JOINT TRANSPORTATION COMMITTEE

Washington State Air Cargo Movement Study

FINAL REPORT:
Appendix A – Market, Facilities and Forecast Technical Report

May 9, 2018
Note: *Minor revisions were made to this document, but the original analysis and data have not changed.*

Submitted by

WSP and KPA

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ACRONYMS

ACRP .... Airport Cooperative Research Program
ATI .... Air Transport International
ATS .... Aviation Technical Services
CAGR .... Compound Annual Growth Rate
CBP .... Custom and Border Patrol
DOT .... Department of Transportation
FAA .... Federal Aviation Administration
GDP .... Gross Domestic Product
GEG .... Spokane International Airport
HS .... Harmonized System
IATA .... International Air Transport Association
IMC .... Instrument Meteorological Conditions
LAX .... Los Angeles International Airport
LCF .... Large Cargo Freighter
LOS .... Level of Service
MRO .... Maintenance, Repair and Overhaul
NCA .... Nippon Cargo Airlines
NPIAS .... National Plan of Integrated Airport Systems
PPRP .... Prior Permission Required Pavement
RDC .... Runway Design Code
RFP .... Request for Proposal
RFS .... Road Feeder Service
RPZ .... Runway Protection Zones
SAMP .... Sustainable Airport Master Plan
SASA .... South Aviation Support Area
SODO .... South of Downtown
SSW .... South-Southwest
TSA .... Transportation Security Administration
UPS .... United Parcel Service
WASP .... Washington Aviation State Plan
WPA .... Works Progress Administration
YOY .... Year-Over-Year
YTD .... Year-to-Date

AIRPORT CODES

ALW .... Walla Walla Regional Airport
BFI .... Boeing Field International Airport
BLI .... Bellingham International Airport
EAT .... Pangborn Memorial Airport
MWH .... Grant County International Airport
PAE .... Snohomish County Airport/Paine Field
PSC .... Tri-Cities Airport
SEA .... Seattle-Tacoma International Airport
YKM .... Yakima Air Terminal/McAllister Field

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1   Introduction

The Joint Transportation Committee of the Washington State Legislature initiated this study to evaluate the current and future capacity of the statewide air cargo system. The study objectives are the following:

■   Educate policy makers about air cargo movement at Washington state airports.

■   Explore possibilities for accommodating the growing air cargo market at more airports around the state.

■   Identify the State of Washington's interest and role in addressing issues arising from air cargo congestion.

Seattle-Tacoma International Airport (Sea-Tac) dominates the Washington state air cargo market. The Washington State Department of Transportation's Washington Aviation System Plan (2017) states:

> "the ability of SEA to accommodate and expand air cargo activity, particularly international freighter service, should be closely monitored due to recent, dramatic, increases in demand and discussions of expansion of air passenger and maintenance, repair and overhaul activities."

This study will identify opportunities and constraints for using existing capacity at other airports around the state to meet the increasing demand for cargo operations, potentially reducing the growth that Sea-Tac must accommodate.

This technical report provides the foundational data and analysis for the study and includes the following:

■   An air cargo profile that includes industry background, historic trends, and a description of the airports in the state

■   An assessment of the market capture of state airports

■   An inventory of the air cargo facilities and services at airports in the state

■   A forecast of future air cargo demand within the state

■   Future facility requirements needed to meet the projected air cargo demand within the state

This technical report will serve as a reference throughout the study. The forecast and analysis of future facility requirements are being used to evaluate the costs of air cargo congestion at state airports. The report will also be used to identify opportunities and constraints at airports throughout the state in the next task. Finally, the analysis will support development of strategies to better utilize existing capacity and meet projected demand at state airports.

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Some of the key findings detailed in this report include:

■ Air cargo in the state is primarily generated at three airports: Sea-Tac, the nearby King County International (Boeing Field) Airport, and Spokane International.

■ Non-hub and small commercial passenger airports account for less the 5 percent of state volume, although Moses Lake has unusual capabilities for very large freighters.

■ Most of the expansion of air cargo within the state has been driven by the increase in international wide-body aircraft passenger service at Sea-Tac, and there is recent growth in express cargo driven by e-commerce.

■ The growth in e-commerce presents opportunities statewide as the integrated carriers which handle the lion's share of e-commerce are the principal operators at most airports apart from Sea-Tac. Additionally, since rapid delivery service is a crucial component of e-commerce, this requires local staging of goods near the delivery point, which favors regional airports for part of the business.

■ Sea-Tac is a significant gateway for export and import trade with East Asian countries. This is the chief corridor for the state's international trade by air. For most product categories, Sea-Tac is accommodating Washington state demand and reaching into Oregon, Idaho, and British Columbia, although a few exceptions are discussed in Chapter 3.

■ The forecast air cargo growth rate for Washington state is 3.5 percent compounded annually, which puts total annual growth through the next 10 years over 4 percent. This is driven by the projections for Sea-Tac, but there is growth forecast everywhere in the state.

■ Statewide, airport facilities should be able to absorb the volume. The exception may be Sea-Tac where competition between the development of cargo facilities and the need for expanding passenger terminals. Questions regarding cargo building space are explored in Chapter 6. The pending update of the Port of Seattle's Sustainable Airport Master Plan (SAMP) should clarify some of these questions, and landside matters are taken up in the next stage of this study.

■ These findings and other information in this report will serve as input to future tasks including analysis of congestion and opportunities and constraints at airports around the state.

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2   Air Cargo Profile

2.1   INTRODUCTION

This report profiles the air cargo market and air facilities that make up the air cargo system in Washington state. It provides an overview of how the air cargo industry operates, air cargo activity levels, and current air cargo trends in the context of Washington state. This report reviews international and local historical data and includes interviews with industry stakeholders.

This report relied on recent airport studies and plans. However, air cargo data for many Washington state airports does not exist or the data was often incomplete or inconsistent.

To remedy this situation, this report relies heavily on historical air cargo data published by the U.S. Department of Transportation (U.S. DOT) Bureau of Transportation Statistics in Form 41 T-100 Market data. The Port of Seattle provided historical data for Sea-Tac, and Spokane Airports provided data for Spokane International Airport. Air cargo tonnages used in this report are in metric tons unless otherwise noted.

Key findings include:

- Air cargo in Washington state is primarily generated by activity at Sea-Tac, King County, and Spokane International Airports.

- Reflecting trends in the general economy, as well as systemic changes in the air cargo industry, air cargo volumes in Washington state have fluctuated significantly over the past 12 years.

- Most of the growth in air cargo within the state is driven by the increase in international wide-body aircraft air service at Sea-Tac, although e-commerce is recently having an effect.

- Sea-Tac dominates the State air cargo market due to the size of the Seattle metro market, number of wide-body aircraft (both passenger and freighter) in service, the variety of destinations served, the frequency of departures and arrivals, the large investment in infrastructure and facilities, and the network of air freight forwarders that has developed near the airport.

- Most small airports in the state have experienced a decline in air cargo volumes corresponding to a reduction of passenger service at smaller airports, the downsizing of aircraft serving the smaller markets, and a shift of air cargo to trucks.

- Nevertheless, secondary airports in the state can also play an important role for specialized services, as reliever airports during peak shipping seasons, and potentially for e-commerce.

These findings and others in this technical report will be used in development of opportunities and constraints and a statewide air cargo strategy later in this study.

The report utilizes a number of aviation terms, which are defined in a glossary at the end of the document.

2.2   AIR CARGO INDUSTRY BACKGROUND

Air cargo is a $67 billion business worldwide—representing 15 percent of total traffic revenue of the worldwide airline business—and supports approximately 68 million jobs. According to the International Air Transport Association (IATA), the value of goods shipped by air in 2016 was USD $6 trillion dollars.

Air cargo is an increasingly important component of the U.S. economy. In 2015, air freight accounted for 25 percent of the total U.S. import and export trade of $ 4.2 trillion (*Freight Facts and Figures* 2017, published by U.S. DOT).

2.2.1   *Air Cargo Carriers*

In its simplest form, the air cargo market is made up of freight and mail. Air mail in the United States is contracted out by the U.S. Postal Service and travels in the belly hold of commercial passenger aircraft and on freighters operated by contractors. Air freight refers to all cargo other than mail; freighters are aircraft that exclusively carry cargo. Air cargo carriers can be divided into the following components: passenger airlines, traditional all-cargo carriers, and service oriented integrated/express all-cargo carriers.

Air cargo carriers operate under two distinct business models: the door-to-door model and the airport-to-airport model. Each model is based on differing characteristics, varies in its deployment of resources, has differing levels of required capitalization, and yields significantly different levels of return on investment.

The more traditional air cargo business model is the airport-to-airport service. As the name implies, this model is based carrying freight from an originating airport to a destination airport. Freight is delivered to the originating airport from the shipper's dock by a third-party service—typically a freight forwarder—who then tenders it to the airline. At the destination airport, a third-party service—typically an agent of the originating freight forwarder—takes possession of the freight for delivery to the consignee. This type of airport-to-airport carriage is provided by both the passenger and all-cargo airlines.

The cargo-carrying passenger airlines (e.g., American Airlines and Delta Air Lines) emphasize the use of lower deck (or "belly space") of their scheduled passenger aircraft, while the traditional air cargo airlines (e.g., Polar Air Cargo, Cargolux, and Nippon Cargo Airlines) have entire fleets dedicated to air cargo and have few limits on cargo size or type. Some passenger carriers (e.g., Alaska Airlines, China Airlines and Korean Air) also have dedicated freighter aircraft, and others may operate "combis" (i.e., aircraft that are designed to carry a combination of both cargo and passengers on the main deck).

The carriers using the door-to-door model are referred to as the integrator/express carriers because they integrate the complete line of services in the air cargo logistics chain from initial pickup from the shipper's dock to final delivery at the consignee's door into one complete package. This is most often used by services with time-definite delivery standards. Integrator/express carriers typically own and operate their own aircraft, ground transport and IT systems, and essentially provide complete custodial control of the shipment and offer real-time shipment tracking. These assets—all under control of one organization—make possible the seamless flow of goods that provide shippers with substantial

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reductions in their lead times, a critical service element for most of the industries around the world. The two primary integrator/express air cargo carriers are FedEx and UPS. International express traffic has continued to grow faster than the average world air cargo growth rate, expanding 8.9 percent in 2012 and 5.8 percent in 2013.

The distinction between express and general air cargo, however, is beginning to blur. Traditional providers are expanding their time-definite offerings, and express carriers, freight airlines, and postal authorities are consolidating. Air cargo customers have benefited from increased service options and lower prices as a result.

In both airline business models, third-party logistics services are provided both in-house and by contract management companies. For the traditional air cargo carrier, the freight forwarder is the primary customer. Integrator/express carriers, offer supply chain management services as a core competency and a significant part of their business.

Table 2-1 shows the top 10 air cargo airlines in 2016 based on total weight. With the exception of FedEx and UPS, the top world air cargo airlines are the international combination passenger and freighter operators. Most domestic freight in the United States moves by truck rather than by air, including a significant portion of the express traffic handled by FedEx and UPS. This situation limits the amount of air cargo growth that can be expected at non-international hub Washington state airports serving the domestic passenger market.

> Most domestic freight in the United States moves by truck rather than air, which limits the amount of air cargo that can be expected at non-international airports.

Table 2-1.   Top World Air Cargo Airlines, 2016 (by billions of tons)

Rank	Airline	Billions of Tons	Carrier Type	Home Region
1	FedEx Express	15.712	Integrator/Freighters	North America
2	Emirates SkyCargo	12.270	Passengers & Freighters	Middle East
3	UPS Airlines	11.264	Integrator/Freighters	North America
4	Cathay Pacific Cargo	9.947	Passengers & Freighters	Asia
5	Qatar Airways	9.221	Passengers & Freighters	Middle East
6	Korean Air Cargo	7.666	Passengers & Freighters	Asia
7	Lufthansa Cargo	7.384	Passengers & Freighters	Europe
8	Cargolux	6.878	Freighters	Europe
9	Singapore Airlines Cargo	6.345	Passengers & Freighters	Asia
10	Air China	6.089	Passengers & Freighters	Asia
11	China Southern Airlines	5.939	Passengers & Freighters	Asia
12	China Airlines	5.273	Passengers & Freighters	Asia
13	Airbridge Cargo Airlines	4.914	Freighters	Russia
14	China Eastern Airlines	4.561	Passengers & Freighters	Asia
15	Etihad Airways	4.481	Freighters	Middle East

Source: Air Cargo News

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2.2.2   *Logistics Companies*

As with the airlines, contract logistics management companies offer services based on differing business models. The core providers are the third-party logistics companies (3PLs) or freight forwarders, sometimes referred to as indirect carriers. As freight forwarders compete with the integrator/express airlines for yield and market share, many forwarders are offering value-added services such as custom packaging or product enhancement.

The 3PL concept has been evolving, but the basic premise remains unchanged: provide outsourced logistics services, freeing the client to focus on running core operations.

FREIGHT FORWARDERS

Freight forwarders are companies that specialize in arranging storage and shipping of merchandise on behalf of individuals or companies (shippers). They serve both the shipper and air carrier by consolidating small shipments into larger consignments, palletize or containerize shipments for intermodal movement, issue their own documents for the intermodal haul, take legal responsibility for the goods being moved, provide through rates, perform pickup and delivery service, and render other useful functions to simplify the intermodal process and move freight expeditiously. They rely on the airlines to provide line-haul (airport-to-airport) carriage, and in some cases, other third-party providers for customs clearance and final delivery. Under the new TSA security regime, freight forwarders may also provide air cargo screening and inspection as a regulated Certified Cargo Screening Facility (CCSF).

The forwarder's business model is based on obtaining a wholesale rate from the airline by consolidating many small shipments into single containers. By obtaining a lower container rate from the air carrier, the forwarder maximizes the spread between the charges he pays the carriers and the charges he collects on each individual shipment he loads into the container. This spread is their operating margin.

However, not all air freight forwarder terminal locations produce large consolidations. Smaller cities often do not have a large enough market to produce the required volume to build consolidations for a single destination. For this reason, the forwarder will move some individual shipments from smaller cities to a larger city in their system. At the larger airport cities, sometimes known as gateway or hub cities, these small shipments are included into the consolidation being built at that location. The ability to move these smaller shipments in another terminal's larger consolidation is an important advantage for the air freight forwarder's operation.

Many forwarders have large multinational networks (such as Panalpina, Kuehne & Nagel, Expeditors International of Washington, and DB Schenker), while others specialize in specific local markets (such as Alaska Freight Forwarding and Pacific Alaska Freightways).

FOURTH-PARTY LOGISTICS PROVIDERS/ LEAD LOGISTICS PROVIDERS

A fourth-party logistics provider (4PL)/Lead Logistics Provider is typically a non-asset based logistics consultant. The 4PL provider differs from a freight forwarder in that the organization is often a separate entity established as a joint venture or long-term contract between a primary client and one or more partners. Fourth-party logistics organizations act as a single interface between the

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shipper/client and multiple logistics service providers and might handle all aspects of the supply chain. Many major 3PL providers often form a 4PL organization to serve a particular client within their existing structure. Primary examples of 4PL providers are UPS Supply Chain Logistics, CEVA Logistics, and Ryder.

Table 2-2 shows the leading global logistics service providers in 2012.

Table 2-2.   Top International Logistics Service Providers, 2016

Providers	Gross revenues (billions)	Providers	Gross revenues (billions)
DHL Supply Chain & Global Forwarding	26.105	Hellmann Worldwide Logistics	3.443
Kuehne + Nagel	20.294	Imperial Logistics	3.352
Nippon Express	16.976	Kerry Logistics	3.097
DB Schenker	16.746	FedEx Trade Networks/Supply Chain Systems/Supply Chain	2.916
C.H. Robinson	13.144	Ryder Supply Chain Solutions	2.659
DSV	10.073	Damco	2.500
XPO Logistics	8.638	Coyote Logistics	2.360
Sinotrans	7.046	Total Quality Logistics	2.321
GEODIS	6.830	Sankyu	2.275
UPS Supply Chain Solutions	6.793	Schneider National Logistics & Dedicated	2.063
CEVA Logistics	6.646	Echo Global Logistics	1.716
DACHSER	6.320	Transportation Insight	1.710
Hitachi Transport System	6.273	NNR Global Logistics	1.676
J.B. Hunt (JBI, DCS & ICS)	6.181	Landstar	1.632
Expeditors	6.098	Mainfreight	1.627
Toll Group	5.822	APL Logistics	1.620
Panalpina	5.276	Transplace	1.620
GEFCO	4.800	arvato	1.615
Bolloré Logistics	4.670	Americold	1.555
Kintetsu World Express	4.373	Fiege	1.550
Yusen Logistics	4.169	Wincanton	1.516
CJ Logistics	3.808	Penske Logistics	1.500
Burris Logistics	3.629	Swift Transportation	1.431
Agility	3.576	Groupe CAT	1.328
Hub Group	3.573	NFI	1.250

Source: Armstrong & Associates, Inc. Top Global Third-Party Logistics

A number of multinational and regional air freight forwarders have a physical presence in Washington state, including Hellmann, UPS Supply Chain Logistics, Panalpina, Kuehne + Nagel, DB Schenker, Expeditors International of Washington, etc.

To be discussed in a later section, the future for air cargo growth in Washington state relies to a significant extent on the perceptions of the international forwarder community toward Seattle as a cost-effective and efficient place to do business.

AIR TRUCKERS

Trucking is an important component of the air cargo industry. As with the all-cargo airlines, air truckers provide a variety of services. Some air truckers specialize in local pickup and delivery, while others provide nationwide long-haul service. Air-trucking companies (e.g., Jet Airways of the United States) are registered airlines but do not operate any aircraft. Rather, they provide regularly scheduled service between North American city pairs using air waybills. This service is referred to as road feeder service (RFS) or "truck flights", which serve more than 1,000 city pairs in the United States and Canada As an example, air cargo service from Los Angeles to Spokane is published in the Official Airline Guide (OAG) as being available on Monday through Friday on flight QJ 091, departing LAX at midnight and arriving to Spokane International Airport at 10:00 am plus three days. In other words, the schedule reflects the three days required to truck 1,200 miles.

Many foreign flag air carriers use RFS as a means to expand their operational capability in the United States. This allows the air carrier to fly to a limited number of gateways but provide service to many other cities using a combination of scheduled air and truck services. At the present time, the fastest growing segment of air cargo within the United States is the trucking of air shipments between airports.

2.3   NORTH AMERICA, WEST COAST AND REGIONAL AIR CARGO ACTIVITY

2.3.1   *U.S. Air Cargo Market*

According to Boeing, air cargo moving to, from, and within the United States and Canada accounts for 13.8 percent of the world's air cargo traffic in terms of weight.

Figure 2-1 shows the top 15 U.S. air cargo airports. As this figure shows, integrator/express carrier hub airports of Memphis and Louisville and international passenger gateway airports of Miami, Los Angeles, Chicago, and New York JFK dominate the U.S. air cargo market. Anchorage International Airport has minimal enplaned and deplaned air cargo, but acts as a transshipment hub (a transloading point where air cargo is switched between airplanes to varying alternative destinations) for air cargo freighters serving the Asia-North America market. Cincinnati is a gateway hub for DHL, and Indianapolis, Ontario, and Oakland are regional gateways for FedEx and UPS.

Most of the growth in air cargo at U.S. airports is in the international market. Domestic air cargo in the United States has significantly declined since 2000 as passenger airlines downsized the dimensions of their aircrafts and scheduled, traditional domestic air freight airlines exited the U.S. market.

Most of the growth in air cargo at U.S. airports is in the international market.

Figure 2-1.   Top 17 U.S. Air Cargo Airports (by weight)
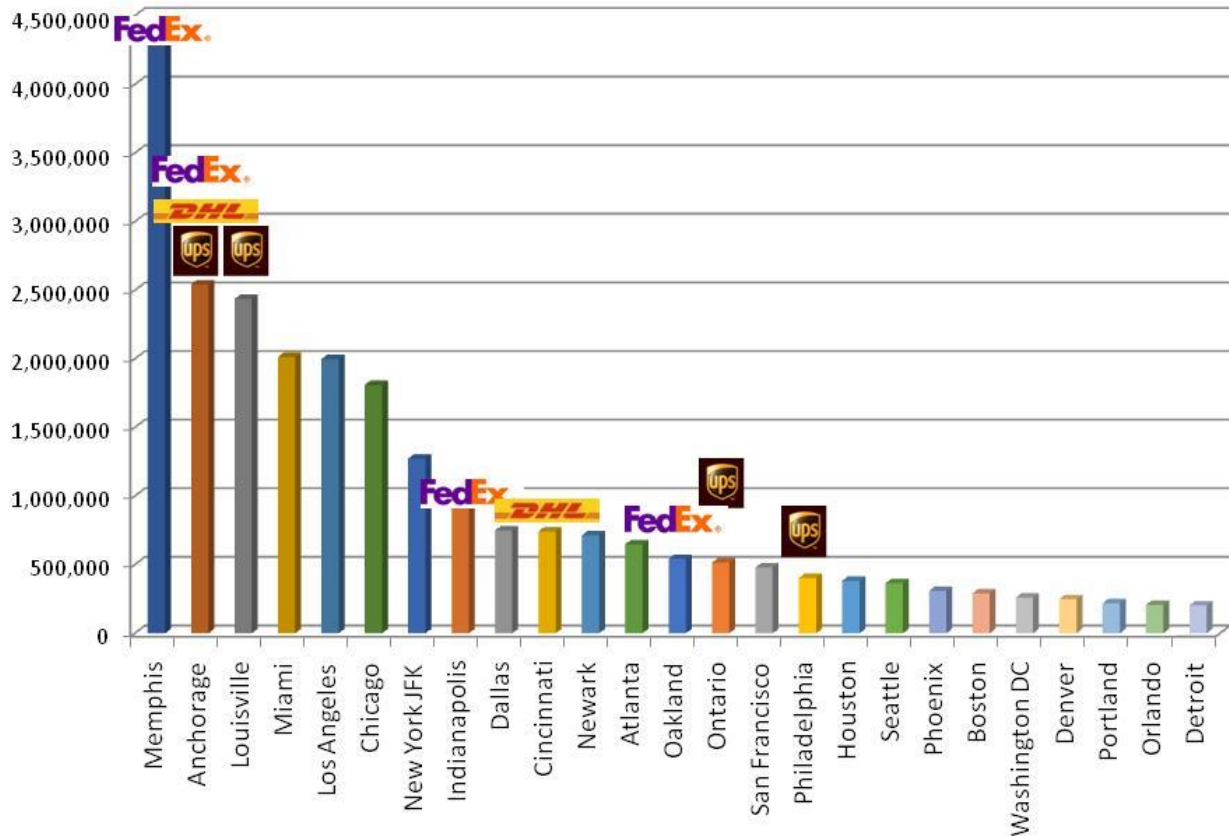
Passenger carriers continue to rely on trucks to offset the loss of domestic air cargo capacity that has resulted from reduced air fleet size and the shift of wide-body airplanes from domestic to international markets. (Wide-body aircraft have two aisles and large belly holds for baggage and cargo; narrow-body aircraft have one aisle and small baggage holds, leaving little room for cargo.) Truck flights allow passenger airlines to offer service comparable to that of pure cargo carriers.

With the decline in both domestic widebody and narrow-body passenger planes that had capacity on the lower-deck (or belly) to carry cargo, the express/integrator share of the U.S. domestic air cargo market has grown to 90 percent—up from 71 percent in 2006. The emergence of e-commerce as a market force has recently given rise to a new type of airline, represented by Amazon Air, which focuses only on domestic express delivery.

> The decline in air cargo volumes is primarily related to a modal shift from domestic air to truck.

2.3.2   U.S. West Coast Air Cargo Market

Washington state, the Pacific Northwest, and the North American West Coast air cargo markets are well served by a combination of passenger carriers (offering both lower-deck and full freighter capacity), by the integrated/express and traditional all-cargo carriers (providing both door-to-door service and line-

haul airport-to-airport service), and by an extensive network of freight forwarders, consolidators, customs brokers, and air-trucking firms.

Air cargo volumes at major West Coast gateway airports declined from approximately 5.2 million metric tons in 2000 to 4.5 million metric tons in 2016. The decline in air cargo volumes was primarily related to a modal shift from domestic air to truck, exacerbated by the recession at the end of the decade and recovering partially since. Most of the air cargo growth is in international shipments at large international gateway airports and by express cargo driven by e-commerce. Due to strong growth in international trade, the West Coast air cargo market has grown approximately 3 percent per year over the past six years.

Table 2-3 indicates the historical air cargo activity at select West Coast airports.

Table 2-3.   Select West Coast Historical Air Cargo Activity (metric tons)

Airport	2000	2005	2010	2016	2016 Market Share
Los Angeles	2,038,784	1,928,894	1,747,629	1,993,308	43.81%
LA/Ontario	464,164	521,853	355,932	519,474	11.42%
Oakland	685,425	675,227	510,947	511,780	11.25%
San Francisco	869,839	584,926	426,725	483,223	10.62%
Seattle-Tacoma International	455,997	338,663	283,291	366,429	8.05%
Vancouver	251,771	223,608	228,387	281,018	6.18%
Portland	282,019	263,599	190,117	218,716	4.81%
King County (Boeing Field)	145,000	112,758	107,370	114,364	2.51%
Spokane International	61,009	52,263	43,390	61,396	1.35%
TOTAL	**5,254,008**	**4,701,791**	**3,893,788**	**4,549,708**	**100.00%**

Source: Los Angeles, Oakland, San Francisco, LA Ontario, Portland, Vancouver: ACI-NA; BFI year 2000 is estimated, years 2005 and 2010 from the BFI Strategic Plan- BFI, year 2016 from DOT T-100 form; Sea-Tac International Airport from Port of Seattle records; Spokane International from airport records.

As can be seen in Table 2-3, the dominant air cargo airport on the West Coast is Los Angeles International Airport (LAX) with a 44 percent market share in 2016; in 2000, it had a 39% share. LA/Ontario International is a distant second followed closely by Oakland, San Francisco and Seattle (Sea-Tac).

LAX dominates the West Coast in air cargo due to a number of factors. The most significant reasons include the size of the local Southern California market, number of wide-body aircraft (both passenger and freighter) in service, the variety of destinations served, the frequency of departures and arrivals, the large investment in infrastructure and facilities, and the network of air freight forwarders that has developed near the airport. Secondary reasons why the Southern California air cargo market dominates the West Coast includes the large number of warehouses, distribution centers, and logistics company operators located in the Inland Empire of San Bernardino and Riverside Counties that service both the Los Angeles/Long Beach seaports and LAX.

The air cargo markets at LA/Ontario, Oakland, King County, and Spokane International Airports are dominated by the integrator/express airlines. LA/Ontario International is the West Coast hub for UPS

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and Oakland International is the West Coast hub for FedEx. King County (Boeing Field) International Airport is the UPS gateway airport for Western Washington, and Spokane is a transload hub for the Pacific Northwest for both UPS and FedEx. Sea-Tac is the western Washington state gateway for FedEx and DHL.

Ted Stevens Anchorage International Airport (not included in Figure 2-1) ranks second in air cargo in the United States according to Airports Council International. It is a unique airport in that it has a small local market but serves as a technical stop and transfer hub for air cargo carriers serving the trans-Pacific market and represents an important market of air cargo from Washington state.

Other secondary West Coast airports competing within the Seattle air cargo tertiary marketshed include Calgary International, Edmonton International, Boise Air Terminal, Salt Lake City International, Reno-Tahoe International, and San Jose International.

2.3.3   *Washington State Air Cargo*

Air cargo in Washington state is primarily generated by activity at Sea-Tac, King County, and Spokane International Airports. Non-hub and small commercial passenger airports within the state account for only 4 percent of the total air cargo volumes moved in Washington state in 2016.

Figure 2-2 shows the trend of air cargo activity for Washington state. Reflecting trends in the general economy as well as systemic changes in the air cargo industry, air cargo volumes in Washington state have fluctuated over the past 10 years, with 543,921 metric tons in 2006 dropping to a low of 454,419 metric tons during the economic crisis of 2008/2009, then reaching a high of 565,728 tons in 2016.

Figure 2-2.   Washington State Air Cargo Volume, 2006–2016 (metric tons)
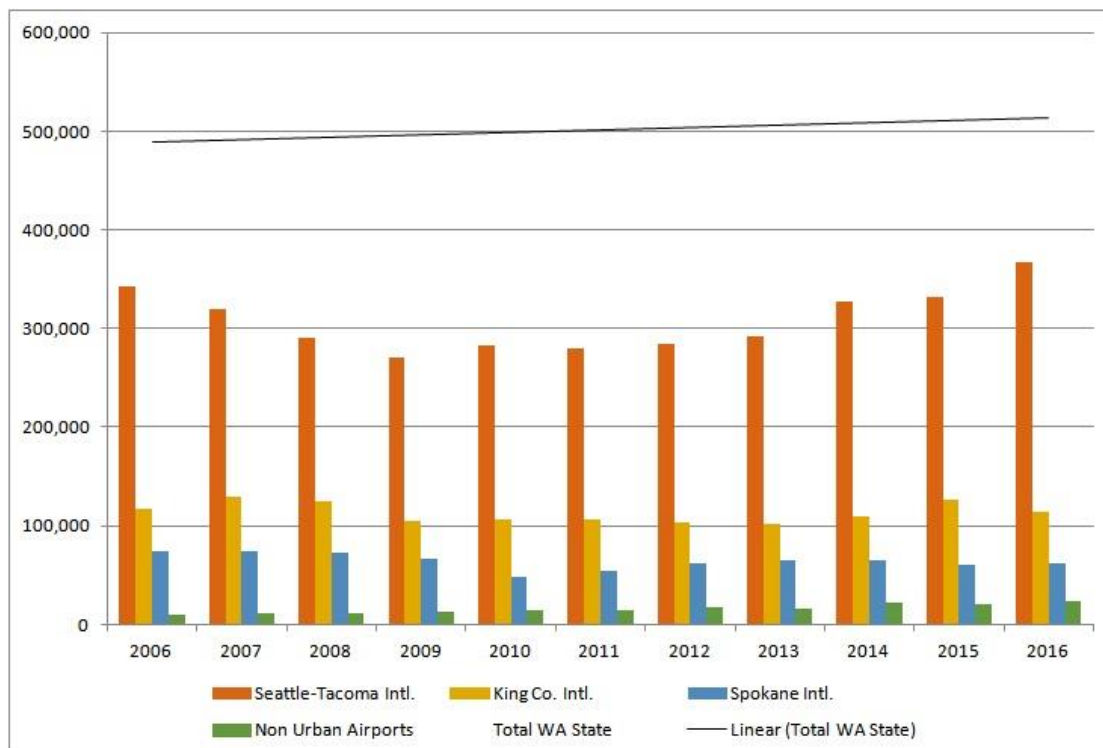
Over the past five years after the recession, air cargo in the state has increased at approximately 5 percent per year. Most of the growth in air cargo within the state is driven by the increase in international wide-body aircraft service at Sea-Tac, and recently by e-commerce.

Figure 2-3 compares Washington state air cargo trends with U.S. trends. As can be seen in this figure, Washington state has slightly increased its market share of from around 2.6 to 2.9 percent of the national air cargo market.

Figure 2-3.   United States and Washington State Air Cargo Tonnage (metric tons)

	2006	2011	2016
■ US Total Air Cargo	19,952,640	17,627,915	19,305,542
■ WA State	456,131	449,276	565,728
■ WA Marketshare	2.29%	2.55%	2.93%
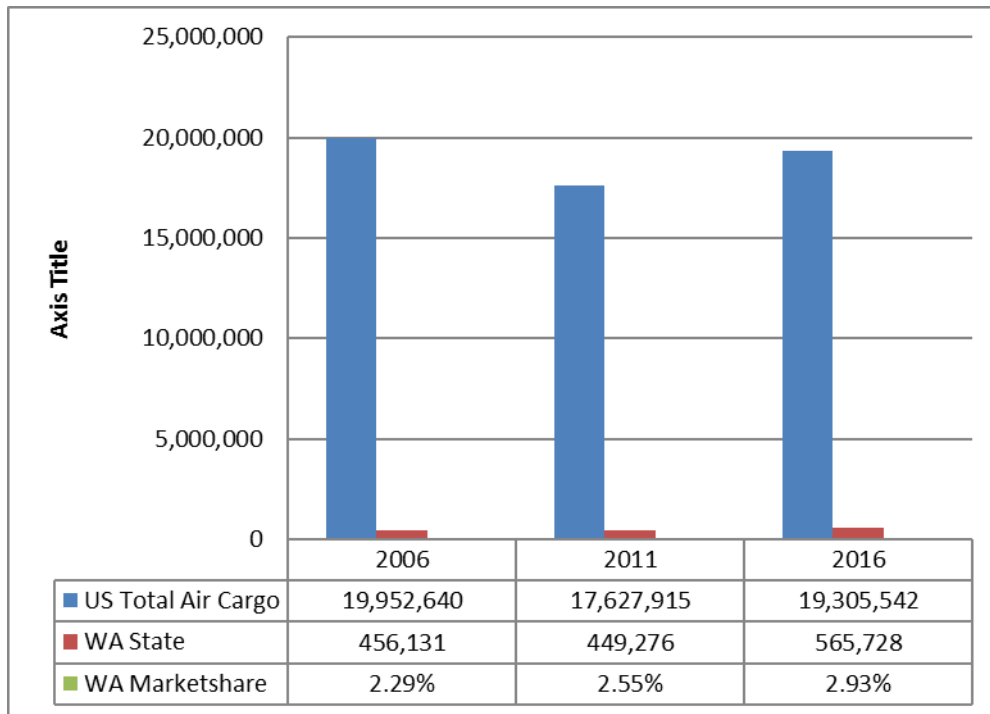
Source: Total U.S. air cargo from DOT T-100 Market All Carrier form

Table 2-4 presents airports in Washington state that handled one metric ton or more of air cargo in 2016. Of the top 20 airports in the state for air cargo, Snohomish County Paine Field experienced the most percentage growth, followed by Grant County International Airport in Moses Lake (although Snohomish County is driven by Boeing manufacturing activity and Grant County compares to a relatively small base). Reflecting an important trend in U.S. air cargo activity, international air cargo at Sea-Tac increased 5.5% per year over the past five years.

As shown in Figure 2-4, the Seattle air cargo market is by far the largest in the state. Sea-Tac and King County (Boeing Field) International Airports combined have an 85 percent share of the total Washington state market. Spokane, the third-largest cargo airport in the state, represents an 11 percent share of the Washington state market.

Table 2-4.   Washington State Air Cargo Airports (metric tons)

	2006	2011	2016	2016 Market Share	5 year CAGR*
Seattle-Tacoma International	342,042	279,893	366,430	64.8%	5.5%
King County International (Boeing Field)	118,394	106,932	114,364	20.2%	1.4%
Spokane	74,846	49,419	61,396	10.9%	4.4%
Snohomish County	38	4,481	15,410	2.7%	28.0%
Tri-Cities	3,049	3,452	2,299	0.4%	-7.8%
Yakima Air Terminal	2,138	1,836	1,926	0.3%	1.0%
Bellingham International	980	1,111	997	0.2%	-2.1%
Grant County International	492	314	752	0.1%	19.1%
William R. Fairchild International	525	527	563	0.1%	1.3%
Pangborn Memorial	612	605	505	0.1%	-3.6%
Orcus Island Airport	245	283	453	0.1%	9.9%
Skagit Regional	428	269	412	0.1%	8.9%
Friday Harbor Airport	104	117	211	0.0%	12.5%
Pullman Moscow Regional	20	12	5	0.0%	-16.1%
Walla Walla Regional	8	3	2	0.0%	-7.8%
Sequim Valley	0	0	1	0.0%	100.0%
Roche Harbor Airport	—	1	1	0.0%	0.0%
Seattle Lake Union	—	1	1	0.0%	0.0%
Total	**549,921**	**449,276**	**565,728**	**100.0%**	**4.6%**

Source: Seattle-Tacoma International Airport data from Port of Seattle. Spokane International Airport data years 2010–2016 from Spokane International Airport and years prior to 2009 from DOT T-100 All Carrier Market data. All other cargo activity is from the DOT T-100 All Carrier Market data.
* CAGR = compounded annual growth rate

Figure 2-4.   Key Washington State Air Cargo Markets (metric tons)
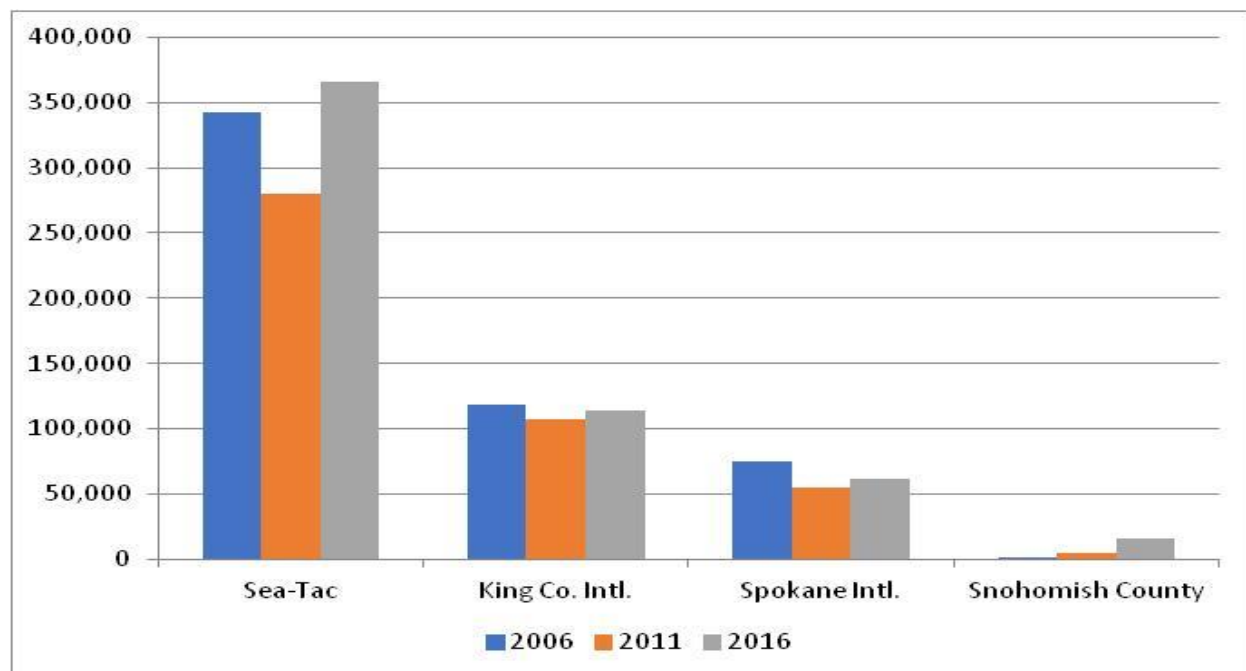
Sea-Tac dominates the local Seattle air cargo market with a mix of domestic and international belly cargo, domestic and international freighter cargo, as well as integrator/express cargo generated by FedEx.

Air cargo at **King County International (Boeing Field)** is generated exclusively by the integrator all-cargo carrier, UPS.

Spokane International Airport is utilized as an integrator/express cargo hub for the Pacific Northwest. It is dominated by FedEx and UPS with a combined market share of 97 percent. The remaining 3 % is carried by passenger airlines.

The air cargo at **Snohomish County Paine Field** in 2016 was generated by special modified wide-body freighters as a part of the Boeing Company's 787 airplane manufacturing and assembly program. Origin and destination cities for cargo generated at Paine Field included Anchorage (a trans-Pacific transload point), Charleston, Nagoya and Wichita. The general cargo demand in Snohomish County is served through Sea-Tac and King County International (Boeing Field) Airports.

Air cargo activity at **other airports in Washington state** (Figure 2-5) is generated almost exclusively by FedEx and UPS with small quantities of enplaned and deplaned cargo by Alaska/Horizon Airlines. Lower-deck (belly) cargo capacity at smaller airports in the state is limited due to the regional aircraft utilized to serve these markets.

Figure 2-5.   Secondary Washington State Air Cargo Markets (metric tons)
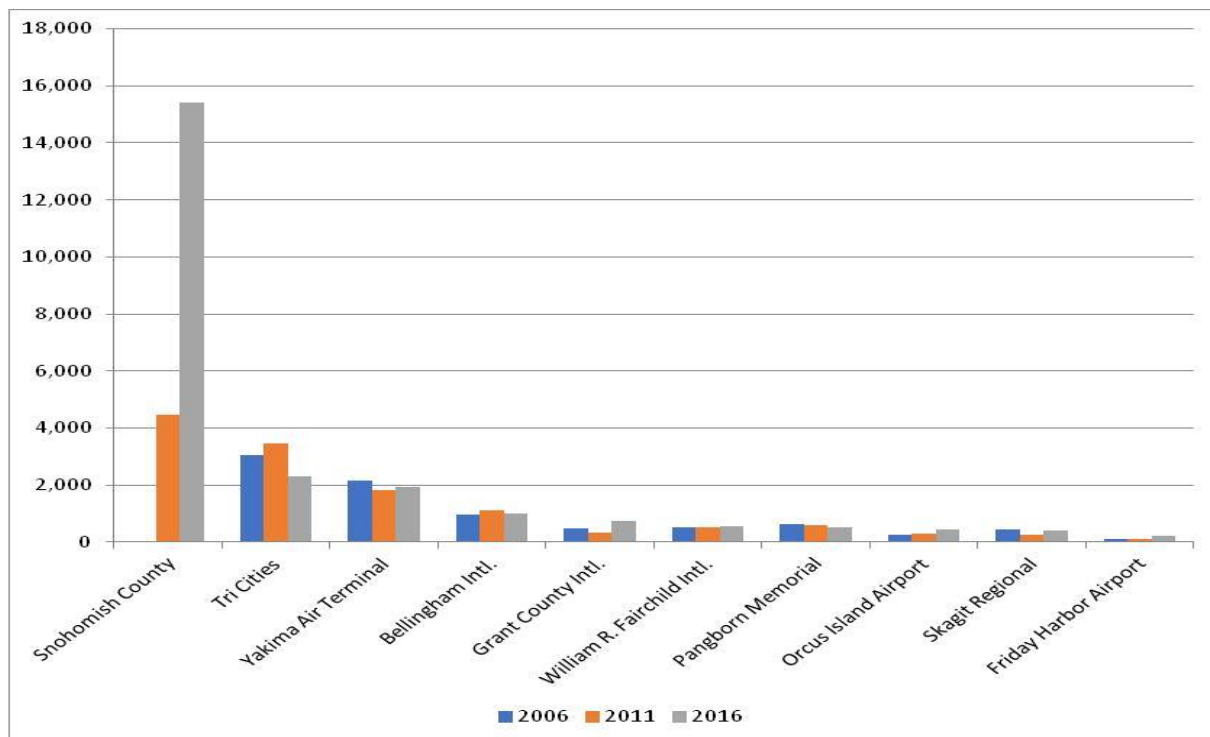
Due to the lack of wide-body air service, smaller population centers, and the general operational economics of the air cargo business explained previously, Washington state businesses located outside

the metropolitan Seattle market are served by truck from Sea-Tac and King County International (Boeing Field) or directly to/from other major West Coast, Midwest, and West airports such as Los Angeles, San Francisco, Chicago, or Dallas.

2.4   WASHINGTON STATE AIR CARGO HUB AIRPORTS

This section focuses on the three main air cargo airports within Washington state.

2.4.1   *Seattle-Tacoma International Airport*

Seattle-Tacoma International Airport (Sea-Tac) is owned and operated by the Port of Seattle. The Port of Seattle is a special-purpose government entity established to foster regional economic activity, provide transportation facilities for cargo and passengers by air, water, and land, and to provide a home for the North Pacific fishing industry.

The Port of Seattle has identified four strategic objectives as a part of its "Century Agenda":

- Position the Puget Sound region as a premier international logistics hub.

- Advance this region as a leading tourism destination and business gateway.

- Promote small business growth and workforce development.

- Be the greenest, and most energy efficient port in North America.

The Port of Seattle's strategy is to "Position the Puget Sound region as a premier international logistics hub" and its objective is to increase "air cargo volume to 750,000 metric tons." To achieve this objective, Sea-Tac must double its existing air cargo tonnage and significantly increase the air cargo capacity of the airport.

SEA-TAC AIR CARGO ACTIVITY

In 2016, Sea-Tac accommodated 45.7 million passengers and enplaned and deplaned 366,431 metric tons of freight and mail. Table 2-5 shows Sea-Tac's historical air cargo activity trends.

As shown in Table 2-5, air cargo at Sea-Tac has fluctuated significantly from year to year. Since 1990, air cargo growth at the airport has averaged 0.6 percent per year. Over the past five years, the average annual growth rate has been 5.5 percent. Based upon November 2017 year-to-date statistics, indications are that air cargo tonnages will exceed 425,000 metric tons in 2017. With the exception of the past few years, inbound and outbound cargo volumes are fairly even, indicating a balanced market.

Figure 2-6 shows the trends among domestic and international freight and mail at Sea-Tac. It demonstrates the relative decline of domestic in favor of international freight.

Table 2-5.   **Seattle-Tacoma International Airport – Historical Air Cargo (metric tons)**

Year	Inbound	Outbound	Total Cargo	Percentage Change
1990	139,650	173,810	313,460	—
1991	159,831	187,835	347,666	10.91%
1992	169,751	191,857	361,608	4.01%
1993	181,520	200,022	381,542	5.51%
1994	198,196	211,940	410,136	7.49%
1995	195,120	213,078	408,198	-0.47%
1996	181,502	206,716	388,218	-4.89%
1997	184,263	209,523	393,786	1.43%
1998	207,249	221,078	428,327	8.77%
1999	220,936	223,288	444,224	3.71%
2000	230,530	226,390	456,920	2.86%
2001	199,337	202,198	401,535	-12.12%
2002	185,463	189,290	374,753	-6.67%
2003	175,871	175,547	351,418	-6.23%
2004	173,649	173,868	347,517	-1.11%
2005	175,193	163,469	338,662	-2.55%
2006	173,136	168,904	342,040	1.00%
2007	161,566	157,527	319,093	-6.71%
2008	142,501	148,346	290,847	-8.85%
2009	131,952	138,263	270,215	-7.09%
2010	140,715	142,576	283,291	4.84%
2011	138,337	141,556	279,893	-1.20%
2012	142,235	141,374	283,609	1.33%
2013	152,234	140,475	292,709	3.21%
2014	169,816	157,424	327,240	11.80%
2015	168,400	164,236	332,636	1.65%
2016	186,513	179,918	366,431	10.16%

Source: Port of Seattle

Figure 2-6.   **Seattle-Tacoma International Airport – Historical Air Cargo Trends (metric tons)**
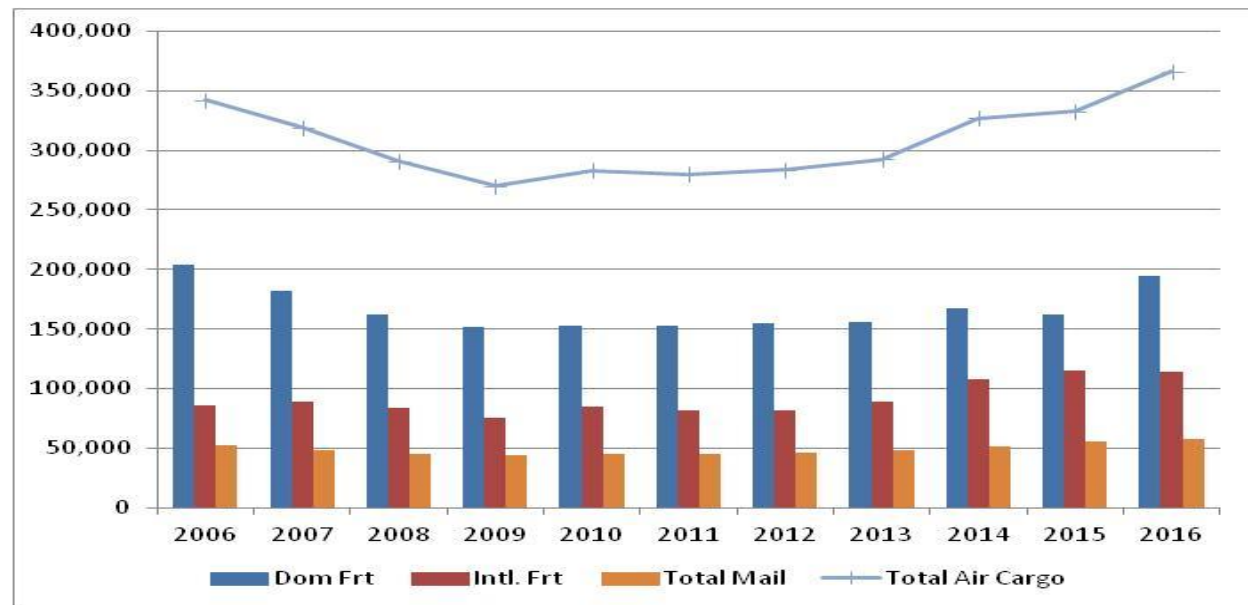
Source: Port of Seattle

The increase of air cargo at Sea-Tac over the past few years can be attributed primarily to the increase in international wide-body passenger traffic, the increase in seasonal international freighter cherry charters and the growth of the local economy. Sea-Tac also received a large boost in air cargo in 2014 due to an eight-month protracted waterfront labor dispute that closed or slowed down most U.S. West Coast seaports. In November 2014, the airport handled four to five additional freighters each week in an effort to move freight for the Christmas holiday buying season. In 2015, air cargo returned to a more sustainable 1.7 percent annual average growth rate, reaching 332,636 metric tons. In 2016, the air cargo growth rate jumped to over 10 percent from the previous year with the introduction of additional international wide-body passenger service, the growth of e-commerce, and the move of DHL from King County International (Boeing Field) to Sea-Tac.

Mail tonnages as a percentage of total cargo is fairly steady and is dominated by domestic mail. The mail is delivered to the airport by the U.S. Postal Service and tendered to the designated Terminal Handling Supplier (THS), who scans and containerizes the mail and then delivers the containers of bags to the airlines. The reverse is true for inbound mail. Most of the air mail at Sea-Tac is handled by FedEx as domestic shipments.

SEATTLE-TACOMA INTERNATIONAL AIRPORT AIR CARGO BY TYPE

Sea-Tac has both domestic and international passenger air services. The domestic passenger carriers servicing Sea-Tac include Alaska Airlines, American Airlines, Delta Air Lines, Frontier, Hawaiian, JetBlue Airways, Southwest Airlines, Sun Country, United Airlines, and U.S. Airways. International combination carriers include Air Canada, All Nippon Airways, Asiana Airline, British Airways, Condor, Emirates, EVA Airlines, Hainan Airlines, Korean Air, and Lufthansa Airlines.

The passenger aircraft fleet mix at Sea-Tac is a combination of regional turbo-props, regional jets and both small narrow-body and wide-body transport jets. The largest passenger planes used are Boeing 747-8s. Air carriers that also utilize freighter aircraft are sometimes referred to as mixed-use carriers. The two largest air cargo carriers among the passenger airlines are Alaska Airlines and Delta Air Lines, both with approximately 9 percent Sea-Tac market share.

Similar to passenger service, domestic and international airlines provide air cargo freighter service at Sea-Tac, utilizing a variety of aircraft. The largest all-cargo airlines operating at Sea-Tac are FedEx, ABX Air (contracting for DHL), Air Transport International (ATI, contracting for Amazon), and Cargolux.

