ATTACHMENT 5

Feasibility of an Intermodal Transfer Facility in the Willamette Valley, Oregon

Executive Summary

December 14, 2016

Prepared for:

Business Oregon
Infrastructure Finance Authority

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Acknowledgments

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ECONorthwest prepared this report to Business Oregon. It received substantial assistance from Business Oregon staff and the members of the ITF Steering Committee. Other firms, agencies, and staff contributed to other research that this report relied on.

That assistance notwithstanding, ECONorthwest is responsible for the content of this executive summary and underlying technical information. The staff at ECONorthwest completed this project based on their general knowledge of economic and business feasibility, and on information derived from government agencies, the reports of others, interviews of individuals, and other sources believed to be reliable. ECONorthwest has not independently verified the accuracy of all such information, and makes no representation regarding its accuracy or completeness. Any statements nonfactual in nature constitute the authors' current opinions, which may change as more information becomes available.

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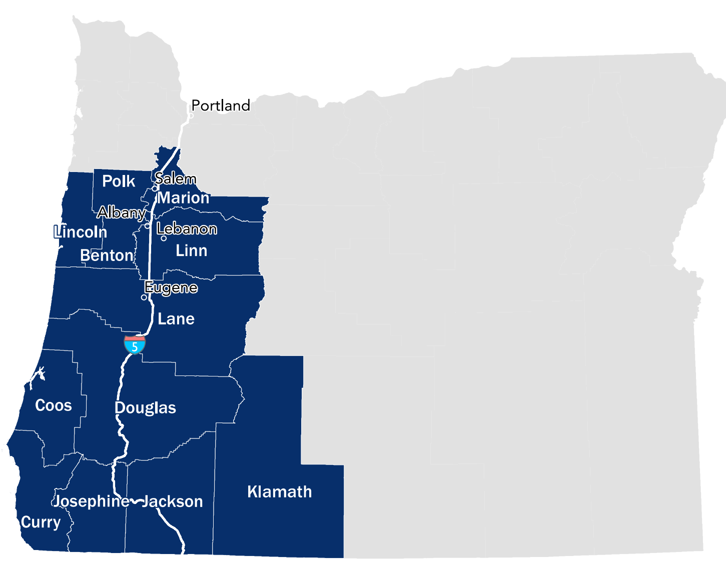
Executive Summary

The Oregon Legislature is concerned about recent changes in shipping activity at the Port of Portland due to the loss of weekly containerized shipping service at Terminal 6 (T6). Among the concepts proposed to improve shipping options for Oregon's exporters following the changes at the Port is the notion of providing improved transloading facilities at strategic locations across Oregon (i.e., facilities that facilitate transfer of product between rail and truck modes, in particular). To further the discussion and explore tangible solutions for Oregon's exporters, the Oregon Legislature asked Business Oregon and the Infrastructure Finance Authority (IFA) to identify and evaluate the business case for an Intermodal Transfer Facility (ITF) located in the Willamette Valley. This summary presents the findings of the analysis. The full analysis is detailed in two Technical Memoranda provided as appendices.

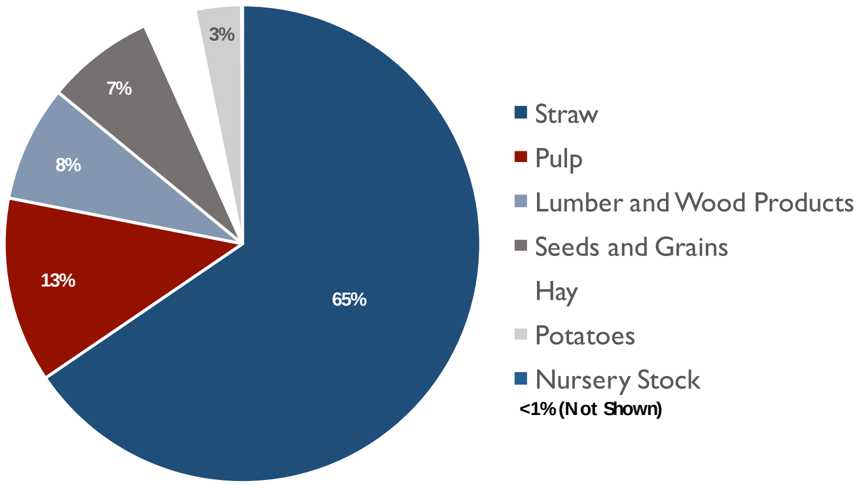
Size of the Market and Potential Demand for the ITF

