at least one trip ends within Oregon were disaggregated from FAF2 zones to Oregon counties. In the case of truck flows, this was done based on county employment and IMPLAN inter-industry coefficients. For rail flows, the FAF2 flows were compared to the Surface Transportation Board's Rail Carload Waybill data set which contains county level detail of origin and destinations. The overall numbers were found to be comparable, so the Waybill data for 2002 was used as the base, and the FAF2 growth rates were applied to obtain the forecast. The other modes relied on local data to allocate FAF2 flows to specific Oregon facilities (rail stations, airports, marine ports, or pipeline terminals), including US Corps of Engineers Waterborne Commerce data and the Oregon Energy Report. Zones outside of Oregon were aggregated from FAF2 zones to "Other Domestic" and "Other International" categories. Special consideration was made for air mail and fish commodities. The Oregon CFF methods and data are described further in Appendices A through D.

## Statewide Commodity Flow Findings

The data for all the modes and years was compiled into a master database and then summarized by mode and across modes in order to study overall trends in freight. Since the base year for FAF2 is 2002, current economic trends are not reflected. The Oregon Office of Economic Analysis (OEA) Global Insight subscription forecasts (April and June 2009) show the current downturn having little to no impact on the 2035 forecasts, after a slight disruption to 2010. This should be kept in mind while reviewing the forecast values.

As shown in Exhibit 2, truck flows dominate throughout the Oregon CFF, with a share of roughly 72 to 78%. All modes retain a stable share over the forecast period. Air remains less than 0.1% in terms of overall tonnage, but represents six to 11% of flows in terms of value of all state freight movements. The Oregon CFF numbers obscure the importance of air in the state freight system as the ability to ship products by air is critical to seamless delivery of high-value products for business, industry, and personal uses. Such key commodities moved by air range from pharmaceuticals (e.g., blood and organs) to other time-sensitive deliveries (e.g., legal documents, auto parts).

The compound average growth rate (CAGR) of all Oregon freight averages 1.9% annually in tonnage, but goods are becoming more valuable, showing a 3.0% growth in value over the 2002-2035 period. Air and water grow faster than average, while pipeline and rail grow slower. For comparison, OEA forecasts of annual employment (June 2009) and population (2004) growth from 2003 to 2035 are 3.2% and 1.3%, respectively.

**Exhibit 2: 2002-2035 Oregon Commodity Flow by Mode**

| Mode | 2002 | 2010 | 2035 | Growth Rate 2002-2035 | Mode split 2002-2035 | |
|---|---|---|---|---|---|---|
| Tonnage (1000s) | | | | | | |
| Truck | 259,213 | 294,458 | 508,331 | 2.1% | 75% | 78% |
| Rail | 39,008 | 47,314 | 64,289 | 1.5% | 11% | 10% |
| Water | 34,835 | 47,926 | 60,296 | 1.7% | 10% | 9% |
| Pipeline | 13,599 | 13,436 | 17,401 | 0.7% | 4% | 3% |
| Air | 236 | 288 | 767 | 3.6% | 0.1% | 0.1% |
| TOTAL | 346,892 | 403,423 | 651,083 | 1.9% | 100% | 100% |
| Value (Millions of $ in 2002$) | | | | | | |
| Truck | $159,878 | $185,862 | $411,465 | 2.9% | 73% | 72% |
| Rail | $15,631 | $16,906 | $27,434 | 1.7% | 7% | 5% |
| Water | $22,467 | $31,660 | $60,798 | 3.1% | 10% | 11% |
| Pipeline | $7,307 | $6,828 | $9,530 | 0.8% | 3% | 2% |
| Air | $13,253 | $17,575 | $61,408 | 4.8% | 6% | 11% |
| TOTAL | $218,536 | $258,830 | $570,635 | 3.0% | 100% | 100% |

Notes: Growth Rate = Compound annual growth rate 2002-2035.
Excludes tonnage traveling through Oregon without an Oregon origin or destination.

Exhibit 3 summarizes commodity flows by direction of flow (inbound, outbound or internal). The outbound flows are growing the fastest, nearly twice the inbound flows, reflecting the high FAF2 growth rates in domestic outbound truck flows for selected commodities.

**Exhibit 3: 2002-2035 Oregon Commodity Flow Tonnage by Direction (1000 tons)**

| Direction | Year | | | Growth Rate 2002-2035 |
|---|---|---|---|---|
| | 2002 | 2010 | 2035 | |
| Inbound | 86,365 | 101,157 | 131,957 | 1.3% |
| Internal | 197,993 | 223,356 | 364,482 | 1.9% |
| Outbound | 62,533 | 78,909 | 154,644 | 2.8% |

Notes: Growth Rate = Compound annual growth rate 2002-2035.

The Oregon CFF tonnage is summarized by Oregon region in Exhibit 4 and excludes pipeline flows. Overall the growth rates are relatively consistent, with Portland growing at the highest rate due to the fact that it provides a gateway, and thus an origin or destination for many state flows, resulting in compounding of flows that cause it to grow at a faster rate. Non-Portland regions are growing slightly faster than OEA population growth rate of 1.3%).

**Exhibit 4: 2002-2035 Oregon Commodity Flow Tonnage by Region (1000 tons)**

| Oregon Region | Year | | | Growth Rate 2002-2035 |
|---|---|---|---|---|
| | 2002 | 2010 | 2035 | |
| Portland | 252,002 | 284,571 | 519,770 | 2.2% |
| Eastern Oregon | 40,353 | 48,113 | 69,365 | 1.7% |
| Central Oregon | 57,419 | 68,353 | 100,035 | 1.7% |
| Willamette Valley | 100,928 | 119,292 | 174,615 | 1.7% |
| Southern Oregon | 45,415 | 52,972 | 78,040 | 1.7% |
| Coastal Oregon | 34,535 | 39,409 | 55,536 | 1.4% |

Notes: Growth Rate = Compound annual growth rate 2002-2035.
Does not include pipeline flows. Internal flows counted in multiple regions
Regions defined by county groupings consistent with OEA forecasts.

Exhibit 5 shows that the top commodities shipped in terms of tonnage are: farm and associated food products (STCC 1 and 20), forest and associated wood/paper products (STCC 8, 24, 26, and 27), coal/fuels (STCC 11, 13, and 29), clay/stone/glass (STCC 32), and waste/scrap/misc shipments (STCC 40, 41, 46, 48, 49, and 50). Other sizeable commodities are transportation equipment and machinery (STCC 35 and 36), metal/metal products (STCC 33 and 34), and rubber/plastics (STCC 30). Of the larger commodities, forest and related wood/paper products as well as construction materials show lower than average growth, while equipment and rubber/plastics show higher than average growth.

## Exhibit 5: 2002-2035 Oregon Tonnage by Commodity (1000 tons, all modes)

| | | Tonnage (1000 tons) | | | Growth Rate | Value ($M in 2002$) | | |
|---|---|---|---|---|---|---|---|---|
| | STCC | 2002 | 2010 | 2035 | 2002-2035 | 2002 | 2010 | 2035 |
| 1 | Farm products | 48,301 | 58,375 | 88,932 | 1.9% | $11,310 | $13,941 | $21,132 |
| 8 | Forest products | 18,033 | 16,470 | 16,888 | -0.2% | $780 | $713 | $733 |
| 9 | Fresh fish | 347 | 414 | 745 | 2.3% | $1,617 | $1,931 | $3,476 |
| 10 | Metallic ores | 492 | 619 | 579 | 0.5% | $484 | $648 | $563 |
| 11 | Coal | 15,458 | 14,771 | 30,131 | 2.0% | $2,813 | $2,671 | $5,628 |
| 13 | Petroleum, natural gas | 5,017 | 5,074 | 8,767 | 1.7% | $5,765 | $5,352 | $8,007 |
| 14 | Nonmetallic minerals | 3,745 | 4,823 | 7,468 | 2.1% | $279 | $362 | $564 |
| 19 | Ordnance or accessories | 281 | 335 | 1,365 | 4.9% | $146 | $174 | $711 |
| 20 | Food and kindred products | 17,810 | 20,522 | 38,411 | 2.4% | $15,731 | $18,345 | $34,769 |
| 21 | Tobacco products | 486 | 553 | 1,202 | 2.8% | $882 | $1,004 | $2,182 |
| 22 | Textile mill products | 299 | 257 | 235 | -0.7% | $5,617 | $4,913 | $4,544 |
| 23 | Apparel & related prod | 173 | 151 | 149 | -0.5% | $9,985 | $8,563 | $7,954 |
| 24 | Logs, lumber, wood prod | 30,816 | 31,014 | 40,145 | 0.8% | $12,399 | $12,445 | $15,972 |
| 25 | Furniture or fixtures | 595 | 677 | 1,375 | 2.6% | $1,444 | $1,635 | $3,223 |
| 26 | Pulp, paper, allied prod | 6,603 | 7,150 | 10,325 | 1.4% | $5,737 | $6,182 | $8,822 |
| 27 | Printed matter | 1,236 | 1,310 | 1,657 | 0.9% | $2,849 | $3,022 | $3,821 |
| 28 | Chemicals, allied products | 17,354 | 21,721 | 38,210 | 2.4% | $13,918 | $17,291 | $34,775 |
| 29 | Petroleum or coal prod | 32,361 | 34,500 | 54,487 | 1.6% | $9,298 | $10,013 | $16,616 |
| 30 | Rubber or misc plastics | 1,857 | 2,465 | 5,579 | 3.4% | $4,928 | $6,530 | $14,765 |
| 31 | Leather or leather prod | 114 | 97 | 88 | -0.8% | $702 | $596 | $536 |
| 32 | Clay, concrete, glass, stone | 100,463 | 128,072 | 168,924 | 1.6% | $3,458 | $4,342 | $5,929 |
| 33 | Primary metal products | 4,602 | 5,502 | 7,792 | 1.6% | $4,330 | $5,099 | $7,457 |
| 34 | Fabricated metal products | 3,603 | 4,664 | 9,646 | 3.0% | $10,019 | $12,986 | $27,165 |
| 35 | Machinery | 2,772 | 4,241 | 11,444 | 4.4% | $21,681 | $33,017 | $89,096 |
| 36 | Electrical equipment | 678 | 841 | 2,277 | 3.7% | $24,215 | $30,855 | $90,827 |
| 37 | Transportation equipment | 3,310 | 3,858 | 9,904 | 3.4% | $14,470 | $17,596 | $45,228 |
| 38 | Instrum, photo/optical equip | 104 | 111 | 623 | 5.6% | $2,154 | $2,530 | $13,905 |
| 39 | Misc products of manuf. | 1,060 | 1,281 | 4,713 | 4.6% | $4,084 | $4,933 | $17,868 |
| | Waste/scrap(STCC40,48,49) | 13,731 | 16,139 | 45,218 | 3.7% | $1,747 | $2,083 | $5,638 |
| | Misc freight (STCC 41,46,50) | 14,582 | 16,651 | 42,832 | 3.3% | $25,216 | $28,460 | $77,967 |
| 45 | Shipping Containers (rail) | 403 | 508 | 647 | 1.4% | $315 | $397 | $506 |
| | Mail (STCC 43,45,47) | 207 | 257 | 328 | 1.4% | $162 | $201 | $257 |
| | TOTAL | 346,892 | 403,423 | 651,083 | 1.9% | $218,536 | $258,829 | $570,635 |

Notes: Some rail waybill-only commodities combined with related categories, as noted.
Excludes tonnage traveling through Oregon without an Oregon origin or destination.
Growth Rate = Compound annual growth rate 2002-2035.

## Truck

Of the 226 Mtons that originate as truck trips in Oregon in 2002, 85% stayed within Oregon, with the remainder shipped to the rest of the world, mainly to Washington (15.9 million short tons) and California (11.0 million short tons). The Washington flows include local trips within the Portland-Vancouver region that travel between states. This outbound truck flow is forecast to grow significantly (3.6%) while inbound and internal flows grow more slowly (1.3% and 1.8%, respectively). The outbound growth is dominated by a few commodities exhibiting significantly large domestic outbound growth.

The FAF2 truck growth forecasts imply that the currently balanced inbound (head-haul) and outbound (back-haul) flows for the state will become more outbound focused by 2035. This is primarily the result of a large growth in domestic outbound flows for the following selected commodities: farm products, food products, rubber/plastics, clay/concrete/glass/stone, fabricated metals, transportation equipment, waste/scrap, and miscellaneous freight shipments.

Even though the FAF2 Oregon Remainder zone is more than 20 times larger in area than the FAF2 Oregon Portland zone, Oregon Remainder receives only 46% more goods, receiving 133.5 million short tons in 2002 compared with Oregon Portland’s 91.2 million short tons.

Clay, concrete, glass, or stone products (STCC 32) are the dominant commodity in terms of tons carried by truck, making up 41.6% of internal and 6.8% of outbound tonnage flows in 2002. FAF2 forecasts that this commodity will remain the highest tonnage level commodity transported by trucks, although its share of internal truck tons are forecast to decrease to 38.2 %. The largest outbound commodity in 2002 is machinery, excluding electrical (STCC 35), with 28.2% of all outbound flows.

Exhibit 6 shows the major shifts in commodity tonnage flows by trucks. The high growth rate of STCC13 (crude oil, natural gas or gasoline) is due to the small absolute numbers in the base year. According to FAF2, the largest growth in internal as well as inbound flows is in instruments, photo/optical goods (STCC 38), and waste/Scrap (STCC 40) is expected to grow more than 13-fold.

The FAF2 truck growth forecasts imply that the currently balanced inbound (head-haul) and outbound (back-haul) flows for the state (33.3 Mtons IB and 31.4 Mtons OB Truck), will change into a more outbound-focused balance by 2035 (50.6 Mtons IB and 101.7 Mtons OB Truck). This is primarily the result of large growth in outbound domestic flows for the following selected commodities: farm products, food products, rubber/plastics, clay/concrete/glass/stone, fabricated metals, transportation equipment, waste/scrap, and misc. freight shipments. While this growth may be optimistic, the commodities experiencing the domestic outbound growth seem reasonable. Indeed, the list includes Oregon's fastest-growing export commodities: Primary metal manufactures, Miscellaneous manufactures, and Transportation equipment all grew more than 94% between 2002 and 2006 per the Bureau of Census, Foreign Trade Division data. And domestic demand for Oregon farm and food products and plastics is certainly strong. [1] As a result, no adjustment was made to alter these high FAF2 growth rates, keeping the integrity of the FAF2 forecast intact. It should be noted that these trends are being verified by discussions with weigh station staff and FAF2 forecasters