Some airlines (e.g., Alaska Airlines, Asiana, EVA Air and Korean Air) operate freighter aircraft in addition to passenger aircraft. Table 2-6 presents recent lower-deck passenger air cargo and freighter air cargo tonnages at Sea-Tac.

Table 2-6.   Seattle-Tacoma International Airport – Recent Year Belly and Freighter Cargo (metric tons)

Year	Total Cargo	Freighter Cargo	Pax Lower-Deck Cargo	Percentage Freighter
2014	327,239	182,599	144,640	55.8%
2015	332,636	180,954	151,682	54.4%
2016	366,430	220,591	145,839	60.2%

Source: Port of Seattle

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The percentage of air cargo carried in freighters at Sea-Tac can vary, depending on the strength of the cherry season, which tends to generate a significant amount of ad-hoc charter flights.

Table 2-7 shows the top airlines for air freight by weight at Sea-Tac for 2015 and 2016.

Table 2-7.   Seattle-Tacoma International Airport – Freight Market Share (by weight)*

	2015	2016	% Chg	2016 % Mkt Share
FedEx	101,638	102,044	0.40%	33.01%
Delta Air Lines	33,213	29,866	-10.08%	9.66%
Alaska Airlines	30,840	28,145	-8.74%	9.11%
ABX Air	141	18,427	12,927.23%	5.96%
China Airlines	12,297	13,143	6.88%	4.25%
Korean Air	14,704	12,692	-13.68%	4.11%
Air Transport Intl.	92	12,431	13,345.85%	4.02%
EVA Airways	8,223	9,609	16.86%	3.11%
Cargolux	11,742	9,139	-22.17%	2.96%
Hainan Airlines	7,221	8,888	23.10%	2.88%
British Airways	8,226	8,617	4.76%	2.79%
Asiana Airlines	5,862	7,594	29.54%	2.46%
All Nippon Airways	9,384	7,167	-23.62%	2.32%
Hawaiian Airlines	5,139	5,674	10.41%	1.84%
Southwest Airlines	5,957	5,594	-6.09%	1.81%
Emirates	3,947	4,761	20.61%	1.54%
Atlas Air	1,498	4,565	204.79%	1.48%
Lufthansa Airlines	5,337	4,370	-18.12%	1.41%

Source: Port of Seattle data
* Volumes on this table represent air cargo exclusive of mail.

As shown in Table 2-7, FedEx dominates the air cargo market. Indications from partial 2017 data is that ABX Airlines, operating for DHL, is increasing its share of the air cargo market, along with ATI Airlines, operating as Amazon Air,[1] a subsidiary of Amazon.com.

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[1] Formerly Prime Air

2.4.2 King County International (Boeing Field) Airport

King County International (Boeing Field) Airport is a mixed-use general aviation, commercial service and industrial airport located just south of the SODO (south of Downtown) District in Seattle. The highly constrained airport is bounded by the following:

- On the east by Interstate 5 (I-5)
- On the west by East Marginal Way and the Duwamish Waterway
- On the north by the community of Georgetown
- On the south by a cluster of private warehouses and truck terminals

Due to its inner-city location and access to I-5, the airport is attractive to domestic express air cargo operators. As mentioned previously, air cargo at King County International (Boeing Field) is generated exclusively by UPS, an integrator all-cargo carrier. Since DHL relocated its operations to Sea-Tac in June 2016, it is expected that UPS will be responsible for 100 percent of the cargo in 2017.

In 2016, enplaned and deplaned air cargo at King County International (Boeing Field) totaled 114,634 metric tons. The top inbound and outbound market was the UPS primary hub of Louisville, KY. Other top inbound markets in 2016 included Ontario, CA, Spokane, WA, and Vancouver, BC. The second top outbound market was Vancouver, BC, followed by Ontario, CA, and Spokane.

The historical trend of air cargo activity at King County International (Boeing Field) is presented in Table 2-8 and shown graphically in Figure 2-7.

The air cargo average annual growth rate for King County International (Boeing Field) over the past 10 years is –0.3%. There was a 3 percent absolute decline over the period, and while the second-highest volume was recorded as recently in 2015, the DHL move to Sea-Tac occurred in 2016 and turned the tonnage downward.

Freighter aircraft types used on a regular basis at King County International (Boeing Field) include medium wide-body aircraft such as the A300-600, B767-200/300ER, large widebody aircraft such as MD11, MD DC-10 and large standard body B757-200.

Table 2-8.   King County International (Boeing Field) Airport – Air Cargo (metric tons)

	Enplaned Cargo	Deplaned Cargo	Total Cargo	% Change
2006	54,123	63,775	117,898	-3.0%
2007	59,664	69,113	128,777	9.2%
2008	59,145	65,616	124,761	-3.1%
2009	54,727	49,575	104,302	-16.4%
2010	55,269	50,905	106,174	1.8%
2011	56,619	50,313	106,932	0.7%
2012	47,867	55,147	103,014	-3.7%
2013	54,933	46,951	101,884	-1.1%
2014	59,047	50,606	109,653	7.6%
2015	57,306	68,960	126,266	15.2%
2016	51,220	63,144	114,364	-9.4%

Source: U.S. DOT T100 Market Data

Figure 2-7.   King County International (Boeing Field) Airport – Air Cargo (metric tons)
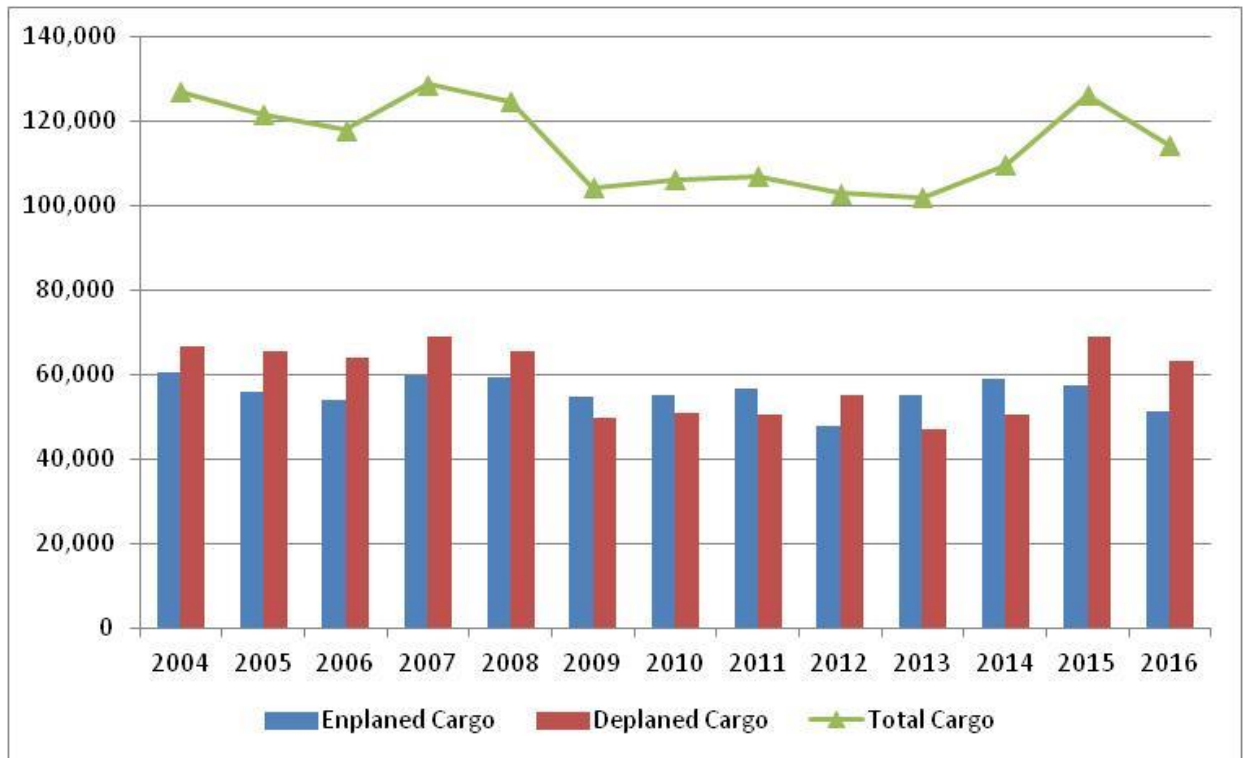
2.4.3 *Spokane International Airport*

Air cargo service at Spokane International Airport is provided by the combination passenger/cargo belly carriers, the integrator/express carriers and small air taxi all-cargo operators. In 2014, the combination carriers accounted for approximately 9 percent of the total enplaned and deplaned cargo tonnages at the airport with the all-cargo carriers handling the remaining 91 percent.

The combination passenger/cargo carriers include Alaska Airlines, Allegiant Air, Delta, Frontier, Horizon, Republic, Shuttle America/UAL, Southwest, Sun Country, United, and U.S. Airways (American). The largest regularly scheduled passenger planes used are A320s and Boeing 737-8/900s. Alaska and Delta had the highest air cargo tonnages in 2014 among the combination carriers.

The all-cargo airlines at Spokane International include FedEx, UPS, Empire, and AIRPAC. The two dominant cargo carriers are FedEx and UPS. Both carriers service the local air cargo market and also utilize Spokane International as a regional transload hub for aircraft originating and departing to other destinations. FedEx accounted for 58 percent of all air cargo handled by the all-cargo carriers and UPS accounted for 33 percent. A significant portion of the cargo carried by FedEx is U.S. mail. The largest freighter aircraft used on a regular basis included the A300-600, B767-300, MD11, MD DC-10.

Table 2-9 and Figure 2-8 present historical air cargo volumes at Spokane International. The airport lost 42 percent of its tonnage between 2006 and the recession year of 2010, but steady growth in the ensuing years has recovered more than half the loss. Since 1992-93, a major part of the freighter volume at Spokane International has been generated by transload operations.

Table 2-9.   Spokane International Airport – Air Cargo (metric tons)

	Enplaned Cargo	Deplaned Cargo	Total Cargo	Percentage Change
2006	31,719	43,127	74,846	-4.6%
2007	32,318	41,697	74,015	-1.1%
2008	31,069	41,223	72,292	-2.3%
2009	28,624	38,505	67,129	-7.1%
2010	16,551	26,839	43,390	-35.4%
2011	20,352	29,067	49,419	13.9%
2012	23,711	31,995	55,706	12.7%
2013	24,368	33,850	58,218	4.5%
2014	24,149	35,418	59,567	2.3%
2015	24,300	36,012	60,312	1.3%
2016	25,088	36,308	61,396	1.8%

Source: Years 2010–2016 from airport records; years 2004–2009 from DOT T100 Market data.

Figure 2-8.   Spokane International Airport – Air Cargo (metric tons)
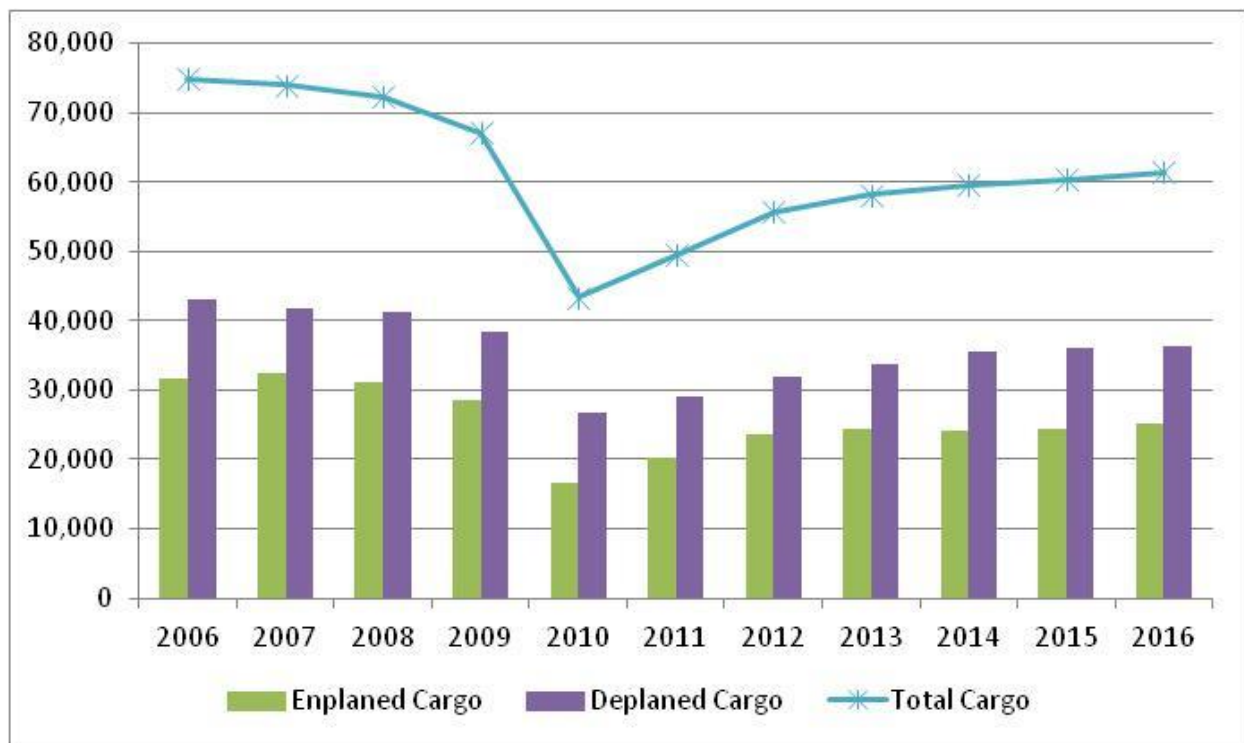
In a typical transload operation, the cargo is physically deplaned from one aircraft and enplaned onto a second aircraft. The transload may take place over a few hours, or over the course of a few days. Depending upon a particular carrier's type of operation, if a transload of two or more aircraft is performed simultaneously, then sufficient ramp space must be available in close proximity to facilitate the transload operation. If the transload takes place over a few days, then sufficient warehouse space must be available for storage and/or sorting.

At present, FedEx is performing transload operations at Spokane International with aircraft, trucks and cargo ultimately to and from Memphis, TN; Oakland, CA; Seattle; Vancouver, BC; Reno, NV; and Great Falls, MT. UPS is transloading freight between planes coming to and from Seattle; Portland, OR; Des Moines, IA; and Dallas, TX.

Only a very small portion of the total volume generated in these transload operations originates, or is destined for the Spokane regional market. Spokane International's unique geographical location in eastern Washington lends itself to this type of hubbing operation taking place at the airport. Both FedEx and UPS have major operations in the Seattle region, but are constrained in their ability to expand in that city due the overcrowded facilities at King County International (Boeing Field) (Boeing Field) and Sea-Tac. By using Spokane

Spokane International's unique geographical location in eastern Washington lends itself to this type of hubbing operation taking place at the airport. Both FedEx and UPS have major operations in the Seattle region, but are constrained in their ability to expand in that city due the overcrowded facilities at Boeing Field International (Boeing Field) and Sea-Tac.

International, the integrator carriers can maximize the utilization of their aircraft serving the Pacific Northwest and beyond.

Key destinations being served by freighter aircraft to/from Spokane International include Dallas, Portland, Seattle, Vancouver BC, Memphis, Louisville, Des Moines, Billings, Pendleton, Wenatchee, Sacramento, Missoula, Moses Lake, Lewiston, Yakima, Ontario, CA, and Pasco.

2.5 WASHINGTON STATE NON-HUB CARGO AIRPORTS

2.5.1 *Bellingham International Airport*

Bellingham International Airport is typical of Washington state's non-hub commercial service airports. Located in Whatcom County, it lies approximately three miles northwest of the city limits of Bellingham, WA. The airport is situated approximately 90 miles north of Seattle and 20 miles south of the U.S.-Canada Peace Arch Border crossing in Blaine, WA.

Passenger service is provided by airlines using narrow-body 130-200 seat aircraft and by small regional air taxis. Air cargo handled at the airport is typically less than 150 pounds.

Aircraft belly cargo service at the airport is provided by Alaska Airlines. Belly cargo is processed through the passenger terminal.

FedEx provides small-package express service using air-taxi aircraft. Charter service is also provided by local air-taxi operators. Approximately 90 percent of the air cargo moving by aircraft through Bellingham International is by FedEx.

The FedEx operation provides door-to-door air freight service in the Bellingham International market through the use of a fleet of small service vans, and to the San Juan Islands by air. Freight is delivered to the FedEx facility in the morning by both over-the-road tractor trailer rigs and by aircraft, typically a Cessna Caravan operated by Empire Airlines. Inbound freight for the Bellingham International region is then sorted on-site and put on delivery trucks for distribution. Freight destined for the San Juan Islands is placed back on the aircraft to be flown to Friday Harbor.

In the afternoon, the reverse occurs. Outbound freight picked up in the Bellingham International region is brought back to the airport by delivery truck, where it is sorted and East Coast priority packages are put on a Cessna 208 Caravan to meet an early evening flight from Sea-Tac to Memphis. Most of the West Coast priority packages and deferred delivery packages are loaded onto trucks for over-the-road delivery to the Seattle FedEx station later in the evening.

2.6 OTHER WASHINGTON STATE CARGO AIRPORTS

Other small commercial service airports in Washington such as Tri-Cities, Yakima Air Terminal, Pangborn Memorial (Wenatchee), and Walla Walla Regional Airport have similar air cargo profiles as Bellingham International. That is, most air cargo are small packages under 150 pounds in weight and are moved almost exclusively by FedEx and UPS with small quantities of enplaned and deplaned belly cargo by Alaska/Horizon Airlines. Lower-deck cargo (belly cargo) capacity at smaller airports in the

state is limited due to the regional aircraft utilized to serve these markets. Cargo ground handling is done on the passenger ramp, in small specialized facilities operated by FedEx or UPS, or on the general aviation ramp.

Beyond space for FedEx and UPS airport operations, the need for airport air cargo facilities at most non-hub commercial service airports in Washington state is limited. Air cargo tendered at these airports is typically same-day express cargo moving in small packages with limited dwell time.

An exception to this profile is Snohomish County Paine Field. The surge in air cargo at Paine Field in 2014 was generated by special modified wide-body freighters as a part of the Boeing Company's 787 airplane manufacturing and assembly program. Origin and destination cities for cargo generated at Paine Field included Anchorage (a trans-Pacific transload point), Charleston, Nagoya, and Wichita. The general cargo demand in Snohomish County is served through Sea-Tac and King County International (Boeing Field) Airports.

2.7 INDUSTRY PERCEPTIONS OF SEATTLE-TACOMA AIRPORT

A panel of air cargo stakeholders discussed the growth in the air cargo market in the Seattle region and resultant challenges at Sea-Tac as part of a forum sponsored by the Air Freight Forwarders Association in September 2017. Comments made during that panel discussion were recorded. Additional, interviews were held with industry stakeholders including air cargo carriers and handlers in Fall/Winter 2017/2018.

As stated by these stakeholders, emerging trends include the following:

■ Growth of air cargo at Sea-Tac and limited ground-handling space and constrained layout led to congestion and delays. Among the concerns are:

– Significant wait times for trucks accessing the terminal

– Delays in handling goods, particularly for airlines that do not handle their own cargo

– Lack of TSA screening resources on the airport

■ Several stakeholders noted that similar constraints exist at other airports around the world and more efficient layout and additional off-airport facilities could resolve many of these problems.

■ There is a lack of consensus among airlines interviewed about utilizing facilities at other airports. Some indicate an openness to it, but concerns about facilities and services exist. Ultimately, freight forwarders make the decisions. Their understanding and support for any alternative air cargo services and locations will be critical to its success.

Additional interviews with freight forwarders are planned for spring 2018. Summary notes are attached in Appendix A.

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2.8   SUMMARY

Air cargo in Washington state is primarily generated by activity at Sea-Tac, King County, and Spokane International Airports. Non-hub and small commercial passenger airports within the state account for only 4 percent of the total state air cargo volumes moved in 2016.

Reflecting trends in the general economy, as well as systemic changes in the air cargo industry, air cargo volumes in Washington state have fluctuated over the past years from 543,921 metric tons in 2006 to a low of 454,419 tons during the economic crisis of 2008/2009, then rebounding to 565,728 tons in 2016. Most of the growth in air cargo within the state is driven by the increase in international wide-body aircraft air service at Sea-Tac, although e-commerce is recently having an effect.

Most small airports in the state have experienced a decline in air cargo volumes corresponding to a reduction of passenger service at smaller airports, the downsizing of aircraft serving the smaller markets, and a shift of air cargo to trucks.

In the same way that LAX dominates the West Coast in air cargo market (described in Section 2.3.2), Sea-Tac dominates the Washington state air cargo market due to the size of the Seattle metro market, the number of wide-body aircraft (both passenger and freighter) in service, the variety of destinations served, the frequency of departures and arrivals, the large investment in infrastructure and facilities, and the network of air freight forwarders that has developed near the airport.

Nevertheless, secondary airports in the state can also play an important role for specialized services and as reliever airports during peak shipping seasons.

3 Washington State Air Cargo Market Capture

The previous chapter described overall air cargo industry trends and the market profile of Washington state airports. This chapter examines the international market areas served by Washington state airports based on trade data from the U.S. Census Bureau.

Seattle Tacoma International Airport is one of the United States' principal gateways for international air cargo, especially for trade with East Asia. In terms of U.S domestic regions, the airport serves the State of Washington and, in some cases, broader U.S. regional markets.

The basic question, for exports and imports, is how well an airport's market serves Washington state and states beyond Washington, including Oregon and California to the south and Idaho and other states to the east. To understand the market reach and opportunities for a given airport, it is necessary to analyze specific commodities.

The extent of the airport's geographic market reach varies widely by product and by international origins and destinations. U.S. Census data can be used to provide a picture of the U.S. geographic areas served since it includes air cargo volumes by airport, and separately for states. While data on flows between airports and states is not available, a comparison of state air cargo volumes with volumes moving through a state's airports provides a measure of the airports' market reach. For example, if Seattle-Tacoma's volumes for a specific imported product exceed State of Washington imports, the airport's market reach clearly extends beyond the state. Conversely, if Sea-Tac's volumes are much less than state imports, then it is also clear that other airports serve part of the state. When the two are in balance – as frequently happens – then it is likely that Sea-Tac is handling the traffic.

The sections that follow provide summaries for exports and for imports, examining the top commodities for each and focusing on the largest international markets, East Asia and Europe. Additional detail on commodities and markets is included as Appendix B. The conclusion from this analysis is that Sea-Tac serves the Pacific Northwest market for international air cargo for the most part very well, but with exceptions in specific commodities and overseas regions.

3.1 EXPORTS

Washington state and Sea-Tac exports are concentrated in perishable foods. Fresh cherries and seafood together represented over a quarter of the airport's air cargo exports in 2016. These commodities were destined almost entirely to East Asian countries.

3.1.1 *East Asia*

While Sea-Tac's export volumes of seafood seem to be relatively balanced with Washington state exports (Figure 3-1), it appears that a large share of cherry exports may be handled by out-of-state airports, including Vancouver, BC. While this may be due to a variety of seasonal capacity, flight service, or other logistics and market issues, addressing the cherry imbalance may represent an

opportunity for Washington state airports to increase air cargo volumes while improving transportation costs to exporters.

Sea-Tac is a significant gateway port to East Asian countries for several product categories, including footwear parts electronic integrated circuits, and machines and apparatus for manufacturing semiconductors. For each of the product categories list in Figure 3-1, the airport serves a much larger market than the state, with airport volumes significantly exceeding the volume produced in the state for export. Oregon appears to be the main source for much of the out-of-state tonnage.

Figure 3-1.   Washington State and State Airport Top Export Commodities to East Asia (thousands of metric tons)
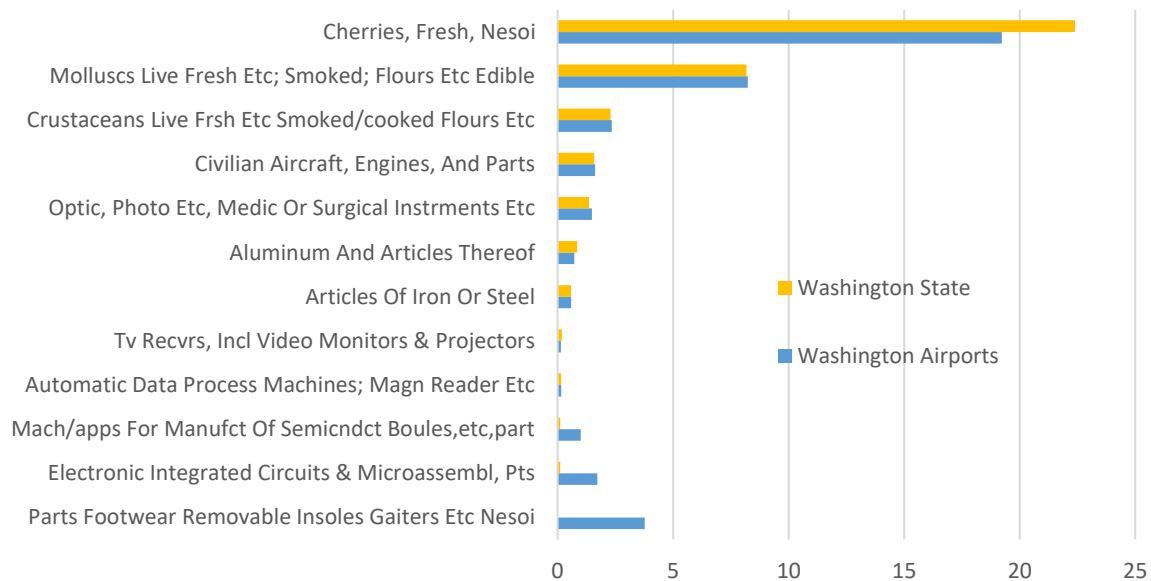
3.1.2   Europe

To a lesser extent than East Asia, Sea-Tac also acts as a gateway port to Europe for product categories such as computers and machines and apparatus for manufacturing semiconductors.

Sea-Tac also handles significant exports to Europe for commodities including instruments; civilian aircraft and engines, and parts, TV receivers and monitors; metals and metal products. For these foreign destinations, the airport's volumes are less than Washington state exports, which indicates some leakage to airports outside of the state – LAX and Chicago O'Hare are probable competitors. While the differences in airport and Washington state exports may be due to a range of supply chain and flight service issues, these commodity categories represent possible opportunities for increasing services to European markets.

Figure 3-2. **Washington State and State Airport Top Export Commodities to Europe (thousands of metric tons)**
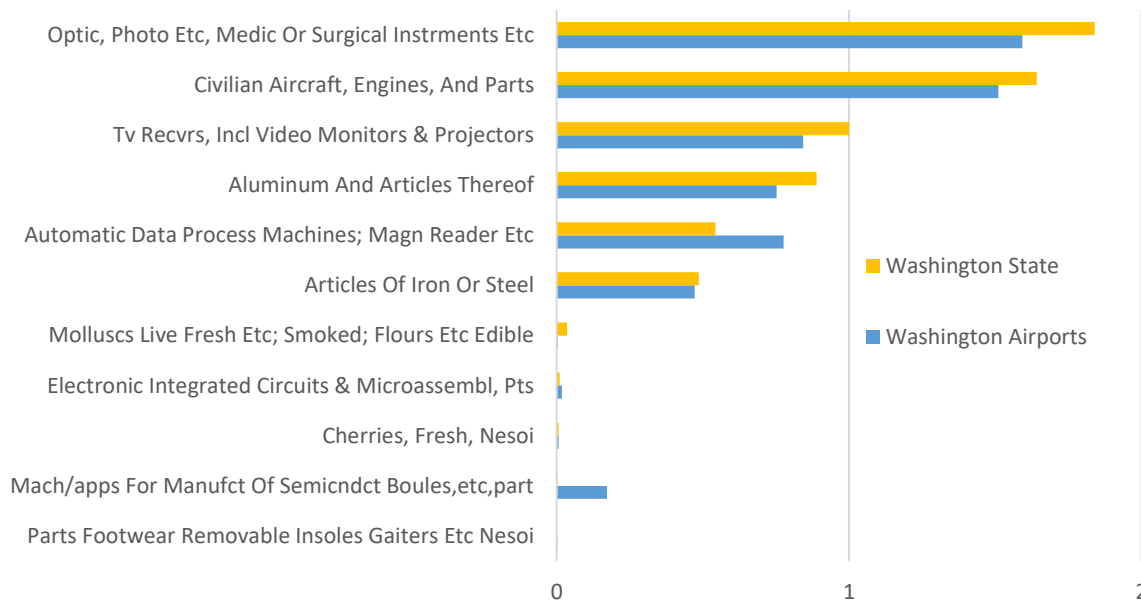
3.2   IMPORTS

3.2.1   *Summary of Washington State and Seattle-Tacoma International Airport Import Markets*

Washington state airports imported 68.0 thousand metric tons in 2016, 1.6 percent of the U.S. total. Sea-Tac handled 64.4 thousand metric tons, or 95 percent of the state's total. In aggregate, this would indicate that Sea-Tac's geographic market reach generally corresponds to Washington state, with some shippers also using airports outside the state. However, this measure of Sea-Tac's market area varies widely by commodity and origin of imports.

Total Washington state air imports are heavily skewed to volumes from East Asia, as shown in Figure 3-3. While 44.4 percent of U.S. air imports originate in East Asia, 61.5 percent of Washington's imports originate in that region and most of these are brought in through Washington airports.

Figure 3-3. **United States, Washington State, and Washington State Airport Shares of Air Imports by World Region**
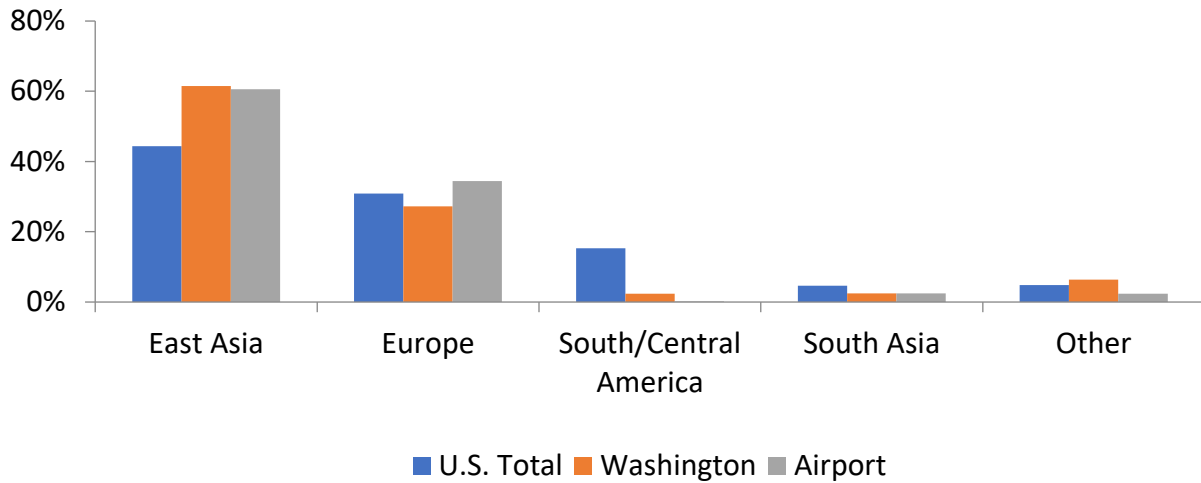
Source: U.S. Census Bureau Foreign Trade Statistics

Washington state imports from Europe represent slightly less of its total imports than the rest of the country. Imports from Europe represent 30.9 percent of total U.S. imports and 27.2 percent of Washington state imports. Washington state airport import shares and volumes overall are significantly larger than state imports, however, indicating that, across all commodities, Sea-Tac's market reach extends beyond the state.

Imports from South and Central America are even less concentrated in Washington state than the United States. Such imports represent 15.1 percent of the U.S. total but just 2.4 percent of state imports and only 0.2 percent of airport imports.

In summary, total air import volumes into Washington state and through Washington state airports are principally from East Asia and Europe. The sections that follow focus on these origin regions and examine Sea-Tac's market reach for specific commodity groups. An appendix provides further details on 36 specific product groups. Together, these products represent 73 percent of Sea-Tac's imports in 2016.

3.2.2   *East Asia*

East Asia is the principal origin region of U.S. air imports, representing 44.4 percent of U.S. total air tonnage in 2016. Sea-Tac's air import markets are concentrated in commodities from East Asia, and it acts as a principal gateway to Washington state and beyond for many of these product groups.

For many product categories, Sea-Tac East Asia import volumes significantly exceed Washington state imports. This indicates that Sea-Tac reaches geographic markets well beyond Washington state. Figure 3-4 shows for various commodities how state air imports compare to imports for the State of Washington. As can be seen, aircraft parts and apparel represent the commodity groups where Washington airports bring in much more than the state uses.

Figure 3-4. **Washington State and State Airport Top Import Commodities from East Asia (thousands of metric tons)**
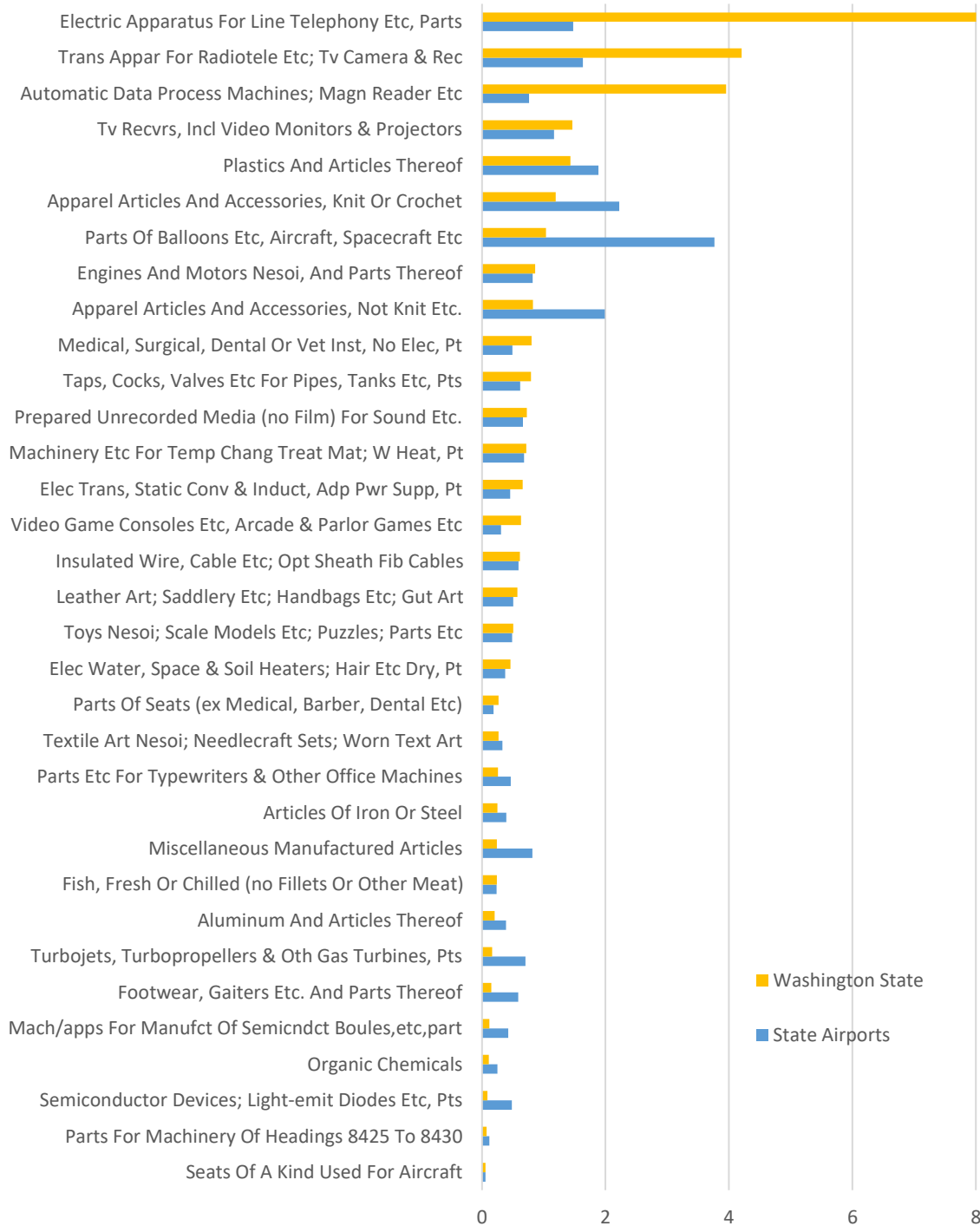
For a more limited set of product categories, imports from East Asia through Sea-Tac are about the same as Washington state imports, indicating that the market area served by the airport roughly corresponds to the state. These product categories include the following:

- Leather Articles

- Other Fresh or Chilled Fish

- Engines, Motors and Parts

- Temperature Change Machinery

- Prepared Unrecorded Media (no Film) for Sound Etc.

- Insulated Wire, Cable; Optical Sheath Fiber Cables

- Toys and Games

Product categories for which East Asia imports through Sea-Tac are much less than Washington state imports include several of the largest volume categories for state imports and are concentrated in electronic equipment and instruments. That means Washington state is getting a lot of the following commodities from airports other than Sea-Tac, and they're coming into the state on trucks. These large-volume commodities, shown at the top of the figure above, include the following:

- Electric Apparatus for Line Telephony, Parts

- Transmission Apparatus for Radiotelephone; TV Cameras and Recorders

- Automatic Data Processing Machines; Magnetic Readers, etc.

For commodity categories in electronic equipment and instruments, Washington state imports are handled in part by airports in California and elsewhere outside the state. This service pattern may result from supply chain designs, limitations in air freight services, or other factors. They could be explored further as potential opportunities for increasing the airport's volumes.

3.2.3 *Europe*

Europe is the other principal origin of U.S. air imports, representing 30.9 percent of total import volumes in 2016. For selected product categories, Sea-Tac also acts as a gateway port from Europe. As displayed in Figure 3-5, commodities with the largest difference between state airport volumes and state imports include:

- Pacific, Atlantic, Danube Salmon Fillet Fresh/Chilled, which originate almost entirely in Europe

- Aircraft seats and seat parts, two aircraft-related commodity groups for which imports from Europe are greater than volumes from East Asia.

Figure 3-5. **Washington State and State Airport Top Import Commodities from Europe (thousands of metric tons)**
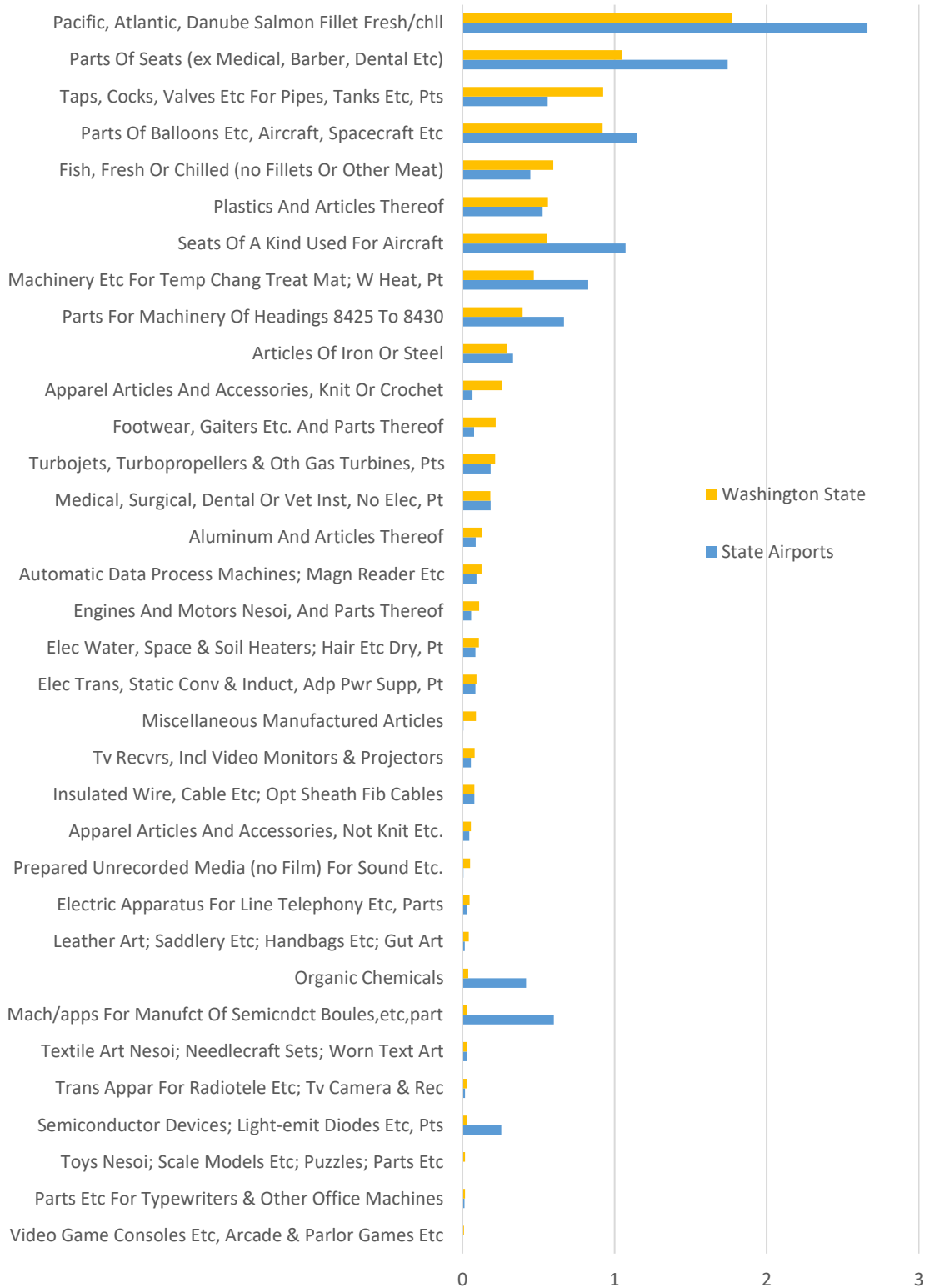
4 Inventory of Existing Facilities

4.1 INTRODUCTION

4.1.1 *Objectives*

This chapter presents an inventory of the existing air cargo facilities at airports in Washington state with significant air cargo activity and concludes with a synthesis of current conditions at the various airports and their ability to attract and accommodate growth in the near term. This will allow a more detailed assessment (Chapter 6) as to future facility requirements at the various airports to accommodate forecasted growth.

This chapter considers the following airports (Figure 4-1):

- Seattle-Tacoma International Airport (SEA), Sea-Tac...Large Hub Airport
- Spokane International Airport (GEG), Spokane ....Small Hub Airport
- Bellingham International Airport (BLI), Bellingham ....Small Hub Airport
- King County International (Boeing Field/BFI) Airport, Seattle....................................Non-Hub Airport
- Snohomish County Airport/Paine Field (PAE), Everett and Mukilteo ....Reliever Airport
- Yakima Air Terminal/McAllister Field (YKM), Yakima ....Non-Hub Airport
- Tri-Cities Airport (PSC), Pasco ....Non-Hub Airport
- Walla Walla Regional Airport (ALW), Walla Walla..Non-Hub Airport
- Pangborn Memorial Airport (EAT), East Wenatchee..Non-Hub Airport
- Grant County International Airport (MWH), Moses Lake..................................General Aviation Airport

Key findings presented in more detail in this chapter include the following:

- **Seattle-Tacoma International (Sea-Tac)** is an international air cargo hub, and a primary U.S. gateway for air freight imported from Asia which has experienced significant, sustainable growth of air cargo operations since 2012. However, future development of cargo facilities is in competition with the need for expanding passenger terminal facilities.

- The role of **King County International (Boeing Field/BFI)** as a commercial service airport has been declining since the end of World War II, with transfer of passenger air carriers and then all-cargo airlines to Sea-Tac. Considering the attractiveness of Sea-Tac, and the fact that land would need to be repurposed to accommodate additional air cargo use at King County, the short-term potential for significant new air cargo operations appears to be limited.

- Cargo activity at **Paine Field (Paine Field)** is dedicated to the needs of Boeing Aircraft Corporation's aircraft manufactures.

- **Spokane International (Spokane International)** is the primary cargo airport for the eastern part of Washington state as well as northern Idaho. The airport benefits from large facilities, land availability, the absence of congestion with direct access to an Interstate highway, and its location within the Spokane/Coeur d'Alene market area.

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■ While they have different sizes and NPIAS categorizations, **other airports represent less than 2.5 percent air cargo market share all together**, and less than 1 percent individually. Air cargo activity at these airports is almost exclusively generated by parcels and mail (same-day express shipments) carried by airlines contracted by FedEx and UPS for feeding their hubs of Sea-Tac and King County, as well as small belly cargo carried by Alaska Airlines.

■ Grant County International Airport (Grant County International Airport), in contrast to the other airports with less than 1 percent market share, has both significantly larger aviation facilities and land availability around the airport. Its 200-foot long runway can accommodate all the existing large cargo aircraft up to the Antonov 225. This specificity may create opportunities in the future.

Figure 4-1.   Airports Inventoried by the Study*
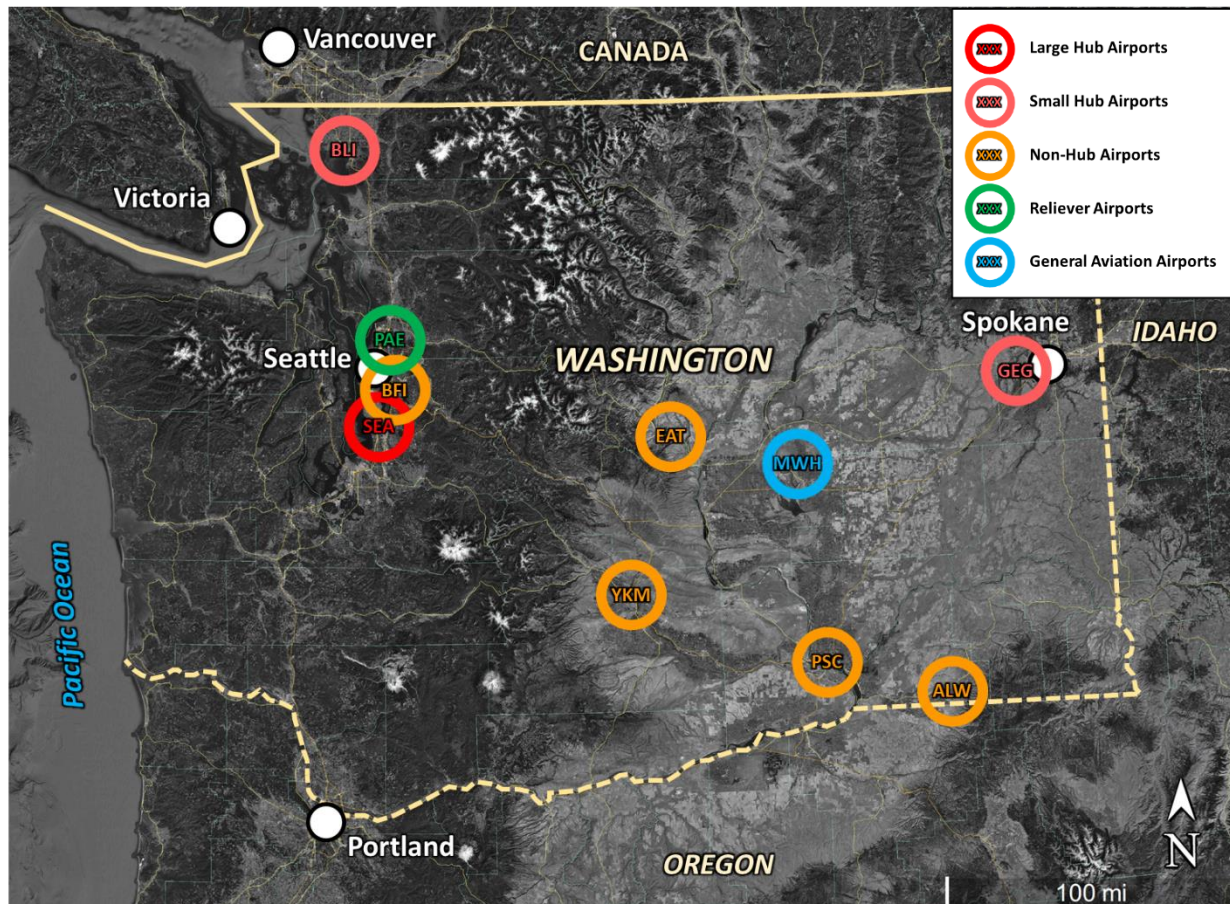
*Airport categories are based on the National Plan of Integrated Airport Systems 2017–2021.

4.1.2   Sources

The main sources of this inventory are the U.S. Federal Aviation Administration's (FAA) National Plan of Integrated Airport Systems (NPIAS) 2017–2021 and the National Flight Data Center (NFDC) website, Washington Aviation System Plan (WASP) of 2017, as well as airport master plans, including recent memorandums and public presentation materials for ongoing master planning updates. Other sources include state and regional studies listed in the bibliography.

4.2   SEATTLE-TACOMA INTERNATIONAL AIRPORT

4.2.1   *Airport History*

In 1944, the Port of Seattle built Seattle-Tacoma International Airport (Sea-Tac) with grants from the Civil Aeronautics Administration (CAA) and financial contribution from the City of Tacoma. The purpose of the new airport was to continue commercial air services to the Puget Sound while King County International (Boeing Field) Airport was controlled by the War Department as a military field and site of production for bombers.

After the war, many airlines moved their operations back to King County International (Boeing Field). In the late 1940s and the next decade, air carriers made the opposite movements and Seattle-Tacoma became the primary passenger airport for Greater Seattle. In 1953, one of the last major air carriers to relocate operations to Sea-Tac was Pan Am.

4.2.2   *Existing Airport Conditions*

Sea-Tac is operated by Port of Seattle. It is categorized as a large hub airport in the FAA's NPIAS 2017–2021. The airport is in the national top ten for passenger traffic and ranks 17th nationally for air cargo tonnage.

Sea-Tac has a unique three parallel runway system. The airport infrastructure is concentrated on the east side of this complex. The main terminal building and its satellites are in the southern part of this Eastfield area. Air cargo is divided between the Cargo 7 ramp, close to Threshold 34R and the Delta Cargo building, and a wider complex occupying the north half of the Eastfield (ramps Cargo 1 to 6). The latter hosts FedEx, UPS, and cargo divisions of various air carriers (Figure 4-3).

The airport is currently going through the revision of its airport master plan—locally designated as a Sustainable Airport Master Plan (SAMP). Elements of inventory and forecast on air cargo has been released, and they were used for preparing the present document. However, as the new SAMP is still an ongoing process, future plans presented by Port of Seattle will be considered as potential development options under review only.