The area an ITF in the Willamette Valley would likely serve is shown on the map below. The market analysis identified intermodal container shipments from this area. The majority of exports are agricultural products. Thus, to quantify the number of container exports, we relied on data from phytosanitary certificates issued in Oregon in 2015, as well as interviews with exporters, to capture some non-agricultural exports (e.g., pulp). Interviews also helped verify the data and provided critical insights about shipping requirements and current options.

From these data, we identified the equivalent of 38,170 40-foot containers (mostly high-cube) of goods exported from the mid- and southern Willamette Valley, Southern Oregon, and the Oregon Coast, via the Ports of Seattle and Tacoma per year. The actual size of the market is likely greater than this, because we did not have data to estimate the number of container exports of processed agricultural products, or non-agricultural containerized exports, such as metal and manufactured goods. We also did not look at domestic shipments.



The graph below shows the proportions of exported goods that comprise the 38,170 identifiable containers. Straw dominates the export containers, followed distantly by pulp, lumber and wood products, and seeds and grains.



In addition to exports, intermodal container imports arrive bound for distribution centers in the mid-Willamette Valley, as well as manufacturers and stores throughout the Valley. Actual volume of imports to the Willamette Valley is at least 9,000 containers per year, and potentially more.

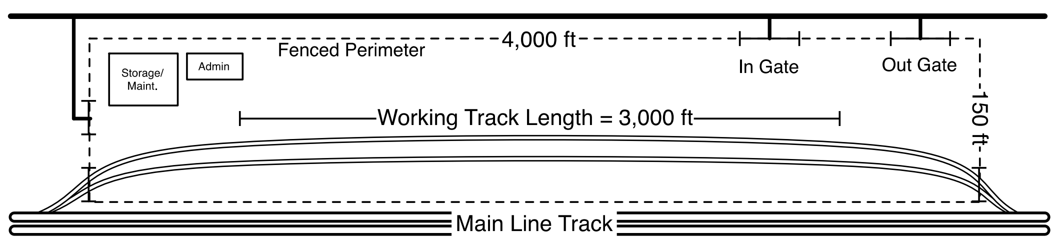
Actual demand for the ITF would depend on cost to use the ITF, the price and availability of alternatives, and non-price preferences of shippers. Our analysis revealed these conclusions:

- Looking at cost alone, the ITF is unlikely to be the least cost transportation option for many shippers. Trucking to Portland then railing containers to the Ports of Seattle and Tacoma through Northwest Container Service's (NWCS) facility costs approximately the same, at $1,200 round-trip. The ITF service would be similar, but potentially slightly more expensive than NWCS service, depending on local trucking costs and actual cost of providing new rail service. Trucking the entire distance is clearly more expensive at approximately $1,450. These are round-trip costs, including getting an empty container to the shipper and bringing the full container to the port.
- Non-price factors are important in shippers' decisions about how to ship their goods. For this reason, they don't always choose the cheapest transportation option. Timely service, flexibility to adjust schedules, and reliability in meeting ocean carrier shipping cutoffs were identified as key variables in choosing a shipping method. Many of these factors favor trucking over rail.

Demand for the ITF is likely to start small, and increase over time as service becomes established and predictable and shippers have time and opportunities to adjust their operations to utilize Willamette Valley ITF services. To assess feasibility of the ITF, the analysis considered a range of operating scenarios that vary primarily by the number of containers handled each year. The lowest volume is around 5,000 containers per year; the highest volume is 76,340. The latter volume is the number of export containers we were able to identify plus the same number of imports or empties southbound. Because it is unlikely the ITF would capture the entire market, it implies the service of domestic shipments as well. We included it in the range to show the effect on feasibility of higher operating volumes for the ITF.