**Exhibit 6: 2002-2035 Growth of Oregon Truck Tonnage Flows by Commodity**

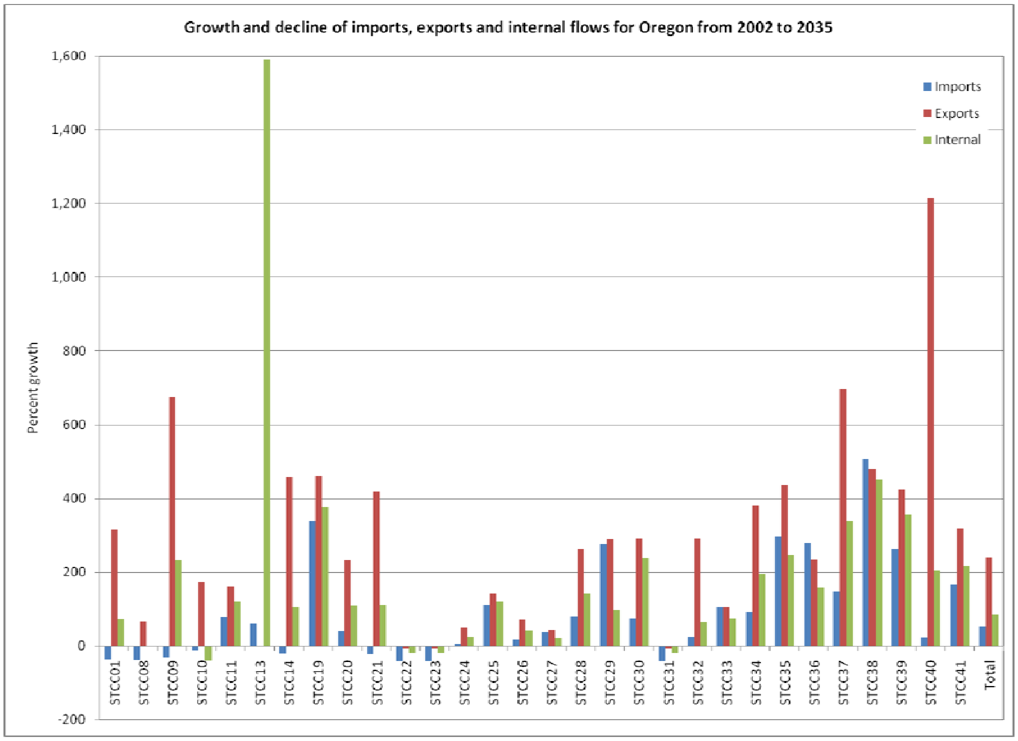
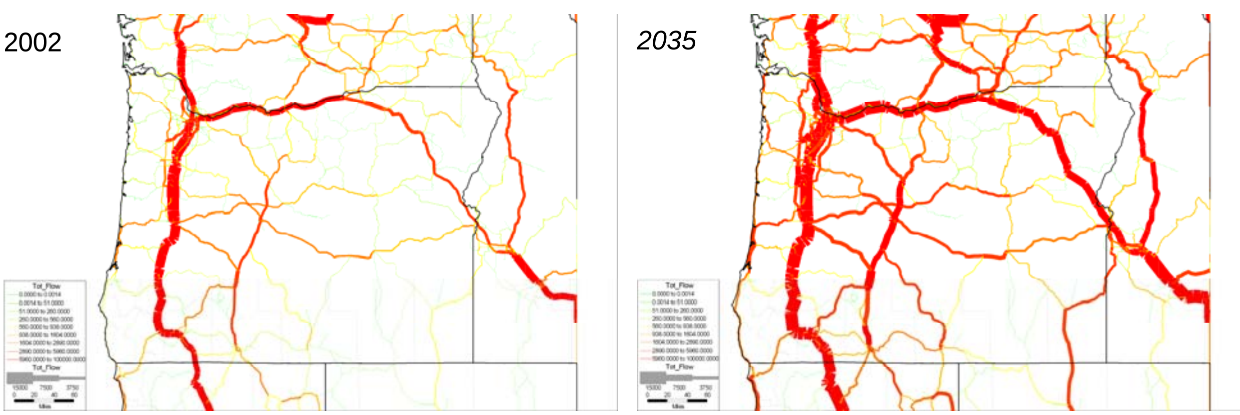



Exhibit 7 identifies the truck trips (vehicles) assigned to the Oregon network in base year 2002 and forecast year 2035. Some adjustment of FAF2 flows was required to replicate the higher flows on the north-south I-5 corridor versus the east-west I-84 corridor.

**Exhibit 7: Oregon CFF Truck Assignment Results (vehicles)**




[1] Sedcor Express: "Oregon's domestic shipments dwarf foreign exports" May 2007
http://www.sedcor.org/pdfs/Express5_07.pdf

## Rail

Approximately 25% of all rail tonnage is lumber or wood products (STCC 24); other top commodities include chemicals, pulp, farm products, and food products. Together, these commodities make up about 65% of all rail tonnage. By direction in 2002, 14 to 16% travel inbound-outbound to non-Portland Oregon locations, roughly in balance. The inbound flows to Portland exceed the outbound flows (29% versus 12%), while 26% of the tonnage travels through the state. The through flows include trains from Washington that travel east up the Oregon side of the Columbia River corridor without stopping in Oregon

All commodities are expected to grow over time, except for forest products, which is expected to decline by .2 percent annually from 2002 to 2035.

Exhibit 8 summarizes rail tonnage in, out, within, and through Oregon, based on waybill data flow pattern and FAF2 growth rates. The largest rail tonnage for the year 2002 moved from the rest of the world (ROW) to Oregon Portland followed by through trips (origin and destination outside Oregon). The next tier of tonnage is from Oregon Remainder to the rest of the world, followed by the reverse direction, and then flows from Oregon Portland to the rest of the world. Over time, the pattern of flows does not change.

**Exhibit 8: Summary of Oregon Rail Flows (1000 tons)**

| Origin | Destination | 2002 Waybill | % of Total | 2010 Forecast | % of Total | 2035 Forecast | % of Total |
|---|---|---|---|---|---|---|---|
| ROW | Oregon Portland | 15,269 | 29.10% | 19,065 | 30.00% | 24,060 | 28.10% |
| ROW | ROW | 13,448 | 25.60% | 16,271 | 25.60% | 21,486 | 25.00% |
| Oregon Remainder | ROW | 8,294 | 15.80% | 9,642 | 15.20% | 12,670 | 14.80% |
| ROW | Oregon Remainder | 7,113 | 13.60% | 8,270 | 13.00% | 13,391 | 15.60% |
| Oregon Portland | ROW | 6,206 | 11.80% | 7,326 | 11.50% | 10,059 | 11.70% |
| Oregon Remainder | Oregon Portland | 625 | 1.20% | 1,142 | 1.80% | 1,215 | 1.40% |
| ROW | Oregon Portl_SeaPort | 536 | 1.00% | 565 | 0.90% | 963 | 1.10% |
| Oregon Portland | Oregon Remainder | 289 | 0.60% | 555 | 0.90% | 542 | 0.60% |
| Oregon Portl_SeaPort | ROW | 249 | 0.50% | 227 | 0.40% | 542 | 0.60% |
| Oregon Portland | Oregon Portland | 228 | 0.40% | 320 | 0.50% | 565 | 0.70% |
| Oregon Remainder | Oregon Remainder | 196 | 0.40% | 201 | 0.30% | 277 | 0.30% |

Oregon Portland – Multnomah, Washington, Clackamas, and Columbia Counties
Oregon Remainder – All other Oregon Counties
Oregon Portl_SeaPort - Port of Portland Sea Port
ROW – locations outside of Oregon

The rail tonnage origin-destination flows were assigned to the corridors as shown in Exhibit 9, using the corridors shown in Exhibit 10. Any rail flow using the corridor for any distance is counted in the Exhibit 9 tonnage for that corridor. Corridor 10 is actually a grouping of the four coastal rail corridors, including the currently inoperable Port of Tillamook Bay and Port of Coos Bay rail lines[2]. The largest corridor flows are in Corridor 9 (system of freeways in the Portland metropolitan area) and Corridor 6 (I-84

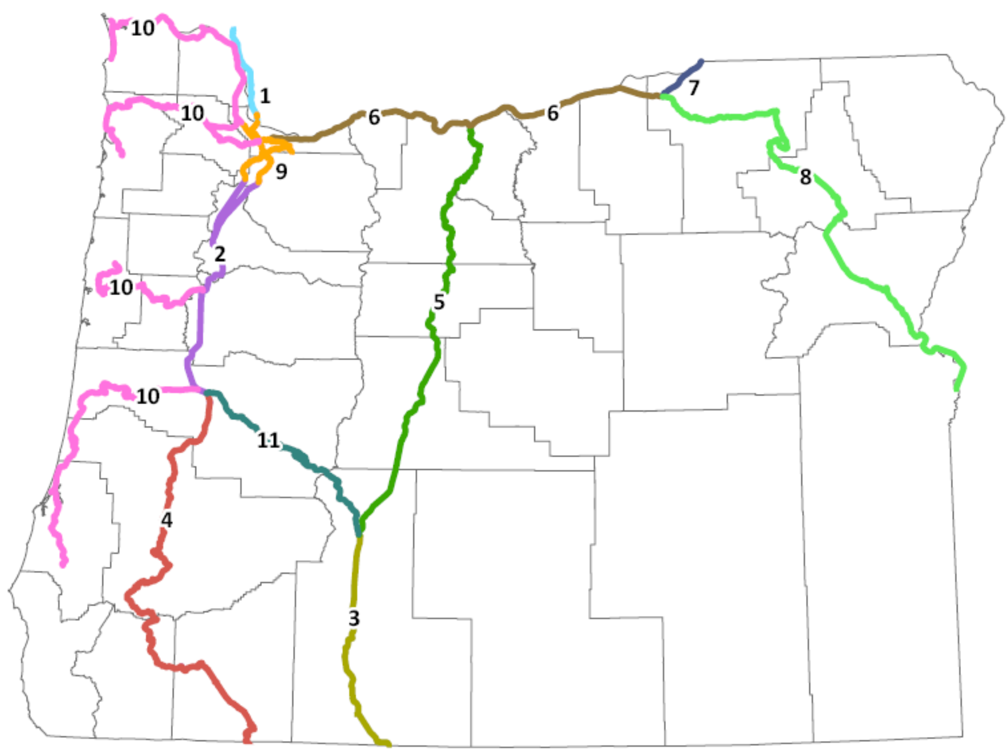
[2] The Port of Coos Bay intends to restore service on their rail line before 2012 (interview with Port of Coos Bay staff as part of the Oregon Strategic Port Plan, July 2009).

east of Portland metropolitan area). The lowest rail flows are on the coast (Corridor 10) and in southwest region of the state (Corridors 4 and 11).

**Exhibit 9: Oregon Rail Tonnage Assignment by Corridor (1000 tons)**

| Corridor | Description | 2002 Waybill | % of Total | 2010 Forecast | % of Total | 2035 Forecast | % of Total |
|---|---|---|---|---|---|---|---|
| 9 | Portland area | 41,713 | 26.0% | 56,489 | 26.1% | 87,197 | 26.1% |
| 6 | Columbia River Corridor | 37,022 | 23.1% | 49,594 | 22.9% | 77,379 | 23.2% |
| 3 | SW OR/I-97 Corridor | 17,100 | 10.7% | 23,227 | 10.7% | 35,230 | 10.6% |
| 2 | Willamette Valley/I-5 Corridor | 15,456 | 9.6% | 20,732 | 9.6% | 31,263 | 9.4% |
| 8 | SE OR/I-84 Corridor | 12,721 | 7.9% | 16,588 | 7.7% | 24,127 | 7.2% |
| 1 | I-5 Corridor/Portland to WA | 10,371 | 6.5% | 14,303 | 6.6% | 25,076 | 7.5% |
| 7 | Umatilla/I-82 Corridor | 8,241 | 5.1% | 11,783 | 5.4% | 17,222 | 5.2% |
| 5 | Central OR/I-97 Corridor | 6,876 | 4.3% | 9,554 | 4.4% | 14,647 | 4.4% |
| 11 | Central Cascades Crossing | 5,580 | 3.5% | 7,705 | 3.6% | 11,028 | 3.3% |
| 10 | Oregon Coast | 2,660 | 1.7% | 3,499 | 1.6% | 5,888 | 1.8% |
| 4 | SW OR/I-5 corridor | 2,506 | 1.6% | 3,065 | 1.4% | 4,612 | 1.4% |

**Exhibit 10: Oregon Rail Corridor Network**




Note: Coastal lines grouped into Corridor #10

## Water

The Portland Harbor, at the confluence of the Willamette and Columbia Rivers, is the connection for 85% of all water flows in Oregon. It is dominated by the Port of Portland, with roughly half of the Portland Harbor commodity movements served by other nearby private facilities in 2002. The primary commodities moved in the harbor include grains, fuels, metals, mineral, machinery, motorized vehicles, and clay/concrete/glass/stone. The Portland Harbor's inbound and outbound flows are both forecast to grow annually by roughly 1.3 and 2.0%, respectively.

Commodity movements by water at coastal ports (Coos Bay and Astoria) are dominated by the exchange of wood chips and logs, with minor flows of fuel, lumber, fish, machinery and transport equipment. Port of Coos Bay is significantly larger than the Port of Astoria (1.4Mtons compared with 0.09Mtons in 2002), but its log flows are subject to dynamic changes in the value of the US and Canadian dollars, and these flows are forecast to decline over time (-1.8 % annually).[3] Other commodity flows at both ports are forecast to grow at a roughly 2-3 % annual rate between 2002 and 2035.

Columbia River ports (Morrow and Umatilla) downriver flows are dominated by the outbound flow of grains, animal feed (hay), and other agriculture products. Upriver flows are primarily waste, fuel, and some fertilizers. Port of Morrow is slightly larger than Port of Umatilla (662ktons compared with 548ktons in 2002), with significant container traffic and agriculture products, while the Port of Umatilla is dominated by the large grain and fuel facilities. The upriver growth is projected to grow by 1%, while the outbound downriver commodities are forecast to grow at a faster 5% growth.

Marine flows by port and direction are summarized in Exhibit 11.

[3] Port of Coos Bay indicated some additional forest product outbound flows not included in the US Army Corp of Engineers Waterborne Commerce Data. These data were not provided at the time of publication of this memorandum, so are not included here.

# Exhibit 11. Water Mode Flows by Commodity and Direction

Oregon Commodity Flow Forecast - Water Mode Tons (1000s)