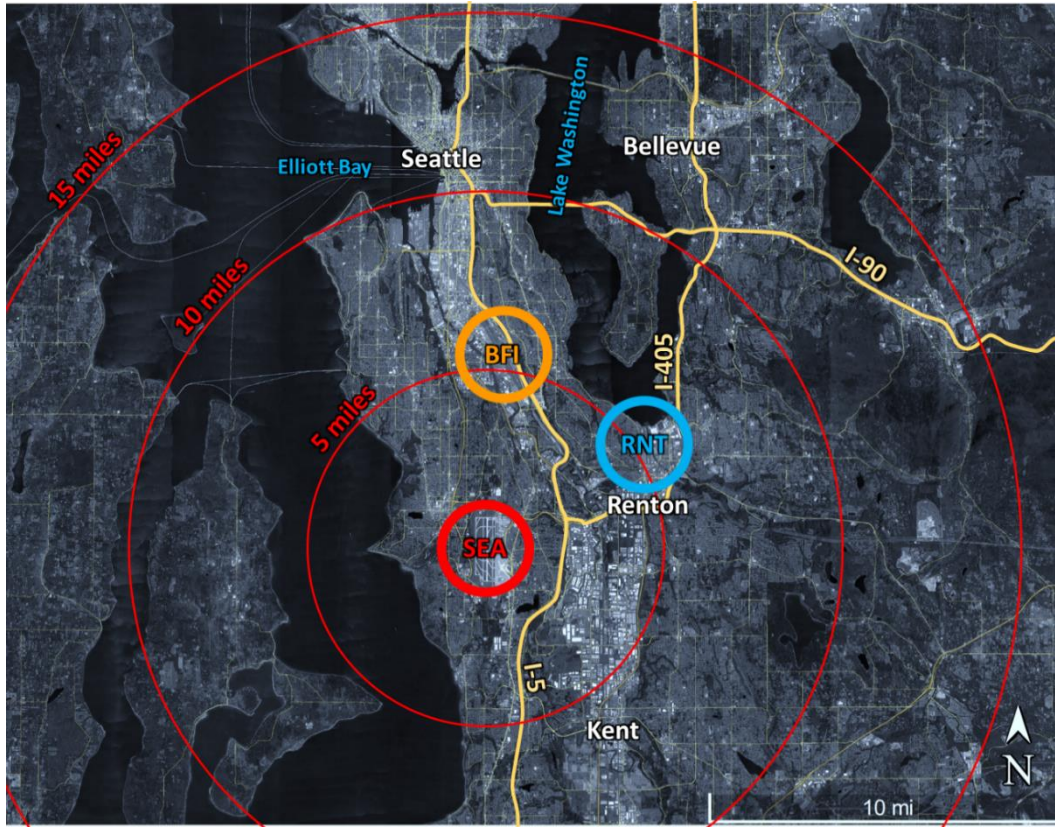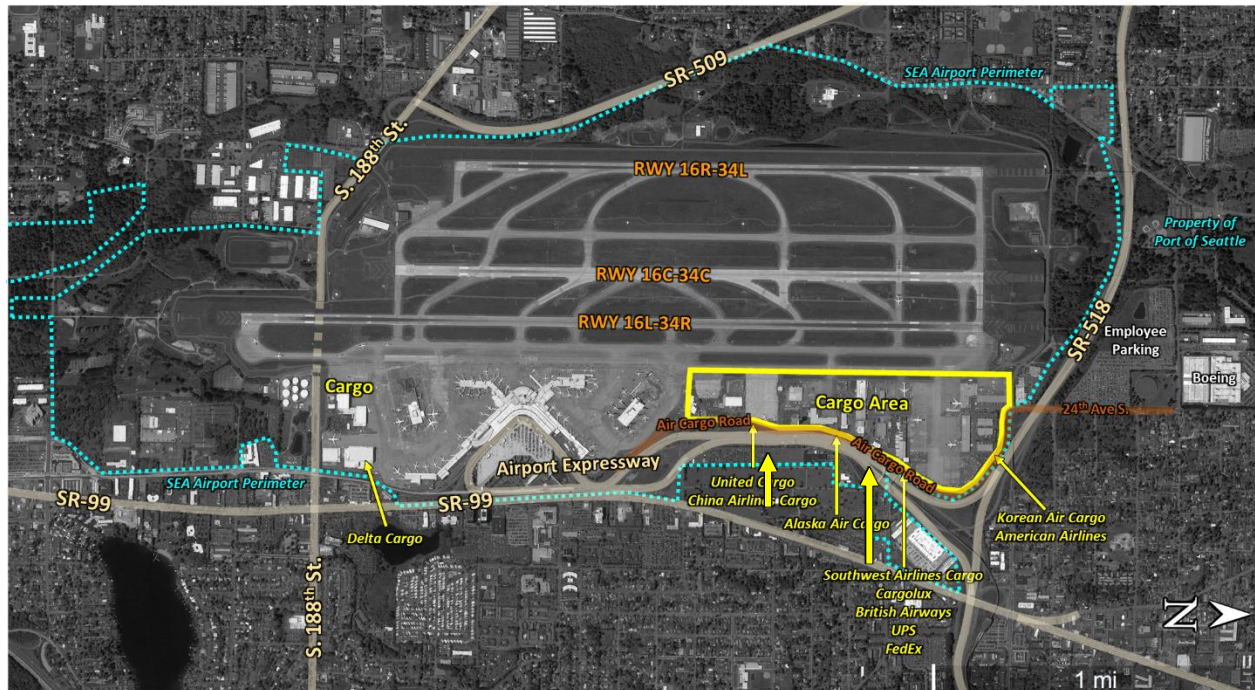**Figure 4-2.   Location Map (Seattle-Tacoma International Airport, SEA)**

Figure 4-3.   Situation Map (Seattle-Tacoma International Airport, SEA)

4.2.3   *Landside Access*

The airport is served by an Airport Expressway running along the terminal building and air cargo area. The expressway provides access to SR-518, connected to I-5 and I-405 through a large connector less than 2 miles away from the airport (Figure 4-3).

Air Cargo Road provides trucks a route independent of passenger cars going to and from the curbside. However, Air Cargo Road is not directly connected to SR-518 in all directions, and both inbound and outbound traffic is slowed by intersections and lights on routes to I-5 through S. 14th Street, S. 188th Street or SR-99. (Figure 4-3).

The ongoing Master Plan effort acknowledges congestion with the current airport access as well as bottlenecks on the Airport Expressway[2] and includes alternatives developed to mitigate the situation. I-5 within the Central Puget Sound region is a busy corridor subject to daily congestion in both directions.

4.2.4   *Airside Facilities*

Sea-Tac's runway system comprises three paved runways:

- Runway 16L/34R is 11,901 feet long and 150 feet wide. It is the preferred runway for departures.

- Runway 16C/34C is 9,426 feet long and 150 feet wide. It is used as a secondary arrival runway. Procedures exist for conducting dependent, parallel approaches to Runway 16R/34L and Runway 16C/34C.

- Runway 16R/34L is 8,500 feet long and 150 feet wide. It was commissioned in 2008 and is the primary runway for arrivals. Spacing with Runway 16L/34R is enough for conducting simultaneous approaches in Instrument Meteorological Conditions (IMC).

Current operational capacity in visual conditions is 100 aircraft movements (takeoff and landings) per hour. These rates drop down to 78 aircraft movements per hour during adverse weather conditions that require instrument approach procedure landings. The ongoing SAMP update project is considering several airfield capacity enhancements such as a full parallel taxiway between the two inner runways, and two end-around taxiways for bypassing the inner runways from Runway 16R/34L (arrivals) or to Runway 16C/34C (departures). These improvements are intended to prevent excessive delays identified through airside simulation modeling.[3]

Sea-Tac's airfield infrastructure was designed for large aircraft like the Boeing 747-400F, and they have been approved by the FAA to accommodate the larger Boeing 747-8F (Freighter) in regular commercial services. The Boeing 747-8F is an FAA Airplane Design Group VI aircraft operated by several large air cargo operators such as AirBridgeCargo, Atlas Air, Cargolux, Cathay Pacific, Nippon Cargo Airlines, Silk

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[2] *Sustainable Airport Master Plan (SAMP) Update*, Port of Seattle, January 27, 2015
[3] *Sustainable Airport Master Plan (SAMP) Update*, Port of Seattle, January 26, 2016

Way Airlines and UPS Airlines. The Antonov 124, another large Group VI aircraft, has served Sea-Tac for delivering extra-large payloads occasionally.

Table 4-1.   Runway Characteristics (Seattle-Tacoma International Airport, SEA)

Runway	RDC	Approach Procedures	Runway Width	Runway Length
Rwy 16L	D-V	ILS CAT I/II/III, RNAV GPS/RNP	150 feet	11,901 feet
Rwy 34R	D-V	ILS CAT I/II/III, RNAV GPS/RNP	150 feet	11,901 feet
Rwy 16C	D-V	ILS CAT I/II/III, RNAV GPS/RNP	150 feet	9,426 feet
Rwy 34C	D-V	ILS CAT I/II/III, RNAV GPS/RNP	150 feet	9,426 feet
Rwy 16R	D-V	ILS CAT I/II/III, RNAV GPS/RNP	150 feet	8,500 feet
Rwy 34L	D-V	ILS CAT I/II/III, RNAV GPS/RNP	150 feet	8,500 feet

4.2.5   *Air Cargo Operations and Facilities*

Sea-Tac ranks 17th nationally for air cargo with 603 million pounds transported in 2017.[4] Sea-Tac has been experiencing significant growth of cargo traffic since 2012. The Bureau of Transportation Statistics reported a 22 percent increase in tonnage between 2016 and 2017, although this includes the effect of DHL's transfer of operations from King County International (Boeing Field).

About 65 percent of air cargo at Sea-Tac is for domestic market, with a significant part being parcels and mail. eCommerce and express package (e.g., Amazon, eBay) have been boosting domestic cargo. The top exports are cherries (20 percent), seafood (15 percent), aluminum alloy, and graphite and aerospace components (13 percent). The top imports are industrial machinery (24 percent), electronics (23 percent) and aerospace components (11 percent).

As a port of entry with federal inspection services, the airport is used by carriers for clearing freight that will fly or re-dispatch on other modes to other destinations throughout the nation. Also, of the 35 percent of international air cargo, more than half of the tonnage is reexported,[5] confirming Sea-Tac's role as an international air cargo hub.

About 34 airlines operate air cargo services (full freighters or belly cargo) to and from Sea-Tac, with non-stop services to 81 domestic and 24 international destinations. Aircraft types range from small feeders (such as ATR 42) and medium-sized, aircraft (e.g., Boeing 737) to large, aircraft (Antonov 124 and Boeing 747-8F). Up to 17 large cargo aircraft can be accommodated simultaneously on the 7 cargo ramps (Figure 4-4). Hangars used for the purpose of cargo and logistics with access to the airside exceed 70 acres, with large hangar facilities operated by Alaska Air Cargo (belly cargo) and FedEx.
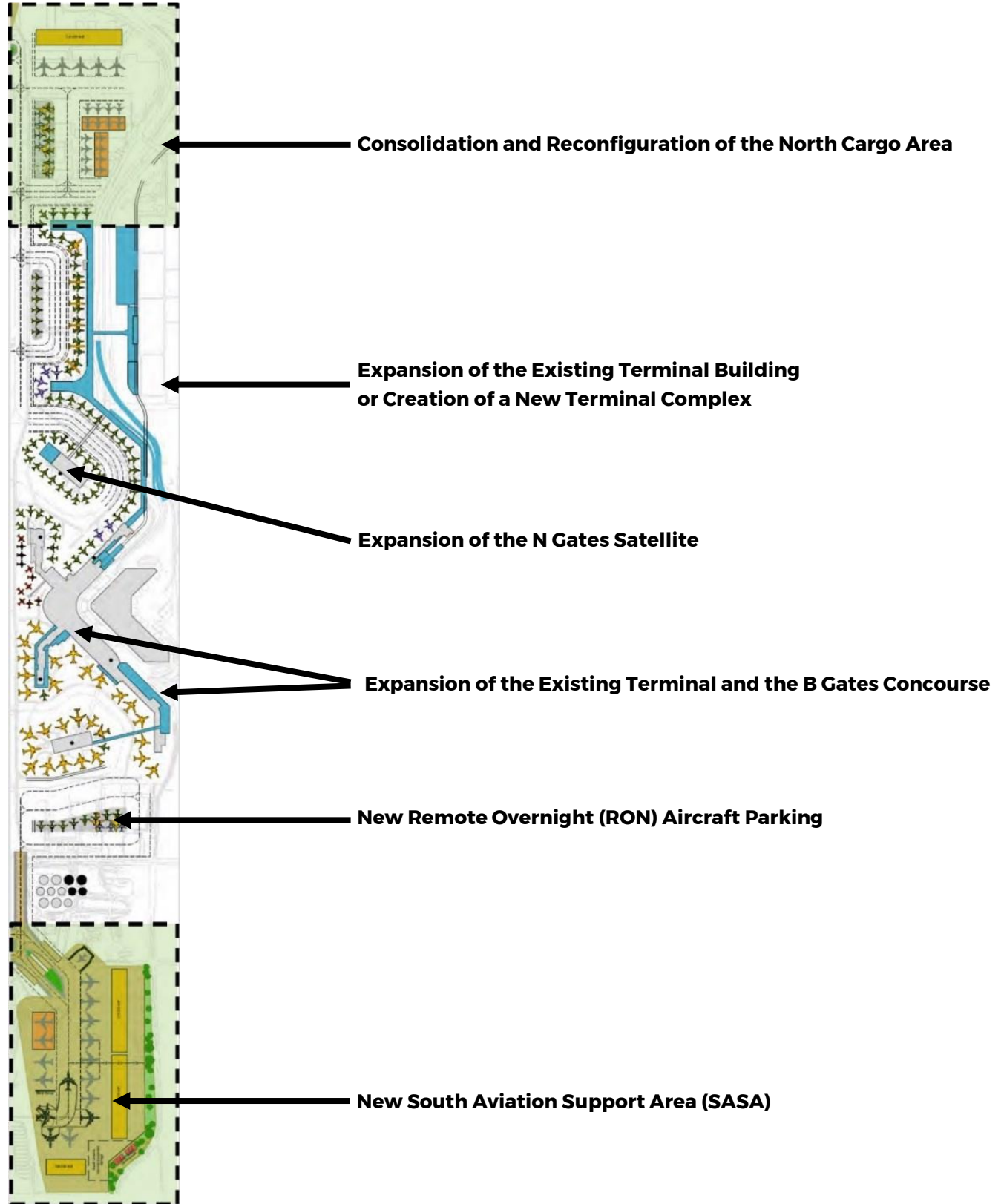
The main findings of the SAMP are the following:

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[4] Period from September 2016 to August 2017.
[5] Air Cargo Briefing, Port of Seattle, May 24, 2016

■ Seattle-Tacoma's air cargo buildings have dated conditions and are laid out inefficiently, hindering the airport ability to fulfill the Port's economic mission to support growing trade.[6]

■ The passenger terminal shall be expanded to the north, causing competition for space between terminal and air cargo facilities.

■ The draft documents propose addressing this issue with a redevelopment and densification of the existing cargo area, and the development of a new South Aviation Support Area (SASA), located south of the fuel farm. This new facility would feature up to eight hardstands available for large cargo aircraft and about 400,000 sq. ft. of air cargo warehouses (Figure 4-4).

■ The new SASA would not address alone the long-term demand for new cargo and logistics facilities. For addressing future growth, the master plan update suggests investigating opportunities for off-airport developments, on either private or Port owned property. On the north side of SR-518, there are approximately 30 acres of Port owned land that is currently unoccupied (Figure 4-4) that could be utilized to support off-airport cargo operations. The property includes options for expanding farther against the existing employee parking (about 50 acres) as long as land use does not violate FAA restrictions regarding developments within the Runway Protection Zones (RPZ) that cover most of this parking area. There are additional privately- owned properties in the vicinity of the airport that could also be developed to meet the demands for off-airport air cargo operations.

■ The draft SAMP cargo redevelopment plan has more efficiently spaced ramps, cargo buildings, and landside access for both the existing North Cargo Area as well as the proposed SASA.

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[6] Briefing on Sea-Tac Air Cargo as Part of the Sustainable Airport Master Plan, M. E. Ehl and E. Leavitt, March 24, 2015

Figure 4-4.   Seattle-Tacoma International Airport – Proposed Air Cargo Redevelopment and South Aviation Support Area (Draft Master Plan)

Consolidation and Reconfiguration of the North Cargo Area

Expansion of the Existing Terminal Building or Creation of a New Terminal Complex

Expansion of the N Gates Satellite

Expansion of the Existing Terminal and the B Gates Concourse

New Remote Overnight (RON) Aircraft Parking

New South Aviation Support Area (SASA)

4.3   SPOKANE INTERNATIONAL AIRPORT

4.3.1   Airport History

In the late 1930s, the Spokane Chamber of Commerce purchased lands west of the city to construct a commercial airport—Sunset Field—for replacing the existing Felts Field. In 1941, the War Department purchased the facility from the County, and used it during World War II for training pilots on Boeing B-17 as Geiger Field. In 1945, military operations were discontinued. The War Assets Administration transferred the airport back to the City and County of Spokane under the Surplus Property Act of 1944. The county converted the airport to its initial purpose.

In 1946, all commercial passenger operations were relocated from Felts Field to Geiger Field. The airport took its current name in 1960.

4.3.2   Existing Airport Conditions

Spokane International Airport and Spokane Felts Field are both owned and operated by Spokane Airports, an entity of the City and County of Spokane. The airport is categorized as a small hub airport in the FAA's NPIAS 2017–2021. Spokane International is located approximately 5 miles southwest of downtown Spokane, 11 miles southwest of Spokane Felts Field, and 5 miles east of Fairchild Air Force Base (Figure 4-5).

Figure 4-5.   Location Map (Spokane International, GEG)
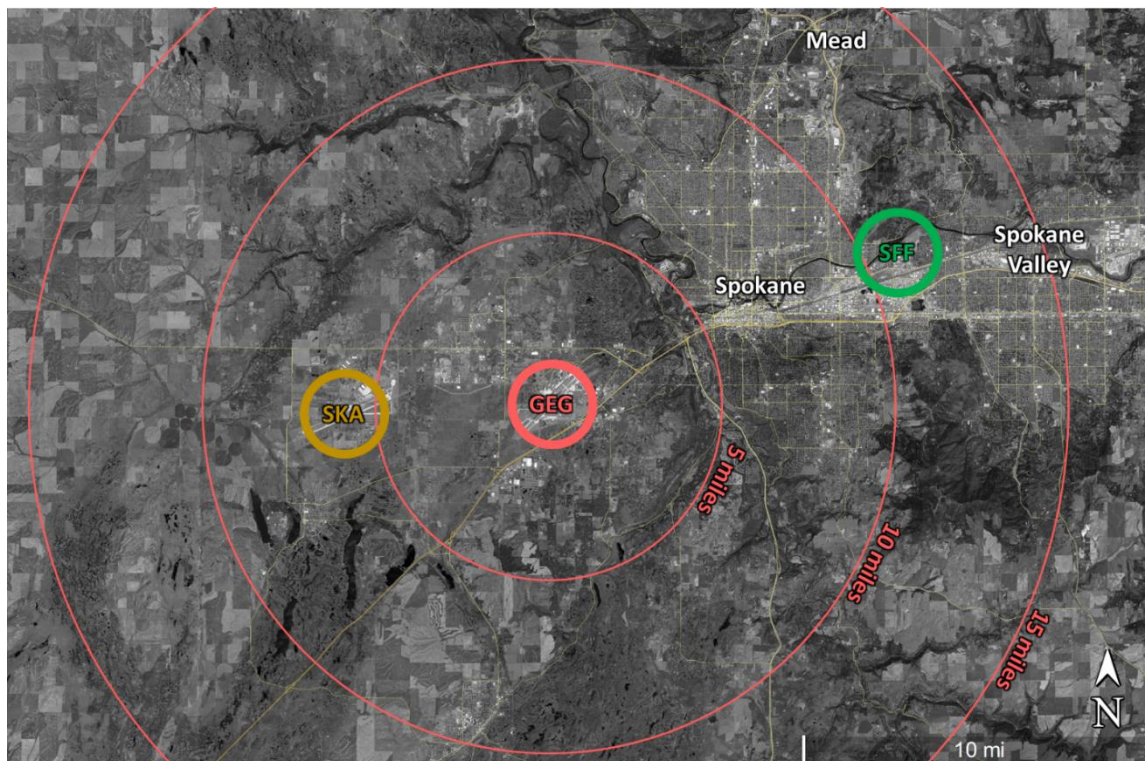
The airport has two intersecting runways. The northwest side is occupied by the commercial passenger facilities (terminals and parking garages). The southeast side concentrates the general aviation operations. Cargo ramps are on both sides of Threshold 21 (West and East Air Cargo Ramps) (Figure 4-6).

Figure 4-6.   Situation Map (Spokane International, GEG)
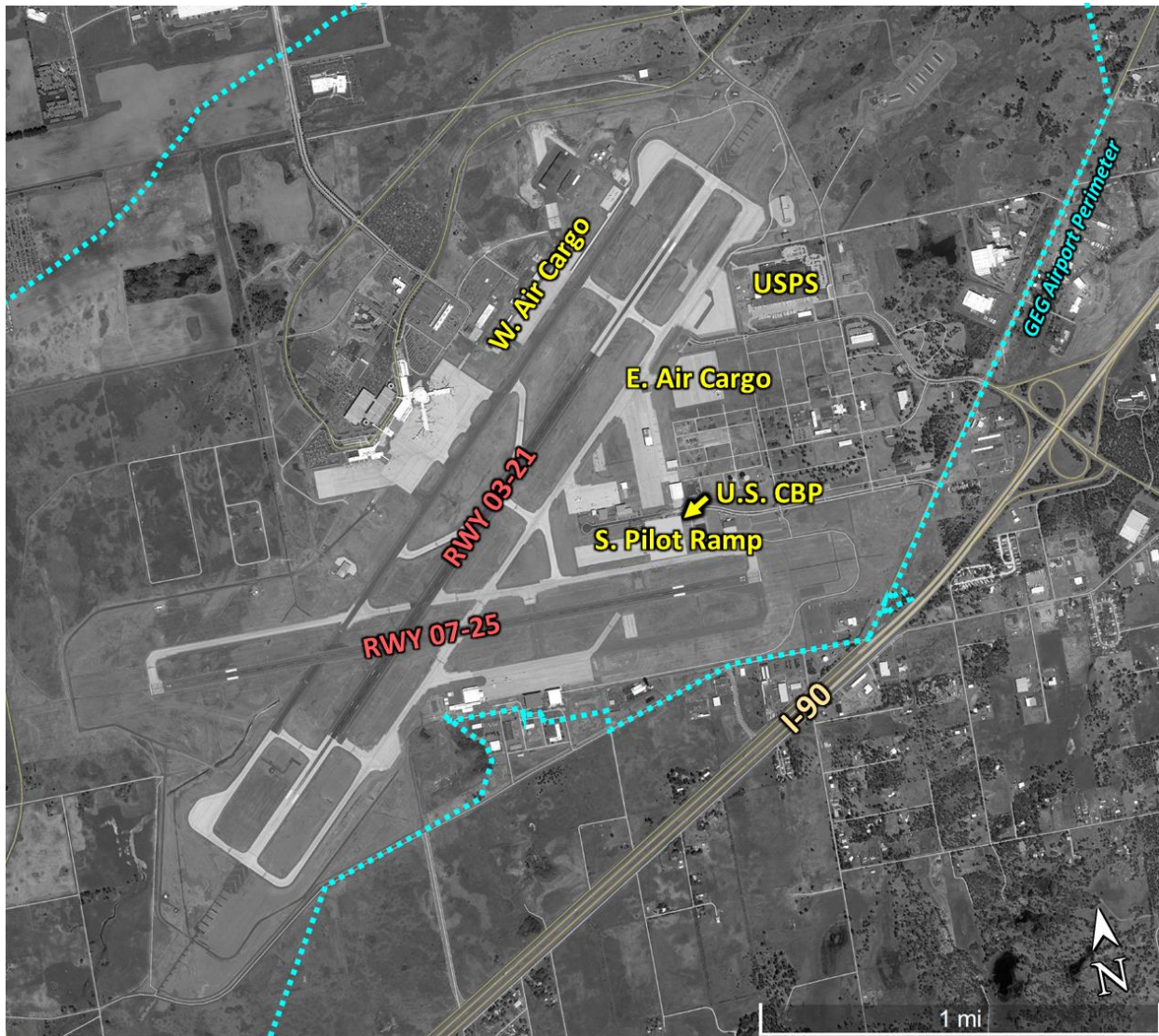
Vast lands are available around the airport for future developments. A commercial and industrial park is located on the northeast side of the airport property, with direct access to I-90.

4.3.3   *Landside Access*

Airport Drive, US-2, and Geiger Boulevard connect the airport to I-90. The northwest air cargo area is less than 5 miles away from I-90 and less than 1 mile from US-2, while the new commercial and industrial park has direct access to the Interstate (<1 mile away).

In the 2014 Master Plan, potential congestion at peak hours was identified along US-2. The document provides recommendations for roadway improvements to maintain at least a Level of Service C (stable flow of traffic) based on the *Highway Capacity Manual* (HCM) of the Transportation Research Board (TRB). However, S. Bush Road provides an alternate, direct access from I-90.

While there are no direct rail-air intermodal transfers at Spokane International, the airport desires to improve the marketability of the Spokane International Airport Industrial Park by adding additional rail service to the property. To accomplish this, a 5,000-foot-long rail extension is being installed that will connect to the existing Geiger Spur, travel across Craig Street on a new grade crossing, and terminate in the airport business park.

4.3.4   *Airside Facilities*

Spokane International's runway system comprises two paved runways (Table 4-2):

■ Runway 03/21 is the primary runway of the airport. It is 11,002 feet long and 150 feet wide. The design aircraft is the Boeing 767-300. Various instrument procedures are published for both runways, including ILS CAT-I/II/III allowing precision approaches and low visibility operations.

■ Runway 07/25 is 8,199 feet long and 150 feet wide. RNAV GPS and RNAV RNP approach procedures are published for both runways.

Table 4-2.   Runway Characteristics (Spokane International)

Runway	RDC	Design Aircraft	Approach Procedures	Runway Width	Runway Length
RWY 03	D-IV	767-300	ILS CAT I/II/III, RNAV GPS/RNP	150 feet	11,002 feet
RWY 21	D-IV	767-300	ILS CAT I/II/III, RNAV GPS/RNP	150 feet	11,002 feet
RWY 07	C-III	737-500 and Q400	RNAV GPS/RNP	150 feet	8,199 feet
RWY 25	C-III	737-500 and Q400	RNAV GPS/RNP	150 feet	8,199 feet

4.3.5   *Air Cargo Operations and Facilities*

Based on the FAA's Air Carrier Activity Information System, Spokane International ranked as the 51st busiest air cargo airport for the landed weight in 2016. This is a decrease of 1.4 percent from 2015. It is the third-busiest cargo airport in Washington state.

Five air cargo carriers operate to and from Spokane International: AIRPAC Airlines, Ameriflight, FedEx Express and Empire Airlines (feeder), UPS Airlines, and Western Air Express. Delta Air Lines and Southwest Airlines operate two belly-cargo facilities for preparing cargo loads to be carried by their passenger aircraft. All-cargo aircraft types range from the Cessna 208 to the Boeing 767-300ER. Small aircraft accounted for 73 percent of the cargo aircraft movements in 2010, while 27 percent were large commercial aircraft.

The airport operator reported an increasing activity of international cargo aircraft landing at Spokane International for clearing customs before continuing flight to their final U.S. destination. This strategy allows aircraft operators to avoid long delays at Custom and Border Patrol (CBP) stations at Sea-Tac and other busy U.S. airports. The recently constructed 5-acre South Pilot Ramp with its Customs facility is used for these international cargo carriers (Figure 4-7).

**Figure 4-7.   South Pilot Ramp (Spokane International)**

Air cargo facilities are divided in two areas on each side of runway 03/21 (Figure 4-8):

- The West Air Cargo Ramp provides approximately 10 acres of apron connected to Taxiway ALPHA, with aircraft stands for up to five medium aircraft and six small aircraft (feeders) simultaneously. Three cargo buildings are located along this ramp, which are occupied by Delta Cargo, Southwest Airlines Cargo, and a FedEx Shipping Center. UPS uses the west half of the West ramp for cargo transfers and FedEx uses the east half for its aircraft operations;

- The East Air Cargo Ramp and Triangle Ramp are 9 and 8.5-acres wide, respectively. They are used as remote apron and can accommodate large cargo aircraft. More than 10 large aircraft can be parked simultaneously.

- A U.S. Postal Service (USPS) regional distribution center is located along the Triangle Ramp, but it does not have direct access to the airside. Mail containers to be shipped by plane are trucked to the West Air Cargo Ramp.

- The 2014 Master Plan forecast a +2.06 percent compound annual growth rate (CAGR) in air cargo operations and tonnage, based on the assumption that Spokane International's U.S. air cargo market share will remain stable in the future. The 2017 Washington Aviation System Plan Update does not identify any issues for accommodation of future air cargo demand at Spokane International.[7]

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[7] Washington Aviation System Plan Update, "5.4.2 Washington State Air Cargo Facilities", WSDOT, July 2017, pp. 5-17

Figure 4-8. **Air Cargo Ramps (Spokane International)**
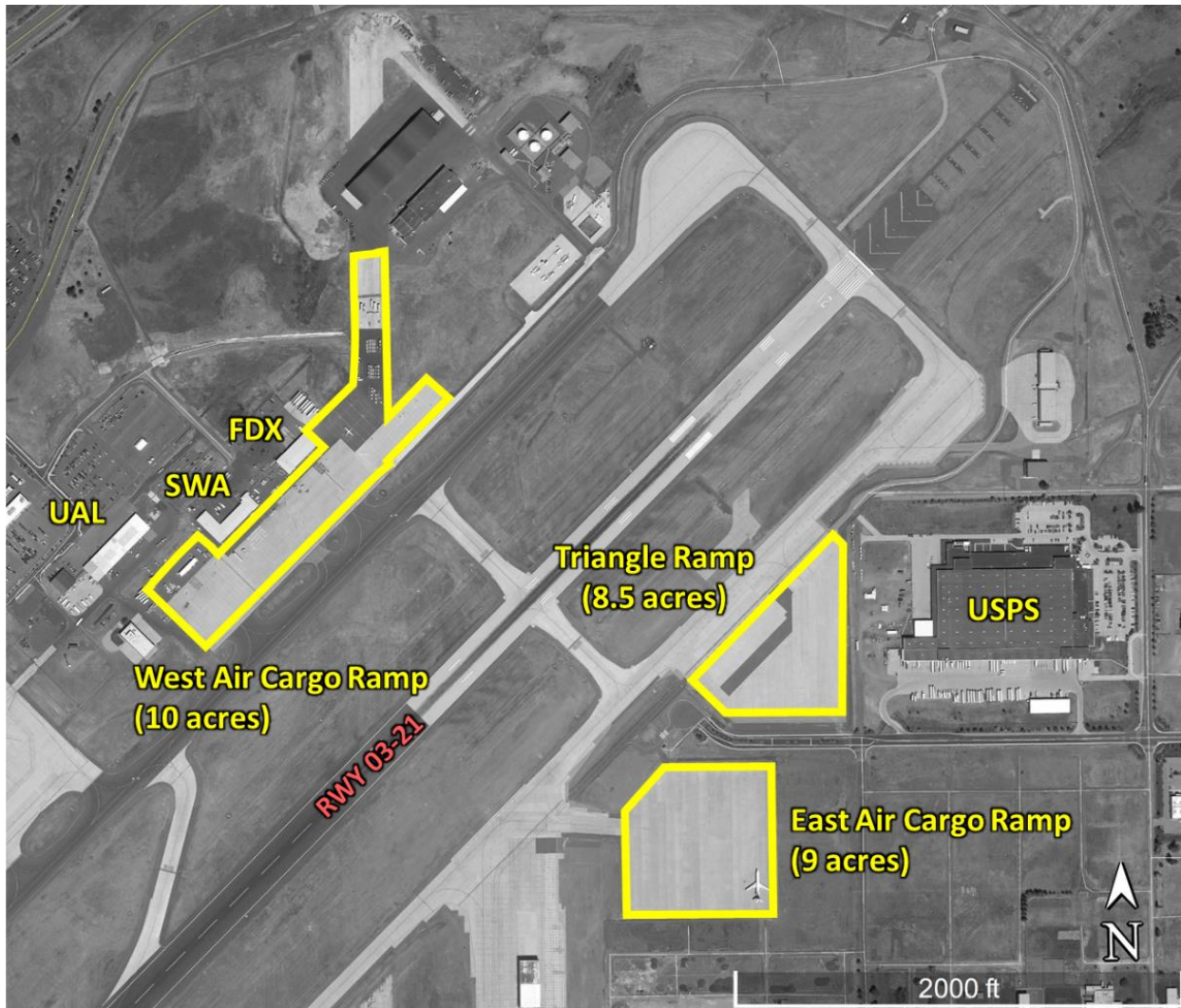
4.4   BELLINGHAM INTERNATIONAL AIRPORT

4.4.1   *Airport History*

Bellingham International Airport opened in 1940. The airport was taken for the war effort the next year, and renamed Bellingham Army Air Field. The airport was returned to Whatcom County in 1946, having expanded from 350 acres to 910 acres with 38 buildings on-site. The airport was sold for $1 to the Port of Bellingham in 1957. In 1985, a new passenger terminal was built to handle the passenger growth. In 1986, Runway 12/30 was closed, and a few years later Runway 16/34 was extended to 6,701 feet. Then in 1997, Runway 02/20 was closed, leaving Runway 16/34 as the only runway at the airport.

Today, the airport is located on 1,200 acres of land and has been reduced back to a one-runway airport, as it was when it originally opened. It is the primary air transportation facility for the city of Bellingham, Northwest Washington, and the southern mainland portion of British Columbia, Canada.

4.4.2   *Existing Airport Conditions*

Bellingham International Airport is owned and operated by the Port of Bellingham. The airport is categorized as a primary small hub airport in the FAA's NPIAS 2017–2021. The airport is located approximately 3 miles northwest of the Bellingham city limits, 90 miles north of Seattle, and 20 miles south of the U.S./Canada Peace Arch Border Crossing in Blaine, Washington (Figure 4-9).

Figure 4-9.   Situation Map (Bellingham International)

The airport has two fixed-based operators: Command Aviation Inc. and Bellingham Aviation Services. Both are full-service fixed-based operators, offering aircraft services and maintenance, as well as aviation fuel and flight school. Both lease space in the general aviation terminal.

4.4.3   Landside Access

The airport is served by I-5 connecting Bellingham International to Greater Seattle and Blaine. The ongoing Master Plan Update mentions that a ramp to the Bakerview Interchange is in the planning stages, justified by commercial developments in the area. The ramp is in addition to the widening and restriping of the Bakerview Interchange that occurred on the section between the Pacific Highway and Bennett Drive. This upgrade was completed in 2013.

4.4.4   Airside Facilities

Bellingham International's runway system comprises one paved runway:

■   Runway 16/34 is 6,701 feet long and 150 feet wide and has a grooved asphalt surface. The design aircraft is the large Boeing 757-200Approaches available are ILS CAT-I at Runway 16 and RNAV in both directions.

Table 4-3.   Runway Characteristics (Bellingham International)

Runway	RDC	Design Aircraft	Visibility Minimums	Approach Procedures	Runway Width	Runway Length
Runway 16	C-IV	Boeing 757-200	½ SM	ILS CAT-I, RNAV	150 feet	6,701 feet
Runway 34	C-IV	Boeing 757-200	≥ 1 SM	RNAV	150 feet	6,701 feet

4.4.5   Air Cargo Operations and Facilities

There are three cargo carriers with operations at Bellingham International: FedEx, UPS, and Alaska/Horizon Air. Facilities are not centrally located at the airport; each carrier operates from a different point on the airfield. FedEx operates from its facility north of the passenger terminal building (30,000 sq. ft.) from dedicated ramp and on-site building, UPS operates from the apron in front of the General Aviation Terminal, and Alaska/Horizon Air cargo operates from the main passenger terminal.

Two types of cargo operations take place at Bellingham International, which are airline belly cargo and all-cargo operators. The former is handled at the north end of the passenger terminal. Per the ongoing master plan efforts, this space is expected to be adequate for all future needs. The second type is all-cargo carriers, such as FedEx and UPS. This type of cargo is processed at private off-site facilities and is then transported to the airport to be loaded onto aircraft on the apron. Per the Washington Aviation State Plan (WASP) of 2017, the projected growth for cargo is not significant (approximately 1 percent per year average annual growth rate), therefore limiting the need for additional cargo facilities. It is projected that the cargo operations will continue to consist of feeder operations with small aircraft.

4.5   KING COUNTY INTERNATIONAL (BOEING FIELD) AIRPORT

4.5.1   *Airport History*

In the late 1910s, Boeing Airplane Company started aircraft production on the West bank of the Duwamish River. Aircraft were tested on an airstrip located on the other side of the river. This testing field was eventually developed by King County into King County International (Boeing Field), a commercial airport dedicated in June 1928. In April 1930, the Terminal Building was inaugurated for accommodating passenger operations of West Coast Air Transport and Pacific Air Transport.

During World War II, the airport closed to the public and focused on the production of the Boeing B-17 and B-29 bombers. For continuing passenger commercial services from Seattle, Port of Seattle built Galvin Airport (the future Sea-Tac) 5 miles away from King County International (Boeing Field).

However, many air carriers resumed operations at King County International (Boeing Field) when the airport returned to its civil management. Ultimately, Sea-Tac became the primary passenger commercial airport for Greater Seattle. Pan American transferred its operations from King County International (Boeing Field) to Sea-Tac in 1953, while West Coast and Air West maintained operations at King County International (Boeing Field) until 1971.

Today, the airport is home of a large industrial complex (Boeing) and air cargo activity. It is also a busy General Aviation airport. Scheduled commercial flights connect King County International (Boeing Field) with the San Juan Islands (Friday Harbor and Eastsound airports) north of Seattle. In 2016, DHL transferred its operations from King County International (Boeing Field) to Seattle-Tacoma, citing better growth opportunities and low visibility operations at Sea-Tac.

4.5.2   *Existing Airport Conditions*

King County International (Boeing Field) Airport is owned by King County, and operated by a division of the County's Department of Transportation. The airport is categorized as a primary non-hub airport in the FAA's NPIAS 2017–2021. King County International (Boeing Field) is located approximately 5 miles south-southwest of downtown Seattle, 6 miles north of Sea-Tac, and 4.5 miles northwest of Renton Municipal Airport (Figure 4-10).

The airport is divided into west and east sides by two closely spaced parallel runways. The east side of the airport is occupied by the terminal building, general aviation hangars, fixed-based operators, air-taxi and charter service providers, and air cargo facilities. The west side comprises Boeing's Museum of Flight, general aviation hangars, and Boeing's factory where the Boeing aircraft (both civil and military variants) are finalized before delivery.

The airport has three fixed-based operators: Kenmore Aero Services, Clay Lacy Aviation and Signature Flight Support. Two helicopter operators are based at King County International (Boeing Field): AirLift Northwest (flight ambulance) and Classic Helicopter (flight school, tours and charters). Kenmore Air Express offers regular passenger air carrier services to Friday Harbor and Eastsound/Orcas Island in Cessna 208/208B aircraft.

Airport development is constrained by the Boeing Company complex and the Duwamish River on the west side, and a major BNSF railway corridor and I-5 on the east side (Figure 4-11).

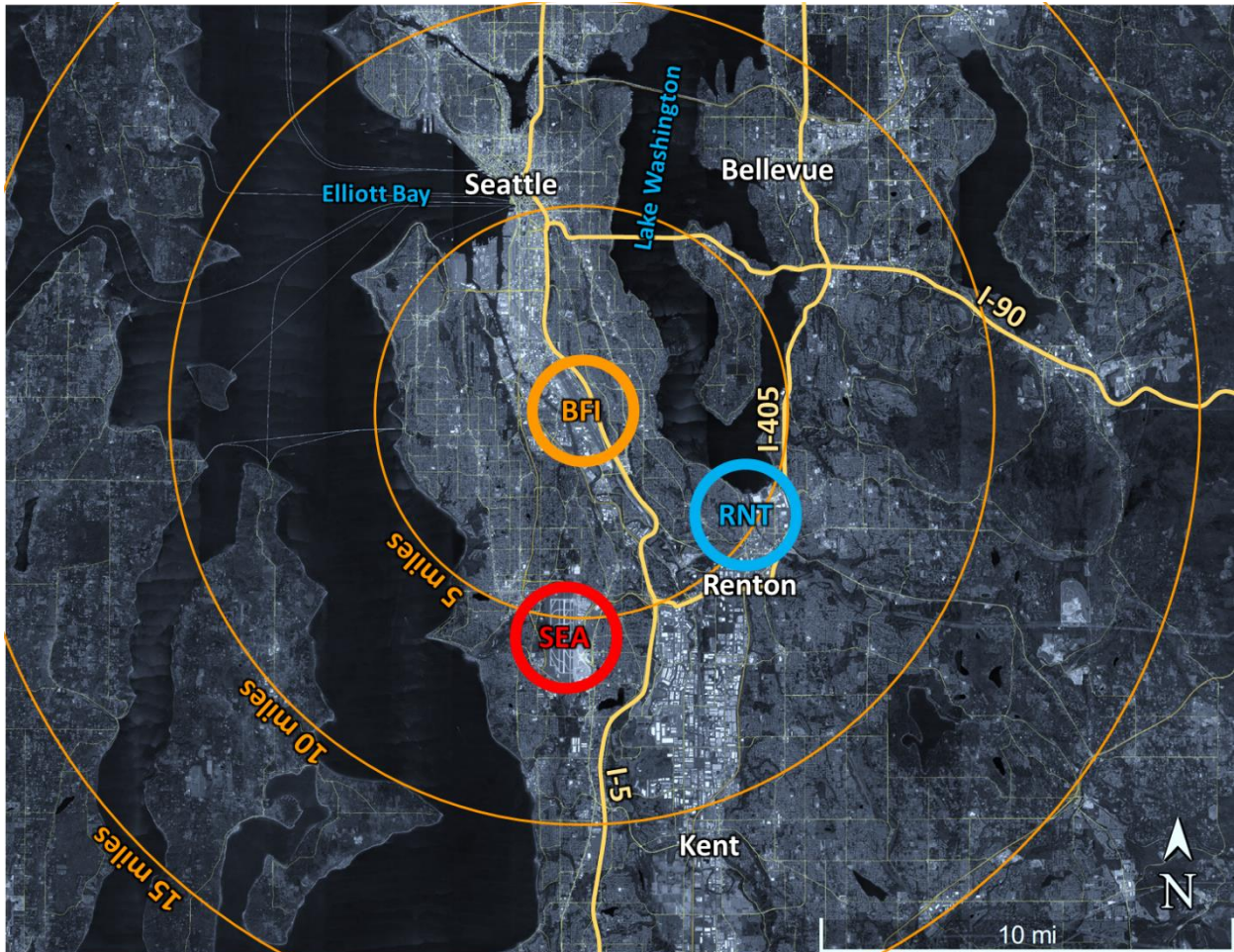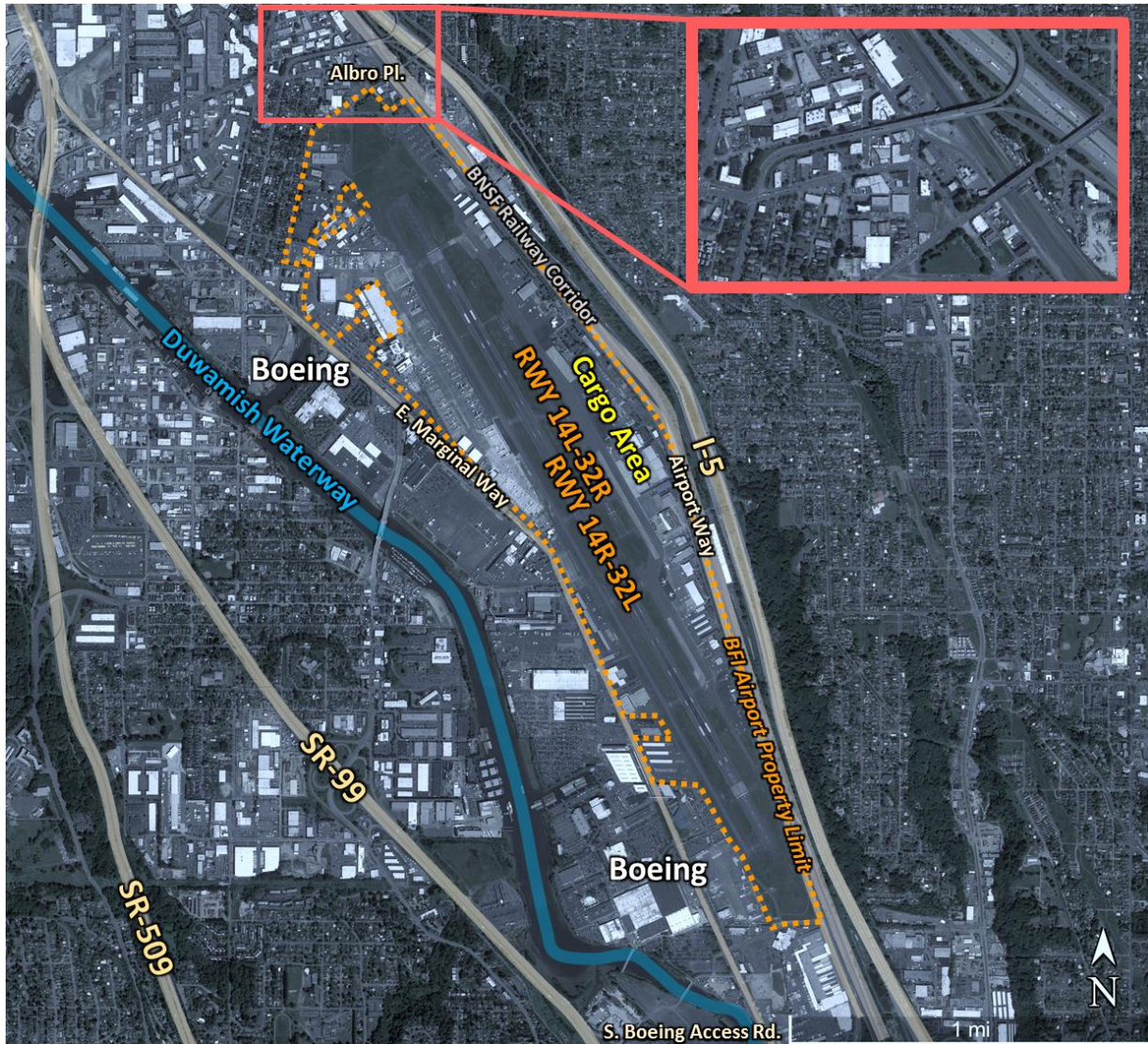**Figure 4-10.   Location Map (King County International [Boeing Field, BFI])**

Figure 4-11.   Situation Map (King County International [Boeing Field])

4.5.3   *Landside Access*

The airport is served by the following:

- I-5, a major corridor running north/south on the east side of the airport provides direct access to downtown Seattle and the South Sound, east of the BNSF rail tracks. Two interchanges provide access to the airport to the north (Albro Place) and to the south (South Boeing Access Road).

- Airport Way, a 4-lane road serving the east side of the airport, including the airport offices, terminal building and air cargo operators, provides a surface road alternative access to downtown Seattle and SODO.

- East Marginal Way, a 5-lane road providing access to the Boeing manufacturing facilities and the Museum of Flight and industrial areas of South Seattle.

- Highways SR-99 (Pacific Highway) and SR-509 are alternate roads to Greater Seattle and Tacoma, and are less than 2 miles away from King County International (Boeing Field).

The ongoing Master Plan Update effort considers that current landside access is adequate for meeting the future demand at the planning horizon (+20 years).[8] The Regional Air Cargo Strategy prepared for the Puget Sound Regional Council in 2005 determined that traffic congestion in the airport vicinity is minimal with regard to the movement of air cargo, except during morning peak hours along Boeing Access Road, E. Marginal Way, SR-99 and I-5—with a level of service on this corridor expected to drop to LOS E by 2020. The study acknowledged regular congestion of major corridors I-5 and I-405 affecting access to the Puget Sound airports, with no real alternative available.[9] No changes have occurred on the roadway system since the 2005 study. Traditionally, the cargo activities at King County International (Boeing Field) are not occurring during peak hour usage of the local facilities. Primary cargo activities are scheduled for the very early morning (e.g. 2:30 a.m.)

4.5.4   *Airside Facilities*

King County International (Boeing Field)'s runway system comprises two paved runways as further detailed in Table 4-4:

- Runway 14R-32L is the primary runway of the airport. It is 10,000 feet long and 200 feet wide. Runway 32L has an 880-foot displaced threshold (landings). Runway 14R features a 880-foot-long runway extension called Prior Permission Required Pavement (PPR) for the exclusive use of Boeing for their newly built airliners leaving Boeing's factory for long-range flights. The design aircraft is the Boeing 767-300ER. Both Runways 14R-32L have instrument approach procedures capabilities with visibility minimums not lower than ¾ mile. The runway has waivers and Modifications of Standards on the Object Free Area and separation distances with parallel runway and taxiways.

- Runway 14L-32R: this runway is 3,710 feet long and 100 feet wide. Runways 14L and 32R's landing thresholds are displaced by 350 feet and 375 feet, respectively. This runway is limited to aircraft

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[8] Master Plan Update – King County Intl./Boeing Field, Working Paper Two, "Ground Access and Parking Requirements", 2016, p. C.55
[9] Regional Air Cargo Strategy, "Chapter V – Regional Air Cargo Forecast", Puget Sound Regional Council, 2005

weighting up to 12,500 pounds, and is not available for air carrier operations. Approaches are visual only.

Table 4-4.   Runway Characteristics (King County International [Boeing Field])

Runway	RDC	Design Aircraft	Visibility Minimums	Approach Procedures	Runway Width	Runway Length
RWY 14R	D-IV	767-300ER	≥ ¾ SM	ILS CAT I, RNAV GPS	200 ft.	10,000 ft.
RWY 14R w/ PPRP	D-IV	767-300ER	≥ ¾ SM	N/A	200 ft.	10,880 ft.
RWY 32L	D-IV	767-300ER	≥ ¾ SM	ILS CAT I, RNAV GPS	200 ft.	10,000 ft.
RWY 14L	B-I	PA-31	Visual	Visual	100 ft.	3,710 ft.
RWY 32R	B-I	PA-31	Visual	Visual	100 ft.	3,710 ft.

4.5.5   Air Cargo Operations and Facilities

Based on the FAA's Air Carrier Activity Information System, King County International (Boeing Field) ranked as the 32nd busiest air cargo airport for landed weight in 2016 with 396,572 tons. This is a 4.8 percent decrease from 2015. It is the second-busiest cargo airport in Washington state, after Sea-Tac and before Spokane International.

Seven air carriers operate air cargo services to and from King County International (Boeing Field): AIRPAC Airlines, Air Transport International, Ameriflight, Kalitta Air, SkyLink Express, UPS, and Western Air Express. The operators use a wide variety of aircraft types, from the Piper PA-31 (AIRPAC Airlines) to the Boeing 767-300F (UPS). ABX Air on behalf of DHL relocated its operations to Sea-Tac in 2016.

Most of the air cargo tonnage has been generated by UPS since DHL (which accounted for 12 percent of cargo tonnage in 2014) left the facility in June 2016. Without DHL, large cargo aircraft operations are expected to drop down to 20 flights per week in 2017.[10]

Air cargo facilities are divided in two areas on the east side of the airport property (Figure 4-12):

- In the immediate vicinity of the passenger terminal building is where AIRPAC Airlines operates (<0.5 acre).