Feasibility of the ITF

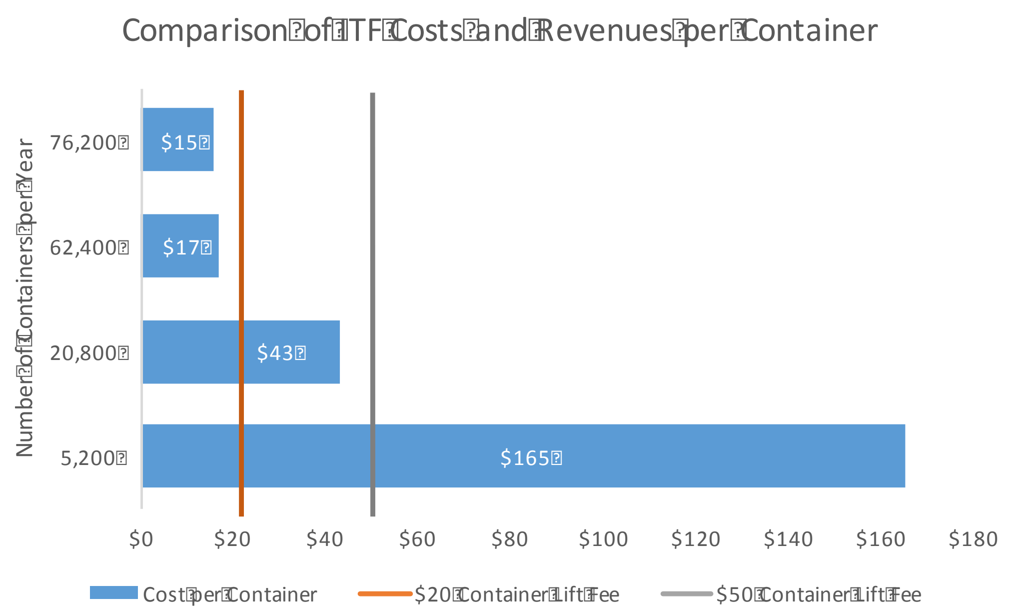
To accommodate this range of potential volumes of container traffic, the ITF would require approximately 14 acres of land, located on a railroad main line, close to major highways. The facility would be paved, and streets to the ITF would need to be capable of handling frequent and heavy weight truck traffic. The figure below shows the basic features of the site. In addition to the site and site improvements, the ITF would require lift equipment, and staff to manage the facility and operate the equipment.



The capital cost of the ITF, not including land, would be approximately $7 million. The cost of land would depend on where the site is ultimately located. Operating costs would range from approximately $230,000 to $510,000 per year, depending on the number of containers served.

The ITF would generate revenue by charging each shipper a fee to lift containers off of trucks and onto rail cars (for exports) or off rail cars and onto trucks (for imports or empty containers arriving for exporters to fill). The per-container lift charge would depend on what shippers would be willing to pay, based on the cost and characteristics of other shipping options. Typical fees charged by similar facilities range from $20 to $50 per container. More shippers would be willing to use the ITF at lower lift fee rates, and fewer shippers would use the ITF at higher rates. The likely range of revenue the ITF could generate each year, based on a range of volume scenarios, is between $260,000 and $1.5 million. The upper end of this range is based on an assumed volume that includes some domestic container shipments, but illustrates the effect of higher operating volumes.

The figure below shows the per-container costs at different volumes of containers handled, compared to charges of $20 and $50 per container. The comparison indicates that the ITF may be feasible without public investment if the ITF can capture sufficient container volume. At a $50 lift charge, the ITF would have to handle over 17,000 containers per year (1,500 containers per month) to break even. At a $20 lift charge, that volume would increase to over 43,000 containers per year (3,500 containers per month). The per-container costs shown include fixed operating costs, variable operating costs, and amortized capital costs.