| | | | Portland Harbor | | | | | Astoria | | | | CoosBay | | | | Morrow | | | | | Umatilla | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCTG | STCC | Description | IB-Dom | IB-Intl | Internal | OB-Dom | OB-Intl | IB-Dom | IB-Intl | OB-Dom | OB-Intl | IB-Dom | IB-Intl | OB-Dom | OB-Intl | IB-Dom | IB-Intl | Internal | OB-Dom | OB-Intl | IB-Dom | IB-Intl | OB-Dom | OB-Intl |
| | | | Year 2002 (1000 tons) | | | | | | | | | | | | | | | | | | | | | |
| 1-4 | 1 | Farm products | 1,934 | 47 | - | 0 | 6,200 | - | - | - | - | - | - | - | - | - | 0 | 218 | - | 236 | - | - | 124 | 285 |
| 25 | 8 | Forest products | - | 228 | - | - | 99 | - | 7 | - | - | - | 154 | - | 1,216 | - | - | - | - | - | - | - | - | - |
| 1,5 | 9 | Fresh Fish | 90 | - | - | - | 16 | 11 | - | - | 29 | 11 | - | - | 7 | - | - | - | - | 0 | - | - | - | - |
| 13,14 | 10 | Metallic ores | - | 0 | - | - | 207 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 15 | 11 | Coal | 0 | 214 | - | 0 | 72 | - | - | 0 | 43 | - | - | - | - | - | 16 | - | - | - | - | 134 | - | - |
| 16 | 13 | Crude petroleum, natural gas or gasoline | - | 260 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | 14 | Nonmetallic ores, minerals, excluding fuels | - | 0 | - | - | 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5-7 | 20 | Food and kindred products | 31 | - | - | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | 24 | Lumber or wood products, excluding furniture | 9 | 30 | - | 6 | 26 | - | - | - | - | - | 5 | 0 | 0 | - | - | - | - | - | - | - | - | - |
| 39 | 25 | Furniture or fixtures | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27,28 | 26 | Pulp, paper, or allied products | 8 | 12 | 124 | 1 | 329 | - | - | - | - | - | - | 0 | - | - | - | - | - | - | - | - | - | - |
| 20,22 | 28 | Chemicals or allied products | 709 | 185 | - | - | 3,861 | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 0 | 0 | - | 4 |
| 17,19 | 29 | Petroleum or coal products | 128 | 362 | 577 | 3,082 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | 30 | Rubber or miscellaneous plastics products | - | 175 | - | 1 | 167 | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| 12 | 32 | Clay, concrete, glass, or stone products | 9,081 | 433 | 489 | 9 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30,32 | 33 | Primary metal products | - | 974 | - | - | 65 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | 34 | Fabricated metal products | 0 | 340 | - | - | 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 34 | 35 | Machinery, excluding electrical | - | 758 | - | - | 78 | - | - | - | - | 3 | - | - | 0 | - | - | - | - | - | - | - | - | - |
| 35,38 | 36 | Electrical machinery, equipment, or supplies | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 36,37 | 37 | Transportation equipment | 0 | 592 | - | 0 | - | - | - | - | - | - | 1 | - | 2 | - | - | - | - | - | - | - | - | - |
| 40 | 39 | Miscellaneous products of manufacturing | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 41 | 40 | Waste or scrap materials not identified by producing industry | - | 0 | - | - | 15 | - | - | - | - | - | - | - | - | 186 | - | - | - | - | - | - | - | - |
| 43 | 41 | Miscellaneous freight shipments | - | 28 | - | - | 24 | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - |
| | | Total | 11,990 | 4,640 | 1,190 | 3,098 | 11,217 | 11 | 7 | 0 | 73 | 14 | 160 | 0 | 1,225 | 186 | 17 | 218 | - | 241 | 0 | 135 | 124 | 289 |
| | | | Year 2035 (1000 tons) | | | | | | | | | | | | | | | | | | | | | |
| 1-4 | 1 | Farm products | 1,444 | 98 | - | 0 | 10,035 | - | 1 | - | - | - | - | - | - | 0 | 1 | 3,247 | 0 | 240 | 0 | 1 | 2,554 | 489 |
| 25 | 8 | Forest products | - | 198 | - | - | 49 | - | 5 | - | - | - | 134 | - | 610 | - | - | - | - | - | - | - | - | - |
| 1,5 | 9 | Fresh Fish | 193 | - | - | - | 33 | 24 | - | - | 68 | 24 | - | - | 9 | - | - | - | - | 0 | - | - | - | - |
| 13,14 | 10 | Metallic ores | - | 0 | - | - | 250 | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| 15 | 11 | Coal | 0 | 348 | - | 0 | 75 | 0 | - | 0 | 45 | - | - | - | - | - | 27 | - | - | - | - | 236 | - | - |
| 16 | 13 | Crude petroleum, natural gas or gasoline | - | 466 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | 14 | Nonmetallic ores, minerals, excluding fuels | - | 0 | - | - | 55 | - | - | - | - | - | 0 | - | - | - | - | - | - | - | - | - | - | - |
| 5-7 | 20 | Food and kindred products | 90 | - | - | 0 | - | - | - | - | - | - | 0 | - | - | - | 0 | - | 0 | - | 0 | 0 | - | - |
| 26 | 24 | Lumber or wood products, excluding furniture | 13 | 87 | - | 11 | 25 | - | - | - | - | 0 | 14 | 0 | 0 | - | 0 | - | - | - | - | 1 | - | - |
| 39 | 25 | Furniture or fixtures | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - | - | - | - | - | 2 | - | - |
| 27,28 | 26 | Pulp, paper, or allied products | 5 | 20 | 264 | 1 | 608 | - | - | - | - | 0 | 1 | 0 | - | - | 0 | - | - | - | - | - | - | - |
| 20,22 | 28 | Chemicals or allied products | 74 | 214 | - | - | 9,667 | - | - | - | - | - | - | - | - | - | 1 | - | - | 0 | 0 | 0 | - | 4 |
| 17,19 | 29 | Petroleum or coal products | 115 | 268 | 3,604 | 675 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | 30 | Rubber or miscellaneous plastics products | - | 504 | - | 5 | 563 | - | - | - | - | - | - | - | - | - | - | - | 0 | 9 | - | 0 | - | 1 |
| 12 | 32 | Clay, concrete, glass, or stone products | 13,744 | 462 | 614 | 10 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - | - |
| 30,32 | 33 | Primary metal products | - | 1,649 | - | - | 108 | - | 1 | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - |
| 33 | 34 | Fabricated metal products | 0 | 543 | - | - | 30 | - | 1 | - | - | 0 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| 34 | 35 | Machinery, excluding electrical | - | 4,126 | - | - | 253 | - | 1 | - | - | 7 | 1 | - | 0 | - | - | - | - | - | - | - | - | - |
| 35,38 | 36 | Electrical machinery, equipment, or supplies | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - | - |
| 36,37 | 37 | Transportation equipment | 0 | 586 | - | 0 | - | - | - | - | - | 0 | 4 | - | 7 | - | - | - | 0 | - | - | 2 | - | - |
| 40 | 39 | Miscellaneous products of manufacturing | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - | - | - | - | 3 | - | - |
| 41 | 40 | Waste or scrap materials not identified by producing industry | - | 0 | - | - | 42 | - | - | - | - | - | - | - | - | 207 | - | - | - | - | - | 1 | - | - |
| 43 | 41 | Miscellaneous freight shipments | - | 37 | - | - | 26 | - | - | - | - | - | 1 | - | - | - | - | - | - | 3 | - | - | - | 0 |
| | | Total | 15,678 | 9,606 | 4,482 | 702 | 21,819 | 24 | 9 | 0 | 113 | 32 | 160 | 0 | 627 | 207 | 30 | 3,247 | 0 | 252 | 0 | 248 | 2,554 | 494 |

## Air

PDX accommodates 99% of all international air cargo flows into and out of the state and 95% of all domestic flows in 2002. Shipments greater than 100 pounds from parcel carriers were included in freight; smaller shipments are included as air mail. International air freight, representing 18ktons of textiles, machinery, base metals, electronics, agriculture products, and precision instruments in 2002, grows annually by 5% for inbound and 3% outbound between 2002 and 2035.

A variety of commodities move by air in small quantities. Top domestic commodities moved by air to and from PDX include: electronics, prepared foodstuffs, base metals, transportation equipment, meat/fish/seafood, machinery, chemicals/chemical preparations, and miscellaneous manufactured products. PDX transports pharmaceuticals and mixed freight to other Oregon airports. Top air freight domestic commodities for the other Oregon airports include: prepared foodstuffs, base metals, meat/fish/seafood, and electronic equipment. Overall domestic freight grows annually by 3.5% for both inbound and outbound flows between 2002 and 2035 (less for non-PDX airports). Higher growth is forecast in agricultural products, pharmaceuticals, machinery, and precision instruments, with lower than average growth in chemicals, wood/paper products, metals, electrical equipment and mixed freight. Despite the high growth rates the tonnage moved remains a small but critical freight movement for the state.

All air mail (STCC50), representing 6.5ktons in 2002 was assumed to pass through PDX, before/after other Oregon airports. Since FAF2 does not provide forecasts of air mail, it was assumed to grow at the rate of population (1.3% per year per OEA population forecast) from 2002 to 2035.

FAF2 data was scaled to have inbound and outbound flows roughly in balance in 2002, growth rates of various commodities, led to non-PDX airports having 2:1 outbound flows in 2035.

## Pipeline

Natural gas is 100% delivered via pipeline. Natural gas imports used by Oregon (4.7Mtons in 2002) are forecast to grow by 1.7% annually from 2002 to 2035. Natural gas passing through Oregon to California (13.7Mtons in 2002) grows by a slow 0.7% annually during this period, showing almost no growth at all until after 2010). Natural gas imports shift, less is imported via the Williams Eastern Oregon Branch from Salt Lake City via Ontario, balanced by an increase from the PGE Alberta line through Idaho and Umatilla.

Pipeline-delivered petroleum is imported to Oregon via the Olympic Pipeline from Washington via Portland (92%) and the Chevron Pipeline (8%) from Washington via Umatilla. The Kinder Morgan pipeline distributes petroleum from Portland to the Willamette Valley via Eugene. Oregon has no through petroleum pipeline flows. Petroleum delivered by pipeline to Oregon is expected to grow by less than 0.1% from 2002 to 2035.

# Comparison to Other Forecasts

This section compares the Oregon Commodity Flow forecast to the following studies:

- Prior Oregon Commodity Flow Forecast (Global Insight base year 1997)
- Panama Canal Expansion Impact
- Port of Portland Portland/Vancouver Trade Capacity Analysis (Global Insight base year 1997)
- Oregon Agriculture statistics

### Prior Commodity Flow Forecast

The most recent detailed study of Oregon's statewide commodity flow patterns was prepared by Global Insight in 2004. This prior forecast was used in the 2006 Oregon Transportation Plan (OTP). This section compares that prior commodity flow forecast with the results of this work.

In the base year, which was 1997 for the prior Global Insight commodity flow forecast and 2002 for the current FAF2 work, the Global Insight forecast is quite a bit higher in both tonnage and value terms (value numbers may reflect dollars in different year constant dollars). Global Insight had overall growth of 1.7% for 1997 to 2030 as compared with the FAF2 forecast of 2.2% for 2002 to 2035, with some variance by mode (see Exhibit 12). Global Insight has lower water growth rates and holds the pipeline flows fixed (0% growth).

The following tables use 2030 as the forecast year since it was included in the current ("Oregon CFF") and previous ("Global Insight") commodity flow forecasts and will be used as the point of comparison.

**Exhibit 12: Global Insight and FAF2 Forecast (Mtons)**

| Mode | Oregon CFF 2002 | Oregon CFF 2030 | Oregon CFF Growth Rate 2002-2030 | Global Insight 1997 | Global Insight 2000 | Global Insight 2030 | Global Insight Growth Rate 1997-2030 |
|---|---|---|---|---|---|---|---|
| Tonnage (MTons) | | | | | | | |
| Truck | 259,213 | 466,782 | 2.1% | 330,027 | 341,778 | 631,172 | 2.0% |
| Rail | 39,008 | 61,395 | 1.6% | 55,225 | 56,971 | 100,606 | 1.8% |
| Water | 34,835 | 59,216 | 1.9% | 38,266 | 35,238 | 45,092 | 0.5% |
| Pipeline | 13,599 | 16,601 | 0.7% | 10,713 | 10,713 | 10,713 | 0.0% |
| Air | 236 | 624 | 3.5% | 318 | 329 | 747 | 2.6% |
| Total | 346,892 | 604,618 | 2.0% | 434,549 | 445,029 | 788,330 | 1.8% |
| Value ($M) | | | | | | | |
| Truck | 159,878 | 353,660 | 2.9% | 399,272 | 419,364 | 1,114,936 | 3.2% |
| Rail | 15,631 | 25,126 | 1.7% | 70,583 | 72,889 | 138,403 | 2.1% |
| Water | 22,467 | 52,989 | 3.1% | 30,233 | 31,091 | 40,023 | 0.9% |
| Pipeline | 7,307 | 8,939 | 0.7% | 3.816 | 3,816 | 3,816 | 0.0% |
| Air | 13,253 | 47,077 | 4.6% | 3.232 | 3,316 | 10,536 | 3.7% |
| Total | 218,536 | 487,790 | 2.9% | 507.136 | 530,477 | 1,307,715 | 2.9% |

Growth Rate = Compound annual growth rate 2002-2035.

Global Insight and the Oregon CFF forecast a similar growing truck share, and the rail and air shares are also consistent between the two forecasts. Global Insight shows smaller and declining water and lower pipeline forecast than the Oregon CFF.

As shown in Exhibit 13, the variation in growth rates can be attributed in large part to the FAF2's much higher forecast for tonnage heading out of the state of Oregon.

**Exhibit 13: Global Insight and FAF2 Forecast, by Flow Direction**

| Flow | Oregon CFF (Mtons) 2002 | Oregon CFF (Mtons) 2030 | Oregon CFF (Mtons) Growth Rate 2002-2030 | Global Insight (Mtons) 1997 | Global Insight (Mtons) 2000 | Global Insight (Mtons) 2030 | Global Insight (Mtons) Growth Rate 1997-2030 |
|---|---|---|---|---|---|---|---|
| Inbound | 86 | 131 | 1.3% | 215 | 222 | 386 | 1.8% |
| Internal | 198 | 367 | 1.9% | 77 | 76 | 132 | 1.6% |
| Outbound | 63 | 152 | 2.8% | 85 | 87 | 148 | 1.7% |

Growth Rate = Compound annual growth rate 2002-2035.

In both forecast sets, base year major commodities are stones/minerals/ores, food products, and fuels, as shown in Exhibit 14. GI shows a higher share of forest/wood products, while the Oregon CFF shows higher shares for miscellaneous commodities and waste. Overall growth rates are very similar between the two forecasts, although there are some differences by commodity; specifically Oregon CFF exhibits higher growth for manufacturing products, chemicals, miscellaneous products and waste, and a much lower forest/wood products growth rate. The Global Insight forecast did not separately forecast Commercial Fish (Live Fish) commodity flow.

**Exhibit 14: Global Insight and FAF2 Commodity Share**

| STCCs | Description | Commodity Mix (% of total) | | Growth Rate | |
|---|---|---|---|---|---|
| | | Oregon CFF 2002 | Global Insight 1997 | Oregon CFF 2002-2035 | Global Insight 1997-2030 |
| 10,14,32 | Stone Minerals Ores | 27% | 20% | 1.6% | 1.3% |
| 1,9,20,21 | Food Products | 20% | 21% | 2.0% | 1.9% |
| 11,13,29 | Petroleum Coal | 14% | 9% | 1.7% | 1.9% |
| 8,24 | Forest Wood Products | 9% | 27% | 0.5% | 1.5% |
| 25,26,27 | Pulp Paper Wood Products | 2% | 4% | 1.4% | 1.7% |
| 28 | Chemical Products | 6% | 5% | 2.4% | 1.8% |
| 33,34 | Metals | 3% | 3% | 2.3% | 2.5% |
| 22,23,30,31, 39 | Manufacturing products | 2% | 2% | 3.5% | 2.6% |
| 37 | Machinery Transportation | 2% | 2% | 3.4% | 3.7% |
| 35,36,38 | Instruments | 2% | 1% | 4.3% | 3.9% |
| 19,41, 44-45 | Miscellaneous | 7% | 4% | 3.3% | 2.1% |
| 40 | Waste | 7% | 2% | 3.7% | 2.4% |
| | TOTAL | 100% | 100% | 1.9% | 1.8% |

Growth Rate = Compound annual growth rate 2002-2035.

## Panama Canal Impacts/Forecasts

The Oregon CFF was compared with forecasts developed for the Panama Canal expansion study, by Parsons Brinckerhoff staff experienced with international freight movements. It is difficult to speak specifically about Oregon commodity movements within this larger international context given that there are other U.S. and West Coast ports (Tacoma, Seattle, Oakland, Los Angeles/Long Beach) that have a much larger share of the international export/import market compared to Portland Harbor. Additionally, forecasts from the Panama Canal work are proprietary; however, a few general comparisons can be drawn.

In general, the Panama Canal study found that international export commodity annual growth rates of 2 to 4% are within a reasonable range for nearly all commodities over the next 30 years. Oregon CFF has a 2002 to 2035 average annual growth rate for outbound (domestic and international flow) of 2.8%, 1.8% if considering only international non-truck mode[4] Forest, lumber and wood products (STCC8 and 24), fuels (STCC13), and primary metals (STCC33) outbound flows are forecast to grow less than 2% annually in the Oregon CFF. In the case of forest and wood products, this reflects Oregon's declines in this industry. In the case of fuels, the lower growth is consistent with the Oregon CFF assumption that fuel usage growth is population-based Commodities with a higher growth rate of 4 to 7% include rubber/plastics (STCC30), transportation equipment (STCC37), waste/scrap (STCC40), miscellaneous shipments (STCC39 and STCC41). Only the growth rates of the low growth commodities listed

[4] International truck flows are not broken out, but include a small 100ktons in 2002, consisting primarily of motorized vehicles and plastics/rubber exported to Mexico.

above fall outside of the 2 to 4% range when considering non-truck outbound international flows.