- South of the terminal building has operations by large aircraft carriers UPS and Ameriflight. This area covers approximately 11 acres of apron. It comprises areas used for storing cargo, ground support equipment and vehicles, as well as four stands for large aircraft (Boeing 757/767) co-located with several stands for small aircraft. This ramp has potential for accommodating at least two additional stands for large cargo aircraft if reconfigured.

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[10] Washington Aviation System Plan Update, "5.4.2 Washington State Air Cargo Facilities", WSDOT, July 2017, pp. 5-16/5-17

wsp

■ UPS terminal facilities are off-airport. Its ground-handling operations at King County International (Boeing Field) are essentially limited to transfers between aircraft and trucks that come onto the airfield.

Figure 4-12. **Air Cargo Ramps (King County International [Boeing Field])**
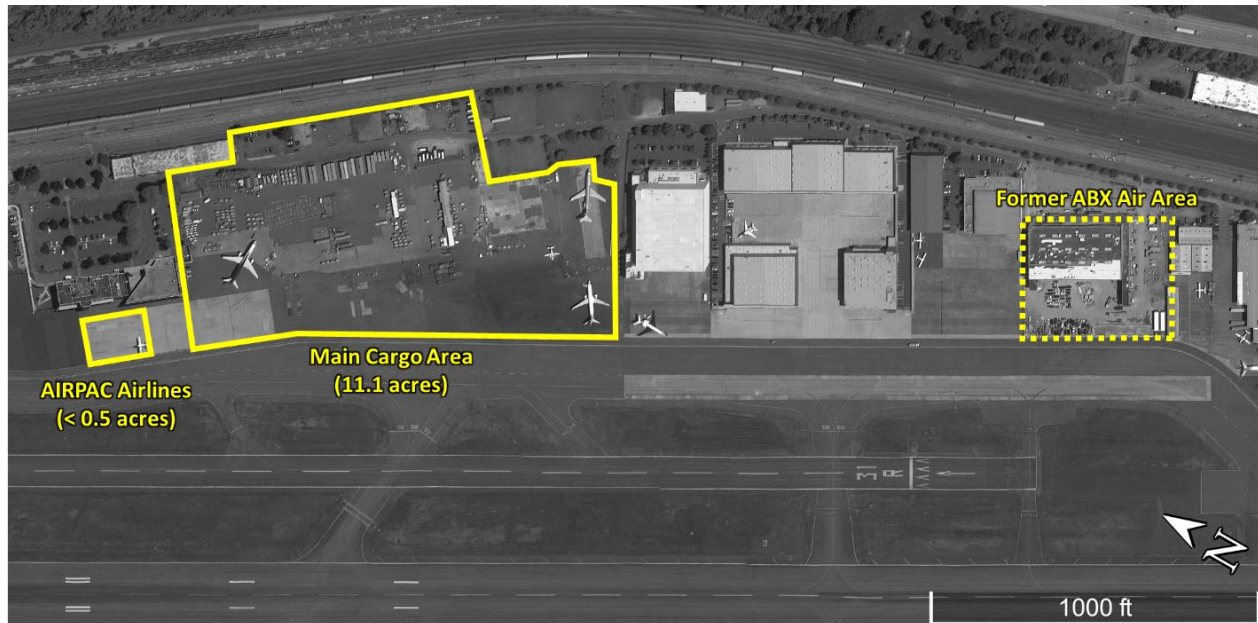
Another area, located farther to the south, was previously used by ABX Air (DHL) until 2016. This area could accommodate two large Group IV aircraft (Boeing 757/767). A corporate jet hangar was built on this site in 2017.

The airport is currently updating its Master Plan for future development. The draft plan includes space to accommodate expansion of air cargo areas to include expansion of cargo ramp space to the north of the existing main cargo ramp area as well as development of a new cargo facility on the west side of the airport, just north of the museum of flight. On the new west side cargo location, the existing general aviation T-hangar area will be relocated to another position on the airfield.

4.6 SNOHOMISH COUNTY AIRPORT/PAINE FIELD

4.6.1 Airport History

Construction of Paine Field started in 1936 as a Works Progress Administration (WPA) project. The U.S. Army Air Corps took control of the facility in 1941, and the airport was used during World War II as a base for interceptors protecting the Bremerton Navy Yard and the Boeing aircraft manufactures around Seattle. Between 1946 and 1948, the field was returned to Snohomish County. In 1951, the U.S. Air Force resumed tactical air defense operations, developing Paine Air Force Base in the South of the airport property. The airport became a joint-use facility. In 1966, The Boeing Company installed the production of the Boeing 747. The Everett plant expanded each time Boeing launched a new long-haul airliner program: the 767 in 1978, the 777 in 1992, and more recently the 787.

In 1968, the U.S. Air Force closed Paine Air Force Base. Two years later, Snohomish County acquired the lands from the federal government, and redeveloped it for new business opportunities. The airport master plan of 1981 confirmed the strategic orientation of the airport, encouraging general and business aviation, maintenance, repair and overhaul (MRO), and aircraft manufacturing. Pilot training, military operations and air freight was to be discouraged. While provisions for air-taxi and commuter operations were included in the master plan, the only air carrier—San Juan Airlines—providing services at Paine Field started flights to Portland in 1987 before stopping the next year due to financial problems. In June 2017, New York-based Propeller Airports broke ground on a 30,000-square-foot passenger terminal adjacent to the airport's control tower and is scheduled to open in summer 2018 with new passenger service being provided by Alaska Airlines and United Airlines.

4.6.2 Existing Airport Conditions

Paine Field is categorized as a national reliever airport in the FAA's NPIAS 2017–2021. This means the FAA has identified Paine Field as capable of providing congestion relief for SeaTac for non-commercial traffic. The airport is located 6 miles southwest of Everett, WA. Paine Field is home to the Boeing manufacturing plant for the long-haul models 747, 767, 777, and 787 (Figure 13).

The lands west of Runway 16R/34L are occupied by a complex used for loading and unloading the Boeing 747 LCF (Large Cargo Freighter), a series of special aircraft converted for extra-large payloads for the purpose of Boeing's own logistics, as well as a Boeing air museum and hangars of the Historic Flight Foundation.

The area east of Runway 16R/34L hosts two large industrial complexes (north and south) mainly operated by The Boeing Company and its subcontractors for aircraft manufacturing. Boeing's plant extends beyond the airport property to the north, and has access to Paine Field with a Through-The-Fence agreement. General aviation hangars, maintenance hangars, and aviation preservation associations are in the midfield area and around Runway 16R/34L, a short runway used for light aircraft only. Runway 11/39 was converted to ramp space and used by Boeing for storing aircraft.

Figure 4-13.   Situation Map (Paine Field)

4.6.3   *Landside Access*

Paine Field is served by SR-525, SR-526 and Airport Road/SR-96, all providing access to I-5, 3.5 miles away. I-5 connects Paine Field to Seattle, which is 30 miles south of Paine Field, along with Bellevue and Redmond through I-405.

4.6.4   *Airside Facilities*

Paine Field has three runways (Table 4-5):

- Runway 16R/34L is the primary runway for the airport. It is 9,010 feet long and 150 feet wide. It is mainly asphalt, except for the first 1,000 feet of Runway 16R is concrete.

- Runway 16L/34R is the secondary parallel runway for Snohomish County Airport. It is 3,004 feet long and 75 feet wide and constructed of asphalt.

- Runway 11/29 (Closed) was 4,504 feet long and 75 feet wide and constructed of asphalt. However, Runway 11/29 is indicated as "closed indefinitely" in the published aeronautical information. Since 2011, Boeing has used it for parking aircraft between Taxiway ALPHA and Threshold 29. Threshold

11 is not marked anymore, and the runway itself is discontinued at the intersection between Taxiways A, A5 (the runway) and A6 being reconfigured in 2016.

Table 4-5.   Runway Characteristics (Paine Field)

Runway	RDC	Design Aircraft	Visibility Minimums	Approach Procedures	Runway Width	Runway Length
RWY 16R	D-V	747-400	½ mile	ILS CAT-II, VOR/DME, GPS	150 feet	9,010 feet
RWY 34L	D-V	747-400	¾ mile	RNAV GPS	150 feet	9,010 feet
RWY 16L	B-II	King Air B100	Visual	Visual	75 feet	3,004 feet
RWY 34R	B-II	King Air B100	Visual	Visual	75 feet	3,004 feet

4.6.5   *Air Cargo Operations and Facilities*

For decades, commercial services were limited due to the County's 1978/1979 Paine Field Mediated Role Determination that focused on general aviation and support to The Boeing Company, and discouraged growth of air cargo service beyond the 1978 level. It also calls for aircraft manufacturing and light aircraft being Paine Field's primary users.

Consequently, air cargo at Paine Field is largely dedicated to the supply of the on-site aviation industry. The only based air cargo operator is The Boeing Company, flying a fleet of Boeing 747 LCFs. The apron used for the 747 LCF operations is more than 600,000 sq. ft. and has dedicated taxilane and special equipment parking areas.

Commercial service activities are now approved, and a passenger terminal is under construction and should be commissioned at the end of 2018. United Airlines and Southwest Airlines plan to operate eight and nine flights, respectively, daily from PAE. With scheduled air carrier service, opportunities for air cargo operations will likely follow as well.

The FAA reports a total air cargo volume of 117,500 U.S. tons in 2016, making Paine Field the 86th largest cargo airport in the United States.

## 4.7   YAKIMA AIR TERMINAL/MCALLISTER FIELD

4.7.1   *Airport History*

Charlie and Alister McAllister built their first airplane around 1925, and opened a flight school at a location near Yakima. In 1928, Yakima County purchased the field. The airport hosted U.S. Army Air Forces operations during World War II. In 1948, the facility was transferred from the County to the City of Yakima for $46,000. A new terminal building was dedicated in 1949. In 1982, the City of Yakima and Yakima County entered into an agreement to operate jointly the facility and share operating costs. Today, Alaska Airlines and three air cargo airlines operate flights to Yakima Air Terminal.

4.7.2   *Existing Airport Conditions*

Yakima Air Terminal is owned by the City and County of Yakima. The airport is categorized as a primary non-hub airport in the FAA's NPIAS 2017–2021. Yakima Air Terminal is located less than 3 miles away from Yakima downtown (Figure 4-14).

Figure 4-14.   Location Map (Yakima Air Terminal, YKM)
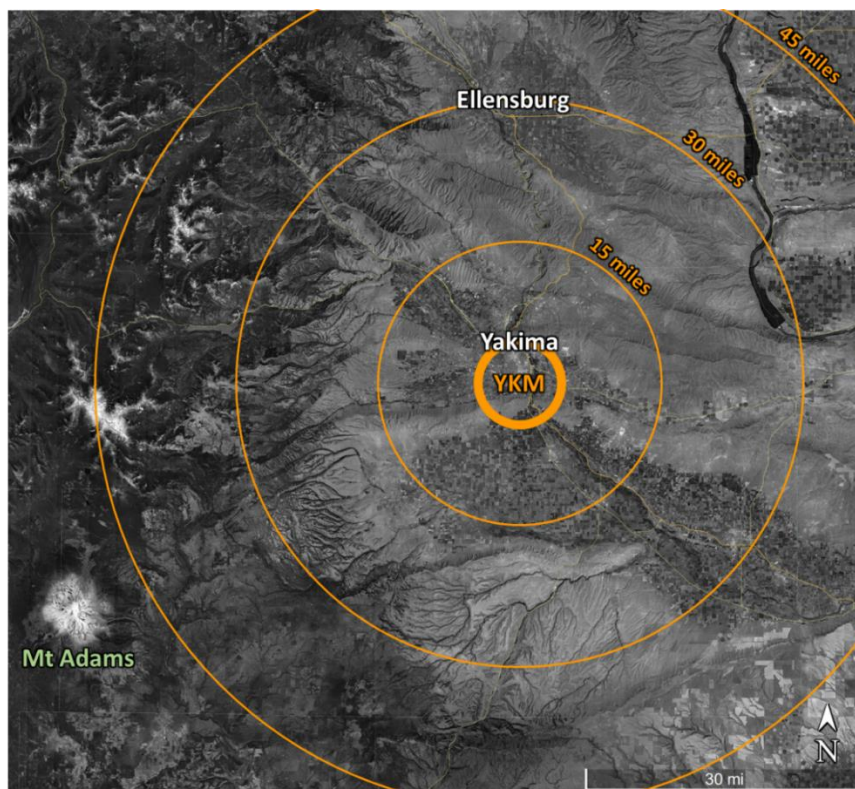
The airport has two intersecting runways. The Terminal Building is on the North side of the runway system, close to the runway's intersection. The North side also hosts General Aviation hangars and parking stands, aircraft repair shops, a light aircraft manufacturer (Cub Crafters), the McAllister Museum of Aviation, and a FedEx Ship Center (Figure 4-15).

Figure 4-15.   Situation Map (Yakima Air Terminal)
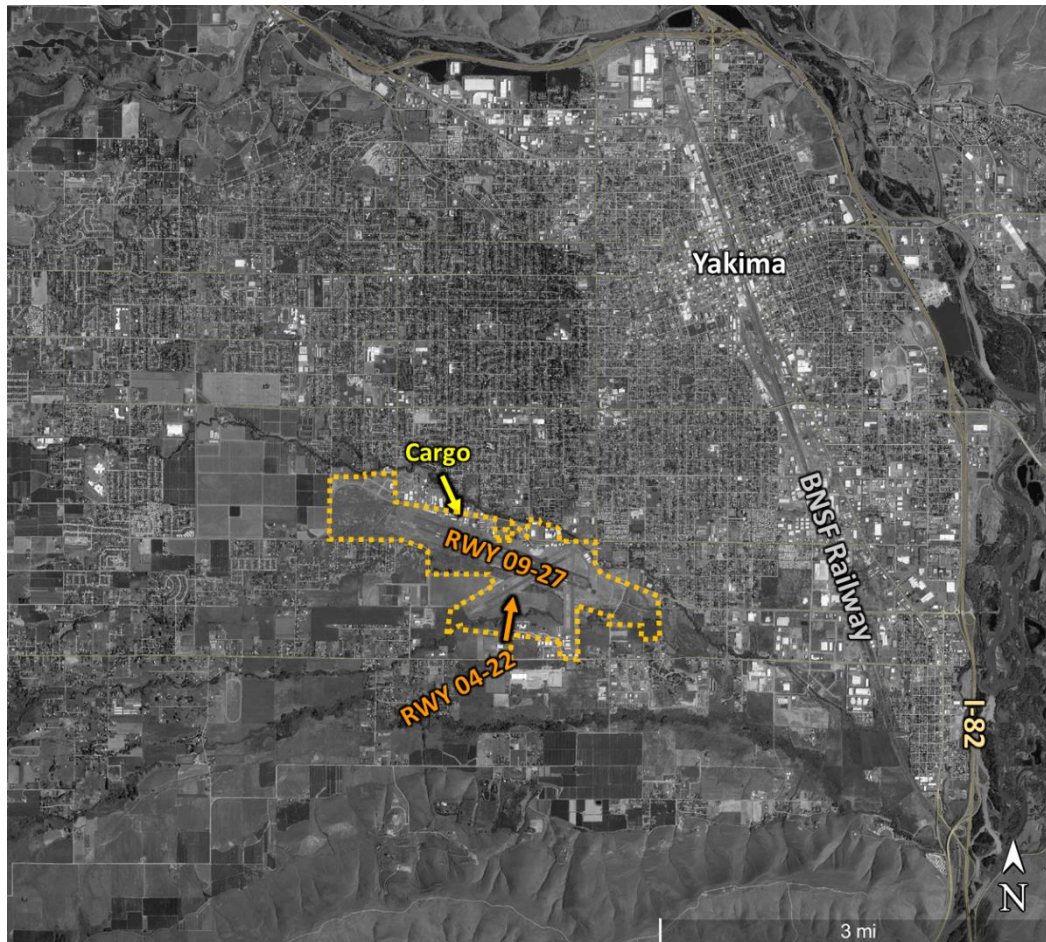
4.7.3   *Landside Access*

The main access to the airport is W. Washington Avenue. I-82 is 3.5 miles away by W. Valley Mall Boulevard, as well as Yakima downtown by 16th Avenue.

4.7.4   *Airside Facilities*

Yakima Air Terminal has two paved runways as further detailed in Table 4-6:

- Runway 09/27 is 7,604 feet in length and 150 feet wide and is composed of grooved asphalt.
- Runway 04/22 is 3,835 feet in length and 150 feet wide and composed of asphalt.

Table 4-6.   Runway Characteristics (Yakima Air Terminal)

Runway	RDC	Design Aircraft	Approach Procedures	Runway Width	Runway Length
RWY 04	B-I (Small)	Beech Baron	Visual	150 feet	3,835 feet
RWY 22	B-I (Small)	Beech Baron	Visual	150 feet	3,835 feet
RWY 09	C-III	727	ILS CAT I, RNAV RNP	150 feet	7,604 feet
RWY 27	C-III	727	LOC/DME, RNAV GPS/RNP	150 feet	7,604 feet

4.7.5   Air Cargo Operations and Facilities

Three air carriers operate air cargo services to and from Yakima Air Terminal: Aeroflight, Empire Airlines on behalf of FedEx and Ameriflight on behalf of UPS. Flights are performed with small "feeder" aircraft: Cessna 208, Cessna 340, Embraer 120 and Piper PA32.

There are two air cargo ramps (Figure 4-16):

■ The FedEx Ship Center Ramp with four parking stands for small aircraft (Cessna 208, and occasionally ATR 42/72).

■ McCormick Air Center Ramp, used by UPS and Aeroflight. The ramp provides six aircraft stands for small aircraft.

Figure 4-16.   Air Cargo Ramps (Yakima Air Terminal)

The 2014 Master Plan reports 14 air cargo operations daily, and provides forecasts for the next 15 years with a compound annual growth rate (CAGR) of +1.36 percent. Air cargo requirements show needs for up to 5 aircraft stands and 19,480 sq. ft. in 2030—a need that is largely satisfied with the current infrastructure.

4.8   TRI-CITIES AIRPORT

4.8.1   *Airport History*

The United States Navy built a naval air training station in the early 1940s. The ownership of this field was transferred to the City of Pasco after World War II. Port of Pasco took ownership of the facility in 1963, and opened a new passenger terminal building in 1966. This infrastructure expanded multiple times, until the 2017 expansion project designed for accommodating traffic growth until the horizon 2030.

4.8.2   *Existing Airport Conditions*

Tri-Cities Airport is located 2 miles from Pasco, WA. It provides air transportation access for the Tri-Cities region, which includes the communities of Pasco, Kennewick, and Richland. The airport is categorized as a primary non-hub airport in the FAA's NPIAS. It is the largest airport in the southeastern Washington and northeastern Oregon Region and the fourth-largest air carrier airport in Washington state (Figure 4-17).

Figure 4-17.   Situation Map (Tri-Cities Airport)

4.8.3   Landside Access

The airport is served by I-182, connecting to I-82 and Highway 395. I-182 is less than a mile away from Tri-Cities Airport.

4.8.4   Airside Facilities

Tri-Cities Airport has three runways:

■ Runway 03L/21R is 7,711 feet long and 150 feet wide and has a grooved asphalt surface.

■ Runway 03R/21L is 4,423 feet long and 75 feet wide and is made of asphalt.

■ Runway 12/30 is 7,703 feet long and 150 feet wide and has a grooved asphalt surface.

■ Further details about the runway characteristics are contained in (Table 4-7):

Table 4-7.   Runway Characteristics (Tri-Cities Airport)

Runway	Approach Procedures	Runway Width	Runway Length
RWY 03L	RNAV	150 feet	7,711 feet
RWY 21R	ILS, RNAV GPS	150 feet	7,711 feet
RWY 03R	Visual	75 feet	4,423 feet
RWY 21L	Visual	75 feet	4,423 feet
RWY 12	RNAV	150 feet	7,703 feet
RWY 30	VOR/DME, RNAV	150 feet	7,703 feet

4.8.5   Air Cargo Operations and facilities

Ameriflight and Empire operate feeder flights for FedEx. Ameriflight Airlines usually operates Embraer 120, and Empire operates ATR-42 and Cessna 208 Caravan.

In 2016, Alaska Airlines carried 61 U.S. tons of belly cargo, while FedEx and UPS carried 1,242 and 731 U.S. tons, respectively. This totaled 2,034 U.S. tons, compared to 1,999 U.S. tons carried in 2015—an increase of 2 percent.

A cargo ramp exists on the northeast side of the airport, but is not identified in the 2012 master plan. No cargo building is mentioned or identified.

4.9   WALLA WALLA REGIONAL AIRPORT

4.9.1   Airport History

Walla Walla Regional Airport was taken over by the city of Walla Walla in 1930. The airfield became an army airfield in 1942 and an U.S. Army Air Corps Training Field was constructed adjacent to the airport. When this development occurred, the airport then occupied 2,164 acres of land. In 1947, the City and County of Walla Walla recovered control of the airfield. An airport board was formed to manage the airport. In 1949, the airport became the first joint ownership permitted in the U.S. The airport was transferred to the Port of Walla Walla in 1989. Multiple airlines have provided passenger service

throughout the years. Currently, Horizon Air is the only airline operating at Walla Walla Regional Airport. The airport now sits on 2,400 acres and uses many of the original base buildings with non-aviation uses in an industrial park. Buildings have been used for wineries and other businesses. A new passenger terminal was opened in 2000.

4.9.2 Existing Airport Conditions

Walla Walla Regional Airport is owned and operated by the Port of Walla Walla. The airport is categorized as a primary non-hub airport in the FAA's NPIAS 2017–2021. Walla Walla Regional Airport is located approximately 3 miles Northeast of the city of Walla Walla central business district (Figure 4-18).

Figure 4-18. Situation Map (Walla Walla Regional Airport)
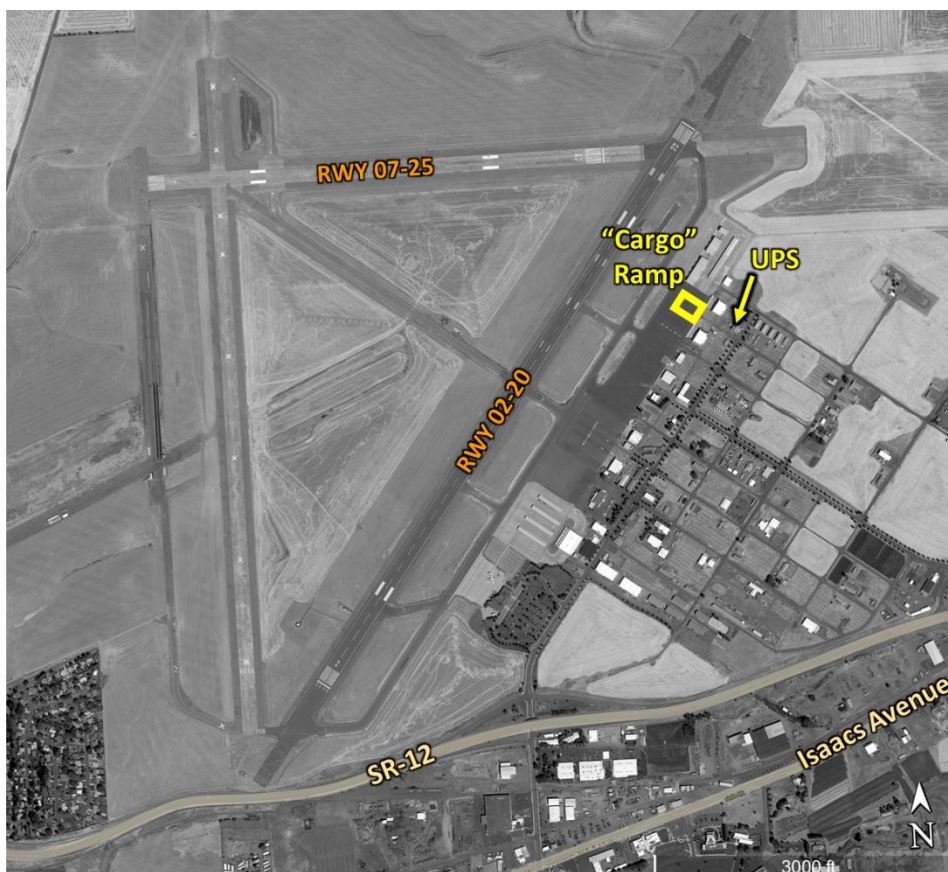
Bergstrom Aircraft is a fixed-base operator at Walla Walla Regional Airport. Blue Mountain Aviation is also located at the airport and provides agriculture spraying services. Life Flight Network provides aircraft maintenance for Life Flight. Skyrunners Corporation, as well as Walla Walla University, operate a flight school at Walla Walla Regional Airport. SullinAir is the fuel supplier for the airport (Figure 4-19).

Figure 4-19.   Location Map (Tri-Cities Airport [PSC] and Walla Walla Regional Airport [ALW])
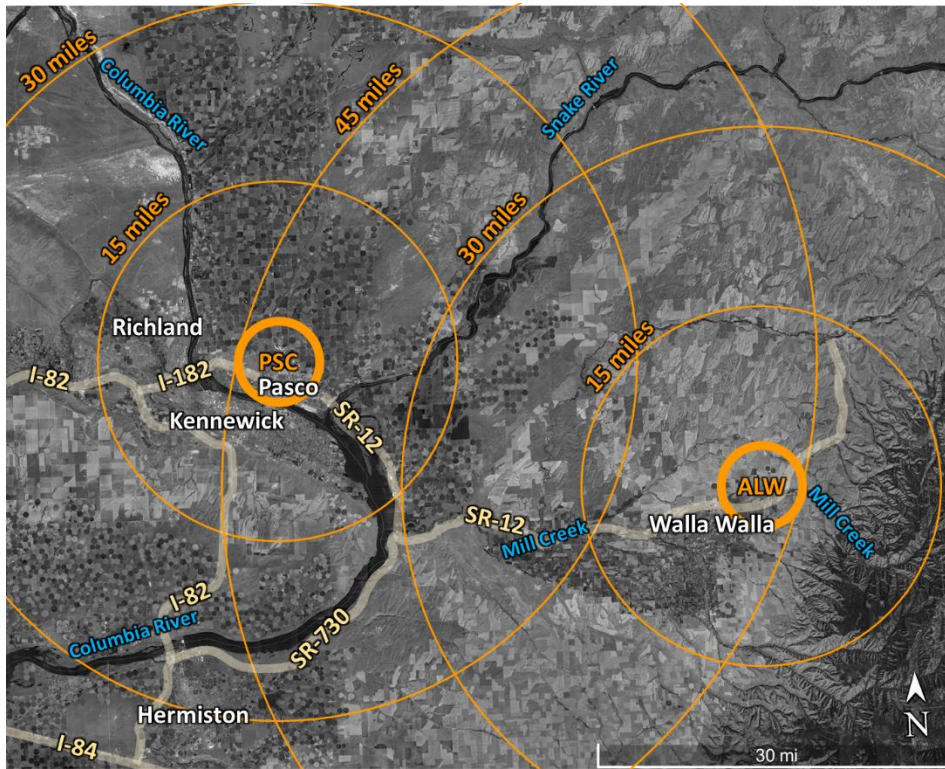
4.9.3   Landside Access

Walla Walla Regional Airport is in the southeast portion of Washington state primarily accessed by Highway 12, connecting the airport to I-82 (50 miles away) and I-84 (44 miles away by SR-11).

4.9.4   Airside Facilities

Walla Walla Regional Airport's runway system comprises two paved runways:

■   Runway 02/20 is 6,527 feet long and 150 feet wide, has a grooved asphalt surface and is the primary runway for the airport.

■   Runway 07/25 is 4,486 feet long and 150 feet wide and has a concrete surface.

Further details regarding the runway characteristics are contained in (Table 4-8).

Table 4-8.   Runway Characteristics (Walla Walla Regional Airport)

Runway	RDC	Design Aircraft	Visibility Minimums	Approach Procedures	Runway Width	Runway Length
RWY 02	C-III	Gulfstream III	≥1 SM	RNAV	150 ft.	6,527 ft.
RWY 20	C-III	Gulfstream III	3/4 SM	ILS CAT-I, RNAV	150 ft.	6,527 ft.
RWY 07	B-III	Beech Super King Air	Visual	Visual	150 ft.	4,486 ft.
RWY 25	B-III	Beech Super King Air	Visual	Visual	150 ft.	4,486 ft.

WSP

4.9.5   Air Cargo Operations and Facilities

Walla Walla Regional Airport has one air cargo operator: Ameriflight. The airline uses Embraer 120 Brasilia aircraft. In 2015, there were 560 cargo aircraft operations. AmeriFlight also has cargo operations out of Tri-Cities Airport. Alaska Airline transports belly cargo to and from Walla Walla Regional Airport occasionally.

The air cargo operator at Walla Walla conducts cargo loading and unloading from a common apron location, transporting packages by truck to a 5,600-square-foot sorting building located along 'A' Street. Cargo is not typically warehoused or further sorted at the airport. Future expansion of the cargo building facility is not anticipated.

4.10   PANGBORN MEMORIAL AIRPORT (WENATCHEE)

4.10.1   Airport History

Pangborn Memorial Airport opened in 1941. The airport was named for Clyde Pangborn who, along with co-pilot Hugh Herndon, completed the first nonstop flight across the Pacific Ocean in 1931, with their flight ending in East Wenatchee, WA. The airport was originally governed by the City of Wenatchee, which transferred ownership to the Port of Chelan County in 1965. In 1974, half of the airport interest was given to the Port of Douglas County. Commercial service was added to the airport by Northwest Airlines in 1945. The terminal building was completed in 1992. Then in 2006 an instrument landing system was installed. Today, the airport has two runways, with the primary runway being extended to 7,000 feet in 2016, allowing for larger aircraft.

4.10.2   Existing Airport Conditions

Pangborn Memorial Airport is owned and operated by the Ports of Chelan and Douglas Counties. The Port of Douglas County is responsible for the airport's business park and the Port of Chelan County has authority of the governing body and is responsible for aviation operations. The airport is categorized as a primary non-hub airport in the FAA's NPIAS. Pangborn Memorial Airport is located approximately 4 miles east of the central business district of east Wenatchee (Figure 4-20).

The airport has one fixed-based operator: Pangborn Flight Center. It is a full-service fixed-based operator, offering services ranging from catering and concierge services to arranging for car rentals. They have aviation fuel available as well.

Aviation services such as aircraft maintenance and repair, as well as Robinson Helicopter technicians are provided by Alpine Aviation, LLC. RantzAir offers flight instruction and aircraft rentals.

Figure 4-20.   Location Map (Pangborn Memorial Airport [EAT] and Grant County International Airport [MWH])
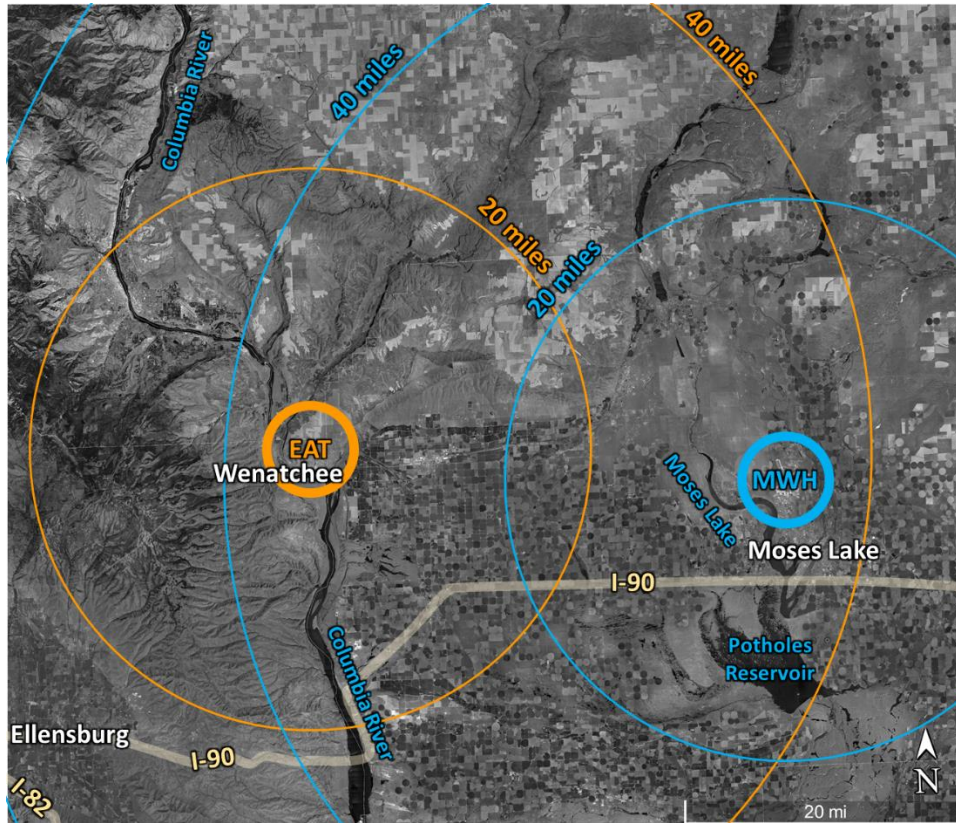
4.10.3   *Landside Access*

Pangborn Memorial Airport is close to SR-28, running along the Columbia River until it connects with I-90, 70 miles away from the airport. The Greater Seattle area is 160 miles away from the airport via interstates.

4.10.4   *Airside Facilities*

Pangborn Memorial Airport has a single runway, Runway 12-30. It is 7,000 feet long and 150 feet wide and has an asphalt surface. Characteristics are further detailed in Table 4-9.

**Table 4-9.   Runway Characteristics (Pangborn Memorial Airport)**

Runway	Approach Procedures	Runway Width	Runway Length
RWY 12	ILS, RNAV	150 ft.	7,000 ft.
RWY 30	RNAV	150 ft.	7,000 ft.

4.10.5   *Air Cargo operations and Facilities*

Per the 2004 airport master plan, air cargo operators currently operating at Pangborn Memorial Airport include Airborne Express, FedEx, and UPS. FedEx operates out of a hangar east of the Aircraft

Rescue and Fire Fighting building, which is owned by Executive Flight (Figure 4-21). The other two cargo operators use the general aviation apron.

Figure 4-21.   Situation Map (Pangborn Memorial Airport)
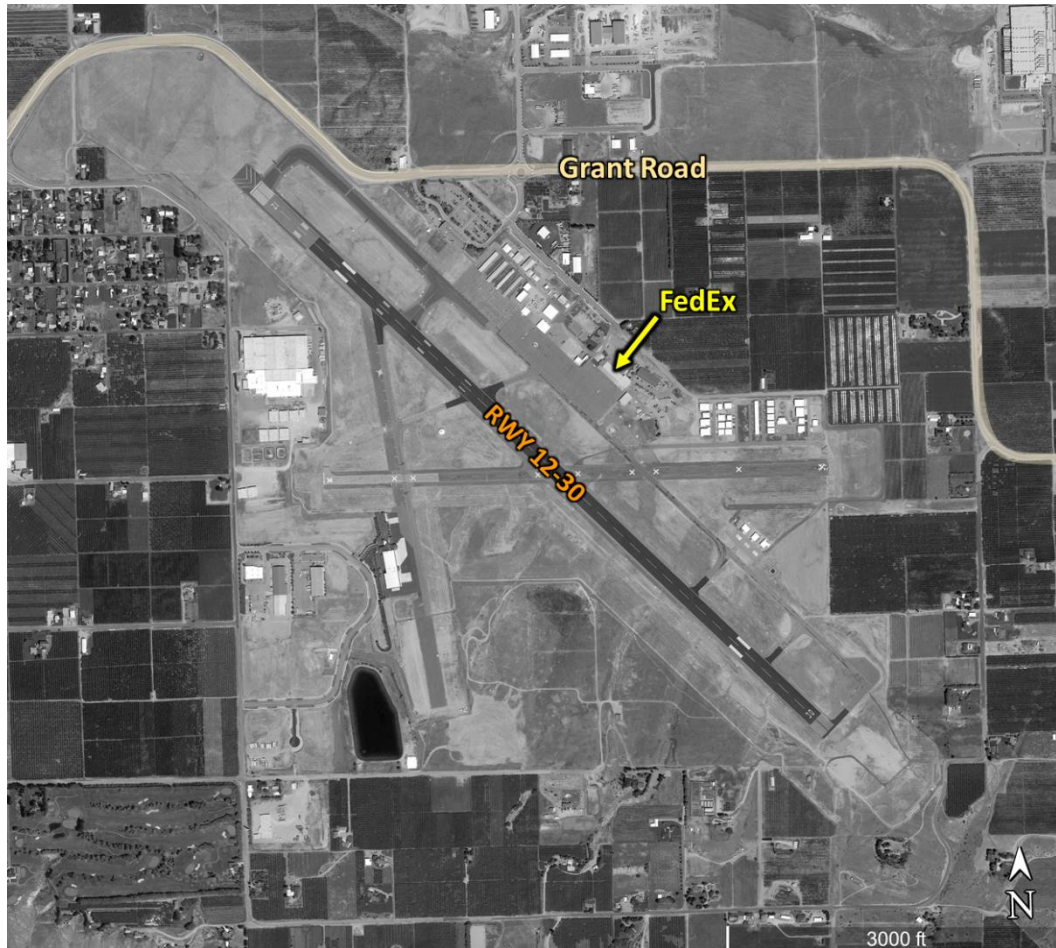
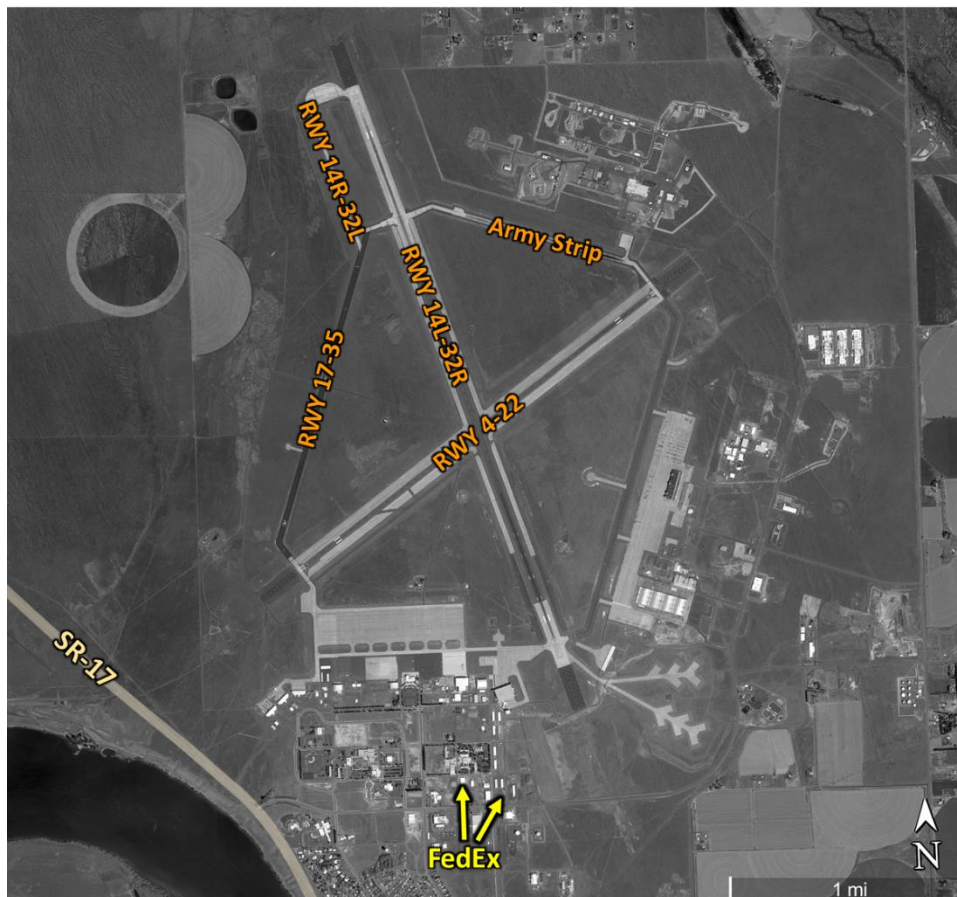## 4.11   GRANT COUNTY INTERNATIONAL AIRPORT

4.11.1   *Airport History*

Grant County International Airport was opened during World War II as a military training facility. The U.S. Air Force operated the facility as Larson Air Force Base until 1966. Larson Air Force Base was home to Tactical Air Command's interceptors, and then Strategic Air Command's aerial refueling aircraft. Grant County International Airport has had commercial service in the past from Horizon, Big Sky and Skywest flying as United Express. This last service ended in 2010 as the airport's Small Community Air Service Development Program grant expired. However, the airport maintains its Part 139 Certification.

4.11.2   Existing Airport Conditions

Grant County International Airport is located 5 miles northwest of Moses Lake and is categorized as a general aviation airport in the FAA's NPIAS 2017–2021. The airport is operated by the Port of Moses Lake. Because of the dimensions of its aviation infrastructure, the airport is used as a testing facility by aircraft manufacturers (Embraer, Boeing, Mitsubishi, etc.) and as a training facility for the military as well as civilian pilots and mechanics. Airfield businesses provide support (and manage, in the case of AeroTEC) these testing and certification campaigns. Also, Grant County International Airport hosts large aircraft maintenance, repair and overhaul (MRO) supply companies Aviation Technical Services (ATS) and Sonico (Figure 4-22).

Figure 4-22.   Situation Map (Grant County International Airport)

4.11.3   Landside Access

The airport is served by I-90 via SR-17 (less than 8 miles to I-90).

4.11.4   Airside Facilities

Grant County International Airport has five runways allowing it the capacity for commercial, military and general aviation use.

■ Runway 14L/32R is the primary runway for the airport. It is 13,503 feet in length—the longest in the state—and 200 feet wide. This runway consists of grooved asphalt and concrete.

■ Runway 4/22 is the crosswind runway for the airport. It is 10,000 feet long and 100 feet wide, with a surface made up of grooved asphalt/concrete.

■ Runway 14R/32L is 2,936 feet long and 75 feet wide and made of concrete.

■ Runway 18/36 is the general aviation runway for the airport. It is 3,327 feet long and 75 feet wide and made of asphalt.

■ Runway 9/27 is exclusively for military use. It is 3,500 feet long and 90 feet wide and made of grooved concrete. It is unmarked and has military landing zone lights only.

■ Further details are contained in Table 4-10.

Table 4-10.   Runway Characteristics (Grant County International Airport)

Runway	Approach Procedures	Width	Runway Length
Rwy 14L	VOR, GPS	200 ft.	13,503 ft.
Rwy 32R	ILS CAT-I, VOR, GPS	200 ft.	13,503 ft.
Rwy 4	VOR, GPS	100 ft.	10,000 ft.
Rwy 22	VOR/DME RNAV, GPS	100 ft.	10,000 ft.
Rwy 14R	Visual	75 ft.	2,936 ft.
Rwy 32L	Visual	75 ft.	2,936 ft.
Rwy 18	Visual	75 ft.	3,327 ft.
Rwy 36	Visual	75 ft.	3,327 ft.
Rwy 9	Military	90 ft.	3,500 ft.
Rwy 27	Military	90 ft.	3,500 ft.

4.11.5   *Air Cargo Facilities*

Grant County International Airport is served by both FedEx and UPS, which subcontract to private air cargo carriers for daily air cargo operations. Empire Air contracts with FedEx and utilizes a Cessna Caravan (single-engine turboprop) for daily flights between Moses Lake and Spokane. Ameriflight contracts with UPS and operates a Beech 99 Airliner (twin turboprop) between Moses Lake and Seattle.

Airports that exceed 100 million pounds of landed air cargo receive a predetermined Airport Improvement Program entitlement. Grant County International Airport has not, to date, become a major air cargo hub eligible for additional air cargo federal entitlements. Even if both these aircraft operated daily at full capacity, the maximum annual cargo weight would be approximately 3 million pounds. Therefore, current air cargo activity does not approach the level where federal air cargo entitlement would be available.

In 2012, the Antonov 225—the largest commercial aircraft in the world—delivered extra-large equipment for the oil industry. The large packages were trucked to the port of Bellingham for shipment to Alaska.

wsp

Grant County International Airport has over 80 acres of available preferred ramp space that is conveniently located for regular cargo flights and an additional 160 acres of available aircraft parking. There is not a dedicated cargo facility at the airport.

The airport also maintains an ARFF facility that operates at FAA index D 24/7 and can provide Index E service with advanced notice. The airport also has a collocated control tower and Terminal Radar Approach Control (TRACON) facility.

4.12   SYNTHESIS

Seattle-Tacoma International (Sea-Tac) is an international air cargo hub, and a primary U.S. gateway for air freight imported from Asia. Part of these goods arrive in the Puget Sound for distribution within Washington state, but there is a significant "transient" cargo activity with freight landing at Sea-Tac for receiving custom clearance and then continuing its way by air to other airports in the United States. The State of Washington is also an exporter of fresh food as well as metallurgical and aerospace products that fly from Sea-Tac. eCommerce boosts the air cargo activity at the airport, with Amazon Prime Air leasing a dozen of aircraft including the "Amazon One" flagship. These positive dynamics have been generating a significant, sustainable growth of air cargo operations since 2012.

However, future development of cargo facilities is in competition with the need for expanding passenger terminal facilities. Port of Seattle is currently conducting an update of its SAMP, which will have to address this issue—in a context where available on-airport lands are becoming scarce. Options include developing a new cargo and maintenance complex to the South, and exploring opportunities for building cargo warehouses and logistics facilities to the North.

The role of **King County International (Boeing Field)** as a commercial service airport has been declining since the end of World War II, with transfer of passenger air carriers and then all-cargo airlines to Sea-Tac International (Sea-Tac). In 2016, this trend was confirmed with the relocation of the DHL-affiliated operations from King County International (Boeing Field) to Sea-Tac. UPS and Ameriflight remain the main air cargo operators. With DHL leaving the airport, King County International (Boeing Field) has been seeking for new aviation real estate opportunities. The former DHL facility is being converted for corporate aviation. Considering the attractiveness of Sea-Tac, and the fact that land would need to be repurposed to accommodate additional air cargo use at King County International (Boeing Field), the short-term potential for significant new air cargo operations appears to be limited.

Cargo activity at **Paine Field (Paine Field)** is dedicated to the needs of Boeing Aircraft Corporation's aircraft manufactures. Extra-large payloads are aircraft parts packed to be carried by the Boeing 747 LCF also known as Dreamlifter, which is a specially modified Boeing 747-400. The recent surge of air cargo at Paine Field has been generated by the Boeing 787 program, the primary user of the Boeing 747 LCF.

Spokane International (Spokane International) is the primary cargo airport for the eastern part of Washington state as well as northern Idaho. While its current regular activity is generated by FedEx and UPS feeders, the airport has the ambition to develop its recently opened industrial park, promoting an easy access to the new East Air Cargo Ramp. Also, the airport wants to attract international air cargo

transient operations for custom clearance purpose. The airport benefits from large facilities, land availability, the absence of congestion with direct access to an Interstate highway, and its location within the Spokane/Coeur d'Alene area.

While they have different sizes and NPIAS categorizations, **other airports represent less than 2.5 percent air cargo market share all together**, and less than 1 percent individually. Air cargo activity at these airports is almost exclusively generated by parcels and mail (same-day express shipments) carried by airlines contracted by FedEx and UPS for feeding their hub of Sea-Tac and King County International (Boeing Field), as well as small belly cargo carried by Alaska Airlines. All-cargo operators serve these communities with small Group II and sometimes Group III aircraft (from Cessna Caravan to ATR 42). Future growth of air cargo operations is not expected to exceed 1 percent average annual growth by the Washington DOT. Consequently, future needs for air cargo facilities appear to be limited, and existing facilities should be able to accommodate the long-term demand.

It is noticeable that **Grant County International Airport (Grant County International Airport)**, in contrast to the other airports with less than 1 percent market share, has both significantly larger aviation facilities and land availability around the airport. Its 10,000 foot long by 200-foot wide runway can accommodate all the existing large cargo aircraft up to the Antonov 225. This available infrastructure may create opportunities in the future.

5 Washington State Air Cargo Forecast

5.1 INTRODUCTION

The forecast of aviation demand is a key element in both the short and long-term planning for air cargo facilities in Washington state. Forecasts provide a basis for determining the type, size, and timing of airside and landside facilities development.

The purpose of this effort is to provide an estimate of a 10-year forecast of air cargo demand for Washington state. The forecast will then be compared to existing and proposed state air cargo facilities to identify possible areas of congestion with the state airport system in Chapter 6. It will also be used to identify opportunities and constraints and develop a statewide air cargo strategy in later tasks.

It should be noted that data collection, both at the industry and airport level is problematic. Historical air cargo data is limited and activity by carrier and cargo type at many airports in Washington state is unavailable.

Table 5-1 provides a summary of the Washington state ten-year preferred air cargo forecast.

Table 5-1.   Air Cargo Forecast for Washington State* (metric tons)

	Seattle-Tacoma Intl	King County Intl (Boeing Field)	Spokane Intl	Non-hub Airports	Total State
Historical					
2016	366,430	114,364	61,396	23,538	**565,728**
Forecast*					
2021	504,100	151,600	71,200	26,000	**752,800**
2026	579,800	176,700	85,500	28,700	**866,700**

*Many of the factors influencing future aviation demand cannot necessarily nor readily be quantified. As a result, the forecast process should not be viewed as precise, particularly given the major structural changes that have occurred in the air cargo industry, the uncertain global economy and the security regulations imposed by ongoing terrorist threats. Actual future traffic levels addressed here may differ materially from the projections presented herein because of unforeseen or unrealized events.

The projected 10-year average annual growth rate for air cargo demand in the state is 4.4 percent, driven primarily by the express/integrator and international cargo markets.

5.2   RECENT MARKET TRENDS AFFECTING AIR CARGO

5.2.1   Global Economic Trends

Globalization of world markets has expanded trade activity. Global economies are interdependent, and global integration is at a stage that is unprecedented since the late 19th and early 20th centuries. In 2015, over $16 billion of goods traveled by air each day: 1/3 of all world trade by value.

In 2016, total U.S. trade with foreign countries was $4.9 trillion. That was $2.2 trillion in exports and $2.7 trillion in imports of both goods and services. The United States was the world's third-largest exporter, after China and the European Union. It was the world's second-largest largest importer after the EU.

Free-trade agreements are playing an important role in opening up foreign markets to U.S. exporters. In 2017, the United States held free-trade agreements with 20 countries. In 2015, 47 percent of U.S. goods exports went to free-trade agreement partner countries. U.S. merchandise exports to the 20 free-trade agreement partners with agreements in force totaled $710 billion. The United States also enjoyed a trade surplus in manufactured goods with U.S. free-trade agreement partners totaling $12 billion in 2015.

Fundamentally, over the medium and long terms, demand for aviation is driven by economic activity. A growing U.S. and world economy provides the basis for aviation to grow over the long run. The 2017 FAA forecast calls for international air cargo growth over the next 20 years to average 3.8 percent per year. The sharp decline in the price of oil in 2015-16 was a catalyst for an uptick in cargo growth in 2016 continued into 2017. The price of oil was projected to rise from around $39 per barrel in 2016 to $47 in 2017 but in fact cleared $60 by the end of the year. The FAA forecast assumes that it will rise thereafter to exceed $100 by 2026 and approach $132 by the end of the forecast period. Headwinds are buffeting the global economy—uncertainty surrounding "Brexit" as well as U.S. trade policy, recession in Russia and Brazil and inconsistent performance in other emerging economies, a "hard landing" in China, and lack of further stimulus in the advanced economies apart from the large U.S. tax cuts late in 2017. Although the U.S. economy has managed to maintain steady growth, there is uncertainty regarding the impact of the new U.S. administration's policies.