It is unlikely that sufficient volume would materialize immediately to allow the ITF to be self-supporting: at a minimum, shippers would need time to test the facility and adjust their operations before committing long-term. Given the small margin in cost between other transportation options available to most shippers, and importance of non-cost factors, it is possible that many shippers would not choose the ITF at all, or wait until its benefits were proven first by other shippers, which may further delay sufficient operating volumes and revenues for the ITF to operate profitably.

Container volume is critical to the financial independence of the ITF, and achieving sufficient container volumes would at a minimum take time. It is possible they may not materialize, if other shipping options continue to offer lower costs or other advantages important to shippers. Improving the feasibility of the ITF would involve strategies to increase container volume by lowering costs, and reducing time to Port and increasing reliability (frequent rail service is critical to accomplishing this).

Public Investment and Public Benefits

Public investment would be required to support the ITF, especially in its start-up phase. There are several strategies public agencies may consider to support the development of the ITF. Some involve financial support, such as:

- **Providing land**. This would reduce the capital costs by removing the carrying cost of the land.
- **Guaranteeing bonds**. This would reduce the capital costs by lowering financing costs.
- **Subsidizing capital costs**. This would directly lower the capital costs by providing grants to build the facility or purchase capital equipment.
- **Subsidizing operating costs in early years.** This would directly lower operating costs

Other strategies may involve providing political support:

- **Coordinating with the Railroads:** This may be essential in garnering the cooperation necessary to make the ITF a reality. If the Class I railroads are not interested in the business generated by the ITF, the ITF is not possible. Assuming there is interest, support may also involve negotiating solutions to remove the paper barriers that currently narrow the options for the flow of rail traffic, and providing leadership for evaluating solutions for potential infrastructure upgrades that may be required on certain routes.
- **Coordination with the Ocean Carriers:** Public officials may be able to play a role in discussing service options for the ITF with ocean carriers. Securing the support of ocean carriers for servicing the ITF may reduce some of the uncertainty shippers perceive in committing to the ITF, particularly surrounding issues of cost and equipment availability.
- **Coordination with Large Importers:** If importers shift their current shipping practices to utilize the ITF, there is greater potential for exporters to be able to access containers already positioned in the Valley, reducing their total shipping costs. Public officials may be able to facilitate discussions with businesses that increase overall imports into the Valley by intermodal container, as well as facilitating ways to coordinate equipment needs (container and chassis) between importers and exporters.

Intermodal container transportation produces public benefits, which are often used to justify public investment in intermodal infrastructure. The transportation industry has adopted intermodal containers, in part, because they are able to take advantage of efficiencies associated with each form of transportation. These efficiencies produce private cost benefits, as well as benefits that accrue to the public, including reduced pollution, congestion, and highway wear and tear.

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MARKET AND DEMAND ANALYSIS

Introduction

This is the first of two memoranda that report the results of an economic feasibility analysis of a Willamette Valley Intermodal Transfer Facility (ITF).[1] This facility has been the subject of public discussion and study for over 15 years, as exporters from the Willamette Valley explore strategies to reduce transportation costs and become more competitive in global markets. Even before the Port of Portland's Terminal 6 container operations shut down in 2015, the prospect of an intermodal terminal in the Valley was seen as a possible complementary element of a broader intermodal support system in Oregon. Others have studied the potential container volume and facility operations costs before, however none of these study efforts are publically available.[2] This study assembles existing information and new information, collected through interviews and assessment of new data sets, together to describe as completely as possible the factors relevant to the economic feasibility of the ITF.

This memorandum addresses Tasks 1 through 3 of the scope of work: the size of the potential market for services at an intermodal facility located in the Willamette Valley, if such a facility were to be built, and factors affecting demand for such a facility. A separate memorandum addresses Tasks 4 through 10 of the scope of work: the feasibility of operating such a facility, including revenues, operating costs, capital needs, and public investment.