The expansion of the Panama Canal is expected to shift some container liner calls from West Coast to East Coast ports, as it becomes less expensive to reach East Coast markets via the Panama Canal rather than shipping across the U.S. mainland through West Coast ports. The impact to Oregon, however, is expected to be limited, if any. The Oregon CFF identifies only selected international commodities shipped through Oregon ports to the East Coast. Of such flows (roughly 65,000 tons in 2002), over 75% are machinery and base metals (STCC 35 and 34) shipped from Asia to the Port of Portland and then via air, land or rail to the East Coast. Automobiles handled through the Port of Portland are not expected to be impacted, as they are typically destined for the Midwest rather than East Coast.

**Portland/Vancouver Trade Capacity Study**

The Port of Portland commissioned Global Insight to prepare a Portland/Vancouver Trade Capacity Analysis (Trade Study) for the bi-state metro region in 2006, covering air, water, truck, and pipeline. The comparison with the Oregon CFF is complicated by the fact that the Trade Study includes both Oregon and Washington sides of the Portland-Vancouver region, while FAF2 includes an four-county Oregon-only Portland zone (Multnomah, Washington, Clackamas, and Yamhill Counties), and Vancouver is grouped with the rest of Washington State (outside Seattle and Blaine, Washington). Additionally, the Trade Study uses SCTG commodity classification, rather than the STCC codes used in the Oregon CFF. An effort to add the Vancouver share of flows to the Oregon CFF would require some in-depth analysis of the Trade Study and other relevant data sets such as Washington traffic counts, origin-destination truck surveys, rail waybill data, and employment by industry data.

As expected the Trade Study, which covers both Vancouver and Portland, includes quite a bit more tonnage - 261Mtons in 1997 as compared with 188Mtons in 2002 for the Oregon CFF within the Portland Harbor - with the difference representing the Washington side of the Metro area, and the inclusion of some local trips (express shipments) absent or under-reported in the Oregon CFF. After accounting for the different commodity classifications, the mix of commodities in the Portland region compares favorably between the two studies as shown in Exhibit 15. Oregon CFF shows more stones/minerals/ores and waste, while having slightly less food/forest products in the base year. Growth rates are largely consistent. Oregon CFF has lower growth for stone/minerals/ores, forest/wood growth, metals, and machinery rate, and higher growth for fuels and manufacturing products.

**Exhibit 15: Commodity Mix of Port Trade Study and Oregon CFF**

| | | 1997 Portland/Vancouver Trade Study | | 2002 (Portland Only) Oregon CFF | |
|---|---|---|---|---|---|
| STCCs | Description | Share | Growth Rate | Share | Growth Rate |
| 10,14,32 | Stone Minerals Ores | 20% | 2.0% | 34% | 1.3% |
| 1,9,20,21 | Food Products | 25% | 2.1% | 18% | 2.0% |
| 11,13,29 | Petroleum Coal | 16% | 1.6% | 14% | 2.1% |
| 8,24 | Forest Wood Products | 12% | 1.6% | 8% | 1.0% |
| 25,26,27 | Pulp Paper Wood Products | 3% | 1.8% | 2% | 1.5% |
| 28 | Chemical Products | 8% | 2.1% | 8% | 2.0% |
| 33,34 | Metals | 4% | 3.2% | 3% | 2.1% |
| 22,23,30, 31, 39 | Manufacturing products | 3% | 2.4% | 1% | 3.0% |
| 37, | Machinery Transportation | 2% | 4.4% | 1% | 2.9% |
| 35,36,38 | Instruments | 1% | 4.0% | 1% | 3.7% |
| 19,41, 44-45 | Misc | 0% | 5.9% | 0% | 4.5% |
| 40 | Waste | 7% | 3.7% | 9% | 0.5% |
| | TOTAL | 100% | 2.2% | 100% | 1.7% |

Growth Rate = Compound annual growth rate 2002-2035.

### Agriculture

National agricultural statistics, the Oregon Department of Agriculture, and the Oregon State University Extension Service provide Oregon agriculture facts and figures. Given the differences in commodity categories (crops, livestock, fish, and nursery products), units (ranging from bushels to hundredweights rather than tons), and years it is difficult to directly compare these data. Additionally, agriculture statistics are typically reported as production amounts that are consumed both within the state and exported both domestically and internationally. As an order of magnitude estimate, the Oregon agriculture facts and figures report 2008 agricultural production valued at $4.9 billion, a record high. The comparable figure for Oregon CFF is an outbound flow of $3.9 billion forecast for 2008 (given 2002 base year), excluding commodities in-state. Overall, the Oregon CFF agriculture estimates seem to be with a reasonable range of the reported statistics.

## Potential Future Efforts

The Oregon CFF 2002 to 2035 forecast provides a basis for understanding the primary freight movements today and in the future under existing conditions. In several instances circumstances are likely to change, and the detail and transparency provided in Oregon CFF can provide a starting point for evaluating such changes. Alternative scenarios, as identified by groups such as the Freight and Economy Working Group or Freight Steering Committee, might include changes to transportation networks (e.g., reflecting the cessation of operations across the Coast Range of the Port of Tillamook Bay and Port of Coos Bay Railroads, one or more potential new liquid natural gas terminal(s)), freight mode shifts (e.g., truck-rail diversion), changes in infrastructure capacity and/or operational philosophy (e.g., Union Pacific restrictions through the Siskiyou Mountains, bi-directional running between Class I railroads), or potential new cargo market opportunities (e.g., Port of Portland attracting new dry bulk cargos, closure of aluminum smelters, shipment of new wind turbines, truck driver shortage). In such cases, specific flows (by commodity or origin-destination pair) can be isolated and modified, such as changing the mode (truck-rail mode share changes), or the change in forecast growth rate.

One caution in the modification of the Oregon CFF is in keeping the intact nature of the overall flows. These are based on an underlying economic forecast (Global Insight forecast for FHWA FAF2 work). As such, changes in the economy (e.g., alternative economic conditions or linkage to WOC2 Economic Forecast) affect many sectors and thus multiple commodities, and for that reason it is hard to consistently capture all the likely effects without a careful analysis and accounting of the underlying economics.

Three other potential future enhancements to the Oregon CFF database are:

- Further classification of the marine flows to the handling group level, such as containers, bulk, break-bulk, autos, etc.
- Inclusion of shortline railroad commodity movements, using ODOT collected and processed data, combined with FAF rail commodity-specific growth rates.
- Inclusion of inter-modal commodity flows. These are flows that travel by more than one mode, such as truck transferring to rail. Because it is not possible to identify which leg of the trip was made by which mode within the FAF data, these flows were not evaluated for this effort. However, it would be possible to establish a methodology to split these trips, particularly the truck and rail trips which use established corridors.
- Update of the Oregon CFF based on more recent economic forecasts.
- Review of the Oregon CFF by industry and/or key commodities across all modes.

## Conclusions

The Oregon CFF examines all commodity flow modes using a methodology derived from the FHWA FAF2 national commodity flow forecast. The Oregon CFF forecasts have undergone scrutiny from:

- The consultant teams' modal experts and quality assurance and control process,
- Port of Portland economic and planning staff,
- The Freight and Economy Working Group, and
- Comparisons with other efforts, including the Port of Portland's Trade Study.

The Oregon CFF method is transparent in its assumptions and data sources; the inability to alter the underlying FAF2 economic forecasts is a potential shortcoming, but the FAF2 commodity growth assumptions have shown a strong resilience in the face of close scrutiny. The Oregon CFF should provide a solid basis for ODOT freight planning work, including a strong basis for the upcoming multi-modal Oregon Freight Plan and a sound foundation for the evaluation of alternative scenarios.

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# Appendix A: Detailed Methodology

The Oregon CFF approach of building on the FHWA FAF2 national commodity flow forecast was chosen because FAF2 is national in scope, highly regarded in terms of capturing interstate and international flows, uses a relatively recent base year (2002), and provides a quick way to complete a forecast in time for the Oregon Freight Plan work anticipated for Fall 2009. However, the inability to adjust or quantify the FAF2 underlying economic forecasts, particularly the optimistic economic conditions and low fuel price assumptions, poses some limitations that must be taken into account, which are partially addressed through adjustments noted herein. This section discusses the methodology and data sources used to develop the Oregon CFF, including the FHWA FAF2 dataset and disaggregation of each model to sub-state level within Oregon.

### FHWA FAF2 Forecast Dataset

The key source for the Oregon CFF is the FAF2, published by FHWA in 2002. FAF2 provides freight flows in tons or dollar value between 130 FAF2 regions encompassing the US for the year 2002 plus forecasts from 2010 to 2035 in five year increments. The mode is distinguished as well as 43 commodities classified by Standard Classification Transported Goods (SCTG) codes. FAF2 is based on the national Commodity Flow Survey, which only captures freight flows of 50 miles or more; therefore short-distance flows, which are less important in analyzing freight flows at the statewide level, are underrepresented in the FAF2 dataset.

FAF2 does not make explicit assumptions about future mode split. The mode split for every commodity derived in the base year is kept constant in forecast years, and the mode split only changes if the share of a commodity grows or declines. For instance, if the amount of coal shipped in the US declines in a given year, the, that share of the rail mode also declines because most coal is currently shipped by rail.

FAF2 flows are provided in 43 SCTG commodity classes. For this study, the commodities were converted into the Standard Transportation Commodity Code (STCC) classification for two reasons. First, flows by truck were transformed into actual truck trips, using payload factors provided by Battelle (2002) given in STCC commodity classifications. Further, the Rail Waybill Data from the Surface Transportation Board, which is used to disaggregate rail flow forecasts, is provided in STCC categories.

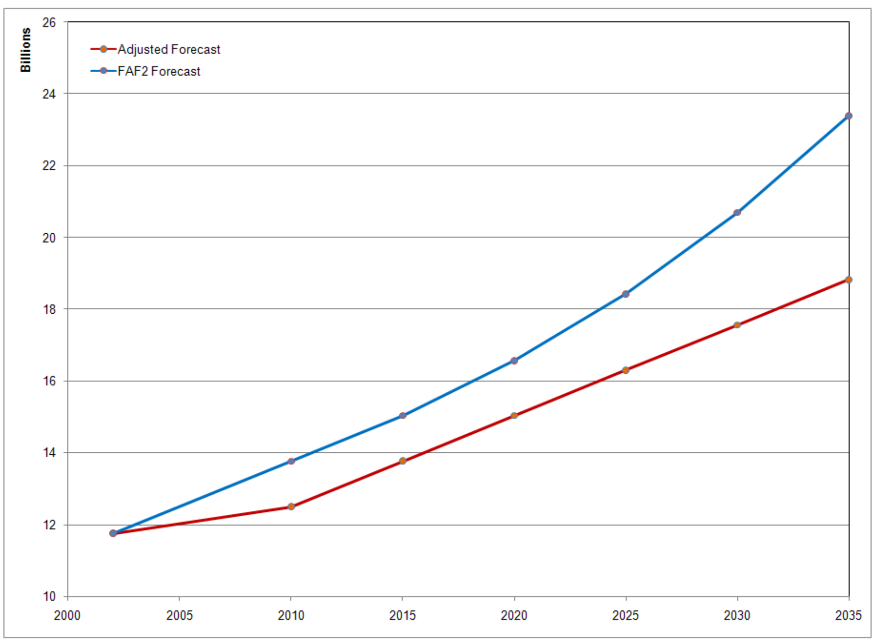
The SCTG-to-STCC conversion used by truck and rail modes is based on 1999 IMPLAN[5] freight data compiled under ODOT TPAU work done in support of the 2002 ODOT Bridge Limitation Study. The conversion process allocates each SCTG flow into multiple STCC flows in a many-to-many mapping, where each of the 43 SCTG categories is split into multiple STCC categories.

[5] IMPLAN, (Impact analysis for Planning), is a static model based on input-output modeling structures, adapted for geographic areas down to the county level.

For the air, water, and pipeline modes a more simplistic one-to-many mapping process is used.6  This approach is better suited to the select commodities moved by these modes, where the many-to-many proportional allocation would result in some commodity tonnage that is not transported by air, water or pipeline.  Both the SCTG and STCC commodity codes were retained in the Oregon dataset for air, water, and pipeline modes because the SCTG categories are a more accurate description of the commodity as initially classified by FAF2, while the STCC code allows consistency with the other modes in the Oregon CFF.  Appendix B provides a listing of both the FAF2 SCTG and the Oregon CFF STCC commodity codes.

The FAF2 forecasts for the years 2010 through 2035 are based on an economic forecast provided by Global Insight in 2002, specifically for FAF2.  This underlying economic forecast is proprietary and unavailable for further analysis or adjustment.  A paper by Battelle (2007) summarizes the forecasts' key assumptions on macro-economic growth.  This economic forecast leads to fairly optimistic FAF2 growth rates for freight in the US, as shown  by the blue line in Exhibit A1 which shows the growth of truck flows (in tons) as an example.

**Exhibit A1.  Original and Adjusted FAF2 Total Truck Commodity Growth Rates (Btons)**




After 2015, FAF2 proposes an exponential growth of trucks flows, almost doubling the tons shipped by truck from 2002 to 2035, which appears too optimistic for two primary reasons.  First, the current economic downturn could not have been foreseen when the FAF2 flows were released in 2006; the first forecast year 2010 is likely to generate significantly fewer truck trips then proposed by the FAF2 forecast.  Second, Battelle

[6] For instance, for Oregon trucks STCG 13 "Nonmetallic minerals n.e.c." corresponds to 67% STCC 32 "Clay, concrete, glass, or stone product" and 33% STCC 14 "Nonmetallic ores, minerals, excluding fuel."  However for air, SCTG 13 is likely only to correspond to STCC 14, as the heavier STCC 14 commodity is unlikely to travel by air.

(2007) assumes constant fuel prices until 2035, but the expected depletion of the oil reserves will most likely result in significant fuel cost increases that will affect truck flows more severely than rail or water flows. Though there is little consensus on the actual mode split after the oil price shock seen in recent years, it is likely to limit growth in freight traffic overall.

The red line in Exhibit A1 represents a more conservative growth rate for truck flows used in the Oregon CFF work, as compared with the FAF2 growth rate. The years 2005 and 2010 have been scaled down to account for the current economic downturn, consistent with the Oregon Office of Economic Analysis (OEA) recent forecast (Global Insight, April 2009), which assumes a 1.8% growth rate, relative to the 5% growth rate in FAF2. For future years after 2010, a linear growth rate was assumed, consistent with the nearly linear FAF2 growth rate from 2002 to 2015. The same 2% rate has been applied to FAF2 forecast freight flows from 2015 onward, as compared with the more optimistic 3% growth rate in the out-years of the OEA Global Insight forecast. This down-scaling only affects the total tonnage volume, as the flow patterns given by FAF2 remain unaffected. The resulting ratio of adjustment for FAF2 data for all modes was applied and is shown in Exhibit A2.[7]

**Exhibit A2. Adjustment to FAF2 Growth Rates for All Modes**

| Year | Adjustment to FAF2 Growth Rate |
|---|---|
| 2010 | 0.907703 |
| 2015 | 0.915536 |
| 2020 | 0.907576 |
| 2025 | 0.88464 |
| 2030 | 0.848849 |
| 2035 | 0.804833 |

While the effects of the economic downturn and fuel price changes on the air, rail, water, and pipeline modes are less certain than the effects on the truck mode, it was determined that all modes are impacted by the overly generous forecasts and thus are all impacted using the factors noted above. The impacts of fuel prices on rail, water and air are disputed and even more uncertain than for trucks. Therefore, while the FAF2 flows were down-scaled for all flows, it is important to recognize the uncertainties in these adjustments.

The FHWA FAF2 database provides both tonnage and value in its results. Exhibit A3 summarizes the 2002 average value density function ($/ton) for each commodity by mode, based on a sample of FAF2 domestic flows for Oregon, which can be applied to the tonnage in this report. Value density values are highly variable, depending upon the mix of commodities in each category and vary by state and mode, and over time. For example, the values shipped by air are typically quite a bit higher than those shipped by rail.