In the near term, IHS Global Insight projects that world economic growth will pick up from its 2016 low of 2.4 percent to 2.8 percent in 2017 and 3.1 percent in 2018. Growth is forecast to accelerate in the United States as its tax stimulus package takes effect while Europe remains sluggish, with the impact from Brexit and political uncertainty hampering growth. Japan's economic growth is projected to be slow and steady, helped by a weaker yen. In emerging markets, China's growth continues to slow while others such as Brazil and Russia return to positive growth and see an acceleration helped by rising commodity prices and increased demand for exports. In 2016, India's gross domestic product (GDP) grew 6.9 percent, down from 7.5 percent in 2015, but is projected in 2017-18 to return to levels close to the 2015 rate.

IHS Global Insight predicts world real GDP to grow at 2.9 percent a year between 2017 and 2037. Emerging markets are forecast to grow above the global average but at lower rates than in the early

2000's. Asia (excluding Japan), led by India and China, is projected to have the fastest growth followed by Middle East and Africa, Latin America, and Eastern Europe. Growth in the more mature economies will be lower than the global trend with the fastest rates in the U.S. followed by Europe. Growth in Japan is projected to be very slow with rates below 1 percent a year reflecting deep structural issues associated with a shrinking and aging population

Figure 5-1.   World Gross Domestic Product Forecast (2017–2037)
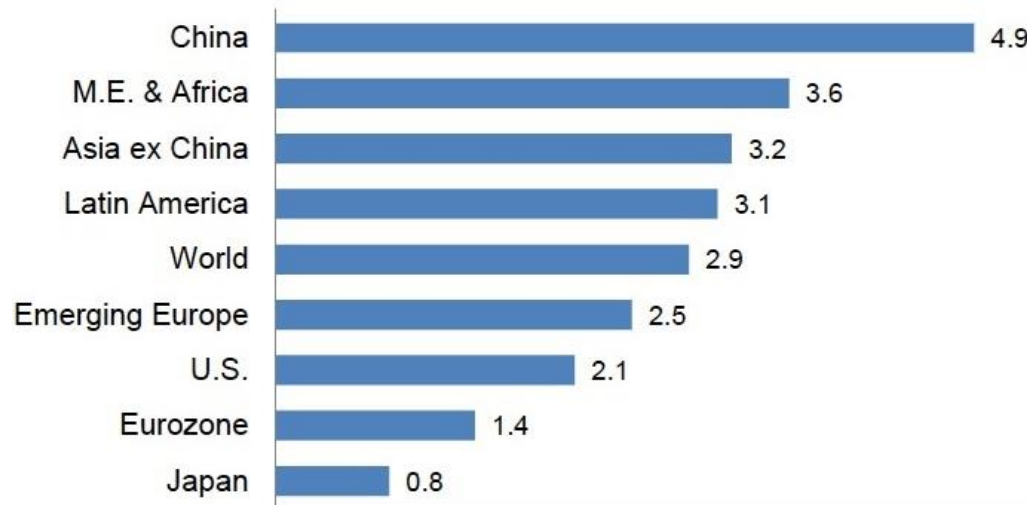
Source IHS Global Insight, December 2016 World Forecast

Historically, air cargo activity has moved in synch with GDP, influenced by fuel price volatility, movement of real yields, and globalization. Over the past five years, however, the profound structural changes have occurred in the air cargo industry, including the following:

- Tighter air cargo security regulations issued by the U.S. and EU regulators

- Market maturation of the domestic express market (e.g., UPS, FedEx)

- Domestic U.S. modal shift from air to other modes (especially truck)

- Significant decrease in the cost of oil

- Growth in international trade from open skies[11] agreements

- Increased use of mail substitutes such as email

- Emergence of the cross-border e-commerce market

5.2.2   *Washington State Economic Trends*

According to the September 2017 Washington State Economic and Revenue Forecast, the Washington economy is expanding at a solid pace and growing faster than the national economy. Washington's per

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[11] Open Skies agreements set liberal ground rules for international aviation markets and minimize government intervention. Provisions apply to passenger, all-cargo and combination air transportation and encompass both scheduled and charter services.

capita GDP increased from $55,780 to $56,831 in 2016 while the state's #10 rank remained unchanged. The 50-state average was $48,399 in 2016. Since 2012, the state's per capita GDP has grown every year and averaged $55,042 with a rank of 10th. The five-year national average was $47,702.

Reported in the 2017 Washington State Economic Climate Study, Washington ranked 2nd in exports as a percent of personal income in 2016 for the fourth consecutive year; however, the state's export value decreased from 23.21 percent of personal income in 2015 to 20.41 percent in 2016. Despite the decrease, Washington's rate remains well above the national average of 8.67 percent. Washington was one of only two states to have exports as a percent of personal income above twenty percent this past year. Number-one-ranked Louisiana was the other state. Louisiana ranks high in this category due largely to its exports of refined petroleum products

Washington's perennially strong performance in this category is due mainly to the presence of Boeing and PACCAR, two of the world's leading manufacturers of commercial aircraft and trucks, respectively. Exports of transportation equipment from these and other Washington manufacturers account for over half of Washington's exports. Excluding the exports of these products, Washington's exports were equivalent to 8.12 percent of personal income in 2016, and this figure represents a relatively large decrease from 2014's 10.88 percent. The drop may be partly explained by the strength of the U.S. dollar in foreign markets over the past two years. Still, Washington's rate remains above the national average of 6.93 percent. The state's rank climbed from 13th to 11th in the nation in 2016. Over the past five years, Washington ranks 10th in exports excluding transportation equipment as a percentage of personal income.

Note that the trade data used for this indicator only include trade in goods, ignoring trade in services, which is difficult to track and credit to specific states. Software, one of Washington state's main exports, is classified as a service when it is not exported on physical media and is therefore not included in the census measure. As software giant, Microsoft contributes greatly to state personal income while most of its exports are not included in the trade data. Thus, the measure of Washington exports as a percent of personal income understates the contribution of trade to Washington's economy. This growing understatement is part of the reason that exports, excluding transportation products, as a percentage of personal income, begins to decline in 1997.

According to the U.S. Department of Commerce data, state air exports rose strongly from $3.6 billion in 2002 to $8.5 billion in 2016, a growth rate of 6 percent per year.

As shown in Table 5-2, air exports from Washington state accounted for $8 billion in 2016 and air imports to Washington were $6.8 billion. Air imports and exports totaled 156,580 metric tons in 2016, down from a high of 168,617 metric tons in 2014. Year-to-date November 2017 data indicates that the tonnage of air exports will exceed 2016 levels and imports will decline slightly.

Figure 5-2.   Washington State Air Imports and Exports
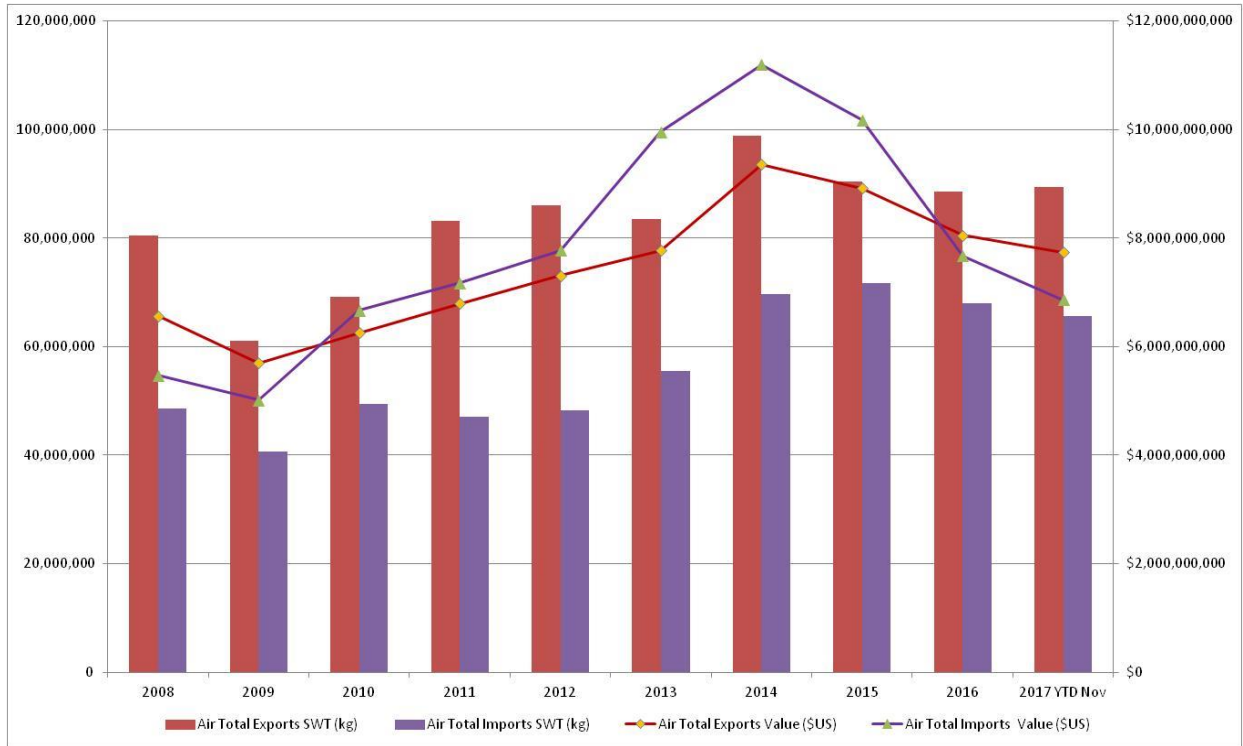
As presented in Figure 5-3, the largest markets for air exports from Washington state as measured by weight were Asia, followed by Europe and Canada and Mexico, South America and Australia and Oceania and Africa.

Figure 5-3.   Washington State International Air Exports and Imports by Region (YTD November 2017)
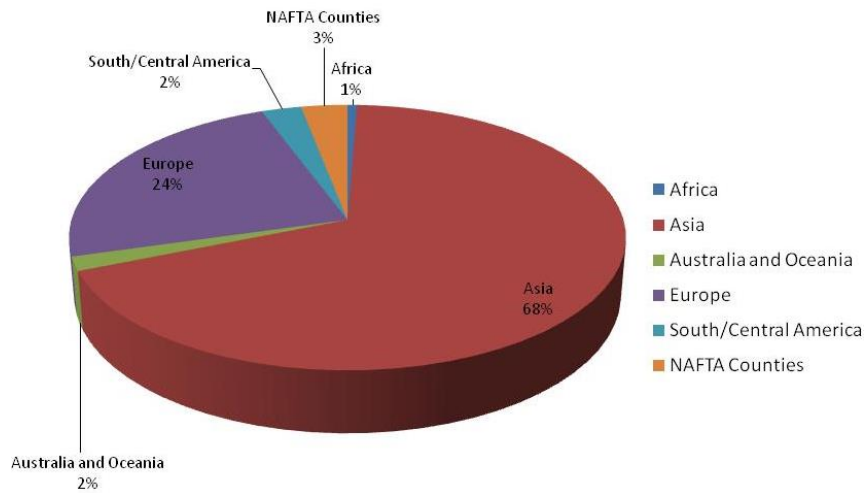
Washington state air exports represented 60 percent market share by value of total exports for the state for YTD November 2017.

5.2.3   *World Air Cargo Trends*

GLOBAL OVERVIEW

According to the Boeing World Air Cargo Forecast, world air cargo traffic has averaged 5 percent growth per year between 1985 and 2015. The growth rate actually exceeded 6 percent in several years throughout the 1980s, 1990s, and early 2000s. Growth slowed as fuel prices began to rise in 2005 and many shippers began to divert freight to truck or ocean modes of transport.

The global economic downturn of 2008-2009, the worst economic contraction since the Great Depression, dragged down all modes of freight transport. World air cargo traffic dropped 13 percent over the two years ending in 2009. Traffic jumped 19.4 percent in 2010 and gained a further 0.8 percent in 2011 as global businesses replenished their inventories. The net result of these developments, however, is a world air cargo traffic growth rate of only 2.6 percent for the span of years between 2003 and 2013.

Airlines based in North America led all other world regions with a 35 percent share of the world's air cargo traffic in 1992. This changed during the 1990s and early 2000s as the share flown by airlines based in Asia, including those based in China, grew from 28 percent in 1992 to 39 percent in 2010, reflecting the rapid expansion of Asian export markets. Since 2000, however, carriers based in the Middle East have leveraged their geographic position at the crossroads between Africa, Asia, and Europe. Middle East carriers have quickly expanded their wide-body passenger and freighter fleets, allowing them to increase their share of world air cargo traffic from 4 percent in 2003 to 11 percent in 2013.

In 2015, most major regions experienced weakness in air freight demand. This included Asia Pacific, where growth was just 2.3 percent in 2015 compared to 2014. The growth in North America was 2.4 percent, down from 2.7 percent the year before.

According to the IATA global air freight grew by a solid 3.6 percent in 2016. The solid expansion in air freight in 2016 reflected strengthening in the upward trend for freight traffic during the second half of the year. This trend coincided with a steady and ongoing rise in the new export orders component of the global purchasing managers' index over the same period, pointing to healthy orders for global manufacturing exporters. The industry is reported strong growth in areas such as cross-border e-commerce and pharmaceuticals, which are expected to continue to offer opportunities for air freight in the future. International air freight rose by 11.0 percent year-on-year in December 2016, up from 7.2 percent in November.

According to the *FAA Aerospace Forecast Fiscal Years 2017-2017*, US air carriers flew 35.5 billion revenue ton miles in 2016, down 0.9 percent from 2015, with domestic cargo revenue ton miles increasing 1.8 percent to 13.3 billion while international revenue ton miles fell 2.4 percent to 22.2 billion. Air cargo RTMs flown by all-cargo carriers comprised 77.6 percent of total RTMs in 2016, with passenger carriers flying the remainder. Total RTMs flown by the all-cargo carriers decreased 0.4 percent in 2016 while total RTMs flown by passenger carriers declined by 2.6 percent. All-cargo carriers carried 89.0 percent of domestic cargo RTMs.

A review of IATA statistics indicates that industry-wide air cargo grew by 9.0 percent year-on-year in 2017, up from 3.6 percent year-over-year (YOY) in 2016 and the strongest calendar-year of growth since 2010. 2017 was also the strongest year of global goods trade growth since 2011. Air cargo grew more than twice as fast as global trade volumes during the year – the widest margin of out-performance since 2010. This out-performance reflects an improved business environment for manufacturing businesses, which enjoyed buoyant demand, linked to the global restocking cycle. A number of factors are likely to be contributing to the out-performance, including recent strong increases in consumer confidence, along with the impact that growing sectors such as e-commerce and pharmaceuticals are having on air freight growth.

According to IATA, international air cargo grew by 9.9 percent year-on-year in 2017, up from 3.6 percent in 2016. U.S. registered airlines experienced a 10.3 percent increase in international air cargo tonnages compared with 10.35 percent for Asia-Pacific airlines and 11.9 percent for European airlines. The relative strength of the U.S. economy and dollar over recent years has helped to support inbound air freight volumes to the United States. The potential boost to activity from the recently agreed tax package may be a further positive in this regard, although this will be offset in part by the recent weakening in the dollar.

THE AIR EXPRESS/INTEGRATOR MARKET

The air express/integrator market has been introduced previously in Chapter 2. FedEx Express and UPS are ranked as the number one and number three top air cargo airlines in the world respectively. DHL is a 49 percent equity owner of Polar Air Cargo Airlines, the 17th largest air cargo airline in the world. All three companies have a significant presence in Washington state air cargo market.

According to the FedEx Annual Report the average daily weight of freight carried by FedEx system wide has increased an average of 34 percent per year from 2014 to 2017. Total package volume growth for FedEx increased YOY from 2016 to 2017 by 45 percent, with most of the growth in international shipments. US overnight domestic envelopes increased YOY by 3.7 percent in FY 2017 while overnight box shipments stayed the same.

According to the UPS Annual Report, total volume increased across all UPS products in 2016, largely due to continued growth in e-commerce and overall retail sales. Business-to-consumer shipments, which represented more than 48 percent of total U.S. domestic package volume, grew nearly 9 percent for the year and 11.5 percent in the fourth quarter, which drove increases in both air and ground shipments. Business-to-business volume remained flat in 2016, offset by increased volume from the retail industry, including the use of UPS solutions for omni-channel (including ship-from-store and ship-to-store models) and returns shipping. Next Day Air volume increased 5.2 percent in 2016, due to strong growth in e-commerce.

According to the DHL Annual Report, revenue in the Americas region increased by 7.1 percent in 2016 over the previous reporting year. Revenue in the DHL eCommerce Division business was up in 2016 by 12.5 percent due to strong performance in the U.S. domestic business as well as cross-border business in Asia. Excluding currency affects, growth was 14.1 percent. DHL reports that due to the e-commerce boom, they expect their parcel business to continue growing robustly in the coming years and are therefore extending their parcel network.

SUMMARY

World air cargo traffic has averaged 5 percent growth per year between 1985 and 2015. Growth slowed as fuel prices began to rise in 2005 and many shippers began to divert freight to truck or ocean modes of transport. The global economic downturn of 2008-2009 dragged down all modes of freight transport resulting in a 13 percent drop in world air cargo traffic over the two years ending in 2009. Air cargo has grown only modestly year over year for the past seven years. Recent strong increases in consumer confidence, along with the impact that growing sectors such as e-commerce and pharmaceuticals resulted in a surge in air freight growth. International air cargo grew by 9.9 percent year-on-year in 2017.

5.2.4   *Industry Forecasts of Air Cargo Activity*

According to most industry analysts, worldwide air cargo is expected to rise between 3 percent and 5.5 percent per year over the next 20 years. This growth relates to an improving world economy and accelerating rates of international trade. Following is a selection of outlooks from leading industry forecasters: Boeing, Airbus, FAA and IATA.

According to the Boeing Company World Air Cargo Forecast 2016-2017, over the next 20 years, world air cargo traffic will grow 4.2 percent per year. Air freight, including express traffic, will average 4.3 percent annual growth. The Asia–North America and Europe-Asia markets will grow slightly faster than the world average growth rate. Boeing forecasts low, baseline, and high annual growth of 3.6 percent, 4.3 percent, and 5.0 percent, respectively, for world air freight traffic.

Boeing predicts that air cargo markets linked to Asia, especially the Pacific Rim countries, will lead all other international markets in average annual growth between 2015 and 2035; but the mature markets of North America and intra-Europe are expected to grow more slowly, both at 2.2 percent per year, over the next 20 years.

Regionally, North America air traffic is projected by Boeing to average 2.3 percent growth over the next 10 years and then at 2.2 percent to the 2035 forecast period. Baseline growth in North America–to-Europe air trade is predicted by Boeing to average 2.2 percent per year, with the high end of the range at 3.8 percent. Europe-to–North America baseline growth is expected to average 2.5 percent per year with 3.1 percent at the high end. Boeing projects the combined total market average annual growth for the next 20 years to be 2.4 percent, compared with 1.9 percent over the past 20 years.

Boeing forecasts Asia–North America air cargo traffic flowing in both directions across the Pacific to grow an average of 4.6 percent per year over the next 20 years with slightly more growth in the eastbound direction.

The total Latin America–North America market for air cargo services is forecast by Boeing to grow 4.3 percent per year between 2016 and 2035. North America–to-Africa flows are expected by Boeing to grow 5.3 percent per year through 2035, driven by continued US and Canadian investment in African extractive industries. Africa-to–North America air trade is expected to grow at the nearly identical rate of 5.1 percent per year, as African light manufacturing develops export markets in North America.

Airbus forecasts air cargo to grow 4 percent per year over the next 20 years. According to Airbus, Asia Pacific (including India and the People's Republic of China) today represents 36 percent of the world freight traffic and will grow to 42 percent by 2032. Europe/CIS and North America combined accounted for 51 percent of the total traffic in 2012; by 2032 its share will be 45 percent. China is the largest driver of air cargo growth; today it represents 15 percent, by 2032 it will be 22 percent of the global market. Due in part to the expanding middle class in emerging countries, traffic from mature to emerging regions is the second fastest growing segment of the industry. Airbus predicts that the North American domestic market will grow at 1.63 percent per year, while the US-Asia market will grow at 4.93 percent per year. The North America-Europe market is projected by Airbus to grow at 2.4 percent per year.

Between 2016 and 2037, the FAA predicts that domestic cargo RTMs are forecast to increase at an average annual rate of 1.3 percent. International cargo RTMs are forecast to increase an average of 3.8 percent a year based on projected growth in world GDP with the Pacific region having the fastest growth, followed by the Other International, Atlantic, and Latin regions, respectively.

According to IATA, air cargo growth over the next five years is positive. It is the emerging markets and regions that are expected to deliver the fastest growth in air cargo volumes over the next five years, led by the Middle East and Africa. Strongest forecasted growth is foreseen on trade lanes between Asia and the Middle East, within the Middle East region, and between North and South America. Growth in mature markets of the North Atlantic and within Europe is expected to be well below the global average. Domestic operations, especially in China and in the U.S., will also form a large portion of future traffic.

IATA predicts that air freight volumes and revenues will rise 4.5 percent and 8.6 percent, respectively, in 2018.

Moderating influences to air cargo growth, according to IATA, are increased uncertainties in three key factors weighing on the global outlook:

- The US Federal Reserve looking to normalize monetary policy—while other major currencies are likely to ease further—paving the way for further tightening in U.S. bank credit conditions
- China's economy embarking on a multi-year rebalancing
- The possible slowing of the decade-long commodity super cycle

THE IMPACT OF E-COMMERCE

The following emerging trends are beginning to influence the makeup and structure of the world air cargo market:

- Increases in urban consumption by the growing consumer class: by 2025 1.8 billion more people in the consumer class and global consumption is expected to surpass $30 trillion—an increase from $22 trillion today.
- Manufacturing moving away from traditional passenger hubs (to areas such as Columbus, Birmingham, Manaus, Chongqing, Zhengzhou, Hanoi, etc.) requiring the use of freighter aircraft
- Change in buying behaviors – the growth of buying or selling online, that is, e-commerce

The popularity and growth of e-commerce is causing major structural changes to supply chain management and the physical movement of commodities and products between suppliers, manufacturers, distributors, warehouse operators and consumers. Most air forwarders and airlines interviewed as a part of this project have mentioned that e-commerce has had a large impact on their operations. A notable example of the impact on the airline industry is the emergence of Amazon Air (formerly Prime Air), an all-cargo airline initiated in 2015 by Amazon.com to expand its e-commerce shipping capabilities. Based in Cincinnati/Northern Kentucky International Airport, Amazon Air utilizes Sea-Tac as one of its West Coast gateways.

The term cross-border e-commerce generally defines international online trade. It entails the sale or purchase of products via online shops across national borders. Buyer and seller are not located in the same country and are often not ruled by the same jurisdiction, use different currencies, and speak different languages. Online trade within the EU, with its single market and common currency in many member states, is even referred to as cross-border e-commerce as though it were, for example selling from Germany to China.

Cross-border e-commerce can refer to online trade between a business (retailer or brand) and a consumer (B2C), between two businesses, often brands or wholesalers (B2B), or between two private persons (C2C), e.g., via marketplace platforms such as Amazon or eBay. In many counties, the fastest growing e-commerce segment is cross-border purchases.

The growth of e-commerce is well documented. The National Retail Federation expects that online retail will grow 8-12 percent annually, up to three times higher than the growth rate of the wider industry. Forrester (Forrester Data: Online Retail Forecast, 2017 to 2022) predicts that online sales will account for 17 percent of all U.S. retail sales by 2022, up from a projected 12.7 percent in 2017, according to Forrester's new Online Retail Forecast as cited by Digital Commerce 360. The report also expects U.S. online sales to grow 13 percent YOY in 2017, which is five times faster than projected offline sales growth, and in line with the National Retail Federation's estimates. Amazon.com Inc, No. 1 in the Internet Retailer 2017 Top 500, is expected to play a heavy role in that growth.

FACTORS AFFECTING INDUSTRY GROWTH

The air cargo industry, like most industrial groups, is dependent upon population growth, gains in the economy, and growth in international trade. The volume of freight shipped by air will also be sensitive to the shipping tariffs of other modes of transportation. In addition to the primary influence of economic activity, many other factors can influence the levels of world air cargo, particularly the express/integrators and small-package carriers. These factors include changing inventory management techniques, deregulation and liberalization of trade, national development programs, and a never-ending stream of air-eligible commodities.

At the local level, many of these same factors apply. However, extreme change in freight volumes at a small hub, or non-hub airport, more often results from the initiation of new carriers or services than from overall industry growth or decline.

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INHIBITORS TO GROWTH

While certain factors mentioned previously have increased air cargo activity faster than GDP in some markets, other factors have come into play that have caused air cargo tonnages to drop at many airports. Among these factors are:

- FAA security directives

- Modal shift from air to other modes (truck and ocean)

- The downsizing of passenger aircraft fleets

- Fuel price volatility

The October 2010 discovery of two explosive devices being prepared for loading on U.S.-bound all-cargo aircraft overseas heightened concerns over the potential use of air cargo shipments to bomb passenger and all-cargo aircraft. The incidents have renewed policy debate over air cargo security measures and have prompted some policymakers to call for comprehensive screening of shipments that travel on all-cargo aircraft. The U.S. currently mandates 100 percent screening of cargo on passenger aircraft. If the United States follows the EU in requiring 100 percent screening of freighter aircraft, some airports facilities at some smaller and/or older U.S. airports may be overwhelmed.

A key factor affecting the growth of air cargo at many airports is the shift from air to trucks, particularly by the integrator/express carriers and the USPS. This shift, which results from improved service and economies of motor carriers, is being accelerated by additional security costs associated with air service, the higher costs of on-airport facilities, and the growth in popularity of time-definite second, third and fourth day delivery products.

Fuel price volatility has been a persistent problem for air cargo. Triggered by increasing production and decreasing global demand, the price of crude oil and jet fuel fell dramatically starting in mid-2014. Recently, fuel prices were less than half of the mid-June 2014 price. Lower fuel prices have decreased operating costs and have allowed airline profitability despite low yields. The drop in fuel price appears to have bottomed and it is now on the rise. Crude oil prices are forecast to exhibit volatility but increase slowly in the range from $60 to $80 per barrel in the next few years.

INDUSTRY FORECAST SUMMARY

Worldwide, air cargo grew by 9.0 percent year-on-year in 2017, the strongest calendar-year of growth since 2010. Air cargo grew more than twice as fast as global trade volumes during the year as a whole – the widest margin of out-performance since 2010. Airlines registered in the United States experienced a 10.3 percent increase in international air cargo tonnages, with Asia-Pacific airlines growing at 10.35 percent and European airlines at 11.9 percent.

A number of factors are likely to be contributing to the out-performance, including recent strong increases in consumer confidence, along with the impact of the growing sectors of e-commerce, pharmaceuticals and perishables.

According to most industry analysts, worldwide air cargo is expected to rise between 3 percent and 5.5 percent per year over the next 20 years. This growth relates to an improving world economy and accelerating rates of international trade.

North America air traffic is projected by Boeing to average 2.3 percent growth over the next 10 years. The Asia–North America and Europe-Asia markets will grow slightly faster than the world average growth rate. The flow from North America to Asia is forecast to grow 4.5 percent per year over the next 20 years.

5.3   FORECAST OF AIR CARGO FOR WASHINGTON STATE

5.3.1   *Introduction*

Air cargo in Washington state is primarily generated by activity at Sea-Tac, King County International Airport (Boeing Field) and Spokane International. Non-hub and small commercial passenger airports within the state account for only 4 percent of the total air cargo volumes moved in 2016.

The Seattle air cargo market is by far the largest in the state. Sea-Tac and King County International (Boeing Field) combined have an 85 percent share of the total Washington state market. Spokane International, the third-largest cargo airport in the state, represents an 11 percent share of the Washington market.

The development of an air cargo demand forecast involves both quantitative analysis and subjective judgment. In general, past air cargo activity data are examined in anticipation of identifying past trends that will give an indication of future activity levels.

Typically, the most reliable approach to estimating aviation demand is through the use of more than one analytical technique. Methodologies considered for forecasting generally include both a bottom-up and top down approach using regression analysis, time-series extrapolation, and market share analysis. Forecasts of air cargo activity prepared as part of existing or ongoing master plans at Sea-Tac, King County (Boeing Field), and Spokane International Airports were also reviewed and considered.

Many of the factors influencing future aviation demand cannot necessarily nor readily be quantified. As a result, the forecast process should not be viewed as precise, particularly given the major structural changes that have occurred in the air cargo industry since airline deregulation, trucking deregulation, the advent of Open Skies, and the war on terrorism. Actual future traffic levels addressed here may differ materially from the projections presented because of unforeseen or unrealized events.

5.3.2   *Seattle-Tacoma International Airport*

Sea-Tac dominates the local Seattle air cargo market with a mix of domestic and international belly cargo, domestic and international freighter cargo, as well as integrator/express cargo. The airport has seen a profound change in its air cargo market composition with the relocation of DHL from King County International (Boeing Field) Airport to Sea-Tac and the recent addition of Amazon Air in mid-2016.

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In 2016 Sea-Tac accommodated 45.7 million passengers and enplaned and deplaned freight and mail that totaled 366,431 metric tons. Due to an increase in wide-body international passenger service Sea-Tac has experienced a significant increase in international air cargo volumes. In the five-year period from 2011 to 2016, international air cargo at Sea-Tac has grown at an average of 7.2 percent per year. In the one year period of 2015 to 2016 air cargo growth at Sea-Tac was 10.2 percent. In 2016 and YTD November 2017, the international air cargo market share at SEA was 32 percent.

Newly released data from the Port of Seattle show that calendar-year (CY) 2017 air cargo volumes at Sea-Tac reached 425,856 metric tons. This puts air cargo growth for 2017 over 2016 at 16.2 percent.

Sea-Tac has also experienced significant growth in freighter activity by airlines that focused on serving the e-commerce market both indirectly (FedEx and DHL) and directly (Amazon Air). Cargo tonnages by the integrated/express airlines at Sea-Tac represented approximately 50 percent of the air cargo market by year-to-date November 2017, up from 42 percent in 2014 and 47 percent in 2016.

FORECAST

Three projections of air cargo tonnages at Sea-Tac were prepared and are presented in Table 5-2. Also included in this table is the SAMP air cargo forecast for Sea-Tac that was prepared in 2014.

Table 5-2.   Seattle-Tacoma International Airport – Air Cargo Projections (metric tons)

	Year	Historical	SAMP 2014 Forecast	SAMP CAGR	Preferred Forecast	Boeing World Growth Rate
Historical	2006	342,042		342,042	342,042	342,042
	2007	319,095		319,095	319,095	319,095
	2008	290,847		290,847	290,847	290,847
	2009	270,216		270,216	270,216	270,216
	2010	283,291		283,291	283,291	283,291
	2011	279,893		279,893	279,893	279,893
	2012	283,611		283,611	283,611	283,611
	2013	292,709		292,709	292,709	292,709
	2014	327,239	319,842	327,239	327,239	327,239
	2015	332,646	326,081	332,646	332,646	332,646
	2016	366,430	332,378	366,430	366,430	366,430
Forecast	2017*	425,000	338,726	425,000	425,000	425,000
	2018		345,117	431,928	445,485	442,850
	2019		351,544	438,968	467,164	461,450
	2020		357,998	446,123	485,249	480,831
	2021		364,251	453,395	504,104	501,025
	2022		370,509	460,785	518,399	522,069
	2023		376,764	468,296	533,106	543,995
	2024		383,008	475,929	548,238	566,843
	2025		389,231	483,687	563,806	590,651
	2026		395,426	491,571	579,824	615,458
2017-2026 CAGR			1.7 percent	1.6 percent	3.5 percent	4.2 percent
2017-2026 % Change			16.7 percent	15.7 percent	36.4 percent	44.8 percent

*2017 air cargo tonnage is a Port of Seattle estimate based on actual year-to-date November 2017 data, and is very slightly below the newly released final year-end total.

The SAMP air cargo forecast, prepared in 2014, represents the low end of the range of future air cargo tonnages at Sea-Tac, while the Boeing "high" world air cargo growth rate of 4.2 percent represents the top range. An adjusted SAMP projection (SAMP CAGR[12]) applied the 2014 projected growth rate of 1.6 percent from the SAMP to the estimated 2017 cargo tonnage of 425,000 tons to generate a forecast of 491,571 tons of air cargo for 2026.

The preferred forecast took into consideration the profound changes to the Sea-Tac market represented by the relocation of DHL from King County International (Boeing Field) Airport to Sea-Tac, the initiation of new air cargo service to Sea-Tac by Amazon Air and the increasing influence that e-commerce is having on the air cargo market as reported in the annual reports of FedEx, UPS, DHL and industry publications.

Going forward, it is assumed that the integrator/express market will maintain a 50 percent market share at Sea-Tac until the year 2040. The preferred forecast predicts that the integrator/express market at Sea-Tac will grow at an annual growth rate of 7 percent for years 2018 and 2019; for years 2021 and 2022 the rate of growth will be 5 percent per year; for years 2022 through 2029 a 3 percent annual rate of growth is assumed; and for years 2030 through 2040 a 2.5 percent annual rate of growth is assumed.

Over the 10-year period between 2005 and 2015, international air cargo at Sea-Tac has grown steadily from a 21 percent share of the Sea-Tac air cargo market to a 35 percent share. Based on the historic trends and other forecasts, it is assumed that the international air cargo market will grow at an annual rate of 3 percent until 2029 at which time it will slow to 2.5 percent for the remainder of the forecast period.

The preferred forecast assumes that air cargo other than integrator/express and international will grow at a steady rate of 2.0 percent per year.

Freighters represented 56 percent of the Sea-Tac air cargo market in 2013 with year to year fluctuation before growing to 60 percent of the market by 2016. YTD Nov 2017 freighters accounted for 63 percent of the Sea-Tac air cargo market due primarily to the new presence of DHL and Amazon Air in the Sea-Tac market. The forecast assumes a 60 percent freighter market share going forward, with additional freighter capacity being added by the upsizing of aircraft gauge.

Figure 5-4 compares Sea-Tac air cargo projections to the year 2040.

As can be determined from Table 5-2 and illustrated in Figure 5-4, the estimated 2017 air cargo tonnage at Sea-Tac (based on YTD November 2017 cargo tonnages) far exceeds the 2014 SAMP forecast for 2026. It not until year 2031 that the SAMP forecast reaches the actual Sea-Tac 2017 cargo tonnages.

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[12] Average annual growth rate

Figure 5-4.   Seattle-Tacoma International Airport – Air Cargo Projections
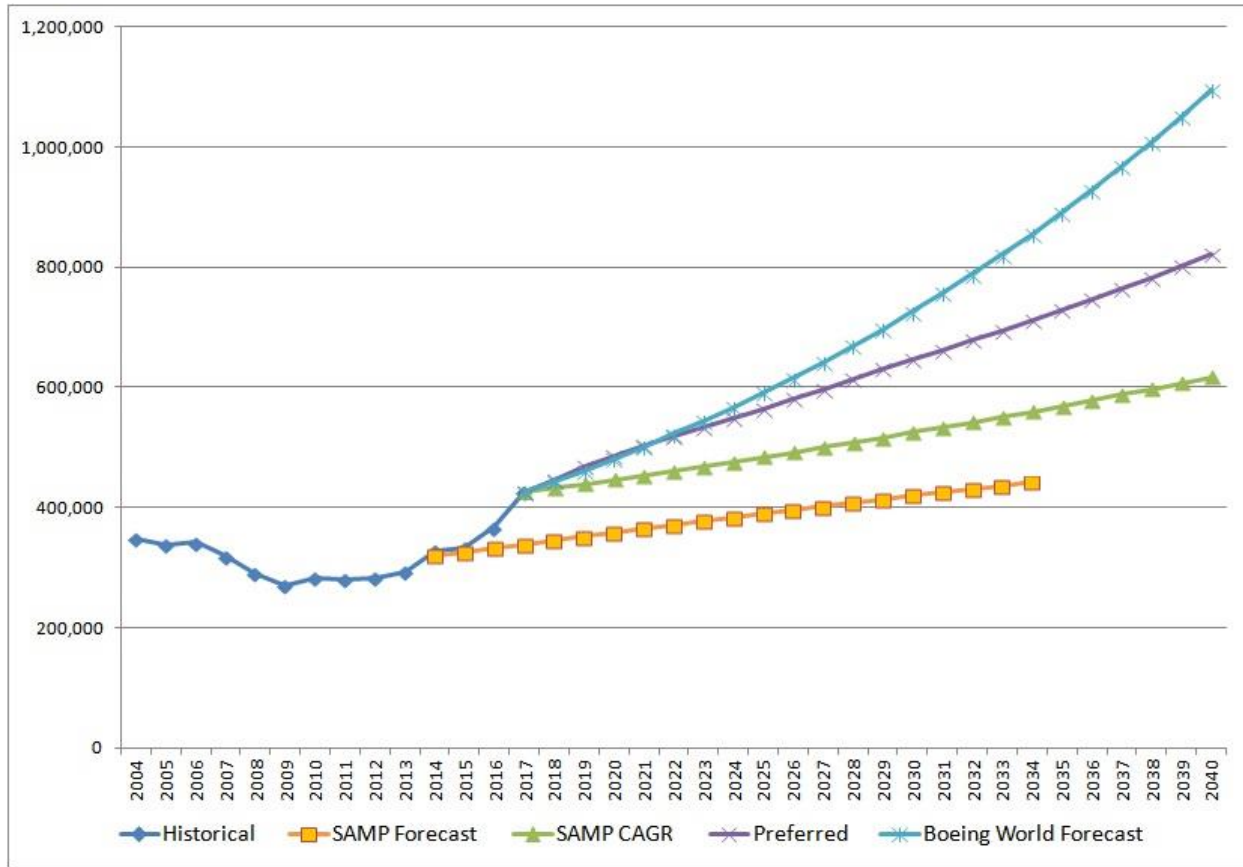
5.3.3   *King County International (Boeing Field) Airport*

As reported previously, King County International (Boeing Field) Airport is a mixed-use general aviation, commercial service and industrial airport located just south of the SODO District in Seattle.

King County International (Boeing Field) does not collect air cargo data from the airlines, so all air cargo data used in this analysis is from the U.S. DOT Bureau of Transportation Statistics T-100 Market (All-carriers) Report. Due to the lack of a consistent data reporting mechanism, historical air cargo volumes reported in the Boeing Field Draft Airport Master Plan Update and the data used in this report do not always match.

From 2013 to 2014 air cargo growth at King County International (Boeing Field) was 7.6 percent. From 2014 to 2015 air cargo at King County International (Boeing Field) increased 15 percent. In 2016 ABX Airlines (flying for both DHL and Amazon Air) relocated from King County International (Boeing Field) to Sea-Tac, resulting in air cargo tonnages decreasing by 9.4 percent.

UPS is now the primary air cargo airline located at King County International (Boeing Field) Airport. For the first six months of 2017, total air cargo at King County International (Boeing Field) declined 12.7 percent over the first six months of 2016, due to the departure of DHL. However, during the first

six months of 2017 UPS carried 7 percent more air cargo at King County International (Boeing Field) than the same period in 2016.

FORECAST OF AIR CARGO

As a part of the ongoing Airport Master Plan Update process for King County International (Boeing Field), Mead & Hunt prepared a 20-year forecast of air cargo for the years 2015-2035. The air cargo forecast was calculated using the past 10-year net total enplaned plus deplaned volumes, which generated an average annual increase of 1,769 metric tons, or 1.3 percent annual growth. This growth rate resulted in a 2026 projection of 141,508 metric tons.

Table 5-3 presents three projections for air cargo at King County International (Boeing Field). The projections are the draft Master Plan Update forecast, an updated projection utilizing the Master Plan annual growth rate of 1.3 percent and a more aggressive preferred projection.

Table 5-3.   King County International (Boeing Field) Airport – Air Cargo Projections

	Year	Master Plan	Master Plan CAGR	Preferred
Historical	2016		114,364	114,364
Forecast	2017	125,464	115,851	122,369
	2018	127,247	117,357	130,935
	2019	129,029	118,882	137,482
	2020	130,812	120,428	144,356
	2021	132,595	121,993	151,574
	2022	134,377	123,579	156,121
	2023	136,160	125,186	160,805
	2024	137,942	126,813	165,629
	2025	139,725	128,462	170,598
	2026	141,508	130,132	175,716

The Master Plan projection was based on a 1.3 percent CAGR rate applied to 2015 King County International (Boeing Field) air cargo tonnages including cargo generated by ABX Air (DHL) for that year. The Master Plan CAGR projection utilized the Master Plan growth rate of 1.3 percent applied to the more recent 2016 King County International (Boeing Field) air cargo tonnages.

The preferred air cargo forecast for King County International (Boeing Field) takes into consideration the increase in e-commerce activity and the growth in air cargo volumes for the first six months of 2017. The preferred forecast predicts that the integrator/express market at King County International (Boeing Field) will grow at a rate of 7 percent for years 2017 and 2019; 5 percent for years 2021 and 2022; 3 percent for years 2022 through 2029; and 2.5 percent for years 2030 through 2040.

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5.3.4   *Spokane International Airport*

Air cargo service at Spokane International is provided by the combination passenger/cargo belly carriers, the integrator/express carriers and small air-taxi all-cargo operators.

In 2016, the integrator/express airlines generated approximately 97 percent of all of the deplaned and enplaned air cargo at Spokane International Airport. Spokane International Airport is used as regional transshipment hub by FedEx and UPS. Much of the air cargo generated at Spokane International is in the form of transshipments, that is, airplane to airplane transloads. With the exception of 2010, when air cargo tonnages dropped 35.4 percent from 2009, air cargo at Spokane International has averaged 3.1 percent growth since 2004.

Table 5-4 presents the air cargo projections for Spokane International Airport. Three forecasts are provided:

- The 2014 Spokane International Airport Master Plan air cargo forecast based on 2010 base year air cargo volumes

- A projection utilizing the Master Plan growth rate of 2.06 percent applied to 2016 historical data

- A preferred forecast

Table 5-4.   Spokane International Airport – Air Cargo Projections

	Year	Master Plan	Master Plan CAGR	Preferred
Historical	2015	—	60,312	60,312
	2016	—	61,396	61,396
Forecast	2017	53,662	62,661	63,238
	2018	54,826	63,952	65,135
	2019	55,990	65,269	67,089
	2020	57,154	66,614	69,102
	2021	58,444	67,986	71,175
	2022	59,733	69,386	73,310
	2023	61,023	70,816	75,509
	2024	62,313	72,274	77,775
	2025	63,602	73,763	80,108
	2026	65,004	75,283	82,511

Because of significant presence of the integrator/express airlines and the growth in e-commerce, the preferred air cargo forecast assumes that Spokane International Airport air cargo volumes will increase going forward at 3.0 percent for the remainder of the forecast period.

5.3.5   *Washington State Non-Hub Airports*

As mentioned previously, air cargo activity at other non-hub airports in Washington state is generated almost exclusively by FedEx and UPS. Small quantities of enplaned and deplaned belly cargo are carried by Alaska/Horizon Airlines. Lower-deck cargo (belly cargo) capacity at smaller airports in the state is limited due to the size of regional aircraft utilized to serve these markets. TSA security requirements to screen 100 percent of belly cargo in passenger aircraft at the piece level also constrain the local air cargo market at non-hub airports.

An exception to this profile is Snohomish County Paine Field. The air cargo tonnages at Paine Field are generated by special modified wide-body freighters as a part of the Boeing Company's 787 airplane manufacturing and assembly program. Origin and destination cities for cargo generated at Paine Field included Anchorage (a trans-Pacific translaod point), Charleston, Nagoya and Wichita. The general cargo demand in Snohomish County is served through Sea-Tac and King County International (Boeing Field) Airports. Projections for Paine Field properly should reflect Boeing production, but that is a confidential matter to the company; the forecast below treated Paine Field instead like other non-hub facilities in the state, and set aside its special circumstances.

The forecast methodology for the State's non-hub airports utilized a top down approach which projected a 2 percent annual growth rate. Individual airport projections were then assigned based on their 2016 market share of total non-hub airport cargo volumes. Table 5-5 presents the air cargo forecast for Washington state's non-hub airports.

Table 5-5.   Washington State Non-Hub Airports – Air Cargo Projections

|	Year	Paine Field	Tri-Cities	Yakima	Bellingham	Grant Co.	Fairchild	Wenatchee	Others	Total Non-Hub
Historic	2016	15,410	2,299	1,926	997	752	563	505	1,086	**23,538**
Forecast	2017	15,726	2,353	1,969	1,008	768	576	504	1,104	**24,009**
	2018	16,040	2,400	2,008	1,029	784	588	514	1,126	**24,489**
	2019	16,361	2,448	2,048	1,049	799	599	525	1,149	**24,979**
	2020	16,688	2,497	2,089	1,070	815	611	535	1,172	**25,478**
	2021	17,022	2,547	2,131	1,091	832	624	546	1,195	**25,988**
	2022	17,362	2,598	2,174	1,113	848	636	557	1,219	**26,508**
	2023	17,710	2,650	2,217	1,136	865	649	568	1,244	**27,038**
	2024	18,064	2,703	2,261	1,158	883	662	579	1,269	**27,579**
	2025	18,425	2,757	2,307	1,181	900	675	591	1,294	**28,130**
	2026	18,794	2,812	2,353	1,205	918	689	603	1,320	**28,693**

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5.3.6 Forecast Summary

The preferred air cargo forecast for Washington state is presented in Table 5-6 and illustrated in Figure 5-5. Washington state's CAGR for the forecast years 2017 through 2026 is 3.52 percent; over the 10-year period from 2016, the growth rate is 4.36 percent. It is expected that the Seattle market will continue to dominate the Washington state air cargo market for the duration of the forecast, with Sea-Tac maintaining the largest share.

Table 5-6. Washington State (Preferred) – Air Cargo Forecast

	Year	NonUrban	Spokane Intl/	King County Intl (Boeing Field)	Sea-Tac	Total WA State
Historical	2016	23,538	61,396	114,364	366,430	**565,728**
Forecast	2017	24,009	63,238	122,369	425,000	**634,616**
	2018	24,489	65,135	130,935	445,485	**666,044**
	2019	24,979	67,089	137,482	467,164	**696,714**
	2020	25,478	69,102	144,356	485,249	**724,185**
	2021	25,988	71,175	151,574	504,104	**752,841**
	2022	26,508	73,310	156,121	518,399	**774,338**
	2023	27,038	75,509	160,805	533,106	**796,458**
	2024	27,579	77,775	165,629	548,238	**819,220**
	2025	28,130	80,108	170,598	563,806	**842,642**
	2026	28,693	82,511	175,716	579,824	**866,744**
2017–2026 AAGR		2%	3%	4.1	3.5%	**3.5%**
2017–2026 % change		19.5%	30.5%	43.6%	36.4	**36.6%**

Figure 5-5. Washington State (Preferred) – Air Cargo Forecast
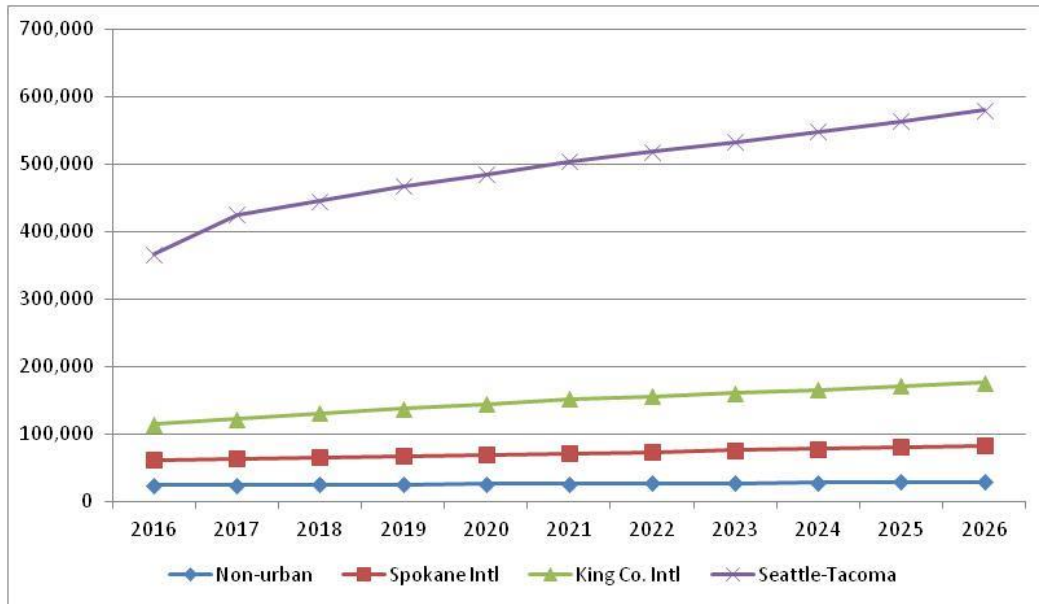
For context, and because there are many uncertainties associated with any forecast, low, preferred and high air cargo forecasts for Washington state were developed. They are presented in Appendix D.

6   Facility Requirements

6.1   INTRODUCTION

6.1.1   Objectives

The purpose of this chapter is to assess the capabilities of the Washington state airport system to accommodate the forecasted air cargo demand over the next 10 years and beyond. A main focus of this effort is to evaluate the ability of Sea-Tac and King County International (Boeing Field) Airports to accommodate future demand, and to identify additional underutilized capacity within the state. Facilities include airside, cargo buildings, as well as landside and road access.

This assessment of facility requirements will develop a baseline of facility needs to meet projected air cargo demands. It will be used to identify congestion in the next technical paper. This work will serve as a basis for an analysis of opportunities and constraints within the state system in the next task. Ultimately, it will feed into recommendations for how to best utilize the existing system to meet forecasted demand.

Questions to be answered in this chapter include – what are the needed facilities to accommodate future demand and do the various airports within the system have them? This will inform future work products aimed at planning for future needs. Even if there are no immediate capacity constraints, a detailed understanding the available facilities at the various airports will allow identification of future opportunities within the state as part of the next task.

6.1.2   Sources

The main sources for this analysis are the preferred air cargo forecast presented in the previous chapter, the Washington Aviation System Plan (2017), the U.S. Transportation Research Board's (TRB) Airport Cooperative Research Program (ACRP) Report 143 on air cargo facility planning and development, and information gathered in the master plans for select airports.

6.1.3   Methodology and Assumptions

When developing the methodology to develop the facility and infrastructure needs to support the air cargo industry at the airport, we determined that using an industry accepted guide would be valuable to provide strong credibility. The ACRP undertakes a number of studies each year to help industry understand a wide variety of topics impacting airport and aviation facilities. The ACRP was originally identified by TRB as a need to complete applied research studies not being covered by other programs. ACRP undertakes research and other technical activities in various airport subject areas, including design, construction, legal, maintenance, operations, safety, policy, planning, human resources, and administration. ACRP provides a forum where airport operators can cooperatively address common operational problems. Due to the ACRP's credibility with their studies, we have determined that utilizing their Guidebook for Air Cargo Development and Planning to help establish the requirements for Air Cargo facilities.