Background

Intermodal shipping has opened opportunities for Oregon exporters to access global markets quicker and at lower cost than previous shipping options. Access to these markets and shipping costs are influenced not only by local and regional infrastructure, but also global forces and trends. Exports produced or grown in the Willamette Valley, southern Oregon, and the Oregon coast bound for export to international markets rely primarily on shipping intermodal containers through ports to the north.[3] Historically, this has involved trucking containers to

[1] This study previously has used the term "Intermodal Transload Facility," referring to a facility where intermodal containers are loaded from truck to train and vice-versa. In response to interviewee suggestions, we have changed the name to "Intermodal Transfer Facility", because for many in the industry, transloading means repacking goods from one type of container or truck to another. Because the facility concept examined in this study would not include or involve this service, we recommend the term "transloading" not be used in relation to this study.

[2] We gained knowledge of these studies through our interviews and gleaned useful information from those who have thought about this before, but none of the interviewees were willing to share completed studies or findings.

[3] Some shippers, especially those in southern Oregon, may at times export through ports in California.

and from the Port of Portland and the Ports of Seattle and Tacoma, where they are loaded onto ships. Rail service, provided by Northwest Container Services (NWCS) in Portland, is also an option for transporting containers between Portland and the Ports of Seattle and Tacoma.

Container service through the Port of Portland ceased operation in 2015. Prior to that, shippers chose which port to ship containers from depending on a variety of factors related to and set by the ocean carriers, including container cost and availability, export destination, and shipping schedules. With the closure of Terminal 6 at the Port of Portland, almost all export containers originating in the Willamette Valley and points south and west are now transported to the Ports of Seattle and Tacoma in Washington by either truck for the entire distance or truck to Portland and rail via NWCS from Portland.[4]

Intermodal shipping is a complex global logistical system. Many players are involved, and the system is constantly evolving in response to global forces and industry actions. By definition, intermodal containers may travel by ship, truck, and/or rail, on their journey between origin and destination. Almost two dozen international ocean carriers transport containers from ports in the Pacific Northwest to ports in Asia, Europe, Central and South America, and Oceania. Various intermediaries and agents may be involved in making the often-intricate arrangements to ensure a container bound for export leaves and returns to port before the ocean vessel it is booked on sets sail. One such intermediary, NWCS, coordinates with Union Pacific Railroad to provide intermodal rail service between Portland and the Ports of Seattle and Tacoma, and physically handles containers at its intermodal facilities in North Portland and in Boardman. Other intermediaries may include independent freight forwarders and booking agents who coordinate the entire intermodal journey, securing the right container at the right price at the right time, and scheduling all needed transportation links on its journey. Trucking companies are another important player, involved in the movement of all intermodal containers at some point along the way.

Almost all containers used for export from Oregon are owned by the ocean carriers. Once a shipper has made arrangements to use a particular ocean carrier, containers from that carrier must be brought to the shipper, filled, and delivered to the appropriate port before the ship sails. Empty containers are made available to shippers ("released") at either the Ports of Seattle and Tacoma or at NWCS in Portland. The ocean carriers cover the cost of transporting the empty container to the point of release, and the shipper is responsible for transportation costs after the container's release. Container availability at either Ports of Seattle and Tacoma or NWCS is managed by each ocean carrier. Ocean carriers are

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[4] A small number of containers may ship out of ports in California, and at least one shipper has shifted some intermodal shipments to break-bulk out of the Port of Vancouver, Washington.

motivated to keep containers moving and generating revenue, so they tend not to position containers far from their ports of operation for long periods of time, resulting in wider availability of containers at the Ports of Seattle and Tacoma than at NWCS. However, intermediaries that are involved in both imports and exports can use that involvement to help optimize the flow of containers and facilitate positioning for export. For example, if they know that exporters will need a large number of refrigerated containers in a couple of months, they can arrange for importers of dry goods to the U.S. to ship some of those dry goods in refrigerated containers (but not turn the refrigeration units on).