[7] Fishing and air mail forecast tonnages, generated outside of the FAF2 forecast, were not adjusted.

## Exhibit A3. Mode-Specific Commodity Value Density ($/ton)

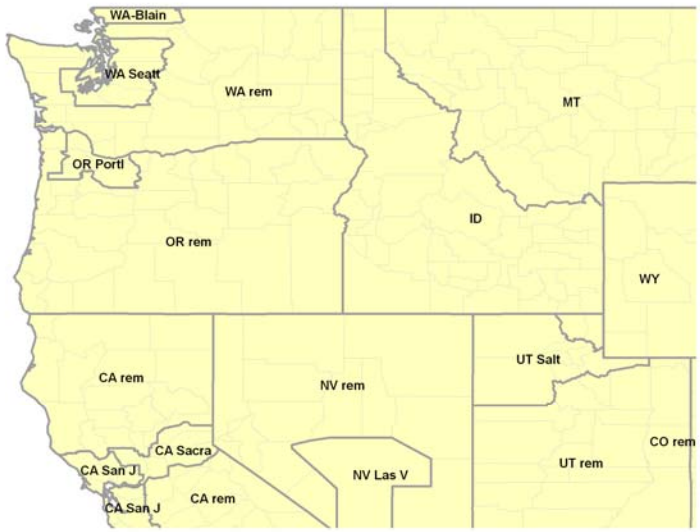
| STCC | Description | Air | Pipe | Rail | Truck | Water |
|---|---|---|---|---|---|---|
| 1 | Farm products | 434.3 | NA | 152.5 | 229.0 | 286.6 |
| 8 | Forest products | NA | NA | 138.2 | 43.7 | 36.5 |
| 9 | Fresh fish | 4,666.3 | NA | 4,666.3 | 4,666.3 | 4,666.3 |
| 10 | Metallic ores | NA | NA | 121.5 | 1,766.4 | 161.5 |
| 11 | Coal | NA | NA | 58.2 | 202.8 | 260.7 |
| 13 | Crude petroleum, natural gas | NA | 307.1 | NA | 305.9 | 305.9 |
| 14 | Nonmetallic ores, minerals | 1,315.0 | NA | 47.5 | 78.3 | 95.9 |
| 19 | Ordnance or accessories | NA | NA | NA | 520.6 | NA |
| 20 | Food and kindred products | 4,765.5 | NA | 519.3 | 921.2 | 1,141.1 |
| 21 | Tobacco products | 7,783.6 | NA | NA | 1,814.9 | 22,890.3 |
| 22 | Textile mill products | 69,043.8 | NA | 6,124.9 | 18,435.9 | 28,277.0 |
| 23 | Apparel/finished textile products | NA | NA | 21,576.8 | 64,946.2 | NA |
| 24 | Lumber or wood products | 6,187.5 | NA | 306.7 | 447.6 | 367.6 |
| 25 | Furniture or fixtures | 95,611.5 | NA | 286.4 | 2,444.7 | 2,818.4 |
| 26 | Pulp, paper, or allied products | NA | NA | 610.7 | 1,200.2 | 806.3 |
| 27 | Printed matter | 4,752.6 | NA | 85.2 | 2,338.9 | 3,619.9 |
| 28 | Chemicals or allied products | 23,829.6 | NA | 212.1 | 1,080.1 | 1,013.6 |
| 29 | Petroleum or coal products | 2,781.9 | 183.8 | 419.4 | 330.8 | 296.3 |
| 30 | Rubber / plastics products | 29,828.1 | NA | 1,132.3 | 2,748.7 | 2,495.0 |
| 31 | Leather or leather products | NA | NA | 2,072.8 | 6,239.2 | NA |
| 32 | Clay, concrete, glass, stone | 140,000.0 | NA | 17.5 | 36.8 | 12.0 |
| 33 | Primary metal products | NA | NA | 385.5 | 1,234.1 | 960.6 |
| 34 | Fabricated metal products | 2,315.2 | NA | 142.5 | 2,870.3 | 2,142.7 |
| 35 | Machinery, excluding electrical | NA | NA | 1,939.8 | 8,172.7 | 7,249.9 |
| 36 | Elec machinery, equipment, supplies | 179,097.1 | NA | 7,064.5 | 23,069.3 | 49,991.9 |
| 37 | Transportation equipment | 20,558.1 | NA | 2,514.9 | 4,955.8 | 5,666.5 |
| 38 | Instruments, photo/optical goods | 72,817.3 | NA | 1,617.1 | 1,001.8 | NA |
| 39 | Misc. products of manufacturing | 43,752.3 | NA | 2,141.7 | 3,544.3 | 3,349.2 |
| 40 | Waste or scrap materials | NA | NA | 191.6 | 107.1 | 118.5 |
| 41 | Miscellaneous freight shipments | 3,579.2 | NA | 781.5 | 1,931.8 | 1,716.9 |
| 42 | Containers, carriers, returned empty | NA | NA | 781.5 | NA | NA |
| 43 | Mail | 781.5 | NA | 781.5 | 781.5 | NA |
| 45 | Shipper association traffic | NA | NA | 781.5 | NA | NA |
| 46 | Miscellaneous mixed shipments | NA | NA | 781.5 | NA | NA |
| 47 | Small packaged freight movements | NA | NA | 781.5 | NA | NA |
| 48 | Waste hazardous materials | NA | NA | 191.6 | NA | NA |
| 49 | Other Waste | NA | NA | 191.6 | NA | NA |
| 50 | Bulk in boxcar | NA | NA | 781.5 | NA | NA |

NA = No Oregon CFF of this commodity by this mode.
Values are based on 2002 FAF2 Oregon dataset domestic sample, in units of $M and 1000tons.
High precision is retained, since this will be applied to large annual tonnages.
STCCs 42+ are not included in FAF2; their rates assumed to match STCC40 or STCC41.

## Modal Disaggregation

FAF2 regional zones are relatively coarse, as shown in Exhibit A4. Oregon is covered by two zones: Oregon Portland and Oregon Remainder. The Oregon Portland zone includes the Oregon portion of the Portland-Vancouver region covering Multnomah, Washington, Clackamas, and Yamhill Counties. The remaining 32 Oregon counties are included in the Oregon Remainder zone.

**Exhibit A4. FAF2 zones and counties**




For those trip ends within Oregon, the FAF2 commodity flows for each mode were disaggregated from FAF2 zones to Oregon counties. In the case of truck flows, this was done based on county employment and IMPLAN inter-industry coefficients, while other modes relied on local data to allocate FAF2 flows to specific Oregon facilities (rail stations, airports, marine ports, or pipeline terminals). Zones outside of Oregon were aggregated from FAF2 zones to "Other Domestic" and "Other International" (including Canada and Mexico) categories.8 These methods and data are described in more detail below.

### County Employment/IMPLAN Disaggregation Method (used by truck)

To increase spatial resolution, truck flows between 130 US FAF2 zones were disaggregated to flows between 3,241 US counties. Even though the disaggregation of flows in the eastern part of the US does not improve precision of Oregon flows, disaggregating all flows the same way enables a coherent method to be applied throughout the country and allows capture of through truck traffic.

Employment was used as a weight for the truck flow disaggregation to counties as counties with more employment are assumed to produce and attract more trucks.

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[8] For example, a container of goods originating in Asia bound for Salem Oregon, would be represented as an International "SEA" flow with origin Asia FAF region and destination 'Oregon Remainder' and an gateway of Tacoma port. For the Oregon CFF, this is further broken down into an 'Other International' trip by water that we ignore, and a 'domestic' truck trip from "Other Domestic" (Tacoma) to Marion County (Salem, OR). Further, each different commodity within the container would be treated as a separate annualized flow between these trip ends.

Within Oregon, nonfarm employment forecasts from the OEA Global Insight forecast (June 2009) were used for the following sectors: construction, natural resources, and mining; manufacturing; transportation, trade, and utilities; information; financial activities; professional and business services; educational and health services; leisure and hospitality; other services; and government. Oregon agriculture employment by county was added based on 2007 U.S. Department of Agriculture data.

The use of employment by industry type combined with inter-industry coefficients allows the allocation of the origins and destinations of flows to counties with the corresponding employment type. For instance, SCTG25 (logs and other wood in the rough) is produced in those counties that have agricultural employment; similarly, this commodity is shipped to those counties that have employment in industries consuming these types of products. The approach makes use of inter-industry coefficients, referred to as "make" and "use" coefficients, developed from 2007 Oregon IMPLAN input/output tables. These coefficients indicate the commodities each industry makes and uses in its production process.

For instance, if there is a flow of SCTG07 (other foodstuff) being shipped from FAF2 zone A to FAF2 zone B, and the IMPLAN data indicates that this commodity is produced by two industries: 3% by agriculture and 97% by manufacturing, then the employment of all counties in FAF2 zone A is used to distribute the origin of that flow over all counties, weighted by the make coefficients derived from IMPLAN data. In this example, the share of the origin of this flow for county C in FAF2 zone A is described by the following equation:

$$sf_{c\in A} = FAF_{A,B} \cdot \frac{0.03 \cdot agEmp_c + 0.97 \cdot manEmp_c}{\sum_{z\in A} 0.03 \cdot agEmp_z + 0.97 \cdot manEmp_z}$$

$sf_{c\in A}$ Share of flows originating in county *c* which is located in FAF2 zone *A*
$FAF_{A,B}$ FAF2 flows from FAF2 zone *A* to FAF2 zone *B*
$agEmp_c$ Employment in agriculture in county *c*
$manEmp_c$ Employment in manufacturing in county *c*

To disaggregate the destination of this flow, the use coefficients derived from the IMPLAN data are applied with the same procedure.

This disaggregation is applied to commodity flows where the origin or destination is within Oregon. No detailed employment forecast at the county level are available outside of Oregon so 2002 total employment is used to disaggregate flows with an origin and/or destination outside of Oregon, and the Global Insight employment forecast is used for future years. No forecast for agricultural employment is available for Oregon or outside of Oregon, so this employment type is kept constant over time.

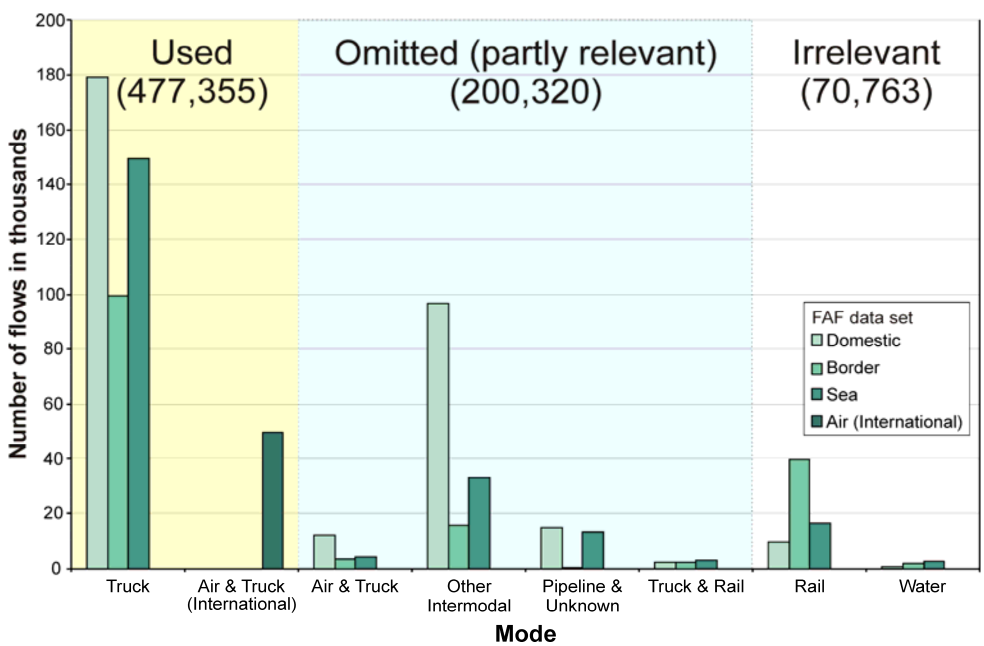
The mode split forecasted in FAF2 should be used with care. In FAF2, the modal split is a function of the commodity composition. For each commodity, the modal split remains unchanged throughout the years. If, for instance, a commodity that is dominated by rail declines over time, the share of rail drops accordingly. No true mode choice is simulated within FAF2. The mode shift reported in FAF2 indicates the demand for modes but is not constrained by capacity, costs, or existence of modal alternatives.

Intra-county trips are not included in the data, and FAF2 data sources tend to under-represent short trips. Additionally, water flows on the Columbia River that do not utilize Oregon's Ports are not included. These limitations are of minimal consequence in the statewide view of freight movement within Oregon that is the goal of this effort.

### Trucks

The FAF2 data distinguishes modes and mode combinations. For truck representation, only the mode 'Truck' and the domestic part of the international flow 'Air & Truck' were used, as shown in Exhibit A5. Combinations such as 'Truck & Rail' or domestic 'Air & Truck' were omitted assuming that the longer part of that trip is made by rail or air, and only a small portion of the trip relies on truck transportation; further the data set is not specific enough to distinguish which part of the trip is made by which mode. Of the 200,320 flows omitted, likely only a small portion of these trips are made by truck, and this shortcoming is assumed to be acceptably small. Data for land-border crossings included the portion of the trip from the border crossing to the domestic destination or from the domestic origin to the border crossing. Likewise, sea and air freight was included as a trip to or from the domestic port or airport. Truck trips to distribute air mail to each Oregon county, not included in FAF2, were added based on the OEA 2002 population distribution and forecast.

**Exhibit A5: FAF2 Truck Data Used in the Oregon CFF**




For the dominant modes, truck and rail, the Oregon CFF provides not only tonnage by origin-destination flows, but also vehicle flows on network links. After disaggregating the flows, commodity-specific payload factors (Battelle 2002: 29) were used to convert

FAF2 goods flows in tons into number of truck trips. An average empty-truck rate of 19.4% was assumed for all flows based on US Census Bureau truck data (2008). The annual FAF2 flows were converted to flows of an average weekday. Flows were divided by 365.25 days and then a factor of 1.048 was applied to transform Annual Average Daily Traffic (AADT) into Annual Average Weekday Traffic (AAWDT), based on national truck data. Finally, trucks were split into the two truck types: medium-heavy duty trucks weighing below 26,000 pounds and heavy-heavy duty trucks weighing 26,000 pounds and above. The share of each truck type depends on the distance of the truck flow – a longer distance implies a larger share of heavy-heavy duty trucks. The share of each truck type for five distance classes is based on the 2002 Vehicle Inventory and Use Survey (VIUS), published by the US Census Bureau (2004).

The resulting truck vehicle flows were assigned to the US highway network using the TransCAD software and US network. It should be noted that these truck trips no longer retain the tonnage and commodity information of the origin-destination flows. Assigning flows from one county to another requires designating one point within each county as the origin or destination of the flow, with geographic centroids commonly used for these points. In many cases, however, the geographic centroid of the county does not match the activity center in that zone, so the centroid of the largest city within each county was used instead to ensure that the representation of flows within every county is more realistic. During assignment, Medium-Heavy Duty (MHD) trucks are assumed to have a passenger car equivalent (PCE) of 1.5, Heavy-Heavy Duty (HHD) trucks are assumed to have a PCE of 2.5. This accounts for the additional space trucks use on the road in comparison to autos. Additionally, to make trucks sensitive to congestion in the assignment step, a volume delay function is used with adjusted coefficients ($\alpha = 1$ and $\beta = 6$, in the Bureau of Public Roads volume-delay function). Air mail (STCC 43) is not captured in the FAF2 data, so air and truck separate forecasts were developed for traffic generate by air mail and were added to the FAF2 data. These estimates assumed airport mail tonnage from airport statistics was further distributed to each county, based on the OEA forecasted state employment share (see further discussion under the air mode discussion below).