In 2016, the ACRP Report 143 Guidebook for Air Cargo Development and Planning was released. This guidebook provided an overview of the planning and development needs for airports to support air cargo activities at an airport. Chapter 4 Planning Considerations and Metrics establishes a framework for determining development needs of the airport and facility types based on the current conditions and forecasted change. The needed facilities to support the air cargo activities are developed using a model that determines the space needs of each facility based on the total tonnage required to be served. Therefore, the forecasted tonnage can help provide a direct indicator of the estimated special needs of each part of the air cargo infrastructure. The cargo tonnage is evaluated on several conditions including international versus domestic, freighter versus belly, and several other sorting categories to define the specific needs of each facility based on the type of cargo passing through the facility. The ACRP Study also provided a spreadsheet model that could be used to evaluate and size the needs of each airport facility.

Three key types of facilities are necessary infrastructure for handling air cargo. These areas were evaluated using the ACRP model to determine the specific facility needs for airports forecasted to receive a significant volume of air cargo activities:

- Air Cargo Apron Requirements: combining requirements for aircraft ramp used by aircraft to maneuver and park, and ground support equipment (GSE) storage used for parking vehicles and equipment assisting aircraft and cargo operations on the ground (e.g., tow-tractors, baggage carts, containers, etc.).

- Air Cargo Buildings Requirements: they encompass warehouses and other cargo buildings (offices, logistics centers, etc.).

- Truck and Auto Parking Requirements (landside): these areas include pavements for the maneuvers and parking of trucks for the purpose of loading and unloading freight, as well as parking space for cars (customers and employees). These needs are aggregated in the ACRP model for planning purposes.

The following tables provide the ratios of air cargo tonnage for splits between domestic and international cargo as well as the market share of integrated express, passenger belly cargo and all cargo carriers by airport. In Table 6-1 and Table 6-2, the ratios for Sea-Tac, King County (Boeing Field), and Spokane International Airports and all others combined that were used to model the facility requirements are provided. These figures confirm the position of Seattle-Tacoma as an international gateway for air freight, and the predominance of domestic traffic at the other airports of the Washington state.

The ACRP model has two variants: one for "international gateways", one for "domestic" airports. Based on Table 6-1, each airport and group of airports was assigned a model. Variables of the models are the prospective tonnage, and the breakdown by types of carrier (Table 6-1). The information in the following tables is utilized in the ACRP model to determine the estimated needs of various portions of the air cargo facility needs.

Table 6-1.   Domestic vs International (% U.S. tons)

	Sea-Tac International	King County International (Boeing Field)	Spokane International*	Others**
Domestic	68%	100%	100%	100%
International	32%	0%	0%	0%
ACRP Model Selected	International Gateway	Domestic	Domestic	Domestic

*Statistics for Spokane International Airport do not include existing international freighters landing at Spokane International Airport for "point-of-entry"/customs clearance purposes.

** Other airports include Grant County, Yakima Air Terminal, Tri-Cities Airport, Paine Field, Bellingham Intl., Pangborn Memorial, and Walla Walla Regional.

Table 6-2.   Tonnage Market Shares (% U.S. tons)

	Sea-Tac International	King County International (Boeing Field)	Spokane International	Others
Integrated Express	45%	100%	97%	100%
Passenger Airline Belly	40%	0%	3%	0%
All-Cargo Carriers	15%	0%	0%	0%

6.1.4   Summary of Synthesis

Table 6-3 provides a summary of our analysis for the existing 2017 conditions and spatial needs for the air cargo ramps (aircraft and GSE), the cargo building, and the landside areas (truck and car maneuvering/parking). As discussed in the previous section, we used the forecast tonnage per airport with the ACRP 143 model to establish the estimate future spatial needs for each facility (see Table 6-4): space required for parking aircraft and supporting their operations, space required for warehouses and offices, and space required for trucking operations and staff auto parking.

Key findings which are further detailed in this chapter include:

■ Sea-Tac, Spokane, and Paine Field Airports all have enough existing cargo ramp space to support the projected cargo forecasts for 2021 and 2026.

■ King County International (Boeing Field)'s existing ramp space is slightly below the forecasted needs based on the model estimates. With the primary cargo provider being UPS, we believe that the ramp space will be sufficient to meet the needs of the current cargo carriers at the forecast levels due to the nature of how UPS operates and the general estimating nature of the model. King County International (Boeing Field) is preparing their updated airport Master Plan and including development of additional ramp space to the north of the UPS ramp and a new facility area on the west side of the airport.

■ Sea-Tac will need additional warehouse areas to accommodate future air freight needs, which could be located either on or off the airport. There are a number of new cargo facilities being built and/or permitted within a five-mile radius of the airport.

■ At King County International (Boeing Field), the model indicates that additional cargo building space will be required. As UPS is the primary cargo carrier at King County International (Boeing

Field) and its business model has the cargo transferring and sorting activities on the ramp without an on-site building, the need for an air cargo building space from the ACRP model is not required. The airport is planning for a new cargo area on the west side of the airport just north of the Museum of Flight. This facility would allow for a cargo building, ramp space, and access to East Marginal Way.

- Spokane International has slightly less existing cargo building space than estimated to be needed to support the future cargo forecast. Additional cargo building space may be required at the airport to accommodate the additional forecast cargo tonnage and there is available space at the airport to support the growth.

Air cargo centers, warehouses and logistics centers need landside pavement for the maneuvers and parking of trucks, as well as employee parking. These needs were derived from the air cargo volume forecast using the ACRP Report 143 models. Requirements for landside paved areas—all needs aggregated together—are reported in Table 6-3 and Table 6-4. The existing conditions for this available truck and auto parking were not able to be developed due to lack of information available in airport master plans, and so we were unable to provide a gap analysis for 2021 and 2026.

These findings, along with others in this report, will be used to develop opportunities and constraints and a strategy to address air cargo needs and airports throughout the state later in this study.

Table 6-3.   2017 Summary Synthesis of Existing Conditions and Facility Requirements at Main Cargo Airports in Washington State

	Seattle-Tacoma	King County Intl. (Boeing Field)	Spokane Intl.	Others
Existing Air Cargo Ramp Area (acres)	> 70	11.5	27.5	104.25
Required Air Cargo Ramp (ACRP) (acres)	18.6	11.9	5.97	2.58
Surplus of Air Cargo Ramp Space Available (acres)	*+50*	*-0.4*	*+21.5*	*+101.7*
Existing Cargo Bldg. Space (sq. ft.)	630,000	–	62,000	> 66,500
Required Cargo Bldg. Space (ACRP) (sq. ft.)	516,375	133,010	66,675	28,766
Surplus of Cargo Bldg. Space Available (sq.ft.)	*+113,625*	*–*	*-4,675*	*+38,000*
Required Truck and Auto Parking (ACRP) (sq.ft.)	612,556	222,761	121,859	51,779

*The Boeing 747-8F operates at Sea-Tac under a Modification of Standards – the airport is certified for. Antonov 124 and 225 can be accommodated occasionally.

Table 6-4.   2026 Summary Synthesis of Existing Conditions and Facility Requirements at Main Cargo Airports in Washington State

	Seattle-Tacoma	King County Intl. (Boeing Field)	Spokane Intl.	Others
Required Air Cargo Ramp Area (acres)	25.4	17.1	7.8	3.1
Surplus of Air Cargo Ramp Available (Base 2017)	*+44.6*	*-5.6*	*+19.7*	*+101.2*
Required Cargo Building Space (sq. ft.)	704,486	190,996	86,995	34,378
Surplus of Cargo Bldg. Space Available (Base 2017)	*-74,486*	*–*	*-20,320*	*+32,000*
Required Truck and Auto Parking (sq.ft.)	835,705	319,873	158,998	61,881

*The Boeing 747-8F will operate at Sea-Tac under a Modification of Standards – the airport is certified for. Antonov 124 and 225 can be accommodated occasionally.

6.2   AIRFIELD REQUIREMENTS

6.2.1   *Runway and Taxiway Systems (movement area)*

No airports evaluated in this document foresee a saturation of their runway system before the planning horizon of 2026 that would require expansion of the system. **Spokane International Airport** is the only airport that has planned a new runway in their master plans. The trigger point in the current version of the airport master plan for initiating a third runway project is not expected before 2030.[13] The air cargo forecasts in this study would not change the projections of the airport master plan and changes to the runway system is not required to support the forecasts.

The ongoing airport planning efforts at **Sea-Tac** have listed airfield capacity enhancements that should address the long-term aviation demand without the addition of a new runway. They include the construction of a full parallel taxiway between the two outer runways and end-around taxiways at the inner runways' thresholds[14], in addition to NextGen enhancements that have been implemented during the past half-decade.[15]

All-cargo aircraft types serving Sea-Tac include the Boeing 747-8F, which falls under FAA's Aircraft Design Group VI. Most of the aviation facilities are designed for Group V aircraft with the Boeing 747-400 as the design aircraft. Yet, Sea-Tac can accommodate the Boeing 747-8F regularly based on a Modification of Standards and moderate adaptations of the infrastructure[16,17] already constructed by the Port of Seattle. The Antonov 124 (Group VI) can operate occasionally with appropriate ground movement procedures.

Other airports have long-term plans for improving their airfield infrastructure. However, none of them are critical for air cargo operations. These planned improvements will bring additional passenger terminal capacities and new general aviation hangars, or improve aviation safety and operational robustness.

At all of these airports, runway lengths are consistent with the existing and future traffic – especially design aircraft. Regarding flight procedures, only Sea-Tac, Spokane International and Snohomish County Airport/Paine Field have Instrument Landing System CAT II/III required for performing landings and takeoffs under poor visibility and ceiling. However, these conditions typically account for about 5% of the time at these airports (e.g. 5.4% at YKM), and CAT I navigational aids are usually considered as consistent with such level of traffic and weather conditions. Remarkably, all of these airports but Pangborn Memorial Airport have RNAV (GPS) published approaches—a robust, state-of-the-art procedure that does not require ground equipment and allows operations down to minima similar to those of an ILS CAT I.

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[13] Spokane International Airport Master Plan, Third Runway Trigger Point, Chapter 3, Section 3.1.3, March 2014

[14] Sustainable Airport Master Plan (SAMP), Item No. 7B, Update of January 27, 2015, Port of Seattle

[15] NextGen Implementation Plan, FAA, 2018

[16] Engineering Brief No. 73, Use of Non-Standard 75-Foot (23-M) Wide Straight Taxiway Sections for Boeing 747-8 Taxiing Operations, FAA, December 2007

[17] Engineering Brief No. 74A, Use of 150-Foot (45-M) Wide Runways and Blast Pads for Boeing 747-8 Operations, FAA, August 2011

Peaks of air cargo activity are not necessarily occurring at the same time as passenger flight peaks. A significant part of air shipments flies by night—especially the integrated express freight that accounts for most of the cargo at most Washington airports. This makes air cargo less subject to peak airfield/airspace congestion.

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6.2.2   Cargo Ramp Requirements

Based on existing conditions (2017), **Sea-Tac** will not lack cargo aircraft ramp space for air freight before the end of the reference period (2026). Currently, some of the cargo ramp positions are utilized by passenger aircraft for Remain Over Night (RON) parking, to support operations of their passenger terminal. It doesn't appear that this usage has any impact on cargo activities. However, the expansion of the passenger terminal facilities will compete with cargo for space with direct access to the ramp. It is very likely that the overall space occupied by the cargo area north to the passenger terminal will be tightened in the future.[18] Options currently under consideration that may compensate for the loss and add new airside capacities include the following:

- Redevelopment of the existing northern cargo areas (optimization and densification)
- Construction of a new maintenance and cargo area (SASA) in the southeast part of the airport property, including more than 9 acres of cargo ramp and GSE areas

Both of these options imply a long timeline for environmental review approval and construction. Consequently, the resulting projects would likely take place to avoid a shortfall in cargo capacity in anticipation of the expansion of the passenger terminal area.

King County International (Boeing Field) appears to be slightly congested with a deficit of cargo ramp space of 0.4 acre, based on the estimates of land needed to support the future forecasts compared to the existing available land. Aerial views confirm this assessment, with UPS occupying 11 acres available for its operations. If forecasts are realized, additional land may be required by 2026. Since the primary carrier is UPS, it may be able to adjust its operations and support the forecasted growth within the same ramp footprint. Two to three acres appear available from near the UPS ramp, located on the other side of Perimeter Road (currently on the landside).

Additional cargo expansion will require a more detailed study and trade-offs balancing the different aviation needs, considering a) the lack of space available between the runway system and Perimeter Road on the east side of the airport property; and b) the loss of the former ABX Air hangar and apron, which is now being converted for corporate aviation.

The airport is currently preparing an updated Airport Master Plan identifying development over a 20-year planning horizon. The current draft plan includes the development of additional cargo areas to

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[18] Sustainable Airport Master Plan (SAMP), Item No. 7A Supp., July 12, 2015, Port of Seattle

the north of the existing UPS ramp to accommodate UPS's growth. A new cargo complex has been planned for a new location on the west side of the airport just north of the Museum of Flight with direct access to the taxiway system and East Marginal Way. This site allows for a new cargo ramp, cargo building, and truck access and parking. The existing T-hangar buildings will be relocated to another location on the airport. **Spokane International Airport** has anticipated future demand with the construction of large ramps on the northeast side of the airport property, along its business park. These new apron areas are expected to cover the long-term demand, assuming current trends continue. The emergence of Spokane International as a port of entry for air freight to the United States and as an alternative to Seattle-Tacoma, and the plans of Spokane International for attracting industrial activities that ship by air (e.g., aerospace industry), may strengthen air cargo operations beyond current expectations. Based on current projections, Spokane International will have a surplus of about 20 acres of apron available for cargo aircraft in 2026.

At **Snohomish County/Paine Field**, air cargo activity is almost exclusively conducted by Boeing, its partners, and contractors. The Boeing 747 LCF apron is a dedicated facility that can be expanded to the south, if needed.

Other airports have sufficient apron areas for meeting the long-term demand. While the typical cargo ramp at these airports includes about four stands designed for Group II aircraft, Grant County International has large aviation facilities inherited from the former Larson Air Force Base, making it attractive location for flight tests and occasional extra-large payload delivery (e.g., by Antonov 124 or 225). In 2026, all these airports together will have a 100-acre cargo apron surplus, including 80 acres at Grant County International.

6.3   CARGO BUILDINGS AND VEHICLE PARKINGS

6.3.1   *On-Site Warehouses and Office Spaces*

According to the output of the ACRP Report 143 model, **Sea-Tac** has enough on-site building areas to address the demand until 2021 (+5 years). Beyond that horizon, the airport will face a growing deficit (up to 75,000 sq. ft. in 2026). As discussed, passenger and cargo facilities will compete for space with direct front access to the airfield. Consequently, off-airport facilities should be envisaged to compensate for this deficit, as further described in the next section. Lands owned by Port of Seattle are available north to SR-518. A Boeing facility as well as a refrigerated warehouse are already located on private land in this area.

Few cargo building facilities exist at **King County International (Boeing Field)**. Unless UPS, by far the main cargo airline at the airport, changes the method it manages operations, no further action will be required.

Based on the results of the ACRP model, **Spokane International** would already be in deficit of warehouses and office space by approximately 4,600 sq. ft. This deficit would grow to 20,300 sq. ft. in 2026. While the airport operator is not aware of unaddressed demand for air cargo facilities, the airport has vast lands available on-site, including within its business park on the northeast side of the airport

with option for direct access to the newest air cargo ramps. Consequently, this potential demand would be covered, since cargo operators would decide to invest in new building infrastructure.

Bellingham International, Snohomish County /Paine Field, Tri-Cities, Yakima Air Terminal/McAllister Field, Pangborn Memorial, Walla Walla Regional, and Grant County International Airport have a surplus until the end of the planning period (2026).

6.3.2   *Off-Airport Facilities*

Detailed review of off-airport facilities is not in the scope of this study. However, off-site warehouses and logistics centers play a significant role in air cargo demand. Not all air freight stakeholders need direct access to the air cargo ramp[19] or minimal distance to the airport for locating their building. So a strong off-airport community of air freight users contributes to the strength and sustainability of air cargo operations at the airport.

At **Sea-Tac**, the development of new off-airport air freight facilities is vital for accommodating the future growth because of the lack of space with direct access to the ramp. Plans for cargo buildings might focus on off-airport sites on the north side of SR-518 (see Figure 4-4), on lands already owned by the Port of Seattle, in order to relieve pressure on the cargo ramp area and to dedicate this space for operators requiring direct access to the airfield. Located seven miles southeast of Sea-Tac, Kent is home to a complex of warehouse and distribution businesses, including those in the air cargo industry. This area is expected to continue to attract air cargo businesses that don't need to be located on the airport.

6.4   LANDSIDE REQUIREMENTS

6.4.1   *Ground Access*

Sea-Tac is near the intersection of two major interstates: I-5 and I-405. Other nearby highways include SR-518, SR-99 and the ongoing extension of SR-509 which provide access from the north and west. Kent Valley, which is located southeast of Sea-Tac, serves as a major warehouse and distribution center. Access to Sea-Tac from Kent Valley is via WA-167 and I-405.

The primary access to the airport from the highways is SR-518 and Airport Expressway (see Figure 4-2). The air cargo area is served by Air Cargo Road, distinct from the main public access provided by Airport Expressway. This flow separation should be preserved in future plans. Unlike Airport Expressway beginning and ending with ramps toward SR-518, Air Cargo Road does not have direct access to SR-518 and requires driving a route through intersections with lights and tight turns. Improvements should be considered in the next master plan update. Connections between these potential northern projects beyond SR-518 and the air cargo area is provided by 24th Avenue, continuing onto Air Cargo Road after S. 154th Street.

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[19] Guidebook for Air Cargo Facility Planning and Development, ACRP Report 143, Section 3.3.2 – Cargo Operations, TRB, 2015

Routes to **King County International (Boeing Field)** from I-5 are less than 2 miles long, but they involve several tight turns and multiple traffic lights along busy roads that are not optimal for semi-trucks transporting express cargo.

Spokane International is connected to I-90 by US-2 and Geiger Road. The existing cargo area is 5 miles away from the interstate, and the business and industrial park is along I-90 (<1 mile). The 2014 Master Plan predicts congestion along US-2. It presents solutions for preventing saturation by means of roadway widening.[20]

Bellingham International, Snohomish County/Paine Field, and Tri-Cities Airports are well connected to the interstate system. **Yakima Air Terminal/McAllister Field, Pangborn Memorial Airport, Walla Walla Regional Airport, and Grant County International Airports** have access to interstates through smaller roads most likely adapted to their traffic. These airports will not require further actions regarding ground access at the horizon of the study (+10 years).

6.5   REGIONAL CORRIDORS

The overall interstate highway system of Washington state is far from being congested, with the noticeable exception of the Puget Sound: I-5, I-405, and state roads to the Greater Seattle and the major ports of the metropolitan area. These corridors are significantly congested at peak hours, with slow traffic and stop-and-goes.[21]

6.6   SYNTHESIS

Table 6-4, in Section 6.1.4 of this chapter, summarizes the results of the analysis of facility needs for 2026. Appendix C contains matrices that detail the results of the facility needs analysis. Key facility characteristics for airports handing cargo as documented in this chapter and Appendix C include the following:

- The design aircraft
- The airport reference code
- The instrument approach procedure to support all weather access
- Cargo ramp facilities.

As shown in table 6-4 and the Appendix C, Seattle-Tacoma will need additional warehouse areas for the purpose of air freight by 2026. While the existing aircraft ramps are enough to meet the long-term demand, the passenger terminal facilities will likely be expanded to the north into the existing cargo area, requiring action to prevent a shortfall in cargo capacity. Current plans include developing a new cargo area with aircraft ramps to the south, and a warehouse and logistics center complex beyond SR-518, which is already served by the extended Air Cargo Road but does not connect directly to the

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[20] Spokane International Airport Master Plan, Chapter 5 – Landside Facilities, March 2014
[21] Regional Air Cargo Strategy, Chapter V – Regional Capacity and Demand, Puget Sound Regional Council, 2005

highway. The SAMP should provide a comprehensive vision for air freight at the airport, encompassing the off-airport facilities to address the significant growth and maintain the position of SEA in air cargo.

King County International (Boeing Field) has a long-term need for about 6 acres of aircraft ramp. This demand is highly dependent on the future of the operations of UPS at this airport and its true ramp space requirements for this facility. If it is confirmed that additional ramp space is needed, it may be able to be addressed by redeveloping the main cargo ramp and its possible expansion adjacent to the ramp on the landside area of the airport.

Spokane International has already anticipated the long-term demand by developing large ramps for remote parking of all-cargo aircraft (Triangle and East Air Cargo Ramp) and customs (CBP) clearance of international air freight (South Pilot Ramp). These facilities cover the needs of transient international cargo flights with aircraft landing at the airport for the purpose of customs clearance and then flying to their destination within the United States. The facilities also cover the need for nearby industrial activities using air cargo to supply their business. The airport operator also has ambitions to attract high-value-added industries (e.g., aerospace) to its airport industrial and commercial park. While no further action is recommended to date regarding the airside facilities, there is a medium-/ long-term need for increasing capacity along US-2 from the airport main entrance, which is the main access to the existing cargo area from Interstate-90.

Bellingham International, Snohomish County/Paine Field, Tri-Cities Airport, Yakima Air Terminal/McAllister Field, Pangborn Memorial, Walla Walla Regional, and Grant County International Airports are adapted to the local landside and airside traffic, and their current facilities should meet the long-term demand (+10 years). They all have sufficient infrastructure to accommodate additional flights (small all-cargo aircraft) and freight (all-cargo and belly-cargo). Grant County International has Aircraft Group VI aviation facilities for movement area and aprons that it inherited from its past military activities, which can be used for occasional receipt of extra-large cargo payloads or serve the air cargo needs of potential adjacent industrial activities.

Overall, **Washington state's aviation system** is already well equipped or has plans to adapt its capacities to the future needs, as long as the preservation of the interests of air freight at Sea-Tac is confirmed in the coming master plan update. Highway congestion in Puget Sound is a concern that goes beyond the scope of this study. The future of air cargo operations at King County International (Boeing Field) calls for vigilance, since it is a constrained airport that hosts a single predominant carrier (UPS).

Express parcel integrators (DHL, FedEx, UPS) and e-commerce corporations (Amazon) have shown a growing interest in unmanned aerial systems for delivering small packages from local warehouses and shops. While this emerging trend has not been taken into consideration here, it should be highlighted for future consideration. Integrating unmanned aerial systems at airports implies specific accommodations from the airport, and requires coordination with manned aircraft operations at existing airports in order to prevent impacts on capacity and safety.

7 Conclusion

This report has profiled the air cargo industry and its dynamics in the Washington state, reviewed competitive catchment areas for air cargo in foreign trade, inventoried airports around the state and assessed facility requirements in light of cargo forecasts. While each section concluded with a summation, some major points should be highlighted overall.

Air cargo in the state is primarily generated at three airports: Sea-Tac, the nearby King County International (Boeing Field), and Spokane International. Non-hub and small commercial passenger airports account for less the 5 percent of state volume, although Moses Lake has unusual capabilities for very large freighters.

Most of the expansion of air cargo within the state has been driven by the increase in international wide-body aircraft passenger service at Sea-Tac, and there is recent growth in express cargo driven by e-commerce. The latter is important statewide for two reasons. First, the integrated carriers providing domestic (or transloaded international) service are the principal operators at most airports apart from Sea-Tac, and these carriers handle the lion's share of e-commerce. Second, rapid delivery service is a crucial component of e-commerce in its competition with traditional retail. This requires local staging of goods near the delivery point, which favors regional airports for part of the business. Spokane International has been serving as a feeder facility for integrated carrier service to regional airports in eastern Washington state, Idaho, and beyond, which reduces the carriers' need to perform this function at Sea-Tac and King County International (Boeing Field). Other airports in the state may be able to take advantage of structural changes occurring in the supply and distribution chain being driven by e-commerce.

Sea-Tac is a significant gateway for export and import trade with East Asian countries. This is the chief corridor for the state's international trade by air, and for most product categories Sea-Tac is accommodating Washington state demand and reaching into Oregon, Idaho, and British Columbia. Cherry exports to Asia are an exception because of the large volume and short season, which pushes overflow traffic to Vancouver, BC, and other airports even though Sea-Tac absorbs most of the surge. Imports of Asian electronic equipment are a second exception, with competition from airports in California. Sea-Tac is a smaller gateway for European trade. It sees somewhat more rivalry for the Pacific Northwest market from airports such as Chicago O'Hare for a variety of goods, and for fresh fish from California airports.

The forecast air cargo growth rate for Washington state is 3.5 percent compounded annually, which puts total annual growth through the next 10 years over 4 percent. This is driven by the projections for Sea-Tac, but there is growth forecast everywhere in the state. Statewide, airport facilities should be able to absorb the volume. Spokane International for example has large facilities, land availability, and little road congestion; King County International (Boeing Field) is more constrained, yet the operating method of its predominant cargo carrier makes this much less of a concern. Overall in the state, there are needs for parking, but not worrisome limits to growth.

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The question mark unsurprisingly is Sea-Tac. The uncertainty stems from competition between the development of cargo facilities and the need for expanding passenger terminals. While growth in international passenger service is an enabler of cargo growth because it provides belly space and flight availability, domestic passenger service is a minor contributor to cargo and freighters are an independent operation. Even so, the existing cargo ramp space can support the cargo forecast, and the needs for cargo building space can be accommodated through options with available land and existing structures. The challenges may lie on the landside with roads, parking, and other concerns.

The pending update of the Port of Seattle's Sustainable Airport Master Plan (SAMP) should clarify some of these questions, and landside matters are taken up in the next stage of this study. This report thus serves as a foundation and a bridge toward the upcoming issues of air cargo congestion and opportunities for the use of capacity across the state.

8   Glossary

- **Aircraft movement:** A movement is a take-off or a landing at an airport. One arrival and one departure of a same aircraft are counted as two movements or operations. A "touch-and-go" (when an aircraft touches down on the runway and then takes-off and does not stop, used for pilot training purpose) operation is counted as two movements.

- **Airfield/airspace capacity:** Capacity is a complex concept encompassing multiple definitions. Capacity is highly dependent on the airspace organization, the runway and taxiway configurations, the types of aircraft and their sequencing, the equipment of the Air Traffic Control Tower, the weather conditions, etc. In this report, we use the expression "maximum capacity" for the theoretical, maximum number of aircraft than can be accommodated in a given period of time, and "operational capacity" for the practical, maximum capacity used by the air traffic control. For instance, an airport can be designed for accommodating 120 aircraft movements per hour, then its operational capacity may be set at 110 aircraft movements per hour, but can achieve 122 aircraft movements per hour at the peak hour of a given day.

- **Airplane Design Group (ADG):** Airplane Design Groups are defined by the U.S. Federal Aviation Administration (FAA) for grouping aircraft according to their wingspan and tail height. There are six groups per FAA Advisory Circular 150/5300-13A Chg. 1:

  - Group I encompasses aircraft with wingspan shorter than 49 feet and tail height smaller than 20 feet. Typical aircraft are small general aviation aircraft (e.g., Cessna 162) and Very Light Jets (VLJ) (e.g., HA-420 HondaJet).

  - Group II encompasses aircraft with wingspan between 49 feet and 79 feet, and tail height from 20 feet to 30 feet. Typical aircraft are large business jet (e.g., Gulfstream G450).

  - Group III encompasses aircraft with wingspan between 79 feet and 118 feet, and tail height from 30 feet to 45 feet. Typical aircraft are medium-size airliner such as the Airbus A320 and the Boeing 737.

  - Group IV encompasses aircraft with wingspan between 118 feet and 171 feet, and tail height from 45 feet to 60 feet. Group IV aircraft are also known as Middle of the Market (MoM) aircraft. This group includes the Airbus A310 along with the Boeing 757 and 767.

  - Group V encompasses aircraft with wingspan between 171 feet and 214 feet, and tail height from 60 feet to 66 feet. Typical aircraft are large airliners such as the Airbus A340 and the Boeing 777.

  - Group VI encompasses aircraft with wingspan between 214 feet and 262 feet, and tail height from 66 feet to 80 feet. These very large aircraft include the Airbus A380-800, Antonov An 124, Boeing 747-8 and Lockheed C-5 Galaxy.

The extra-large cargo aircraft Antonov An 225 operated by Antonov Airlines is off-category with its 290-foot wingspan. The only An 225 ever built is chartered for carrying extra-wide load (e.g., aircraft parts, oil extraction materials, power projection, satellites, trains, etc.).

Most of the airfield design standards (e.g., runway width, taxiway width, taxiway fillets) are a function of the Airplane Design Group of the design aircraft (see below).

■ **Airport Reference Code (ARC):** An airport designation defined in FAA AC 150/5300-13A Chg. 1 that signifies the airport's highest Runway Design Code (RDC), minus the third (visibility) component of the RDC. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport.

■ **Airside:** the airside of an airport is the portion of this airport intended to serve aircraft operations. It includes the runways, taxiways, aprons, navigational aids, and all the onsite facilities serving aircraft (e.g., GSE parking areas, blue water treatment plant, etc.). Most of the airside is typically within the Aircraft Operating Area (AOA).

■ **Annual average growth rate (AAGR):** see compound annual growth rate (CAGR).

■ **Area Navigation Systems (RNAV):** RNAV is a method of satellite navigation which permits the operation of an aircraft on a desired flight path. It allows its position to be continuously determined wherever it is rather than only along tracks between individual ground navigation aids. RNAV includes Performance Based Navigation (PBN) as well as other RNAV operations that are not within the definition of PBN.

   – **RNAV GNSS** is a type of RNAV relying on onboard equipment and signals from a Global Navigation Satellite System (GPS), augmented by the Wide Area Augmentation System (WAAS) for improving its accuracy, integrity, and availability for air navigation purpose. RNAV GNSS procedures do not depend on airport ground equipment, unlike ILS procedures.

   – **RNAV LPV (Localizer Performance with Vertical Guidance)** approaches are the most precise RNAV GNSS procedures with both horizontal and vertical guidance (RNAV LPV) have minima close to a CAT I precision approach – they are sometime called "quasi-precision approach". In other words, a pilot can land at an airport not equipped with an ILS CAT I under visibility conditions close to CAT I as long as the aircraft is equipped with the adequate onboard equipment and there is a published RNAV GNSS procedure with LPV minima.

■ **Bureau of Economic Analysis:** This government agency (as a part of the U.S. Department of Commerce) provides official macroeconomic and industry statistics, most notably reports about the each state's real gross domestic product per capita annually. This calculation measures the income and benefits of labor, total business taxes, and capital income, including depreciation. The total is chained with 2009 dollars and divided by the state population and is the broadest indicator in the study that measures how much each state produces in goods and services per citizen, accounting for inflation.

■ **Commercial Service Airport:** Commercial Service (CS) airports are defined in the National Plan of Integrated Airport Systems (NPIAS) as publicly owned airports that have at least 2,500 passenger boardings each calendar year and receive scheduled passenger service. Passenger boardings refer to revenue passenger boardings on an aircraft in service whether or not in scheduled service. The definition also includes passengers who continue on an aircraft in international flight that stops at an airport in any of the 50 states for a non-traffic purpose, such as refueling or aircraft

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maintenance rather than passenger activity. Passenger boardings at airports that receive scheduled passenger service are also referred to as Enplanements.

■ **Compound Annual Growth Rate (CAGR):** The CAGR is the geometric progression ratio that provides a constant rate of return over a specified time period t (usually in months or years) starting from a present (initial) value P and finish at a future (finish) value F: CAGR = $(F/P)^{1/t}-1$

■ **Declared distances:** Runway declared distances are defined in FAA Advisory Circular 150/5300-13A Chg. 1:

– Takeoff Run Available (TORA): the runway length declared to pilots as available and suitable for satisfying takeoff run requirements. In other words, it is the length of the bearing pavement that pilots can use for taking-off and landing.

– Takeoff Distance Available (TODA): this is the TORA plus the length of any cleared area beyond the end of the departure runway that is suitable for an aircraft to start climbing.

– Accelerate-Stop Distance Available (ASDA): this is the TORA plus the length of any paved area beyond the end of the departure runway that is suitable for the acceleration and deceleration of an aircraft that must abort its takeoff. Such an area is called stopway, and shall be marked with yellow chevrons per FAA standards.

– Landing Distance Available (LDA): Landing Distance Available (LDA) – the runway length that is declared to pilots as available and suitable for satisfying aircraft landing distance requirements for satisfying aircraft landing distance requirements.

■ **Design aircraft:** Also known as critical aircraft and critical design aircraft, the design aircraft is defined by FAA in Advisory Circular 150/5000-17 as the most demanding aircraft type, or grouping of aircraft with similar characteristics, that make regular use of the airport. Regular use is 500 annual operations, including both itinerant and local operations but excluding touch-and-go operations. An operation is either a takeoff or landing.

■ **Essential Air Service (EAS):** A program defined in U.S. 49 CFR Chapter 417 Subchapter II on Small Community Air Service. After the Airline Deregulation Act (ADA) of 1978, the Essential Air Service (EAS) program was put into place to guarantee that small communities that were served by air carriers before airline deregulation maintain a minimal level of scheduled air service. This is generally accomplished by subsidizing two round trips a day with 30- to 50-seat aircraft, or additional frequencies with aircraft with 9-seat or fewer, usually to a large- or medium-hub airport. U.S. DOT currently subsidizes commuter and air carriers to serve approximately 60 communities in Alaska and 115 communities in the 48 contiguous states that otherwise would not receive any scheduled air service.

■ **Instrument Meteorological Conditions (IMC):** IMC are meteorological conditions expressed in terms of visibility, distance from clouds, and ceiling less than the minima specified for visual meteorological conditions (VMC) that defines if an aircraft can land or not. Related Instrument Flight Rules (IFR) requires specific pilot training and licensing, as well as onboard instruments and ground- or space-based navigational aids.

■ **Instrument Landing System (ILS):** The Instrument Landing System is a ground-based radio navigation system which provides aircraft with horizontal and vertical guidance just before and during landing and, at certain fixed points called Markers, indicates the distance to the reference point of landing. The ILS is made of two main components. The Glide Slope (GS) also known as Glide Path (GP) provides vertical guidance to the runway. The Localizer (LOC) provides horizontal guidance aligned with the runway centerline. Onboard equipment provides visual information on the position of the aircraft to these imaginary plans.

ILS approaches exist for the three main categories of precision approach: CAT I, CAT II and CAT III. They allow aircraft to land under decreasing horizontal visibility range and decision heights (the minimum ground elevation the pilot shall see the runway and decide whether or not to land onto the runway), as long as the aircraft has adequate equipment and the pilots the required training. ILS airport equipment are increasingly costly to maintain with the category of operation.

■ **Landside:** the landside of an airport infrastructure is the portion of this airport which is not directly related to the operations of aircraft. Landside is usually outside of the areas with restricted access for aviation safety and security purpose. It includes the ground access, curbside, car parks and parking garages, rental cars, etc.

■ **National Plan of Integrated Airport Systems (NPIAS):** The NPIAS identifies nearly 3,400 existing and proposed airports that are significant to national air transportation and thus eligible to receive Federal grants under the Airport Improvement Program (AIP). It also includes estimates of the amount of AIP money needed to fund infrastructure development projects that will bring these airports up to current design standards and add capacity to congested airports. The FAA is required to provide Congress with a 5-year estimate of AIP eligible development every two years. The NPIAS contains all commercial service airports, all reliever airports, and select general aviation airports.

■ **Visual Meteorological Conditions (VMC):** VMC are weather conditions in which Visual Flight Rules (VFR) are applicable. Basic VFR weather minimums are defined in 14 CFR Part 91 Section 91.155, and they depend on the types of aircraft and airspace. They typically require a horizontal visibility (or visibility range) of 1 to 3 Statute Miles, and a vertical distance between the runway and clouds 1,000 feet vertically.

■ **Pavement Classification Number (PCN):** The PCN is an approved method of the International Civil Aviation Organization (ICAO) for reporting airport pavement strength which relates to what aircraft types can regularly operate on the airfield. This method has been adopted by the U.S. Federal Aviation Administration (FAA) as described in Advisory Circular 150/5335-5C.

■ **Precision approach:** A precision approach is an instrument approach and landing using precision lateral and vertical guidance with minima as determined by the category of operation (e.g., CAT I). Lateral and vertical guidance refers to the guidance provided either by a ground-based navigation aid or computer-generated navigation data based on satellites and displayed to the pilot of an aircraft. There are five categories of precision approach: CAT I, II, IIIa, IIIb, IIIc. Each one is defined by different ranges of minimum runway visual range (RVR) or horizontal visibility on the ground level, and decision height (DH) or minimum ground elevation for the pilot to have visual contact with the runway and decide to continue or aboard the approach and landing.

- **Runway Design Code (RDC):** Per FAA AC 150/5300-13A Chg. 1, the RDC is a three-item code signifying the design standards to which the runway is to be built based on the critical aircraft. The three items are:

  - **Aircraft Approach Category (AAC)** from A to E with increasing range of maximum approach speed;

  - **Airplane Design Group (ADG)** depending on geometric characteristics of the largest aircraft serving the airport on the regular basis (see "Airplane Design Group");

  - **Visibility Minimums** expressed as the maximum Runway Visual Range (RVR) (in feet) aircraft can operate from the runway.

- **Runway length:** In this report, the runway length is the longest value among the Landing Distance Available (LDA) and Takeoff Run Available (TORA) (see "declared distances" above).

- **Runway Protection Zone (RPZ):** Runway protection zones are defined in FAA AC 150/5300-13A Chg. 1. They are a two-dimensional trapezoidal area "off the end of the runway end that serves to enhance the protection of people and property on the ground" in the event an aircraft lands or crashes beyond/before the runway end. Runway Protection Zones underlie a portion of the approach closest to the airport. The primary purpose of the RPZ is the protection of people and property on the ground thus RPZs should be clear of all structures and public roads and owned or controlled by the airport.

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Master Plans, Air Cargo and Other Relevant Studies in Washington State
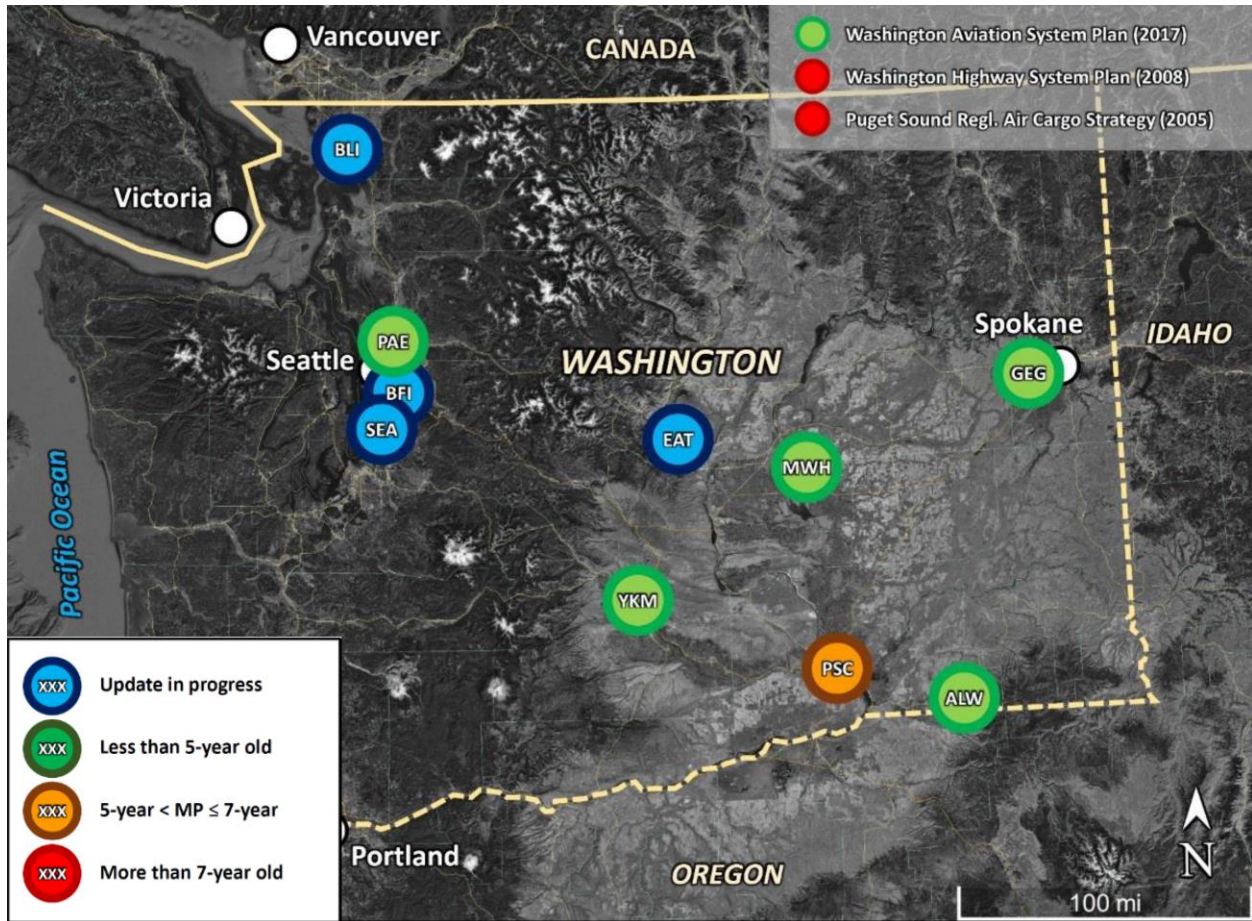
Note: Port of Pasco has published a Request for Proposal to update the Master Plan of Tri-Cities Airport

Appendix A.   Interview Notes

A variety of airlines, air truckers, forwarders and other air cargo stakeholders were interviewed as a part of this project.

According to international airlines interviewed, Seattle-Tacoma International Airport (Sea-Tac) is a good place to do business and most find the facilities and services at Sea-Tac to be more than adequate. Two of the international airlines do not provide regularly scheduled service because there is not enough market demand at this time. One international all-cargo airline when asked if they would operate its charters closer to the cherry production area of Eastern Washington to an airport such as Grant County International in Moses Lake, they answered in the affirmative, with the qualification that it is the freight forwarder that determines what airport they will service. They followed up by reiterating that in the business of providing airport-to-airport service, it is the freight forwarder that makes most of the scheduling decisions, not the airline.

Another international all-cargo airline indicated that they would not fly to alternative Eastern Washington airports to pick up cherries due to the lack of resources related to aircraft ground-handling equipment, lack of personnel, limited federal inspection services and unknown resource options related to fueling and aircraft maintenance.

A third international airline passenger airline indicated that lot the cargo shipped by them in the belly of their aircraft are textiles, shoes and electronics. Due to the growth of ecommerce, they are seeing growth in their inbound U.S. to China cargo traffic. The made a specific mention of Portland as a growing market for them because of location of e-commerce fulfillment centers and duty-free warehouses in Portland. Houston is also another growing market for them that is serviced by truck from Sea-Tac and Los Angeles International Airport (LAX).

Typically, for inbound U.S. air cargo, the airline will usually consolidate their Vancouver and Seattle air cargo shipments by trucking from Vancouver Airport to Sea-Tac airport, and vice-versa for cargo destined for Canada. From Seattle, cargo is trucked to various U.S. West Coast cities.

An interview with a freight forwarding company based in Seattle that specializes in perishables revealed that they utilized Spokane International Airport last year (2017) as a base to stage an international air charter for cherries. Their reasoning was that that they could minimize their costs by using an airport closer to the cherry production region. When asked if they had considered Grant County Airport, they indicated that they were not aware that Grant County Airport could accommodate large aircraft.

According to two air trucking companies, Sea-Tac generates a lot of international air cargo that is trucked to multiple locations both within the PNW and to as far away as Chicago, Dallas, and Miami. They also indicated that a lot of air cargo from Vancouver International Airport is trucked to Seattle where it is consolidated with Sea-Tac air cargo and then trucked to multiple points in the Unites States, with a large share of it going to LAX and San Francisco International Airport.

They indicated that getting trucks in and out of the Sea-Tac air cargo area and on-airport terminals is very challenging. Due to the congested air cargo terminals at Sea-Tac, truckers will sometimes have to wait for over 8 hours to pick up their assignments. But they indicated that this is a common problem and many U.S. airports.

A.1. VARIOUS SEATTLE-TACOMA INTERNATIONAL AIRPORT AIR CARGO STAKEHOLDERS

Seattle Air Cargo Forum, September 12, 2017
Sponsored by Airfreight Forwarders Association

The Seattle Air Cargo Forum was attended by approximately 60 Sea-Tac air cargo stakeholders. A panel comprising the managing director of Air Cargo for Alaska Airlines; general manager of Swissport Cargo Services, a freight forwarder from Transport Global Logistics; the vice president of Operations for Summit Northwest, a warehouse operator and air-trucking company; and the senior manager for Air Cargo Operations and Development for Sea-Tac discussed the growing air cargo market in the Seattle region and the challenges facing Sea-Tac's limited air cargo facilities.

A common consensus among both the panelists and attendees is that Sea-Tac was not designed to be an air cargo hub, but the growing regional economy and the booming e-commerce market is making it into one. According to the vice president of Operations for Summit Northwest, those infrastructure challenges begin long before the air carriers receive the cargo. Inefficiencies at the airport leave truck drivers idling for hours, especially when the cargo is destined for a carrier that does not handle its own cargo. These delays often force the driver to track down individual customer service agents for every airline transporting the cargo, he said.

Once the cargo arrives at the airport, new logistics hiccups emerge as physical space is severely limited. The North Air Cargo Area was not designed for 53-foot trucks, the most common truck size used for the provision of RFS. This leaves a very small area for truck maneuvering and very few parking positions.

The general manager for Swissport Cargo Services at Sea-Tac, acknowledged that Swissport and other ground handlers at the airport contribute to slowdowns for trucks arriving at the airport because they are trying to deal with too much cargo and too many airlines in too little space. Swissport handles cargo for six airlines at the airport and has had to turn away business because of those limitations. During the busy cherry season in 2017, the Swissport 32,000-square-foot facility was operating at 327 percent capacity.

Another capacity constraint mentioned at the forum was the limited resources of the TSA in screening air cargo. A lot of air cargo coming to the airport is not pre-screened, so it must be screened at the airport. However, the TSA has limited screening resources at Sea-Tac. This issue could be alleviated by using off-airport certified cargo screening facilities and by allowing third-party dog-screening teams.

The senior manager for Air Cargo Operations and Development for Sea-Tac pointed out that international wide-body passenger service has grown significantly at Sea-Tac, which not only expands the international air cargo market in Seattle but also requires additional space for passenger facilities that sometimes conflicts with the need for air cargo facilities.

Panelist pointed out that although existing Sea-Tac facilities are overcrowded, other land-constrained airports—such as Hong Kong International—can make air cargo work in a small footprint. It was also pointed out that a lot of activities currently taking place on the airport, can be shifted to off-airport facilities.

Appendix B.   International Air Cargo

This appendix describes the U.S Census Bureau data used in the Chapter 3 international air cargo analyses and provides details on the following.

B.1.   INTERNATIONAL TRADE DATA

The U.S. Census Bureau reports international trade data at the port level, and separately for states. As defined by the Census Bureau, "ports" include airports, water ports, and border crossings. The Seattle Census District includes 28 such ports in Washington, and the Colombia-Snake Oregon district includes three Washington state ports (Kalama, Longview, and Vancouver). International air cargo data is largely reported by airport "ports," but may also be reported at other ports where it is cleared by customs. Of international air imports recorded at the 31 Washington Census District ports in 2016, 93 percent of metric tons were recorded at Seattle-Tacoma International Airport (Sea-Tac). Remaining volumes were reported in the other 30 census ports in Washington state. For exports, Sea-Tac reported 91 percent of international air tons.

The U.S. Census Bureau also reports international air cargo data at the state level, but this data reflects the state origins of exports and state destinations for imports. While total U.S. port and state volumes match, the U.S. Census Bureau does not report the flows between ports and states. Thus, exports out of Washington state ports and airports may come from within Washington state or from states other than Washington. Later analyses in this document examine the balances between total volumes reported by ports versus state totals. If air cargo is much larger through Sea-Tac than Washington state trade, then the airport's market reach clearly extends beyond the state. Likewise, if the airport's air cargo is much smaller than state trade and it is the only state facility active, then competing airports clearly are coming into the market from outside, and the reach of the airport itself probably is very limited for regions beyond state borders. If air cargo is relatively balanced between airport and state trade, then the state likely represents most of the airport's market reach. The key point is that these are interpretations based on comparative volumes, made necessary by data that do not report the link between state trade and airport trade. The interpretations indicate probable, not definitive relationships, and individual shipments may move differently. Nevertheless, the patterns that emerge often are telling and provide a useful picture of airport catchment areas overall.

The analysis of Washington state's exports is complicated by its proximity to Canada. If goods are moved by truck to Vancouver, BC, and then re-exported out of Vancouver by air, they are reported as exports from Canada. U.S. Census Bureau data does not include modal or tonnage information that indicates where this may be the case, but it may be inferred from census data for some commodities, as noted later in this chapter. A second complication is that export goods loaded onto a domestic flight to a U.S. gateway might appear as a Washington state export not handled by a Washington state airport.

Sections that follow examine the balances between air cargo:

■ Reported by the U.S. Census Bureau for Washington state

- ■ Reported for Washington state ports (labeled as "Washington Airports"), including Sea-Tac and the state's other ports. Except where noted, airport volumes recorded at Sea-Tac represent nearly all of Washington state airport volumes

These sections review exports followed by imports for the commodity groups comprising the largest shares of Sea-Tac's volumes. The analysis is broken down by major trading region, which generally include East Asia, Europe, and Other regions.

B.2. EXPORTS

Major commodities examined below cover 55 percent of total Sea-Tac air cargo tons in 2016. Commodities are defined by Harmonized System (HS) codes. Except where noted, Sea-Tac volumes represent all Washington state airport volumes.

FRESH CHERRIES

Fresh cherries (HS 080929 Cherries, Fresh, Nesoi) represent a very large portion of Sea-Tac's total air exports—19.4 thousand metric tons in 2016, or 23.2 percent of the airport's total of 83.6 thousand metric tons for all commodities

Figure B-1.   Exports – Fresh Cherries by Air in 2016 (metric tons)
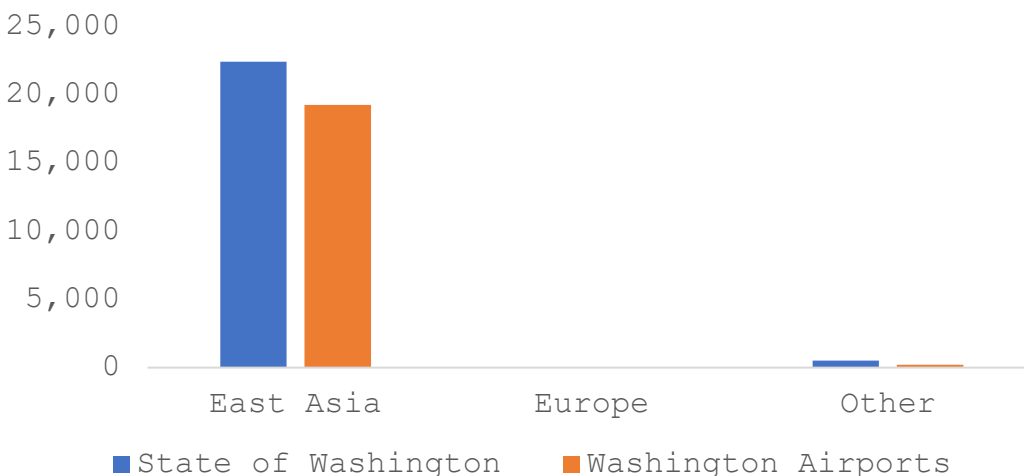
Source: U.S. Census Bureau Foreign Trade Statistics

Note: These numbers only include cherries exported directly from the United States. The numbers do not include cherries that are trucked to Canada and then exported by air, which are discussed in the next section.