Methodology

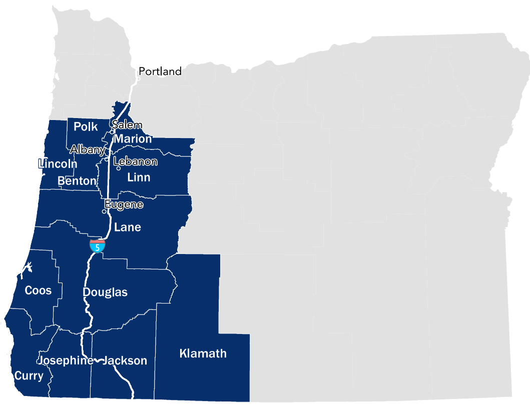
To assess the size of the market and potential demand for the ITF, we used two research techniques: analysis of data sets that indicate the number of container exports from Oregon, and key-informant interviews. We considered two sources of data to quantify container exports: The Port Import/Export Reporting Service, which gathers information on bills of lading for all waterborne cargo vessels that enter and leave U.S. ports; and U.S. Department of Agriculture-issued Phytosanitary Certificates, which provide export certification for plants, plant products, and processed plant products bound for foreign markets.[5]

To verify the analysis of import/export data records, and to understand factors influencing demand for the ITF, we interviewed representatives across all aspects of intermodal shipping in the Pacific Northwest: producers, shippers, freight forwarders, and representatives of the Oregon Department of Agriculture, Oregon Department of Transportation, the Port of Portland, the railroads, and NWCS.[6] We sought to interview shippers of each commodity with significant container shipping activity. We successfully completed interviews with one or more people associated with shipping straw and forage, grass seed, processed refrigerated foods, paper pulp, and Christmas trees in the study area.

[5] Phytosanitary certificates are issued by the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (or a state or county agency on behalf of the USDA) for exports containing plants (e.g., living plants, tissue, and propagation materials), plant products (e.g., grain), and processed plant products (e.g., lumber, veneer). While certificates are not required for export from the U.S., most importing countries require them upon import.

[6] A complete list of interviews is included in Appendix A.

Figure 1. Study Area



We defined the study area for the purposes of the market analysis as the Willamette Valley from Marion County south,[7] the coast, from Lincoln County south, and southwestern Oregon, including Klamath County to the east (see **Figure 1**). We expect that shippers in all other areas in Oregon would continue to use existing container terminals in Portland or Boardman, as there would not be an economic incentive to divert shipments to the Willamette Valley. The actual location of an intermodal facility, if built, would further determine the geographic market it would serve. For example, if the facility were located in the southern part of the Willamette Valley, many shippers in the northern part of the Valley would be unlikely to use it.

The data analysis, reported later in this Memorandum, yielded a number of containers to approximate the size of the market for the ITF. The key-informant interviews yielded valuable perspectives and insights on how shippers currently navigate container shipping, and under what circumstances they would potentially utilize a future Willamette Valley intermodal facility. We report the observations from the interviews below in several categories corresponding to different parts of our market analysis.

Costs to shippers of currently-available alternatives

There are two commonly-available options for shippers in the Willamette Valley to transport their products to ports for export to foreign markets by container:

1. Truck to Port: Pick up empty container(s) at the Ports of Seattle and Tacoma, truck to load point, and truck full container(s) back to the Ports of Seattle and Tacoma.
2. Rail to Port: Pick up empty container(s) in Portland at NWCS, truck to load point, truck full container(s) back to NWCS, and then rail to the Ports of Seattle and Tacoma.

We heard several variations on these alternatives, which seemed to be less commonly used:

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[7] The northern-most portion of Marion County is included on the map, but we excluded exports originating north of Salem based on feedback from interviewees and our assessment of transportation costs.

- Load a single 53-foot trailer, truck to the Ports of Seattle and Tacoma, and transload to two containers that meet the ocean carriers' specifications. Weight was the biggest factor that influenced shippers to use this method.
- Some shippers picked up empty containers in Portland at NWCS, trucked to load point, and then trucked to the Ports of Seattle and Tacoma instead of using rail from Portland. This often occurred when there was limited time to meet an ocean carrier's cutoff.