A detailed analysis of the shipping of fish (STCC 09) revealed that FAF2 and the truck disaggregation method to Oregon origins and destinations using agricultural employment by county did not capture fish flows with the desired detail. Further information was collected, and a fish commodity flow dataset was created synthetically to replace the FAF STCC9 flows (see discussion of 'specialty area' at the end of this chapter with further detail in Appendix D). An average payload factor of five tons per truck was assumed for both air mail and fish flows.

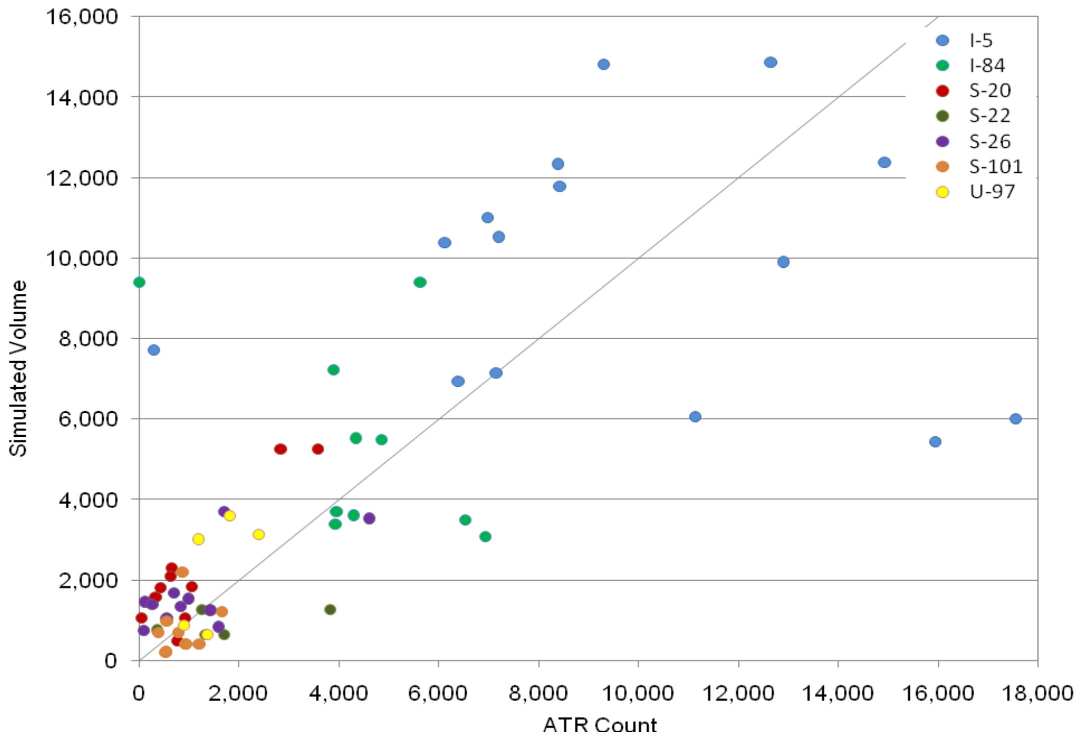
Traffic counts from 133 of Oregon's Automatic Traffic Recorder (ATR) stations were geo-referenced to the network to validate the truck assignment results (ODOT 2009). The ATR data provide total vehicle counts as well as counts by vehicle classification for year 2003. A first comparison of simulated truck volumes with ATR counts revealed a strong overestimation of traffic flows on I-84 and a comparable underestimation of truck flows on I-5, and a thorough network testing did not show any network problems. As the two highways I-5 (north-south) and I-84 (east-west) serve very different markets, this mismatch appears to result from underlying issues in the FAF2 data. A separate analysis of Internal-Internal (II), Internal-External/External-Internal (IE/EI) and External-External (EE) revealed that a significant contribution to this error was contributed by EE flows, which shows that long-distance trips are responsible for a large part of this mis-estimate.

Avoiding a reverse-engineering of the FAF2 data, an adjustment process was implemented that increases flows on I-5 and decreases flows on I-84. All origin-destination county pairs that generate trips using I-5 were isolated from those that contribute to traffic on I-84. Subsequently, tonnage flows for county pairs that use I-5 were scaled up, and flows using I-84 were scaled down. County pairs that use both I-5 and I-84 were not adjusted.

To develop the appropriate scaling factor for both I-5 and I-84, a weighted average deviation was calculated, giving more emphasis on count locations with higher volumes. Using the original flows, I-5 was underestimated by 53% and I-84 was overestimated by 78% – implying scaling factors of 2.169 and 0.357, respectively, to adjust the tonnage flows.

Exhibit A6 provides a validation of how the truck counts match assigned Oregon CFF truck trips. The averages of both I-5 and I-84 match the diagonal line (where the x-axis ATR traffic count would match the simulated Oregon CFF flow exactly), neglecting one unexplainable outlier on each highway with a truck count volume of 311 on I-5 and 8 on I-84. Overall, the match between estimated truck volumes and ATR counts is not unreasonable for truck simulation, but it should be noted that the commodities have been converted into truck loads based on national averages; through trips going through Oregon were disaggregated based on total employment numbers only; the highway network is a simplified national network that does not capture local capacity expansions; all intra-county trips are missing, reducing the simulated volumes and lacking congestion which may trigger detours in reality; and the count volumes represent an annual average, including all uncertainties when applied to comparisons with daily weekday volumes.

**Exhibit A6: Validation of Truck Volumes**




## Rail

The rail mode data obtained from the FAF2 dataset was compared to Oregon's confidential historical 2002 Rail Waybill dataset obtained by ODOT from the Surface Transportation Board. The Rail Waybill data was used to identify the pattern of flows in the 2002 base year, while the correlation provided a way to apply the FAF2 growth rates to the base year waybill data.

The Rail Waybill data trip ends (origin or destination) inside of Oregon were grouped by Freight Station Accounting Code (FSAC), specific to a station and a rail line, and the county code; trip ends outside of Oregon were identified by state name (including Canadian provinces). The data was further classified as the FAF2 Oregon Portland zone (Clackamas, Multnomah, Washington, or Yamhill Counties), FAF2 Oregon Remainder zone (all other counties), Portland Sea Port, Other Oregon Sea Port, or Rest of World to correspond with the categories in the FAF2 dataset.

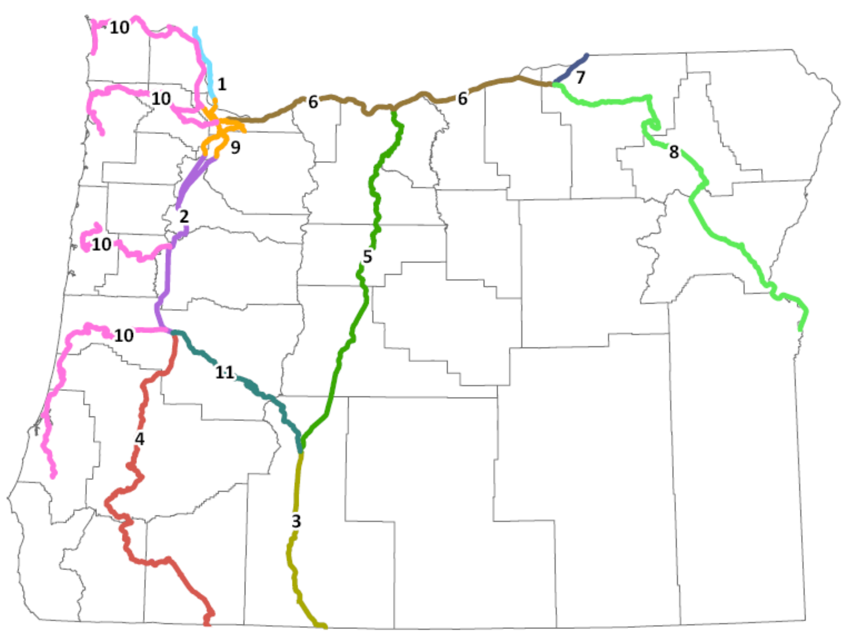
The Rail Waybill dataset is specific to Oregon and contains trips with an Oregon trip origin or destination, as well as trips that travel through Oregon without stopping for re-classification (i.e., trips from Washington to California). The FAF2 data covers the entire nation, and although it was possible to isolate the Oregon trip ends, it was difficult to identify rail through trips that do not stop for re-classification. It was therefore assumed that the origin-destination pairs (by county code, which is common between the two data sets) that appeared in the Rail Waybill data should be used instead of the same origin-destination trips from the FAF2 data. The total amount of through tonnage extracted from the Rail Waybill data was slightly larger (13,448 Ktons) than the tonnage in the same origin-destination pairs of the FAF2 data (12,083 Ktons). It should be noted that the Rail waybill dataset only includes traffic volumes that are reported by the Class I railroads (BNSF and UPRR). Traffic that moves locally on a shortline railroad or between multiple shortline railroads is not included in the dataset. For the base of year 2002, this volume is very small but is expected to grow in future years.

Because theses total amounts of tonnage are very close, the more geographically accurate and spatially disaggregated Rail Waybill data was used for the Oregon CFF baseline 2002 data.

The FAF2 dataset was used to calculate growth rates specific to each commodity from 2002 to 2035, which were applied to the base year rail waybill data. The total value of the future forecast was again very close to the FAF2 total tonnage forecast. The tonnage forecast maintains the city name for the Oregon rail stations and a US Census Bureau Federal Information Processing Standard (FIPS) code which identifies the county, for each trip end.

As with trucks, rail mode tonnage flows were assigned to the rail network, and the origin-destination tonnage data was aggregated by city or county. In addition to tonnage, rail cars were retained from the base year waybill dataset. Since the rail mode utilizes a pre-existing network of track infrastructure, it is logical to evaluate the tonnage flow by corridor; the dominant pre-existing corridors in Oregon are shown in A7. A uniform method was employed to assign the flows to the network, such that any flow starting and ending on the corridor was included in the full corridor flow. The detailed method of assigning certain origin-destination flows to each corridor is included in Appendix C.

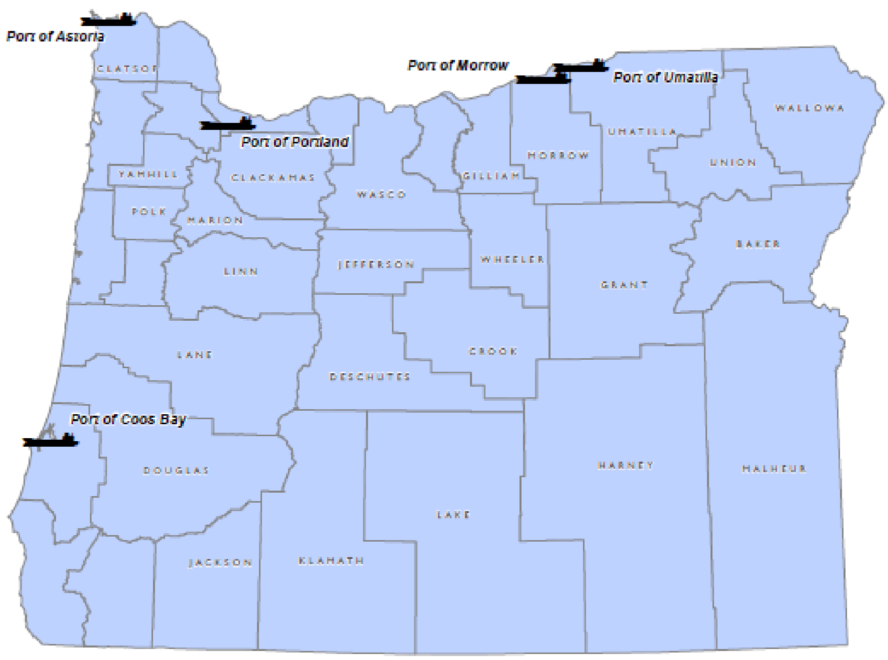
**Exhibit A7. Oregon Rail Corridor Network (coastal lines grouped in #10)**



## Water

The Oregon CFF includes the Marine Ports shown in Exhibit A8 – including two coastal ports, a collective set of facilities in the Portland Harbor, and two ports upstream on the Columbia River.  The Port of Newport was not included as it currently accommodates only limited commercial freight movement.

**Exhibit A8.  Oregon Ports**




*Note: The Port of Newport was not included as it currently accomodates only limited commercial freight movement.

The water flows in the Oregon CFF rely on the FHWA FAF2 dataset for base year flows and growth rates.  This dataset includes domestic and international marine flows that connect to land modes covered elsewhere in the Oregon CFF, to reach the true origin or destination points often outside of Oregon.  The FHWA FAF2 dataset commodities (SCTG) were converted to STCC categories using a simplified one-to-many relationship.

The FAF2 data was disaggregated to ports within Oregon, using the US Corps of Engineers Waterborne Commerce reports, and data from the Port of Portland website.  Through flows on the Columbia River, which is largely served by Washington and Idaho ports, and along the coast are not included in the Oregon CFF.

The FAF2 dataset water flows were aggregated to four regions: Other Domestic, Other International, Oregon Portland, and Oregon Remainder.  In doing so, the true origin, destination, intermodal flow is lost.9  All Oregon Portland FAF2 flows were assigned to

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9 For instance, an international import by sea to the Port of Portland that is shipped inland by rail or truck would be translated into two trips, an "Other Intl" trip to the "Portland Harbor", and a second trip from "Portland Harbor" to "Other Dom".  The international origin is lost in the second leg of the trip.

“Portland Harbor” with flows to and from multiple ports within the three-county region on the Columbia and Willamette Rivers. Auto commodity flows, missing from the FAF2 dataset, were added to Portland Harbor flows as imports from Asia, which is consistent with Port of Portland statistics (613 Ktons forecast for 2010), and assumes the 1993-2008 3.5% annual growth rate in auto imports. Fuel flows were also missing, and were added to internal and outbound domestic flows (577Ktons and 3082ktons, respectively in 2002), assuming a growth rate consistent with OEA population forecasts.

FAF2 water flows were allocated among the Oregon coastal ports in Coos Bay and Astoria to roughly match the commodity mix from the 2002 Waterborne Commerce data. Newport was not included, as no data was provided in this dataset.