Washington state is also the principal U.S. state exporter of cherries by air at 22.9 thousand metric tons in 2016 followed by 14.3 thousand metric tons from California. Together the two states export 99 percent of the U.S. air total. Almost all U.S. air volume (92 percent in 2016) goes to East Asia.

However, Washington state's exports of 22.9 thousand metric tons exceed Sea-Tac's exports of 19.4 thousand metric tons, which indicates that at least the difference is exported out of other airports. These volumes appear to be going to California airports where the airport volumes exceed state exports

by 3.4 thousand metric tons. This data would suggest that Sea-Tac serves most but not all of Washington state's export market.

CANADIAN REEXPORTS OF CHERRIES FROM WASHINGTON

Washington state is also a major exporter of fresh cherries to Canada by land. A large portion of these exports are apparently re-exported to other countries, most likely by air. Exports to Canada by land are not reported by weight, but of the $109 million value in exports of fresh cherries to Canada from the United States by land in 2016, $80 million of this value was exported from Washington state and $21 million was exported from California. A large portion of these exports is likely trucked to Vancouver and then shipped by air to East Asian countries. The $80 million in Washington state exports to Canada compares to $152 million in total Washington state cherry exports by air to all countries. Using $6.60 per kg for Washington state air exports of cherries in 2016, the $80 million in value exported to Canada would correspond to an estimated 12 million tons, or just under one-half the tonnage exported directly by air to all countries.

SEAFOOD: CRUSTACEANS AND MOLLUSCS

Exports of live and fresh crustaceans and molluscs (HS 0306 and 0307) through Sea-Tac totaled 10.8 thousand metric tons in 2016 (12.9 percent of the airport's total export tons). These volumes principally comprise crabs, oysters, and clams. Exports from Washington state totaled 10.7 thousand metric tons, or just less than the Sea-Tac total.

This overall balance between state and airport export volumes suggests that Sea-Tac's market area is equal to Washington state. Note that per Figure B-2, most go to East Asia.

Figure B-2.   Exports – Seafood by Air in 2016 (metric tons)
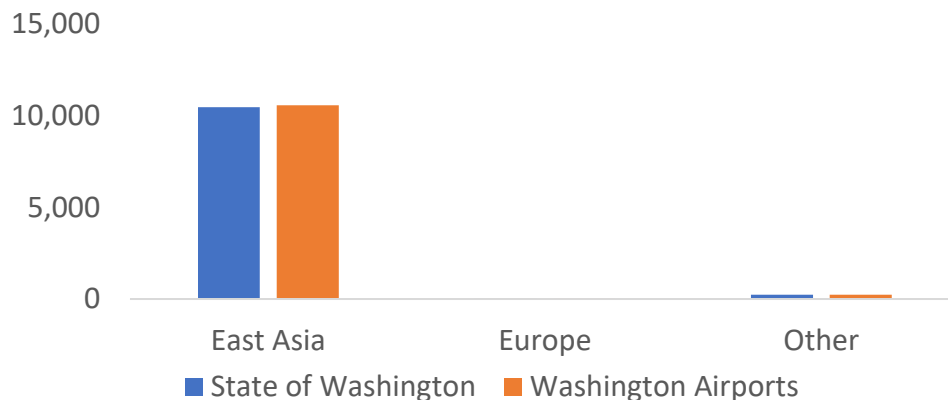
Source: U.S. Census Bureau Foreign Trade Statistics

FOOTWEAR PARTS

Total U.S. exports of footwear parts (HS 640690) by air totaled 5.1 thousand metric tons in 2016 of which 5.0 thousand metric tons, or 97 percent, originated from Oregon. Of these exports 3.8 thousand metric tons were exported through Sea-Tac, with a large portion of the remainder exported through California airports.

The clear conclusion is that exports of this product, almost entirely from Oregon, are served by primarily by Sea-Tac. Almost all volumes were destined to East Asia.

METALS AND METAL PRODUCTS

Articles of iron or steel (HS 73) and aluminum and articles thereof (HS 76) accounted for 3.0 thousand metric tons of Sea-Tac's air exports in 2016(3.6 percent of the airport's total). With state exports slightly exceeding airport exports, which indicates that, to a small degree the state's exports are transported through California or other airports. Small shares of Washington state airport exports were recorded in the Everett (Paine Field), Blaine (Bellingham), and Oroville Census ports on 2016. As shown in Figure B-3, Washington state exports go primarily to East Asia and Europe.

Figure B-3.   **Exports –Metals and Metal Products by Air in 2016 (metric tons)**
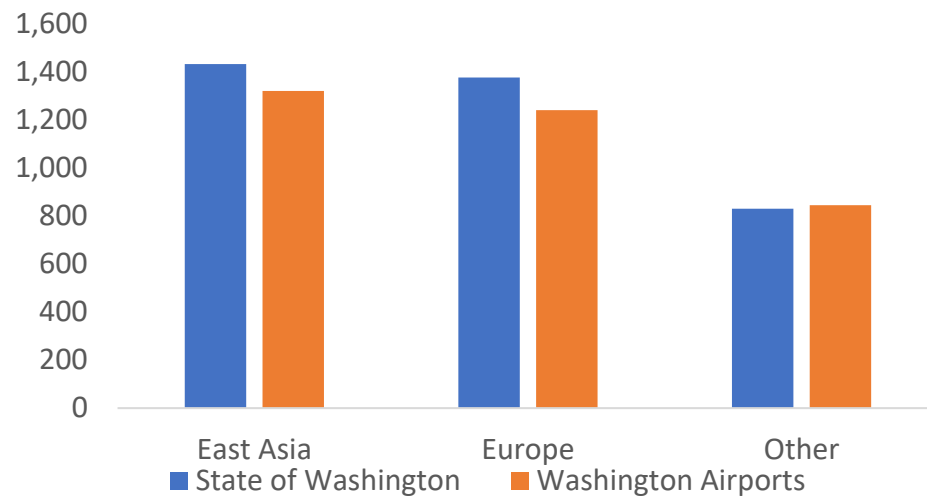
Source: U.S. Census Bureau Foreign Trade Statistics

INSTRUMENTS

Instruments (HS 90 Optical, Photographic, Medical or Surgical Instruments, etc.) accounted for 3.7 thousand metric tons of Sea-Tac's exports, or 4.4 percent of the airport's total exports in 2016.

As shown in Figure B-4, Washington state airport volumes of 1.5 thousand metric tons exported to East Asia exceeded Washington state exports of 1.4 thousand metric tons, indicating that for this foreign region Sea-Tac's market extends just beyond Washington state. However, Washington state volumes exported to Europe and to other regions exceeded Washington state airport volumes, suggesting that, for these regions, competing airports as far away as Chicago could come into play.

Figure B-4.   Exports – Instruments by Air in 2016 (metric tons)
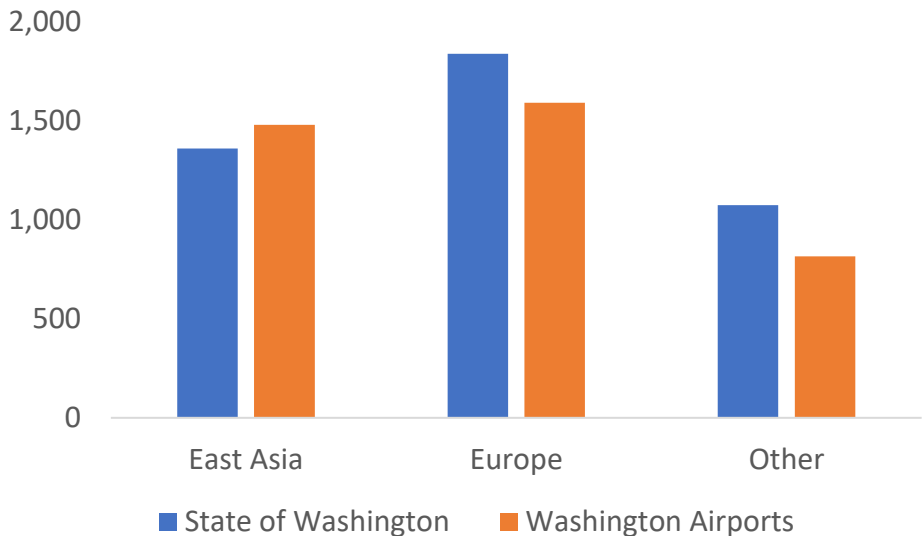
Source: U.S. Census Bureau Foreign Trade Statistics

MACHINES AND APPARATUS FOR MANUFACTURING SEMICONDUCTORS

This commodity includes HS 8486, machines and apparatus of a kind used solely or principally for the manufacture of semiconductor boules or wafers, semiconductor devices, electronic integrated circuits or flat-panel displays. Most U.S. exports by air are destined to East Asia.

Sea-Tac exported 1.0 thousand metric tons of this machinery in 2016 (1.4 percent of the airport's total export volume). However, Washington state produced just 0.1 thousand metric tons for air cargo export, which indicates that most of Sea-Tac's volumes originated from other states.

Figure B-5. **Exports – Machines and Apparatus for Manufacturing Semiconductors by Air in 2016 (metric tons)**
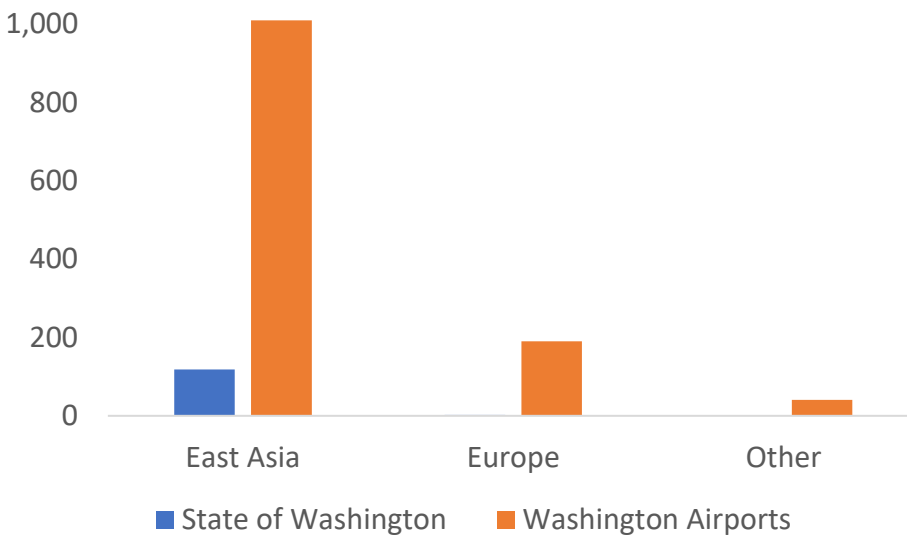
Source: U.S. Census Bureau Foreign Trade Statistics

The major western states that produced these commodities for export are California (12.8 thousand metric tons) and Oregon (3.8 thousand metric tons).[1] California airports export far more than California produced for exports. Oregon's airport exports are negligible, which suggests that Oregon's exports are split between Sea-Tac and California airports.

Some exports out of Sea-Tac could also originate in Idaho or Montana, which, together, exported 0.4 thousand metric tons by air in 2016. These regional exports could also be transported to either California airports or to Anchorage.

COMPUTERS

Sea-Tac exported 1.2 thousand metric tons of computers (HS 8471) in 2016 (1.4 percent of the airport's total exports). Most export volumes are destined to Europe as shown in Figure B-6. The airport's export

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[1] In 2016

volumes are greater than the 0.9 thousand metric tons of computers produced in Washington state for export, which indicates that the airport's service area extends beyond the state. Oregon produced 3.0 thousand metric tons for export. Since only a small volume departs from Oregon airports, some of Oregon's exports likely go through Sea-Tac.

Figure B-6.   **Exports – Computers by Air in 2016 (metric tons)**
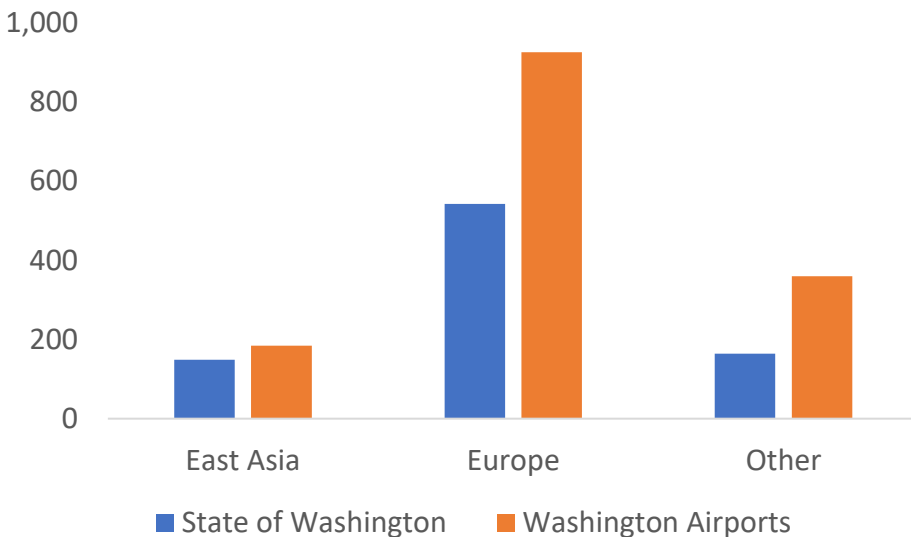
Source: U.S. Census Bureau Foreign Trade Statistics

VIDEO MONITORS, PROJECTORS AND TV RECEIVERS

Air export volumes from Sea-Tac for this commodity group (HS 8528 TV Receivers, incl. Video Monitors & Projectors) were 1.0 thousand metric tons in 2016, 1.2 percent of the airport's total. As shown in Figure B-7, most export volumes were destined to Europe.

Figure B-7.   Exports – Monitors and TV Receivers by Air in 2016 (metric tons)
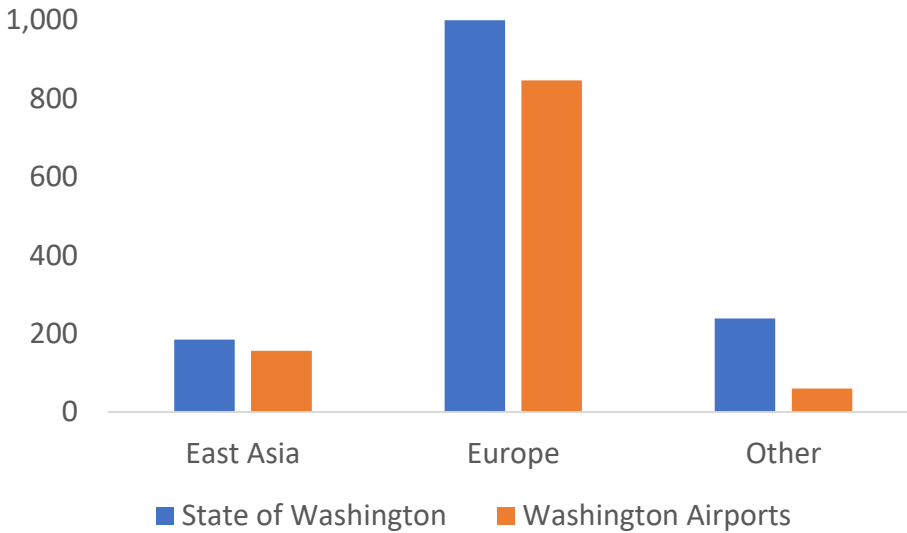
Source: U.S. Census Bureau Foreign Trade Statistics

Exports from Washington airports were slightly less than what was produced in Washington state for export, which suggests that Sea-Tac's market area generally covers Washington state, yet some shipments use airports in other states. There are no clear patterns indicating main competitors.

ELECTRONIC INTEGRATED CIRCUITS

Sea-Tac is a major gateway for exporting integrated circuits (HS 8542) to East Asia, the principal destination region for this product group. The airport's exports of 4.7 thousand metric tons represented 22 percent of total U.S. air exports in 2016 and 2.2 percent of the airport's air exports in 2016. However, production in the state for export is tiny compared to what goes out of its airports (Figure B-8).

Figure B-8.   **Exports – Electronic Integrated Circuits by Air in 2016 (metric tons)**
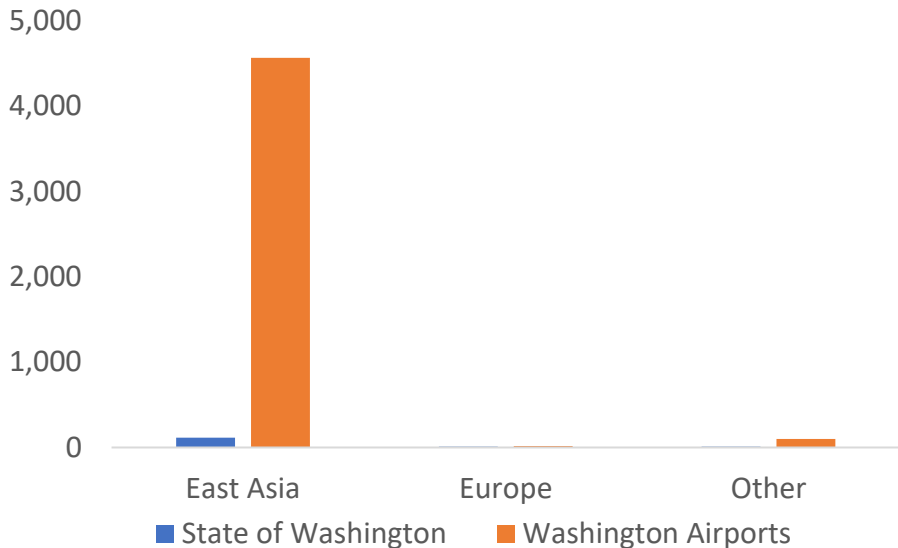
Source: U.S. Census Bureau Foreign Trade Statistics

Oregon exported 7.3 thousand metric tons by air in 2016 (35 percent of the U.S. total) but only 2.9 thousand metric tons were exported from Oregon airports. This suggests that Sea-Tac handles a large share of Oregon exports, with California airports likely handling a significant portion as well.

Idaho also exports a significant volume by air to East Asia, 1.3 thousand metric tons in 2016. This volume was likely shipped out of Sea-Tac.

CIVILIAN AIRCRAFT, ENGINES, AND PARTS

Sea-Tac exported 3.4 thousand metric tons of civilian aircraft, engines and parts (HS 8800) in 2016, which represented 4.1 percent of the airport's total export tonnage for all commodities. The commodity total was evenly balanced between East Asia and Europe and was close to Washington state's total exports, indicating that the airport's market area is Washington state.

Figure B-9. **Exports – Civilian Aircraft, Engines, and Parts by Air in 2016 (metric tons)**
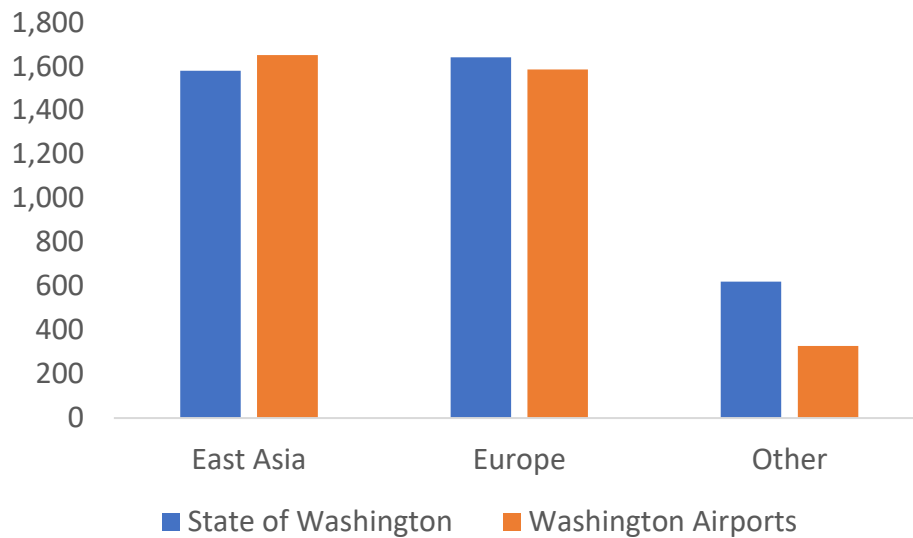
Source: U.S. Census Bureau Foreign Trade Statistics

B.3.   IMPORTS

ELECTRICAL MACHINERY AND EQUIPMENT

Electrical machinery and equipment includes computers (HS 8471, historically counted in HS heading 84 Machinery) plus eight selected products within the HS 85 Electrical Machinery and Equipment heading. Sea-Tac's import volumes for the nine selected products totaled 8.9 thousand metric tons in 2016 or 15.6 percent of the airport's total volume.

HIGH EAST ASIA STATE IMPORT VOLUMES WITH LOW SEA-TAC SHARES

Air import volumes for the following six four-digit HS code electrical machinery commodity groups totaled 6.6 thousand metric tons of Sea-Tac's imports in 2016, or 13.0 percent of the airport's total:

- 8471 Automatic Data Process Machines; Magnetic Readers, etc.

- 8504 Electric Transformers, Static Conv and Induct, ADP Power Supplies, Parts

- 8516 Electric Water, Space and Soil Heaters; Hair Dryers, Parts

- 8517 Electric Apparatus for Line Telephony, Parts

- 8525 Transmission Apparatus for Radiotelephony; TV Cameras and Recorders

- 8528 TV Receivers, Video Monitors and Projectors

These six commodity groups have similar patterns in terms of origins, and they also have relatively low Sea-Tac volumes compared to Washington state imports, although Sea-Tac is the only state airport handling them. East Asia is the principal origin for these six commodities for the United States and for Washington state. For each of these six commodities, Sea-Tac's volumes are less than Washington state import volumes. For the total of these six commodities, Sea-Tac's volumes were 32 percent of Washington state imports, indicating that airports outside the state handle most Washington imports and that Sea-Tac's market reach probably does not extend much beyond the state.

Figure B-10.   Imports – Automatic Data Process Machines; Magnetic Readers, etc. (HS 8471) by Air in 2016 (metric tons)
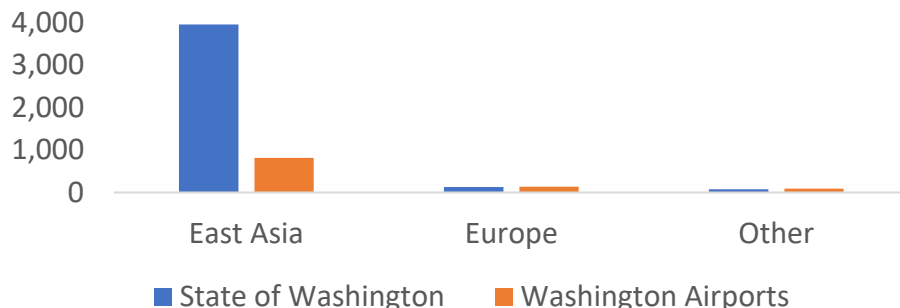
Source: U.S. Census Bureau Foreign Trade Statistics

Figure B-11. **Imports – Electric Transformers, Static Conv & Induct, ADP Power Supplies, Parts (HS 8504) by Air in 2016 (metric tons)**
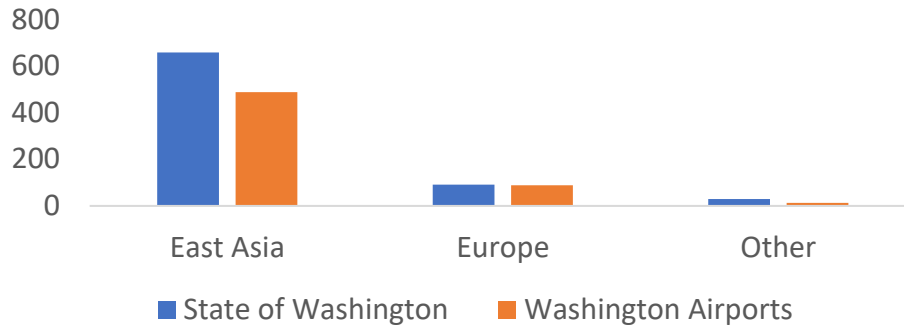
Source: U.S. Census Bureau Foreign Trade Statistics

Figure B-12. **Imports – Electric Water, Space and Soil Heaters; Hair Dryers, Parts (HS 8516) by Air in 2016 (metric tons)**
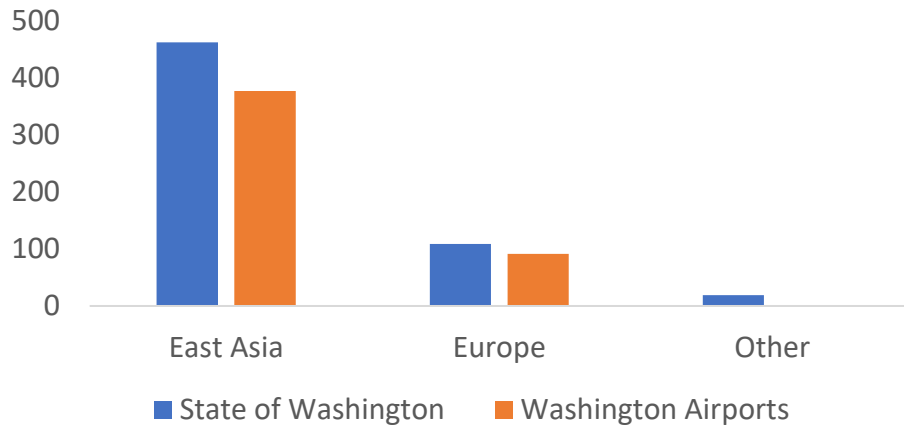
Source: U.S. Census Bureau Foreign Trade Statistics

**Figure B-13.** **Imports – Electric Apparatus for Line Telephony, Parts (HS 8517) by Air in 2016 (metric tons)**
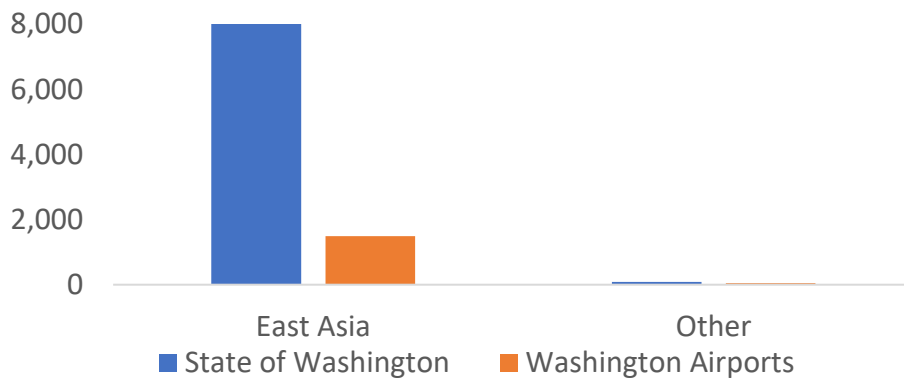
Source: U.S. Census Bureau Foreign Trade Statistics

Figure B-14. **Imports – Transmission Apparatus for Radiotelephony; TV Cameras and Recorders (HS 8525) by Air in 2016 (metric tons)**
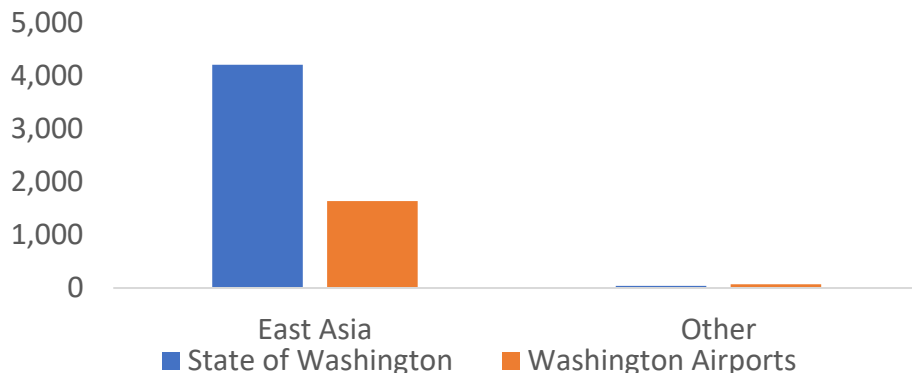
Source: U.S. Census Bureau Foreign Trade Statistics

Figure B-15. **Imports – TV Receivers, Video Monitors and Projectors (HS 8528) by Air in 2016 (metric tons)**
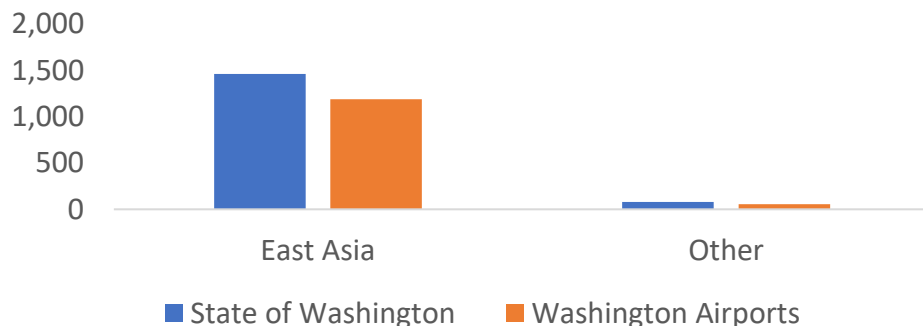
Source: U.S. Census Bureau Foreign Trade Statistics

HIGH EAST ASIA STATE IMPORT VOLUMES WITH HIGH SEA-TAC SHARES

SEMICONDUCTOR DEVICES; LIGHT-EMITTING DIODES, PARTS (HS 8541)

For this electrical equipment commodity group, Sea-Tac's volumes from East Asia exceed Washington state import volumes by 0.4 thousand metric tons, indicating that Sea-Tac's market reach likely extends into Oregon where state imports are roughly equal to this excess. The same market reach into Oregon is also likely for imports from Europe.

Figure B-16. **Imports – Semiconductor Devices; Light-Emitting Diodes, Parts (HS 8541) by Air in 2016 (metric tons)**
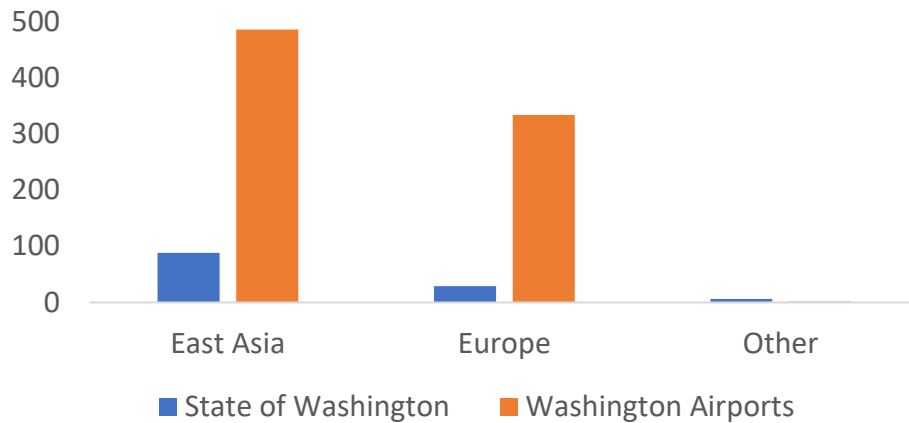
Source: U.S. Census Bureau Foreign Trade Statistics

HIGH EAST ASIA STATE IMPORT VOLUMES WITH EQUAL SEA-TAC VOLUMES

As shown in Figure B-17 and Figure B-18, for two electrical equipment products the principal origin is East Asia and Sea-Tac's imports are very close to Washington state imports, likely indicating Sea-Tac's market reach generally corresponds to Washington state.

Figure B-17. **Imports – Insulated Wire, Cable; Optical Sheath Fiber Cables (HS 8544) by Air in 2016 (metric tons)**
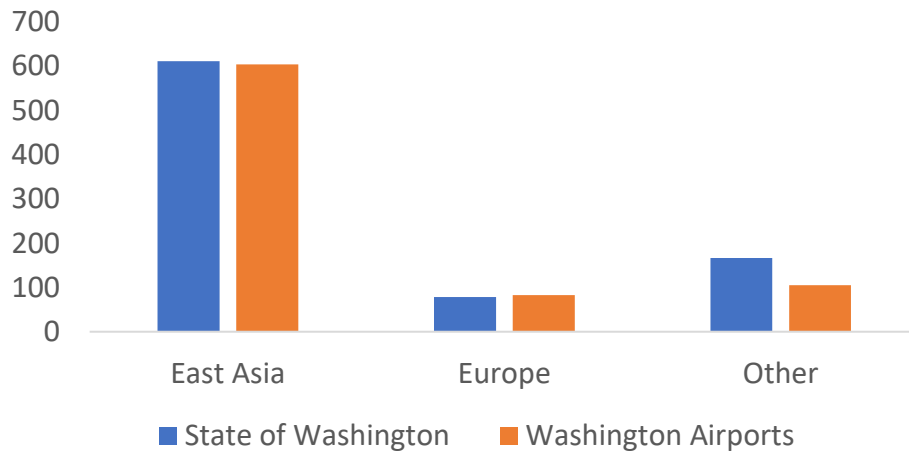
Source: U.S. Census Bureau Foreign Trade Statistics

Figure B-18. **Imports – Prepared Unrecorded Media (no Film) for Sound, etc. (HS 8523) by Air in 2016 (metric tons)**
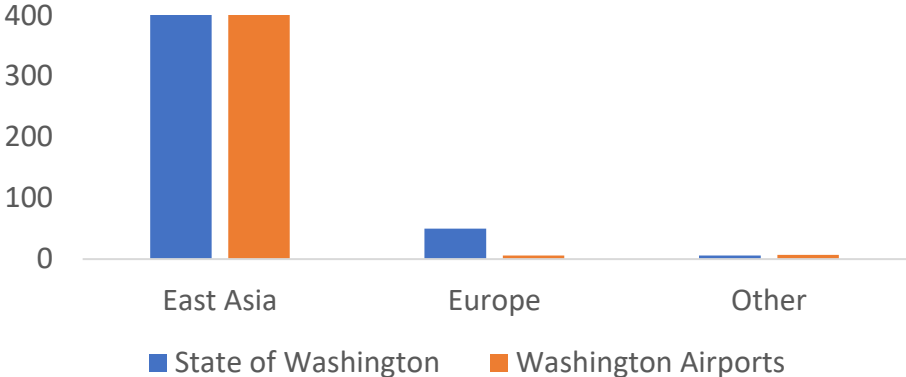
Source: U.S. Census Bureau Foreign Trade Statistics

AIRCRAFT COMPONENTS

Four aircraft-related commodity groups, aircraft seats, seat parts, aircraft parts and turbojets/turbines, are imported from Europe and East Asia into Washington via Sea-Tac. Together these four commodities represented the second-largest volume commodity group at 11.2 percent of Sea-Tac's import volumes in 2016.

Seats and seat parts are imported largely from Europe while aircraft parts and turbojets/turbines are imported primarily from East Asia. For each of these commodities Sea-Tac imports far greater volumes than Washington state totals. These presumably include aircraft parts imported by Boeing through Sea-Tac with the excess largely going to Illinois.

SEAT PARTS, EXCLUDING MEDICAL, BARBER, DENTAL, ETC. (HS 940190)

Sea-Tac's 1.9 thousand metric tons of seat parts imports in 2016 represented 12.6 percent of the U.S. total and 3.4 percent of Sea-Tac's total air import volumes.

As shown in Figure B-19, these imports originated primarily in Europe and Sea-Tac's imports exceeded those into Washington state by 0.7 thousand metric tons. This difference likely went to California, where airport volumes were less than state imports by a difference of 1.1 thousand metric tons.

Figure B-19.   Imports – Seat Parts (HS 940190) by Air in 2016 (metric tons)
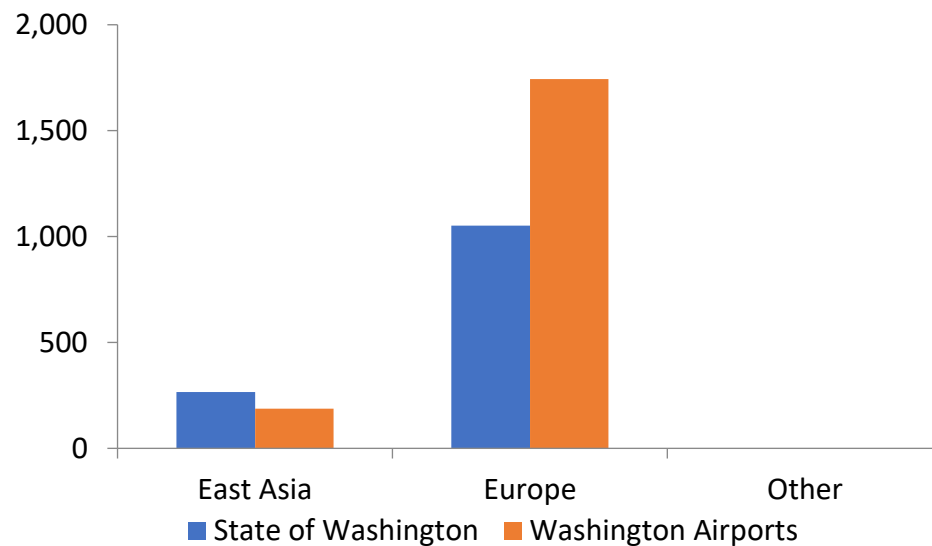
Source: U.S. Census Bureau Foreign Trade Statistics

State airport imports tons from East Asia were 0.1 thousand metric tons less than Washington state imports, with the difference possibly coming from California airports.

AIRCRAFT SEATS

Sea-Tac's 1.1 thousand metric tons of aircraft seat Imports in 2016 represented 42.6 percent of total U.S. imports and 2.0 percent of Sea-Tac's total air import volumes (Figure B-20).

**Figure B-20.   Imports –Aircraft Seats (HS 940110) by Air in 2016 (metric tons)**
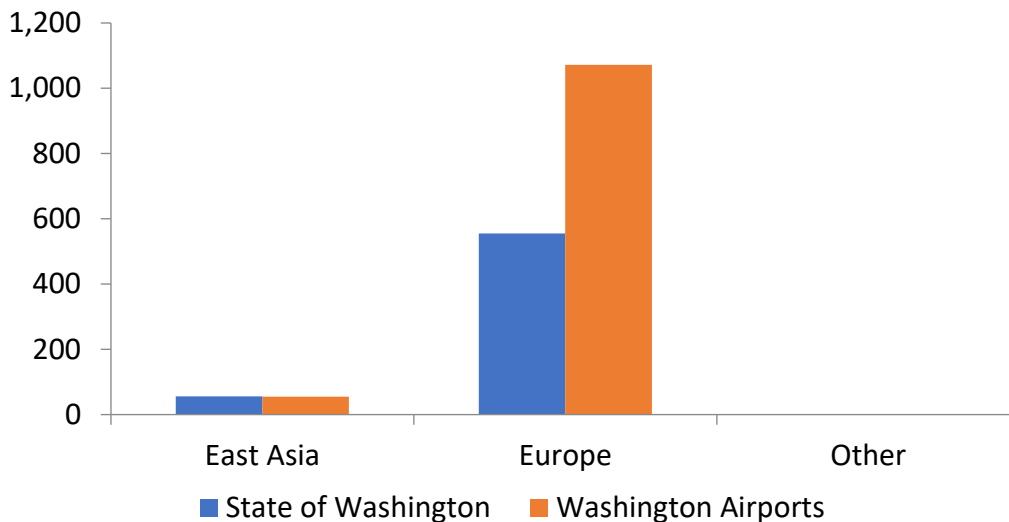
Source: U.S. Census Bureau Foreign Trade Statistics

As is the case for seat parts, these imports originated almost entirely from Europe and Sea-Tac's imports also exceeded those of Washington state by 0.5 thousand metric tons. The data suggests that the difference in volumes may go to Illinois, the only other state with significant state imports.

AIRCRAFT PARTS

Aircraft parts comprised 4.2 percent of Sea-Tac's total import volumes in 2016. In contrast to seats and seat parts, U.S. imports are about evenly split between East Asia and Europe at over 11 thousand metric tons from each. However, as shown in Figure B-21, Sea-Tac's imports of this commodity group originate most heavily from East Asia and represented over a third of total U.S imports in 2016. The large difference between Sea-Tac's imports and those of Washington state, like aircraft seats, appear to go to Illinois, the top importing state for aircraft parts.

Figure B-21. Imports – Aircraft Parts (HS 8803) by Air in 2016 (metric tons)
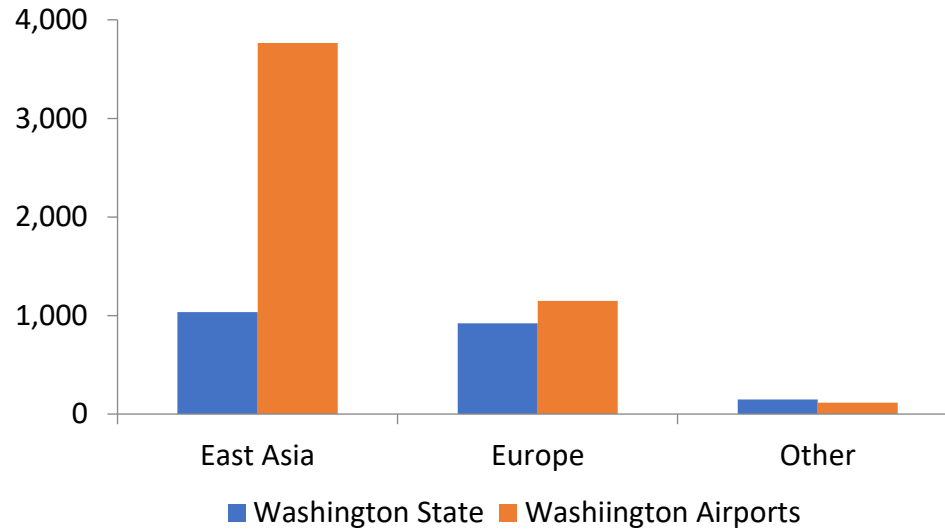
Source: U.S. Census Bureau Foreign Trade Statistics

TURBOJETS, TURBOPROPELLERS AND OTHER GAS TURBINES, PARTS (HS 8411)

Sea-Tac's imports totaled 0.9 thousand metric tons in 2016, or 1.6 percent of the airport's total (Figure B-22). These volumes represented 6 percent of the U.S. total for the commodity group. Like aircraft parts, volumes imported through Washington airports from East Asia significantly exceeded Washington state import volumes. The surplus is going to other states; there are no obvious candidates as to which states are involved, and many of them are far to the east.

Figure B-22.   Imports – Turbojets and Turbines (HS 8411) by Air in 2016 (metric tons)

Source: U.S. Census Bureau Foreign Trade Statistics

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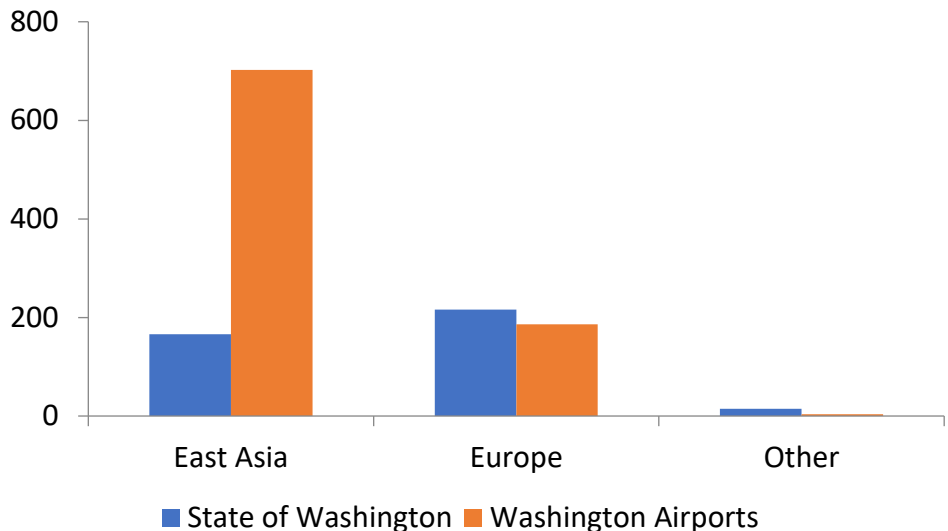
APPAREL, OTHER TEXTILES, FOOTWEAR AND LEATHER ARTICLES

This broad category includes apparel (HS 61 & 62), other textiles (HS 63), footwear (HS 64) and leather articles (HS 42). Sea-Tac imports were 6.8 thousand metric tons in 2016, 12.0 percent of the airport's total.

APPAREL

Sea-Tac's imports of apparel represented 8.8 percent of airport air tons.

U.S. imports of apparel by air totaled 363 thousand metric tons in 2016, the majority of which (62 percent) originated in East Asia. Imports from South Asia represented 22 percent of U.S. import volumes, and Europe and South/Central America both had shares of 6 percent.

Washington state imports totaled 3.1 thousand metric tons. Compared to origins for U.S. imports, state origins of state imports were more concentrated from East Asia (65 percent) and Europe (10 percent) and less concentrated from South Asia (11 percent) and South/Central America (4 percent).

EAST ASIA

As shown in Figure B-23, for the large-volume origin of East Asia, Sea-Tac's imports of 4.3 thousand metric tons were more than double Washington state imports of 2.2 thousand metric tons. With an airport surplus of 2.3 thousand metric tons, Sea-Tac is most likely a gateway airport for states such as Oregon, Idaho, Montana, Nevada, Utah and Colorado, each of which has state imports with small or no airport volumes.

Hawaii, Alaska, and California airports are also significant gateways for East Asian imports, with significant airport surpluses of 7.4, 6.2, and 4.5 thousand metric tons, respectively.

SOUTH ASIA

South Asia represented the second-largest origin region for Washington state (Figure B-23). State and airport imports were approximately equal at 0.6 thousand metric tons in 2016, suggesting a mainly in-state market for Sea-Tac.

**Figure B-23.   Imports – Apparel (HS 61 & 62) by Air in 2016 (metric tons)**
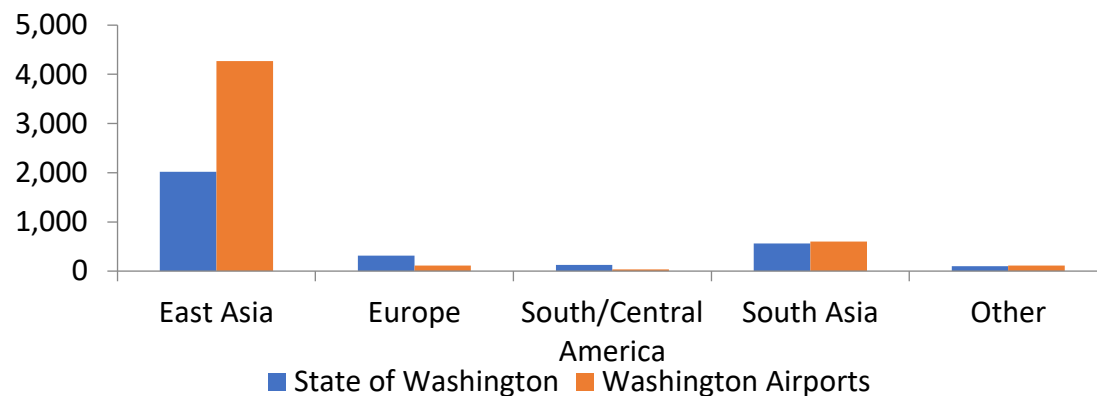
Source: U.S. Census Bureau Foreign Trade Statistics

OTHER TEXTILES (HS 63)

Other textile articles represented 1.0 percent of Sea-Tac volumes in 2016 with a majority originating in East Asia but, like apparel, with a very large share also originating in South Asia (Figure B-24). Sea-Tac's East Asia volumes exceeded Washington state imports with the excess likely going to Oregon or California.

Figure B-24.   Imports – Other Textile Articles (HS 63) by Air in 2016 (metric tons)
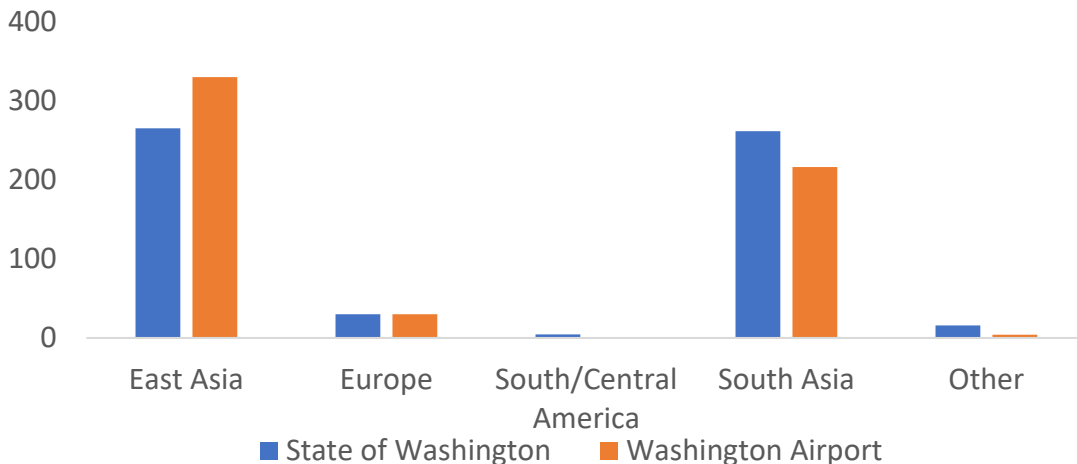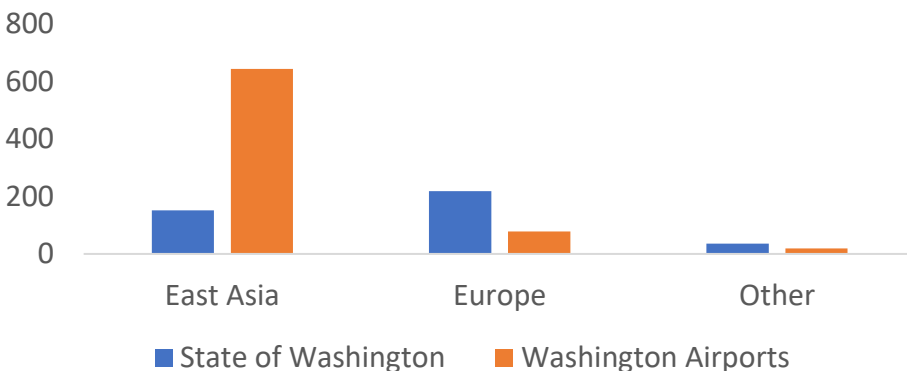

Source: U.S. Census Bureau Foreign Trade Statistics

FOOTWEAR (HS 64)

Air imports through Sea-Tac were 0.7 thousand metric tons in 2016, 1.2 percent of the airport total (Figure B-25). The volume of 0.6 thousand metric tons from East Asia, was more than four times state imports and the excess likely went to Oregon where state imports were close to this difference.