Shippers were unable or reluctant to discuss their specific costs of shipping by container with us. Across all interviewees the consistent conclusion regarding shipping costs was that they vary and are subject to change frequently, depending on a wide range of factors. Prices are not transparent. Ocean carriers, rail lines, trucking companies, and shipping agents all may assess charges that factor into the ultimate cost of export shipping. Some exporters handle all aspects of export arrangements except the actual ocean trip (bookings, trucking—including owning their own trucks) and have opportunities to control certain costs (e.g., trucking), while other exporters rely on third party freight forwarders to arrange all aspects of shipment.

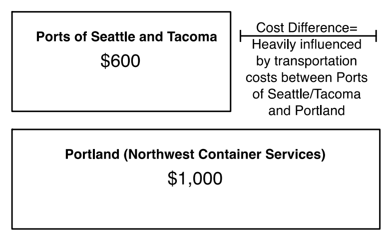
The challenge of gleaning cost information from interviewees is compounded by the fact that the conditions in the regional shipping market have swung dramatically over the last few years with the closure of Terminal 6 in Portland. Distinguishing long-run average prices under normal operating conditions from prices observed as the ocean carriers, trucking companies, and various intermediaries have been adjusting through crisis conditions to a "new normal" is not always possible. Moreover, many of our interviews occurred as Hanjin announced its bankruptcy, so new uncertainties and looming price changes were again at the forefront of many of our interviewee's minds.

Container Costs

Container prices are set by the ocean carriers and include the cost of shipping the container across the ocean, and the cost of transporting the container to the agreed upon "release" location, currently either the Ports of Seattle and Tacoma or NWCS. Additional trucking costs to and from the release location are not included in container prices charged by the ocean carriers, so are covered by the shipper directly. These trucking costs to shippers are discussed separately below.

- Interviewees were not willing to disclose their actual costs of shipping by container when asked, but did state that those prices are agreed to in negotiations for each shipment and may vary considerably between ocean carriers and between shipments on the same ocean carrier for the same destination.

- Ocean carriers set the price of containers based on a variety of factors. Interviewees identified these factors that influence their container costs:
    - Foreign port destination
    - Weight of shipment
    - Value of shipment
    - Type of container equipment needed
    - Opportunity cost of empty container
    - Shipping market conditions
    - Booking/Container release location
- Interviewees reported consistently that containers are cheaper when booked and released at the Ports of Seattle and Tacoma, and more expensive at NWCS in Portland. Some portion (perhaps most, but not necessarily all) of the cost difference is attributable to the transportation costs (ether by rail or truck) the ocean carrier covers to transport and release the container to the shipper at NWCS.
    - One interviewee suggested as a general rule of thumb, a container may cost $600 at the Ports of Seattle and Tacoma and $1,000 from NWCS in Portland. Another interviewee suggested that containers booked and released out of Portland are on average around $300 to $400 more expensive than those booked and released out of the Ports of Seattle and Tacoma.



    - Interviewees understood that the cost difference between the Ports of Seattle and Tacoma and NWCS is primarily attributable to the transportation cost to move the container between the ports, but stated that other factors may also influence this differential, pointing out that it can vary between bookings.
    - Several interviewees stated their contract rates are $600 for round-trip rail service per container using NWCS, or one-way rail cost of $300 per container. One interviewee provided information suggesting one-way rail service cost $450-$500 per container between Portland and Seattle.
    - There was general assumption by many interviewees that containers booked out of a Willamette Valley facility would be expected to cost more than one booked out of either the Ports of Seattle and Tacoma or NWCS, to cover the additional transportation costs. Some interviewees suggested ocean carriers would increase the prices by more than transportation costs

because of the higher opportunity cost of positioning empty containers further from the Ports of Seattle and Tacoma.