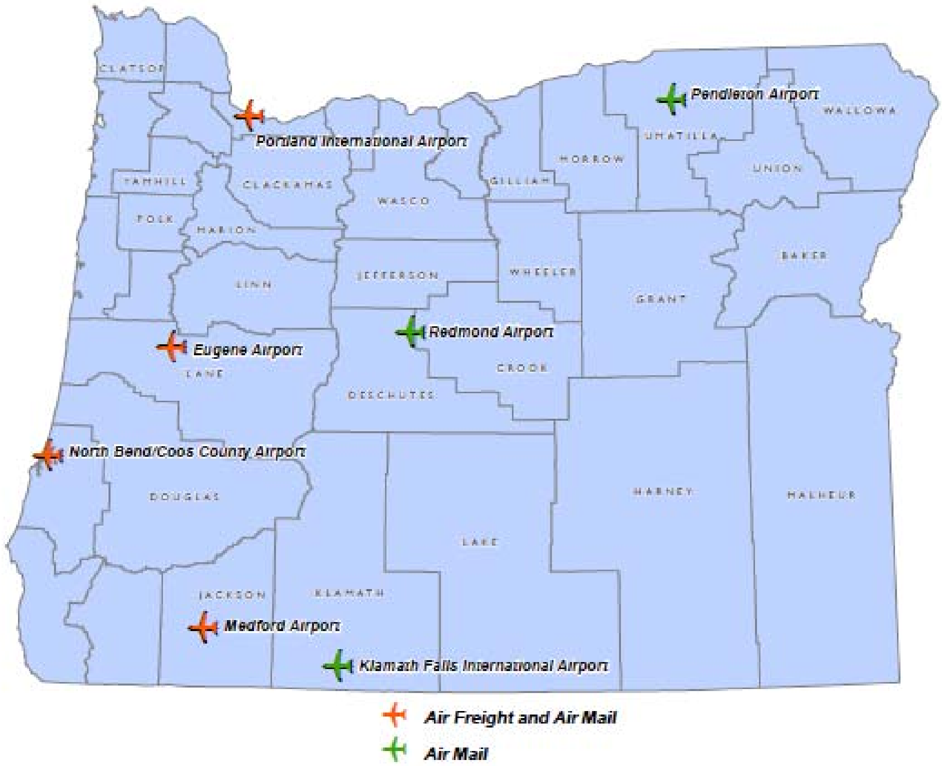
Remaining FAF2 flows were then allocated to the Columbia River ports in Umatilla and Morrow as follows:

- **Grain**: 65% allocated to Port of Umatilla, reflecting the Pendleton Grain Growers and CLD Pacific Grain facilities there for international and domestic grain imports. The remaining Columbia River grain exports were assumed to be shipped from the Port of Morrow via the Port of Portland.
- **Fuel**: 90% allocated to Umatilla tank farms, with the remainder to Morrow (linking to rail line).
- **Animal Feed**: Assumed to be hay from Morrow (100%).
- **Fertilizers**: Assumed to be allocated to the Umatilla Tidewater facility (100%)
- **Waste**: The significant quantity of waste/scrap (STCC 40) shipped from Washington to in containers, missing from FAF2 dataset, was added and grouped with Port of Morrow. Scrap/waste was assumed to represent the bulk of Arlington containers (200 Ktons in 2010, based on 22000 TEUs in 2008) and to grow consistent with the OEA’s Oregon population forecast to 2035.
- **Gravel**: A large flow of gravel from Washington to Oregon non-Portland ports (2 Mtons in 2002) was not consistent with the Waterborne Commerce data or with expert understanding of the river commerce, so it was dropped. This flow may consist of dredging materials that are not expected to be sustained in the forecast periods. A large internal movement of gravel within the Portland Harbor remains.
- **Other**: The remaining mix of commodities (24 Ktons in 2002 of chemical products, agriculture products, mixed freight, etc.), mostly international exports, were split between Port of Morrow (75% and Port of Umatilla (25%)

### Air

Portland (PDX), Medford (MFR), Eugene (EUG), and North Bend/Coos County (OTH) airports serve air freight, while Redmond (RDM), Klamath Falls (LMT), Pendleton (PDT) airports primarily carry air mail services. The locations of these airports are shown in Exhibit A9.

**Exhibit A9. Oregon Airports**




The air mode commodity flows in the Oregon CFF rely on FHWA FAF2 dataset for base year flows and growth rates. This dataset includes both domestic and international air flows. The FHWA FAF2 dataset commodities (SCTG) were converted to STCC categories using a simplified one-to-many relationship.

FAF2 data include shipments that typically weigh more than 100 pounds that are shipped by air by commercial or private aircraft, not including express shipments.10 The 2006 Portland/Vancouver Trade Capacity Analysis (Trade Study) shows air and express mail flows (STCC44) as 0.2% of Portland/Vancouver tonnage in 1997 (467 Ktons).

These small package flows are felt to be less important in a statewide freight view, and it should be noted that the limited data on mail and express shipping is also not very precise. The Port of Portland noted a significant shift in the reported air mail tonnage statistics when FedEx won the US Postal Service (USPS) contract and the actual mail volume for USPS was co-mingled with FedEx's freight volumes. Despite an increasing shift of consumer spending to on-line retail, small package carriers (integrators – FedEx and UPS) have experienced express volume declines since 2002.

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[10] This would exclude FedEx's <100 lb package volume which comprises approximately 99% of its total airfreight volume to or from Oregon (average package weight is approximately 35 lbs.) and UPS' <100 lb package volume which comprises approximately 97% of its total airfreight volume to or from Oregon (average package weight is approximately 8 lbs). FedEx packages going in and out of Oregon generally pass through the main sort facility in Portland. Similarly, UPS sort facilities are in Portland, Tualatin, Roseburg and Hermiston.

The FAF2 data was disaggregated to airports within Oregon, using airport air cargo and mail on/off tonnage statistics for 2007 and 2008 from websites and airport master plans. FAF2 flows were aggregated to flows between four regions: Other Domestic, Other International, Oregon Portland, and Oregon Remainder. In doing so, the true origin, destination, and intermodal flow are lost (see note under water flows above). Since total FAF2 2002 tonnage for the state was a reasonable match to 2008 airport statistics, after adjusting for different years' data, no overall adjustment was needed. Factors, shown in Exhibit A10, were applied to each aggregated flow among the state's airports to roughly balance 2002 inbound and outbound flows at each airport. Internal flows between PDX and other Oregon airports also had to be significantly reduced. The resulting 2035 flows are not very well balanced, for Oregon Remainder airports in particular, due to varying growth rates on FAF2 flows by commodity.

**Exhibit A10: Air Adjustment Factors by Aggregated Flows Factors**

| Airport Flow | Factors | |
|---|---|---|
| | Inbound flow | Outbound flows |
| PDX International | 0.34 | 0.62 |
| Oregon Remainder International | 1.00 | 0.05 |
| PDX Domestic | 2.25 | 0.90 |
| Oregon Remainder Internal | 1.00 | 0.15 |

The Oregon Remainder FAF2 zone was split into the three non-Portland airports, using the factors in Exhibit A11. A significant portion of FAF2 region Remainder flows were shifted to PDX, because although total tonnage for the state was reasonable, there were not enough PDX flows. All Oregon Remainder international flows were assigned to Medford (MFR).

**Exhibit A11: Factors for Allocating Flows among Oregon Airports**

| Airport | Oregon Remainder Share1 | Oregon Remainder Share2 |
|---|---|---|
| Portland (PDX) | 0.9435 | NA |
| Medford (MFR) | 0.0065 | 0.1147 |
| Eugene (EUG) | 0.0239 | 0.4236 |
| North Bend/Coos Bay (OTH) | 0.0260 | 0.4616 |

Note: Constant share for all years assumes airport relative size remains the same.

FAF2 does not include air mail flows, so air mail was added (assigned to STCC 50), based on tonnage statistics by airport in 2008. The growth in air mail was assumed to match statewide population annual growth of 1.3% from 2002 to 2035 and was assumed to travel to PDX before/after reaching other state airports.

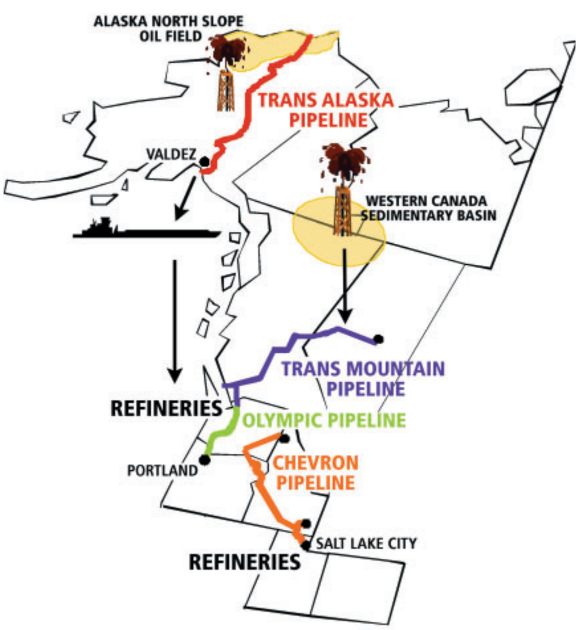
## Pipeline

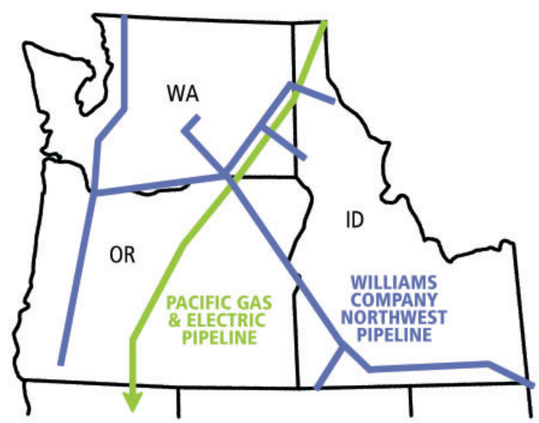
The pipeline flows in the Oregon CFF rely on FHWA FAF2 dataset for base year flows and growth rates. The FAF2 data was disaggregated to pipelines within Oregon using the 2007-2009 State of Oregon Energy Plan, and the websites of Oregon Department of Energy, Kinder Morgan Company, and various energy providers, as well as contact with representatives of these organizations. Natural gas was distributed among Oregon counties based on OEA population forecasts.

Pipeline flows cover two basic commodities: petroleum (SCTG17, SCTG18, and STCC29, which includes gasoline, jet fuel and diesel fuel) and natural gas (SCTG19, STCC13), which were treated separately. All other commodities in the FAF2 "Pipeline & unknown" mode were dropped, as non-pipeline flows. Petroleum is further distributed locally by trucks and barges, but these local trips are not included in the Oregon CFF. Natural gas was assumed to be distributed via local pipeline to each county from the nearest branch line.

Petroleum and natural gas pipeline networks for the Pacific Northwest are shown in Exhibit A12. FAF2 Petroleum flows (SCTG17 and SCTG18) were mapped to these pipeline routes, and volumes were scaled (0.79 factor applied to Olympic pipeline flows) to match Oregon Department of Energy data. Within Oregon petroleum flows consisted of the Kinder Morgan pipeline from Portland to Eugene, and it was assumed that a constant 34.6% share of the Olympic pipeline flow to Portland tank farms continues to be piped on to Eugene based on information from Kinder Morgan staff.

**Exhibit A12. Pipeline Networks: Petroleum (left) and Natural Gas (right)**



FAF2 natural gas flows were limited to pipeline flows from Idaho, Washington, and the Port of Portland (from British Columbia), and the proportions matched Oregon energy data. Significant through flows to California beyond Klamath Falls were teased out of the existing FAF2 flows, given known Oregon usage (FAF2 and Oregon statistics), and total flows through Oregon (FAF2). FAF2 forecasts capture the change in inbound sources starting in 2010, at which point, a price equalization plan will be in place that will mean Oregon receives more of its gas from the Rocky Mountains than it does today. FAF2 assumes 3M3M tons from the Williams Washington pipeline will shift to the PGE Idaho (Alberta) source. FAF2 further assumes a limited growth in through flows to California between 2002 and 2010. Oregon counties served by the Williams, WA I-5 pipeline exceeded FAF2 flows, so flows were shifted from the Williams Columbia River branch as needed. Flows were further distributed to each county based on OEA county population patterns and growth forecasts.

### Specialty or targeted areas: Commercial Fishing

Initially, STCC9 fresh fish was assumed to be produced within Oregon in a spatial pattern of other agriculture products, following the pattern of Oregon agriculture employment. However, because of the high importance and special circumstances of this particular commodity, these initial assumptions were refined. The resulting approach combines fish landing data from the Dungeness Crab Association and Oregon Department of Fish and Wildlife plus port interview data. These fish flows, a total of 219Ktons in 2002 (0.07% of total state freight tonnage), were assumed to be produced on the Oregon coast or nearby fish farms or imported from Alaska or international origins. Half of this tonnage then was then assumed to move to points for internal consumption within the state, with the remainder sent outbound primarily by truck, water, and some air movements (70 Ktons for all modes in 2002). The modified fish commodity is thus housed separately from the modal datasets. A full description of the assumed fish commodity flows data and assumptions are included in Appendix D.

### Structure and Design of the Commodity Flow Forecast Database

All five of the mode-specific processed data files plus special air mail and fish commodity datasets comprise a master commodity flow dataset containing two types of files:

- Origin-destination tonnage flow by commodity and mode
- Assigned flows by link/corridor and vehicle type (truck and rail only)

The origin-destination tonnage flow file contains the geographic identifier (county within Oregon) of the origin and destination, commodity code(s), mode, and tonnage for each origin-destination pair. This data covers the 2002 base year and the forecast years in 5-year increments out to 2035. The assigned flows cover the truck and rail modes, with the flows assigned to the associated network for each (see discussion in methodology section).

# Appendix B: Commodity Codes (STCC and SCTG)

### Exhibit B1: Standard Transportation Commodity Code (STCC)

| STCC | Description |
|---|---|
| 1 | Farm products |
| 8 | Forest products |
| 9 | Fresh fish |
| 10 | Metallic ores |
| 11 | Coal |
| 13 | Crude petroleum, natural gas or gasoline |
| 14 | Nonmetallic ores, minerals, excluding fuels |
| 19 | Ordnance or accessories |
| 20 | Food and kindred products |
| 21 | Tobacco products, excluding insecticides |
| 22 | Textile mill products |
| 23 | Apparel or other finished textile products or knit apparel |
| 24 | Lumber or wood products, excluding furniture |
| 25 | Furniture or fixtures |
| 26 | Pulp, paper, or allied products |
| 27 | Printed matter |
| 28 | Chemicals or allied products |
| 29 | Petroleum or coal products |
| 30 | Rubber or miscellaneous plastics products |
| 31 | Leather or leather products |
| 32 | Clay, concrete, glass, or stone products |
| 33 | Primary metal products |
| 34 | Fabricated metal products |
| 35 | Machinery, excluding electrical |
| 36 | Electrical machinery, equipment, or supplies |
| 37 | Transportation equipment |
| 38 | Instruments, photographic goods, optical goods, watches, or clocks |
| 39 | Miscellaneous products of manufacturing |
| 40 | Waste or scrap materials not identified by producing industry |
| 41 | Miscellaneous freight shipments |
| 42 | Containers, carriers or devices, shipping, returned empty |
| 43 | Mail |
| 45 | Shipper association or other associated traffic |
| 46 | Miscellaneous mixed shipments |
| 47 | Small packaged freight movements |
| 48 | Waste hazardous materials or waste hazardous substances |
| 49 | Other Waste |
| 50 | Bulk in boxcar |

### Exhibit B2: Standard Classification of Transported Goods (SCTG) commodity codes

| Code | Commodity Class |
|---|---|
| 01 | Live animals and live fish |
| 02 | Cereal grains |
| 03 | Other agricultural products |
| 04 | Animal feed and products of animal origin, not elsewhere classified (n.e.c.) |
| 05 | Meat, fish, seafood, and their preparations |
| 06 | Milled grain products and preparations, and bakery products |
| 07 | Other prepared foodstuffs and fats and oils |
| 08 | Alcoholic beverages |
| 09 | Tobacco products |
| 10 | Monumental or building stone |
| 11 | Natural sands |
| 12 | Gravel and crushed stone |
| 13 | Nonmetallic minerals n.e.c. |
| 14 | Metallic ores and concentrates |
| 15 | Coal |
| 16 | Crude Petroleum |
| 17 | Gasoline and aviation turbine fuel |
| 18 | Fuel oils |
| 19 | Coal and petroleum products, n.e.c. |
| 20 | Basic chemicals |
| 21 | Pharmaceutical products |
| 22 | Fertilizers |
| 23 | Chemical products and preparations, n.e.c. |
| 24 | Plastics and rubber |
| 25 | Logs and other wood in the rough |
| 26 | Wood products |
| 27 | Pulp, newsprint, paper, and paperboard |
| 28 | Paper or paperboard articles |
| 29 | Printed products |
| 30 | Textiles, leather, and articles of textiles or leather |
| 31 | Nonmetallic mineral products |
| 32 | Base metal in primary or semi-finished forms and in finished basic shapes |
| 33 | Articles of base metal |
| 34 | Machinery |
| 35 | Electronic and other electrical equipment and components and office equipment |
| 36 | Motorized and other vehicles (including parts) |
| 37 | Transportation equipment, n.e.c. |
| 38 | Precision instruments and apparatus |
| 39 | Furniture, mattresses and mattress supports, lamps, lighting fittings |
| 40 | Miscellaneous manufactured products |
| 41 | Waste and scrap |
| 43 | Mixed freight |

# Appendix C: Rail Corridors Assignment Method

This appendix describes the process used to aggregate rail flows to corridors. The rail origin-destination tonnages were assigned to the Oregon rail network. A rail corridor tonnage flow was counted in the origin corridor, destination corridor, and the corridors it had to traverse.