Figure B-25.   Imports – Footwear (HS 64) by Air in 2016 (metric tons)
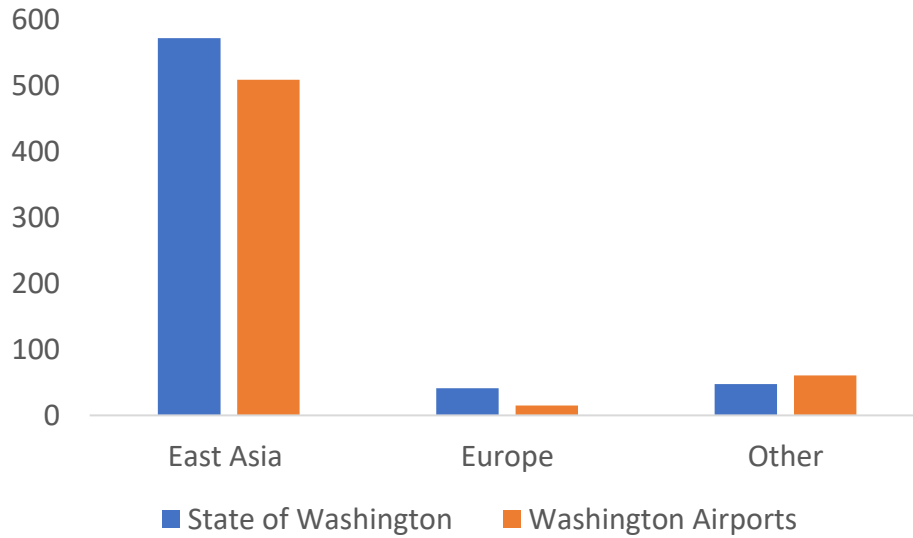

Source: U.S. Census Bureau Foreign Trade Statistics

LEATHER ARTICLES (HS 64)

Sea-Tac imports of leather articles originated primarily from East Asia and totaled 0.6 thousand metric tons in 2016, 1.0 percent of the airport total and just slightly less than state imports (Figure B-26). This suggests that Sea-Tac's market chiefly is Washington state.

Figure B-26.   Imports – Leather Articles (HS 64) by Air in 2016 (metric tons)

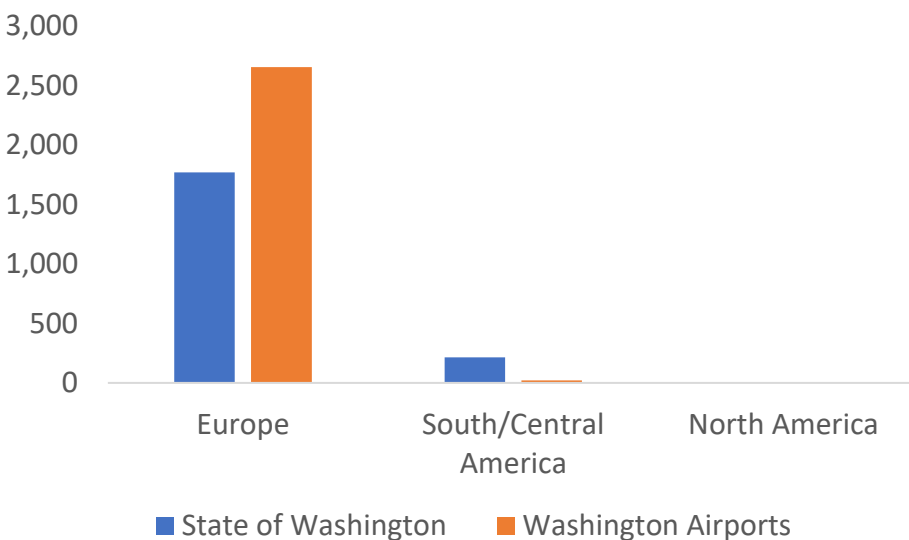Source: U.S. Census Bureau Foreign Trade Statistics

FRESH AND CHILLED FISH

Fresh and chilled fish represented 6.5 percent of the total tons imported through Sea-Tac in 2016. Sea-Tac's shares of state import volumes vary widely by type and origin of fish.

PACIFIC, ATLANTIC, DANUBE SALMON FILLET FRESH/CHILLED (HS 030441)

Salmon imports represented 4.7 percent of Sea-Tac's 2016 total air tons (Figure B-27). Three-quarters of U.S. salmon fillets imported by air originated in South and Central America in 2016 with the remainder from Europe. Imports of 1.8 thousand metric tons into Washington were almost all from Europe, but imports through Sea-Tac exceeded this volume by 0.9 thousand metric tons. California airport imports, the majority of which were through San Francisco and San Jose airports, were less than California state imports by 0.7 thousand metric tons indicating that Sea-Tac's surplus volumes may have come largely through California.

**Figure B-27.** **Imports – Salmon (HS 030431) by Air in 2016 (metric tons)**

Source: U.S. Census Bureau Foreign Trade Statistics

FISH FILLETS, FRESH OR CHILLED, NESOI (HS 030449

Sea-Tac's volumes of other fish fillets were 0.2 thousand metric tons in 2016, half of which of which originated in East Asia countries and the other half from other Asian countries. These volumes were approximately equal to Washington's state volumes, indicating that Sea-Tac's market for Asian imports probably does not extend much beyond the state.

FISH, FRESH OR CHILLED, NO FILLETS OR OTHER MEAT (HS 0302)

Washington state imports of other fresh or chilled fish totaled 1.4 thousand metric tons in 2016 and represented 1.4 percent of the airports imports. These volumes included 0.6 tons from Europe, 0.4 thousand metric tons from South and Central America and 0.2 thousand metric tons from East Asia. Sea-Tac's volumes equaled state imports from East Asia (Figure B-28). Compared to the state's 0.6 thousand metric tons of imports from Europe, 0.4 thousand metric tons were imported through Sea-Tac, with the remainder likely imported through California airports given their large surplus of imports compared to state imports. None of Washington's imports from South and Central America were imported through Sea-Tac.

Figure B-28.   Imports – Other Fresh or Chilled Fish by Air in 2016 (metric tons)
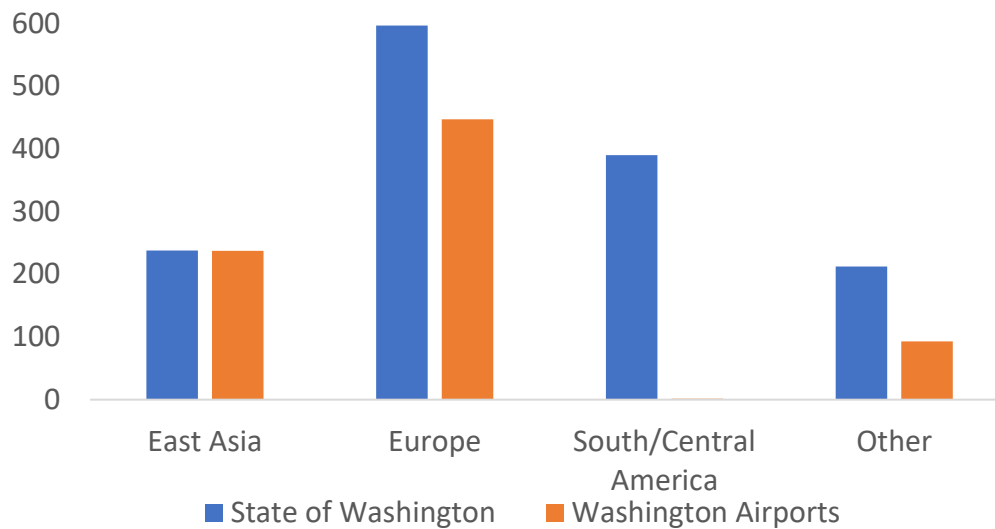
Source: U.S. Census Bureau Foreign Trade Statistics

In summary, Sea-Tac's share of fresh fish imports are heavily related to the region of origin:

- State imports of fish from East Asia are all likely imported through Sea-Tac.

- For imports from Europe, Sea-Tac's share of state fish imports are mixed. For salmon, Sea-Tac's volumes significantly exceed state imports, with the difference likely going to California. For other fresh or chilled fish Sea-Tac's volumes are less than state imports, with California ports likely handling the difference.

- State imports of fish from Central and South America are imported almost entirely through airports outside the state, potentially as far away as Florida, Georgia or Texas.

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OTHER MACHINERY

Other machinery includes six product groups that accounted for 5.9 thousand metric tons of Sea-Tac's imports in 2016 or 10.4 percent of the airport total. These products have widely varying origins and airport shares.

ENGINES, MOTORS NESOI, AND PARTS (HS 8412)

This product group is largely imported from East Asia. Sea-Tac volumes are roughly equal to Washington state imports, and the state is probably the main market (Figure B-29).

Figure B-29. **Imports – Engines, Motors and Parts (HS 8412) by Air in 2016 (metric tons)**
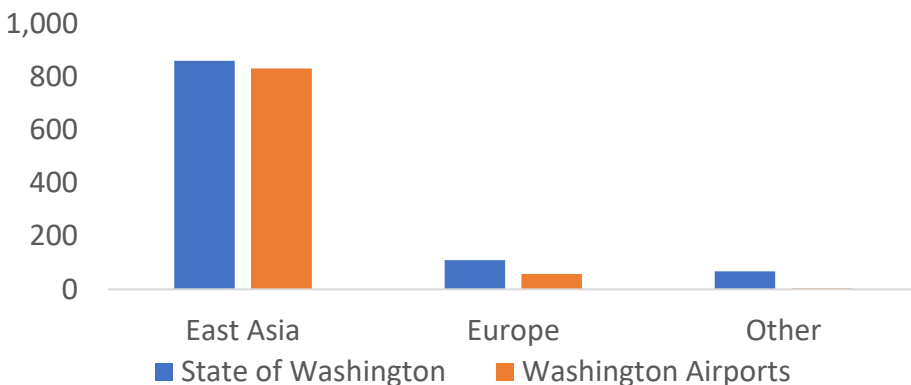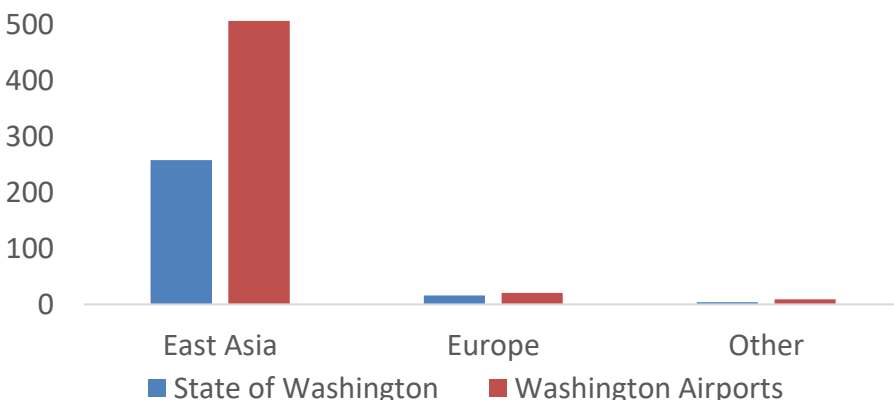

Source: U.S. Census Bureau Foreign Trade Statistics

PARTS FOR TYPEWRITERS AND OTHER OFFICE MACHINES (HS 8473)

Sea-Tac imports from East Asia for this product group were nearly double volumes for the state, indicating that Sea-Tac's market extends beyond Washington state, likely to Oregon (Figure B-30).

Figure B-30. **Imports – Parts for Typewriters and Office Machines (HS 8473) by Air in 2016 (metric tons)**
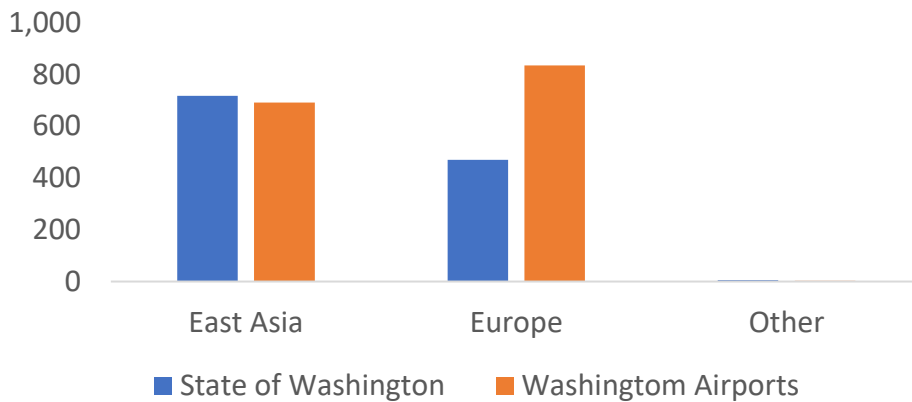

Source: U.S. Census Bureau Foreign Trade Statistics

MACHINERY FOR TEMPERATURE CHANGE, WATER HEATERS, PARTS (HS 8419)

Sea-Tac's imports of 0.7 thousand metric tons from East Asia were nearly equal to state imports in 2016, indicating the airport's market reach generally corresponds to Washington state (Figure B-31).

Figure B-31.   Imports – Temperature Change Machinery (HS 8419) by Air in 2016 (metric tons)
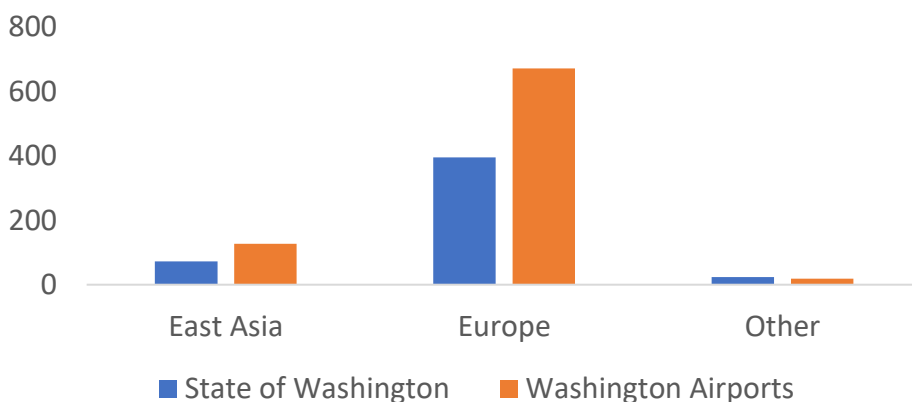

Source: U.S. Census Bureau Foreign Trade Statistics

From Europe, Sea-Tac's imports exceeded state imports by 0.4 thousand metric tons. This difference far exceeds Oregon imports and Sea-Tac's market reach may therefor extend into California and other Western states.

PARTS FOR MACHINERY OF HEADINGS 8425 TO 8430 (HS 8431)

This product category is largely imported from Europe and Sea-Tac's imports exceeded state imports by 0.3 thousand metric tons in 2016 (Figure B-32). This difference significantly exceeds Oregon imports, and Sea-Tac's market reach may therefor extend into California or other Western states.

Figure B-32.   Imports – Miscellaneous Machinery Parts (HS 8431) by Air in 2016 (metric tons)
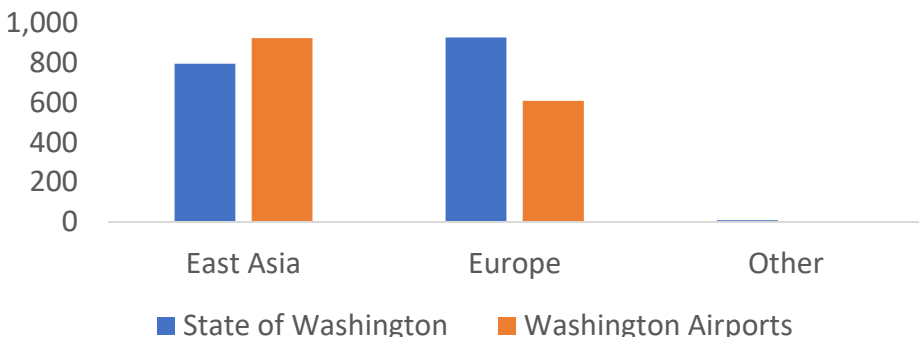

Source: U.S. Census Bureau Foreign Trade Statistics

TAPS, COCKS, VALVES FOR PIPES AND TANKS, PARTS (HS 8481)

Most Washington state imports originate from Europe, with Sea-Tac's import volumes less than the state volumes, indicating Sea-Tac's market generally is limited to the state. The candidates for competing airports covering this shortfall lie well to the east, with Chicago the most likely (Figure B-33).

Figure B-33.   **Imports – Taps, Cocks, Valves for Pipes and Tanks, Parts (HS 8481) by Air in 2016 (metric tons)**
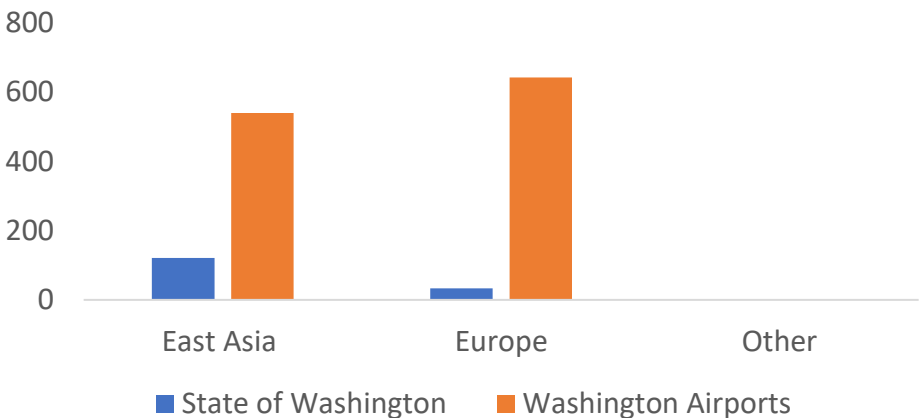

Source: U.S. Census Bureau Foreign Trade Statistics

Sea-Tac's volumes from East Asia exceed state imports. The difference likely goes to Oregon, making up a small part of that state's imports.

MACHINES AND APPARATUS FOR MANUFACTURE OF SEMICONDUCTOR BOULES, AND PARTS (HS 8486)

Sea-Tac's import volumes significantly exceeded state imports from East Asia as well as Europe (Figure B-34). The differences likely go to Oregon, supplying part of Oregon's imports from East Asia. Sea-Tac may import most of Oregon's volumes from Europe.

Figure B-34.   **Imports – Machines and Apparatus for Manufacture of Semiconductors (HS 8486) by Air in 2016 (metric tons)**
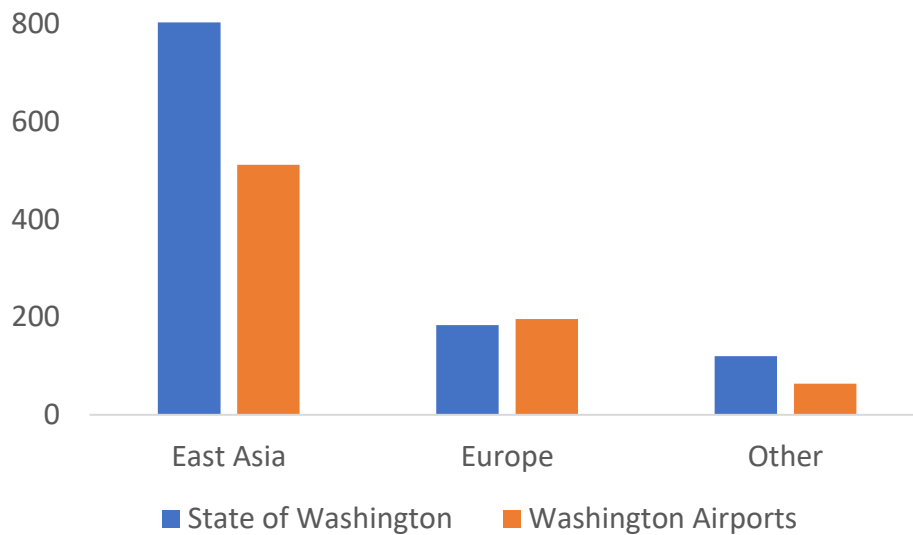

Source: U.S. Census Bureau Foreign Trade Statistics

INSTRUMENTS

MEDICAL, SURGICAL, DENTAL OR VETERINARIAN INSTRUMENTS, NOT ELECTRICAL, PARTS (HS 9018)

Sea-Tac's imports of these instruments totaled 0.8 thousand metric tons in 2016 (1.3 percent of the airport's total) (Figure B-35). The 0.3 thousand metric ton difference between state imports and Sea-Tac volumes were likely imported through California airports.

Figure B-35.   **Imports – Medical, Surgical, Dental or Veterinarian Instruments (HS 9018) by Air in 2016 (metric tons)**

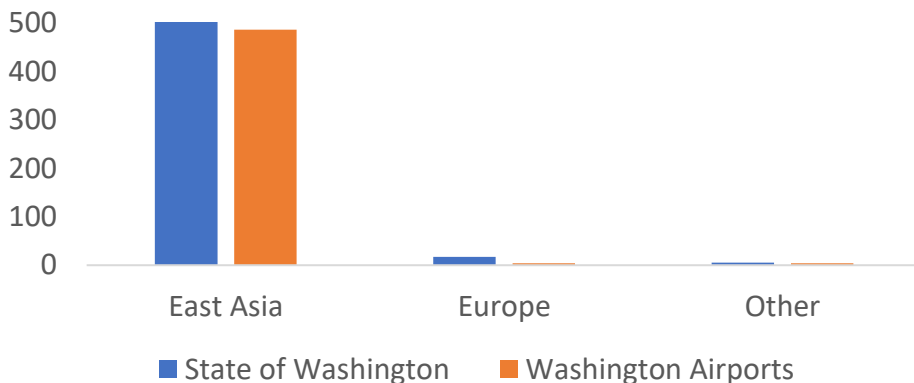Source: U.S. Census Bureau Foreign Trade Statistics

TOYS AND GAMES

Sea-Tac's imports of toys and games totaled 0.8 thousand metric tons in 2016 (1.4 percent of the airport's total).

TOYS NESOI; SCALE MODELS; PUZZLES; PARTS ETC (HS 9503)

Toys are imported into Washington principally from East Asia, and Sea-Tac's closely matching volumes indicate the airport's principal market is within the state (Figure B-36).

Figure B-36.   Imports – Toys and Games (HS 9503) by Air in 2016 (metric tons)

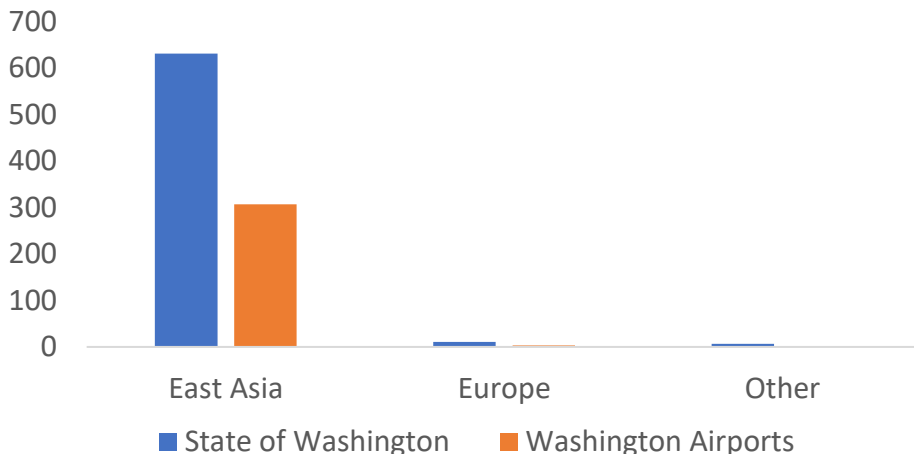Source: U.S. Census Bureau Foreign Trade Statistics

VIDEO GAME CONSOLES, ARCADE AND PARLOR GAMES (HS 9504)

Sea-Tac's volumes were less than half the state volumes in 2016 with the difference likely imported through California airports (Figure B-37).

Figure B-37.   Imports – Video, Arcade and Parlor Games (HS 9504) by Air in 2016 (metric tons)

Source: U.S. Census Bureau Foreign Trade Statistics

MISCELLANEOUS MANUFACTURED ARTICLES (HS 96)

Sea-Tac's imports totaled 0.8 thousand metric tons in 2016 (0.5 percent of airport volumes) (Figure B-38). Sea-Tac's large surplus of imports over state imports from East Asia likely went to Oregon, supplying that state's total imports.

Figure B-38.   Imports – Miscellaneous Manufactured Articles (HS 96) by Air in 2016 (metric tons)
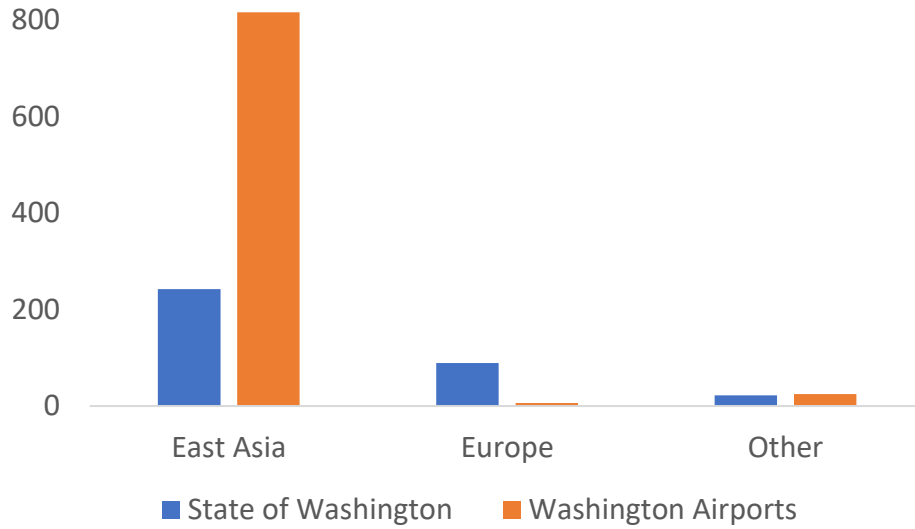
Source: U.S. Census Bureau Foreign Trade Statistics

METAL PRODUCTS

Sea-Tac's imports of iron and steel articles (HS 73, Figure B-39) and aluminum (HS 76, Figure B-40) totaled 1.2 thousand metric tons in 2016 (2.0 percent of the airport total). Most total volumes originated in East Asia with substantial volumes also coming from Europe.

Figure B-39.   Imports – Articles of Iron or Steel (HS 73) by Air in 2016 (metric tons)
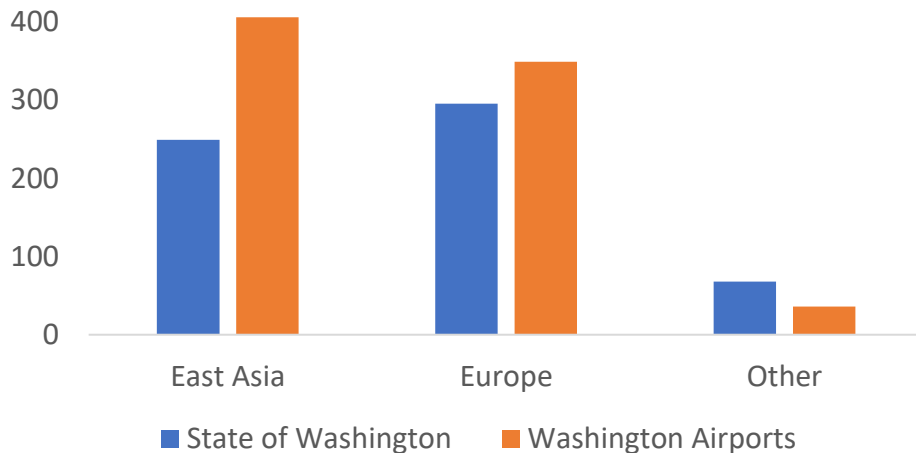
Source: U.S. Census Bureau Foreign Trade Statistics

Figure B-40.   Imports – Aluminum and Articles Thereof (HS 76) by Air in 2016 (metric tons)
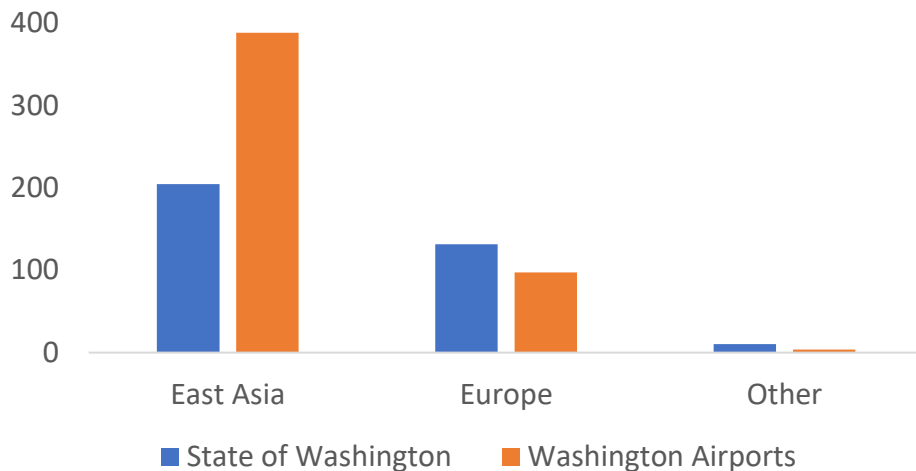
Source: U.S. Census Bureau Foreign Trade Statistics

Sea-Tac's volumes from East Asia significantly exceeded state imports for both product groups, with the excess likely going to Oregon.

GLASS AND GLASSWARE

Sea-Tac's imports 0.5 thousand metric tons of glass and glassware imports in 2016 represented 0.9 percent of total airport imports (Figure B-41). Most originating volumes were from Europe with a large portion originating from East Asia. From both origins, airport tons exceeded state imports with the difference likely going to Oregon.

Figure B-41.   Imports – Glass and Glassware (HS 70) by Air in 2016 (metric tons)
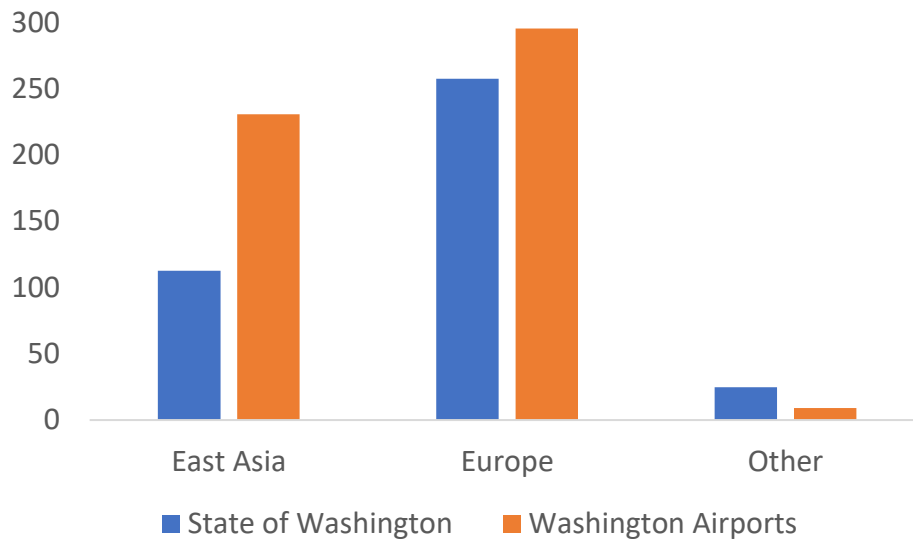
Source: U.S. Census Bureau Foreign Trade Statistics

PLASTIC PRODUCTS

Two plastic-product categories within the HS 39 Plastic Products heading accounted for 2.1 percent of total Sea-Tac imports in 2016.

Sea-Tac imports of plastic containers (HS 3923, Figure B-42) totaled 0.5 thousand metric tons in 2016, almost all of which were from East Asia. This volume was significantly higher than state imports. The difference was about equal with total imports into Oregon, indicating that Sea-Tac's market includes Washington and Oregon.

Figure B-42. **Imports – Plastic Containers (HS 3923) by Air in 2016 (metric tons)**
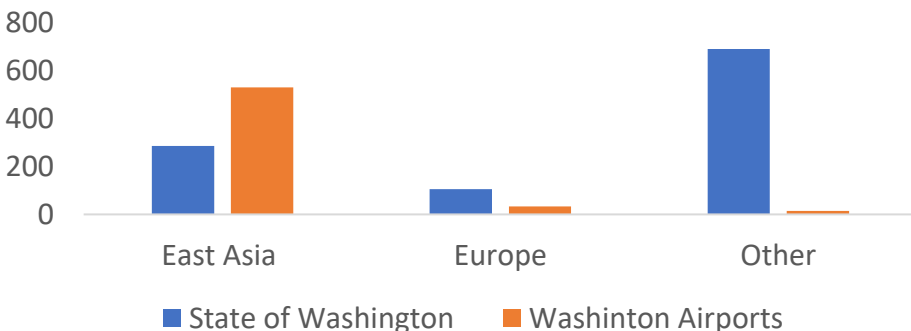
Source: U.S. Census Bureau Foreign Trade Statistics

Sea-Tac's 0.6 thousand metric tons of imports of plastic tableware and other household articles (Figure B-43) were even more concentrated from East Asia. The difference in Sea-Tac's imports and state imports significantly exceeded Oregon's imports indicating that Sea-Tac's imports also went to other western states.

Figure B-43. **Imports – Plastic Tableware and Other Household Articles (HS 3924) by Air in 2016 (metric tons)**

Source: U.S. Census Bureau Foreign Trade Statistics

ORGANIC CHEMICALS

Airport imports of organic chemicals totaled 0.7 thousand metric tons in 2016, 0.4 thousand metric tons from Europe, and 0.3 thousand metric tons from East Asia (Figure B-44). These volumes were both much greater that state imports. The difference from Europe likely went to Oregon and California.

Figure B-44.   Imports of Organic Chemicals (HS 29) by Air in 2016 (metric tons)
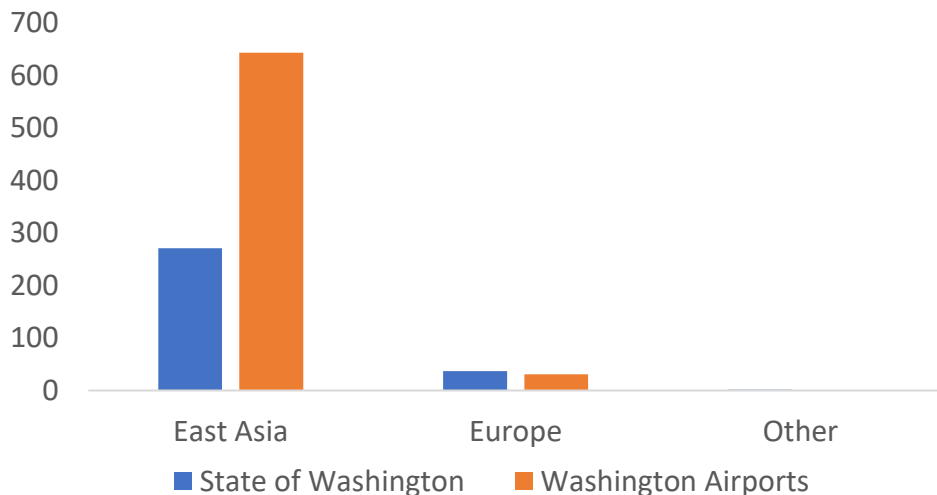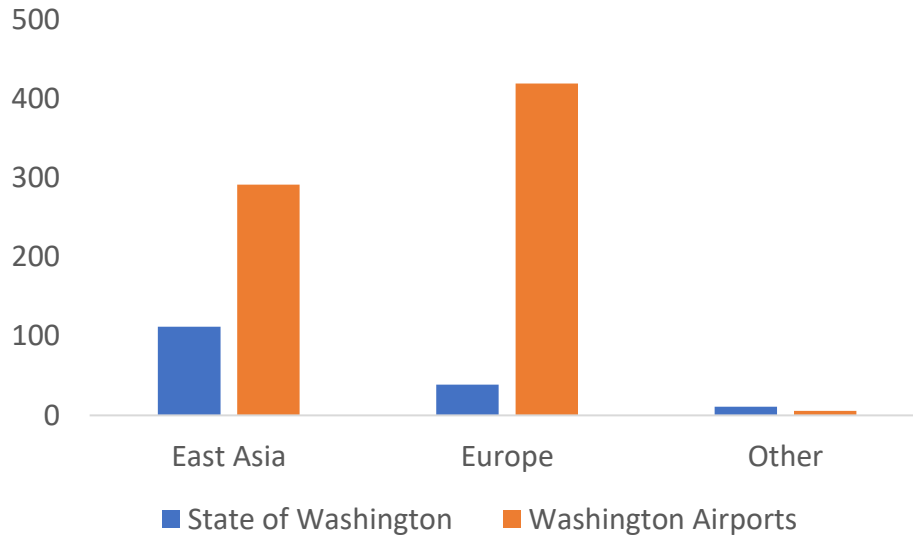

Source: U.S. Census Bureau Foreign Trade Statistics

The 0.2 thousand ton difference from East Asia likely went to Oregon given that state's 0.2 thousand metric tons of imports.

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Appendix C.   Existing Conditions at Main Cargo Airports in Washington State

	Seattle-Tacoma	King Co. /Boeing	Spokane Intl.	Grant County	Yakima Air Terminal	Tri-Cities Airport	Paine Field	Bellingham Intl.	Pangborn Memorial	Walla Walla Regional
FAA 3-Letter Code	SEA	BFI	GEG	MWH	YKM	PSC	PAE	BLI	EAT	ALW
NPIAS Classification	Large hub	Non-hub	Small hub	General Aviation	Non-hub	Non-hub	Reliever	Small hub	Non-hub	Non-hub
Airport Reference Code (ARC)	D-V***	D-IV	D-IV	D-VI	C-III	D-IV	D-V	C-IV	C-III	C-III
Design Aircraft	B747-400	B767-300	B767-300	B777-300	B727	B767	B747-400	B757-200	Gulfstream V	Gulfstream III
Main Rwy Length (ft.)	11,901	10,000	11,002	13,503	7,604	7,711	9,010	6,701	7,000	6,527
Approach Procedures	CAT I/II/III, RNAV	CAT I, RNAV GPS	CAT I/II/III, RNAV RNP	CAT I, RNAV	CAT I, RNAV RNP	CAT-I, RNAV	CAT-II, RNAV GPS	CAT-I, RNAV	CAT-I	CAT-I, RNAV
Most Frequent All-Cargo Aircraft Types	ADG-II to -VI	ADG-II to -IV	ADG-II to -IV	ADG-II to -VI	ADG-II to -III	ADG-II to -III	ADG-IV to -VI	ADG-II to -III	ADG-II	ADG-II
Cargo Aircraft Stands	17+	6+	11+	–	10	–	3+	11	–	3
Cargo Ramp Area (acres)	>70	11.5	27.5	80	2	>6	14 (Boeing only)	0.75 (FedEx)	–	1.5
Warehouses and Support Facilities* (sq. ft.)	630,000	–	62,000	–	33,500	–	–	30,000	2,500	5,600
Air Cargo Operators	34	7	5	2	3	2	4	3	3	2
Port of Entry	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No
U.S. Ranking (Cargo Airports)	17	32	51	–	–	–	86	–	–	–
Air Cargo Trends Per Airport MP or WASP	+ 4-8%/yr. (CAGR 2010-2030)	+2.5%/yr. (AAGR 2014-2034)	+2.06%/yr. (CAGR 2015-2025)	+1%/yr. (AAGR 2014-2034)	+1.36%/yr. (CAGR 2015-2030)	+1%/yr. (AAGR 2014-2034)	+1%/yr. (AAGR 2014-2034)	+1%/yr. (AAGR 2014-2034)	+1%/yr. (AAGR 2014-2034)	+2%/yr. (AAGR 2014-2034)
Distance to SEA by road**	0 mile	7-8 miles	285 miles	189 miles	151 miles	231 miles	38-40 miles	108 miles	160 miles	270-281 miles
Distance to SEA (straight distance)**	0 mile	5.5 miles	223 miles	142 miles	103 miles	172 miles	32 miles	93 miles	99 miles	213 miles
Distance to nearest Interstate**	3-4 miles	>2 miles	1-5 miles	8 miles	3.5 miles	<1 mile	3-5 miles	2 miles	70 miles	44-50 miles

*On-site facilities only. Inventory based on Google Earth. Truck parking spaces are not included.

**Longest distance from cargo areas to SEA's cargo area and Interstate merging lanes.

***The Boeing 747-8F operates at Sea-Tac under a Modification of Standards – the airport is certified for Antonov 124 and 225 can be accommodated when requested.

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Appendix D.   Alternative Forecast Scenarios

For context, and because there are many uncertainties associated with any forecast, low, preferred and high air cargo forecasts for Washington state were developed. They are presented in Table D-1, Table-D-2, and Table D-3.

Table D-1.   Air Cargo Forecast (Low)

	Year	Nonurban	Spokane	King Co. Intl	Sea-Tac	Total State
Historical	2106	23,538	61,396	114,364	366,430	**565,728**
	2017	24,009	62,661	115,851	425,000	**627,520**
	2018	24,489	63,952	117,357	431,928	**637,725**
	2019	24,979	65,269	118,882	438,968	**648,098**
	2020	25,478	66,614	120,428	446,123	**658,643**
	2021	25,988	67,986	121,993	453,395	**669,362**
Forecast	2022	26,508	69,386	123,579	460,785	**680,258**
	2023	27,038	70,816	125,186	468,296	**691,335**
	2024	27,579	72,274	126,813	475,929	**702,596**
	2025	28,130	73,763	128,462	483,687	**714,042**
	2026	28,693	75,283	130,132	491,571	**725,678**

Note: The ten-year 2016–2026 compound annual growth rate for Washington state is 2.52 percent.

Table D-2.   Air Cargo Forecast (Preferred)

|	Year	Nonurban	Spokane	King Co. Intl	Sea-Tac	Total State
Historical	2106	23,538	61,396	114,364	366,430	**565,728**
	2017	24,009	63,238	122,369	425,000	**634,616**
	2018	24,489	65,135	130,935	445,485	**666,044**
	2019	24,979	67,089	137,482	467,164	**696,714**
	2020	25,478	69,102	144,356	485,249	**724,185**
	2021	25,988	71,175	151,574	504,104	**752,841**
Forecast	2022	26,508	73,310	156,121	518,399	**774,338**
	2023	27,038	75,509	160,805	533,106	**796,458**
	2024	27,579	77,775	165,629	548,238	**819,220**
	2025	28,130	80,108	170,598	563,806	**842,642**
	2026	28,693	82,511	175,716	579,824	**866,744**

Note: The ten-year 2016–2026 compound annual growth rate for Washington state is 4.36 percent.

Table D-3.   Air Cargo Forecast (High)

	Year	Nonurban	Spokane	King Co. Intl	Sea-Tac	Total State
Historical	2106	23,538	61,396	114,364	366,430	**565,728**
	2017	24,009	63,238	122,369	425,000	**634,616**
	2018	24,489	65,135	130,935	442,850	**663,409**
	2019	24,979	67,089	137,482	461,450	**691,000**
	2020	25,478	69,102	144,356	480,831	**719,767**
	2021	25,988	71,175	151,574	501,025	**749,762**
Forecast	2022	26,508	73,310	156,121	522,069	**778,007**
	2023	27,038	75,509	160,805	543,995	**807,347**
	2024	27,579	77,775	165,629	566,843	**837,825**
	2025	28,130	80,108	170,598	590,651	**869,486**
	2026	28,693	82,511	175,716	615,458	**902,378**

Note: The ten-year 2016–2026 compound annual growth rate for Washington state is 4.78 percent.

Figure D-1.   Air Cargo Forecasts (Low, Preferred, High)
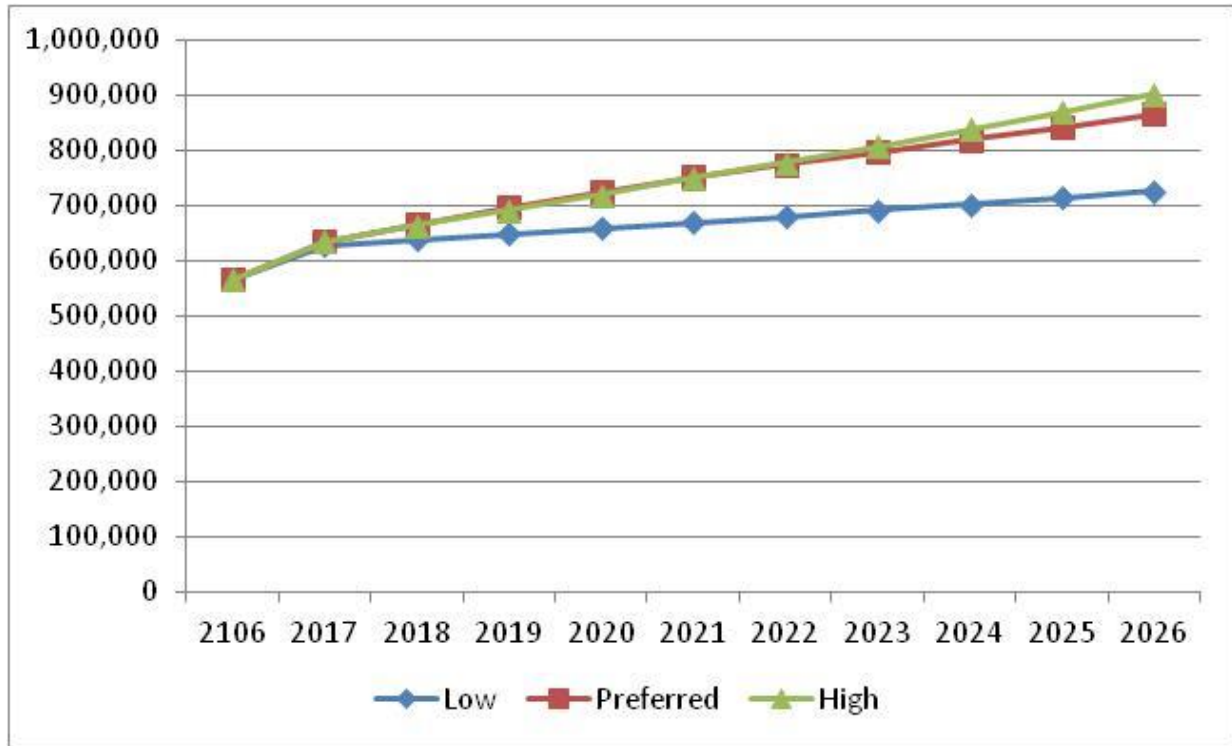
Appendix E.   Existing and Future Inventory Analysis Matrices

Table E-1.   2017 Detailed Existing Conditions and Facility Requirements at Main Cargo Airports in Washington State

	Seattle-Tacoma	King Co. /Boeing	Spokane Intl.	Grant County	Yakima Air Terminal	Tri-Cities Airport	Paine Field	Bellingham Intl.	Pangborn Memorial	Walla Walla Regional
FAA 3-Letter Code	SEA	BFI	GEG	MWH	YKM	PSC	PAE	BLI	EAT	ALW
NPIAS Classification	Large hub	Non-hub	Small hub	General Aviation	Non-hub	Non-hub	Reliever	Small hub	Non-hub	Non-hub
Airport Reference Code (ARC)	D-V*	D-IV	D-IV	D-VI	C-III	D-IV	D-V	C-IV	C-III	C-III
Design Aircraft	B747-400	B767-300	B767-300	B777-300	B727	B767	B747-400	B757-200	Gulfstream V	Gulfstream III
Main Rwy Length (ft.)	11,901	10,000	11,002	13,503	7,604	7,711	9,010	6,701	7,000	6,527
Approach Procedures	CAT I/II/III, RNAV	CAT I, RNAV GPS	CAT I/II/III, RNAV RNP	CAT I, RNAV	CAT I, RNAV RNP	CAT-I, RNAV	CAT-II, RNAV GPS	CAT-I, RNAV	CAT-I	CAT-I, RNAV
Existing Air Cargo Ramp Area (acres)	> 70	11.5	27.5				104.25			
Required Air Cargo Ramp (ACRP) (acres)	18.6	11.9	5.97				2.58			
Surplus of Space Available (acres)	+50	-0.4	+21.5				+101.7			
Existing Cargo Bldg. Space (sq. ft.)	630,000	–	62,000				> 66,500			
Required Cargo Bldg. Space (ACRP) (sq. ft.)	516,375	133,010	66,675				28,766			
Surplus of Space Available (sq.ft.)	+113,625	–	-4,675				+38,000			
Required Truck and Auto Parking (ACRP) (sq.ft.)	612,556	222,761	121,859				51,779			
Cargo Traffic (Forecast) (U.S. tons)	468,482	134,889	69,708				26,465			

*The Boeing 747-8F operates at Sea-Tac under a Modification of Standards – the airport is certified for Antonov 124 and 225 can be accommodated when requested.

Table E-2   2021 Synthesis of Facility Requirements at Main Cargo Airports in Washington State

	Seattle-Tacoma	King Co. /Boeing	Spokane Intl.	Others
FAA 3-Letter Code	SEA	BFI	GEG	
Air Cargo Ramp Area (acres)	22.1	14.8	6.7	2.6
Surplus of Space Available (Base 2017)	+47.9	-3.3	+20.8	+101.7
Cargo Building Space (sq. ft.)	612,486	164,754	75,043	31,138
Surplus of Space Available (Base 2017)	+17,514	–	-8,368	+35,000
Truck and Auto Parking (sq.ft.)	726,570	275,925	137,154	56,048
Cargo Traffic (Forecast) (U.S. tons)	504,104	151,574	71,175	28,647

*The Boeing 747-8F will operate at Sea-Tac under a Modification of Standards – the airport is certified for. Antonov 124 and 225 can be accommodated occasionally.

Table E-3.   2026 Synthesis of Facility Requirements at Main Cargo Airports in Washington State

	Seattle-Tacoma	King Co./ Boeing	Spokane Intl.	Others
FAA 3-Letter Code	SEA	BFI	GEG	
Air Cargo Ramp Area (acres)	25.4	17.1	7.8	3.1
Surplus of Space Available (Base 2017)	+44.6	-5.6	+19.7	+101.2
Cargo Building Space (sq. ft.)	704,486	190,996	86,995	34,378
Surplus of Space Available (Base 2017)	-74,486	–	-20,320	+32,000
Truck and Auto Parking (sq.ft.)	835,705	319,873	158,998	61,881
Cargo Traffic (Forecast) (U.S. tons)	579,824	175,716	82,511	31,628

*The Boeing 747-8F will operate at Sea-Tac under a Modification of Standards – the airport is certified for Antonov 124 and 225 can be accommodated occasionally.