Exhibit C1 summarizes the corridors (Exhibit 10) assigned to each origin-destination flow. For the BNSF line, the regions outside of Oregon were defined as follows:

- BNSFNW: British Columbia, Saskatchewan, Alberta, and Washington State
- BNSFSW: California, Arizona, Nevada, New Mexico, Utah
- BNSFEAST: All other states and provinces

For the UPRR line, the regions out of Oregon were defined as follows:

- UPNW: Washington
- UPSW: California, Arizona, Nevada, New Mexico
- UPCAN: All Canadian Provinces
- UPEAST: All other US States

Inside of Oregon, each FSAC code tied a station to the corridor it falls into.

It was not possible to tie the ‘through’ flows between California and Canada to a specific corridor because there are two different corridors for entering the state from the north. Modal experts determined that a 25-75% split between flows traveling on Corridor 1 versus Corridor 7 from or to Canada should be assumed. The tonnage flowing through the state from the NW to the SW was summarized. The through tonnage was then multiplied by .25 and added to Corridors 1 and 5, and multiplied by .75 and added to Corridors 7 and 6. Corridors 9, 2, 11, and 3 received all of tonnage because they are the common corridors through the state for both entry corridors.

## Exhibit C1: Assignment Logic for Rail Corridor Flows

| OD1 | OD2 | Corridors Traveled | | | | | |
|---|---|---|---|---|---|---|---|
| BNSFNW | 2 | 1 | 2 | 9 | | | |
| BNSFNW | 9 | 1 | 9 | | | | |
| BNSFNW | 5 | 1 | 9 | 5 | 6 | | |
| BNSFNW | 3 | 1 | 9 | 5 | 6 | | |
| BNSFNW | 10 | 1 | 9 | 10 | | | |
| BNSFNW | BNSFSW | 1 | 5 | 3 | 6 | | |
| BNSFSW | 3 | 3 | | | | | |
| BNSFSW | 5 | 3 | 5 | | | | |
| BNSFSW | 9 | 3 | 5 | 6 | 9 | | |
| BNSFSW | 2 | 3 | 5 | 6 | 9 | 2 | |
| BNSFSW | 10 | 3 | 5 | 6 | 9 | 10 | |
| BNSFEAST | 9 | 6 | 9 | | | | |
| BNSFEAST | 2 | 6 | 9 | 2 | | | |
| BNSFEAST | 10 | 6 | 9 | 10 | | | |
| UPNW | 9 | 1 | 9 | | | | |
| UPNW | 2 | 1 | 9 | 2 | | | |
| UPNW | 3 | 1 | 9 | 2 | 3 | 11 | |
| UPNW | 4 | 1 | 9 | 2 | 4 | | |
| UPNW | 5 | 1 | 9 | 6 | 5 | | |
| UPNW | 6 | 1 | 9 | 6 | | | |
| UPNW | 7 | 1 | 9 | 6 | 7 | | |
| UPNW | 8 | 1 | 9 | 6 | 8 | | |
| UPSW | 9 | 3 | 2 | 9 | | | |
| UPSW | 2 | 3 | 2 | | | | |
| UPSW | 3 | 3 | | | | | |
| UPSW | 4 | 3 | 4 | | | | |
| UPSW | 5 | 3 | 2 | 9 | 6 | 5 | |
| UPSW | 6 | 3 | 2 | 9 | 6 | 11 | |
| UPSW | 7 | 2 | 3 | 9 | 6 | 7 | 11 |
| UPSW | 8 | 2 | 3 | 9 | 6 | 8 | 11 |
| UPCAN | 9 | 7 | 6 | 9 | | | |
| UPCAN | 2 | 7 | 6 | 9 | 2 | | |
| UPCAN | 3 | 7 | 6 | 9 | 2 | 3 | 11 |
| UPCAN | 4 | 7 | 6 | 9 | 2 | 4 | |
| UPCAN | 5 | 7 | 6 | 5 | | | |
| UPCAN | 6 | 7 | 6 | | | | |
| UPCAN | 7 | 7 | | | | | |
| UPCAN | 8 | 7 | 8 | | | | |
| UPEAST | 9 | 8 | 6 | 9 | | | |
| UPEAST | 2 | 8 | 6 | 9 | 2 | | |
| UPEAST | 3 | 8 | 6 | 9 | 2 | 4 | 11 |
| UPEAST | 4 | 8 | 6 | 9 | 2 | 4 | |
| UPEAST | 5 | 8 | 6 | 5 | | | |
| UPEAST | 6 | 8 | 6 | | | | |
| UPEAST | 7 | 8 | 7 | | | | |
| UPEAST | 8 | 8 | | | | | |

# Appendix D: STCC9 Fish Commodity Base Year and Forecast Assumptions

### Commercial Fishing Methodology Memo

### Objective

Oregon's commercial fishing industry is a substantial contribution to Oregon's coastal economy and is the livelihood for many Oregon residents. It also is a growing industry both domestically and internationally. Although the tonnage is less than 1% of the total commodity flow on a statewide basis, the impact on Oregon's economy and the value of the product cannot be understated.

This methodology memo is intended to list the process and assumptions used to develop a baseline commodity flow forecast for commercial fish in Oregon. This work is intended to provide a higher level of detail for Oregon than that which is included in national and international datasets such as the Freight Analysis Framework, but continues to utilize those datasets as one basis for estimating the distribution of commercial fish within and outside of Oregon.

For the purposes of this memo, commercial fishing includes salt-water seafood, fresh-water catch, as well as fish farm product.

### Data Sources

This methodology is based on pulling together a variety of data sources. These sources, and how they are proposed to be used for the Commercial Fish commodity flow forecast, are listed below. For the commodity flow forecast, which is in terms of short or "English" tons, data sources reporting in Metric tons have been converted to short tons here. A Metric ton equals approximately 1.1 short tons.

- Pacific Coast Fisheries Information Network (PacFIN) database via a report by BST Associates.
- Oregon Aquaculture Association for information on small, commercial fish producers (fish farms; http://www.oregonaquaculture.org).
- Oregon Department of Fish and Wildlife, Commercial Fish Landings (by Port for ocean fishing, by county for fresh fish, above or below Bonneville Dam for Columbia River).
- "Oregon's Commercial Fishing Industry: Year 2005 and 2006 Review and Year 2007 Outlook", Oregon Department of Fish and Wildlife and Oregon Coastal Zone Management Association Inc., June 2007.
- Discussions with Pacific Seafood (Monica Isbell, July 2009) for mode split, direction and distribution of flow.

### Definition of "Fresh Fish" In Commodity Flow Database

Detailed definition of the "Fresh Fish" commodity is by Standard Classification of Transported Goods Code (SCTG) and Standard Transportation Commodity Code (STCC) codes. The FAF2 provides SCTG that is converted to STCC for the Oregon Commodity Flow forecast. Thus, the components of the Commercial Fish commodity relevant to Oregon are, using the STCC coding:

- STCC09 FRESH FISH OR OTHER MARINE PRODUCTS
  - 091 FRESH FISH OR OTHER MARINE PRODUCTS EXC. PROCESSED
  - 0912 FRESH FISH PRODUCTS, OR FRESH UNPACKAGED (UNPROCESSED) FISH EXC. FRESH OR FRESH FROZEN PROCESSED FISH 2035
  - 09121 FINFISH
  - 09122 SHELLFISH
  - 0913 OTHER MARINE PRODUCTS
  - 09131 SHELLS, OYSTER, CRAB, CLAM, ETC.
  - 09139 MISC. MARINE PRODUCTS, NEC
  - 098 FISH HATCHERIES, FARMS, PRESERVES

**Assumptions**

A variety of assumptions are also necessary to develop a baseline forecast. These include:

- The commodity category of "Fresh Fish" includes commercial fish landed in Oregon (mostly the Oregon coast), plus fish transported to Oregon from Alaska, Hawaii, California and overseas.
- Ocean fish include fish, crab, oysters, and other shellfish.
- Oregon's commercial fishing industry accounts for approximately half (106,000 short tons out of 219,000 short tons) of the total fish/seafood commodity flow, based on the Pacific Coast Fisheries Information Network (PacFIN), ODFW and Freight Analysis Framework databases for the calibration base year of 2002.
- Oregon's fish farms (small, commercial fish producers of trout, steelhead, bass, etc.) account for approximately 0.5% of the fresh fish commodity flow in Oregon (based on information from the Oregon Aquaculture Association).
- Fresh fish tracked by ODFW includes trout, crayfish, and shrimp.

Based on the "Commercial Fishing Industry" report and outlook, and recent trends including establishment of marine preserves off the Oregon coast, the following assumptions are made regarding growth in the industry:

- The South Coast commercial fishing industry will experience continued declining of the fleet, reduction of fisheries and species depletion, and continued consolidation of the commercial fish processing industry. The ports have been making funding requests for cold storage and processing facilities, and it is assumed that these eventually will get built. Additionally, there is a small but growing industry of transporting live commercial fish commodity. Thus the forecast is for an offset between the fleet decline, new storage and processing centers, and the new live market, and commercial fishing growth in the South Coast will be flat.
- The North Coast will continue to experience constrained growth due to depletion of certain fish species, limits due to tribal fishing treaties, and competition from the Alaska and Washington fleets off the Oregon Coast. It will continue to see

some growth in demand. Thus, growth rates for North Coast counties will be approximately 2-3% per year.

- To keep pace with increased demand in Oregon, domestically in the US, and internationally, Oregon's fish farming industry as well as the Columbia River fisheries will continue to see moderate growth, on the order of 2% per year.

Based on the BST report, using the Pacific Ocean commercial fish landings (tons) and value from 2002, adjusted to 2008 dollars, commercial fish is valued at $795,000 per kilo-Ton ($70,000,000 total value divided by 88 Ktons).

**Commodity Flow Parameters**

The commercial fishing supply chain is assumed to consist of the following:

- Ocean fish: fish are caught at sea and brought back to Oregon either for processing or for transporting live (a small, but growing industry). Processing consists of gutting and filleting the fish. Two products are created from this process- fresh fish for sale to the public via stores and restaurants and canned fish (including fish products) for domestic and export sales. Fresh Fish is distributed within a limited number of hours of processing either by refrigerated container/truck for local and regional delivery or by air cargo for national and international markets. Canned fish and fish products are packaged in containers and shipped both domestically (rail and truck) and internationally by ocean vessels.
- The parameters should then reflect the two product types.

Using the assumptions and data above, Exhibit C-1 below summarizes the 2002 commercial fish tonnage produced, by county, as well as 2035 projections. Exhibit C-2 summarizes value.

Other parameters are as follows:

- Domestic/International Split:
    - 34% international
    - 66% domestic.
- Mode Split
    - Ocean – 34%
    - Truck – 55%
    - Air – 10%
    - Rail – 1%.
- Direction of Domestic Flows Outside Oregon:
    - 35% north into Washington
    - 10% east (Idaho, Montana, others)
    - 55% south into California.
- Use FAF2-based method to split out within-Oregon vs. outbound flows
- County disaggregation of flow destinations within Oregon should roughly match population.

Additionally, the commodity flow forecast is being calibrated to the 2002 base year of the Freight Analysis Framework (FAF2). The studies and data referenced in this memo attempt to utilize 2002 data where possible. However, there have been some recent trends regarding fleet condition, depletion of fisheries for certain species while opening of new fisheries for other species, tribal fishing treaties and catch limits, and other events that are ever-changing the nature of commercial fishing. As a reasonableness check, the 2010 year for the commodity flow forecast will be checked against 2008 and 2009 catch data.

## Exhibit D1: Calculation of Commodity Flow Tonnage, Production End

| Commercial Fishing Baseline | Landed | | Adjusted to Include Imported From Elsewhere | | Annual Growth Rate | 2035 Estimate |
|---|---|---|---|---|---|---|
| **County** | **Pounds (2002)** | **kTons (2002)** | **kTons(2002)** | **Share** | | |
| Benton | 100000 | 0.1 | 0.1 | 0.05% | 2% | 0.17 |
| Clackamas | 428371 | 0.2 | 0.4 | 0.21% | 2% | 0.74 |
| Clatsop | 105600000 | 52.8 | 110.9 | 49.59% | 3% | 232.16 |
| Columbia | 362234 | 0.2 | 0.4 | 0.17% | 2% | 0.62 |
| Coos | 13200000 | 6.6 | 13.9 | 6.20% | 0% | 13.86 |
| Curry | 8800000 | 4.4 | 9.2 | 4.13% | 0% | 9.24 |
| Douglas | 2200000 | 1.1 | 2.3 | 1.03% | 0% | 2.31 |
| Gilliam | 490554 | 0.2 | 0.5 | 0.23% | 2% | 0.85 |
| Grant | 100000 | 0.1 | 0.1 | 0.05% | 2% | 0.17 |
| Hood River | 738665 | 0.4 | 0.8 | 0.35% | 2% | 1.27 |
| Jefferson | 32619 | 0.0 | 0.0 | 0.02% | 2% | 0.06 |
| Lake | 161000 | 0.1 | 0.2 | 0.08% | 1% | 0.22 |
| Lane | 6700000 | 3.4 | 7.0 | 3.15% | 0% | 7.04 |
| Lincoln | 66000000 | 33.0 | 69.3 | 30.99% | 2% | 113.69 |
| Marion | 200000 | 0.1 | 0.2 | 0.09% | 2% | 0.34 |
| Morrow | 392443 | 0.2 | 0.4 | 0.18% | 2% | 0.68 |
| Multnomah | 226396 | 0.1 | 0.2 | 0.11% | 1% | 0.30 |
| Tillamook | 6600000 | 3.3 | 6.9 | 3.10% | 2% | 11.37 |
| Wasco | 490554 | 0.2 | 0.5 | 0.23% | 2% | 0.85 |
| Washington | 116000 | 0.1 | 0.1 | 0.05% | 1% | 0.16 |
| | | | | | | |
| TOTAL | 212410463.6 | 106.5 | 219.0 | 100% | 2.5% | 396.09 |

**Exhibit D2. Value of Commercial Fish Commodity Flow, Production End ($2008)**

| Commercial Fishing Baseline | Value | |
|---|---|---|
| County | 2002 | 2035 |
| Benton | $ 39,750 | $ 83,475 |
| Clackamas | $ 170,278 | $ 357,583 |
| Clatsop | $ 41,976,000 | $ 88,149,600 |
| Columbia | $ 143,988 | $ 302,374 |
| Coos | $ 5,247,000 | $ 11,018,700 |
| Curry | $ 3,498,000 | $ 7,345,800 |
| Douglas | $ 874,500 | $ 1,836,450 |
| Gilliam | $ 194,995 | $ 409,490 |
| Grant | $ 39,750 | $ 83,475 |
| Hood River | $ 293,619 | $ 616,600 |
| Jefferson | $ 12,966 | $ 27,229 |
| Lake | $ 63,998 | $ 134,395 |
| Lane | $ 2,663,250 | $ 5,592,825 |
| Lincoln | $ 26,235,000 | $ 55,093,500 |
| Marion | $ 79,500 | $ 166,950 |
| Morrow | $ 155,996 | $ 327,592 |
| Multnomah | $ 89,992 | $ 188,984 |
| Tillamook | $ 2,623,500 | $ 5,509,350 |
| Wasco | $ 194,995 | $ 409,490 |
| Washington | $ 46,110 | $ 96,831 |