  - General Rate Increases recently announced by the ocean carriers are expected to increase rates above baseline costs by $100 at the Ports of Seattle and Tacoma and $300 at NWCS, further widening the current price differential. Interviewees suggested this was at least in part because ocean carriers prefer to keep equipment close to the Ports of Seattle and Tacoma so they can more quickly fill empties or return empties to Asia as revenue opportunities arise.[8]

- Ocean carriers change their prices regularly for the same shipment, depending on their own internal cost considerations and market factors. This requires shippers to frequently reassess ocean carrier booking options.
- Each movement or lift of a container may add to its cost: rail to rail; truck to rail; rail to truck each come with costs, in addition to per-mile charges of each link.
  - For this reason, some interviewees suggested that transport requiring multiple truck or rail connections between the Willamette Valley and the Ports of Seattle and Tacoma could be more expensive than trucking alone.
  - On pickup at the Ports of Seattle and Tacoma, containers may be ready on a chassis, or be stacked and require an extra lift to the chassis. If a lift is required, this may add an extra $100 to the shipping cost. One interviewee provided this as an example that costs aren't always predictable and retrieving a container by truck at the Ports of Seattle and Tacoma may contain this charge, or it may not.
  - One shipper explored moving containers by short line from the Valley, connecting with existing service by UP either in the Valley or in Portland. UP required the short line to rail southbound containers all the way to Portland, where they were then transferred onto UP equipment. These movements increased the

[8] This operational practice of pricing to discourage inland container moves is also discussed in the literature (though primarily for ports further inland and to smaller markets than Portland): "Many ocean carriers are discouraging inland container movements because of excessive dwell time in some inland markets. Cosco management has limited inland movements because demand in Asia is so strong, it wants to turn boxes quickly once they land in the United States so that they can be returned to Asia for their next load… Maersk has developed a policy to keep its boxes close to the ports that it serves, and now disallows shipments beyond roughly a 200-mile radius of the ports or inland terminals it supports. (Prime Focus LLC. 2008. *CONTAINER/TRAILER ON FLATCAR IN INTERMODAL SERVICE ON MONTANA'S RAILWAY MAINLINES*. State of Montana, Department of Transportation. November.)

cost beyond feasibility for this shipper, who was already trucking containers to UP in Portland. Although this example involved domestic exports already shipped by UP, it illustrates the potential complexity and cost implications of a short line to Class I railroad transfer.

- Missing an ocean carrier's cutoff can lead to very high additional costs. These arise from having to rebook the container and redo all paperwork, having to pay container storage until the next booking is available, and potentially from other fees charge by the ocean carrier for holding the container longer than originally negotiated.

Trucking Costs

- Shippers cover the trucking costs between where the container is released by the ocean carrier and where it is received again by the ocean carrier.
- Interviewees reported round-trip trucking costs between Portland and Seattle between $900 and $1,500. Factors that influence the cost include:
    - Whether the load meets extended-weight or heavy-haul weight limits (typically when container and cargo exceed 55,000 pounds), requiring a 3- or 4-axel chassis[9] (most agricultural export shipments require this equipment).
    - Whether an empty container requires a lift onto the chassis at the port, or is already positioned on the chassis.
    - What the fuel surcharge is.
    - Whether delays occur that require extra time or extra drivers to complete the trip and adhere to driver time limits to accommodate federal highway regulations.
- One interviewee reported average round-trip trucking cost between the mid-Valley and Portland at about $400.
- If the shipper can swap a full container for an empty being delivered, the round trip cost may be about the same as the one-way cost if the trucker would otherwise have to make an empty backhaul. If the truck must make separate trips to deliver an empty and pick up a full container, the total round-trip trucking cost will be more than the costs quoted above.
- Standard chassis (2-axel) used to be provided by ocean carriers at the port. Now ocean carriers lease or provide chassis through a third-party chassis pool, or require trucking companies to provide the chassis.

[9] This equipment is sometimes referred to as a "super chassis."

Standard chassis rental can add to the trucking cost. Rental fees are between $20 and $40/day.

- Agricultural and paper/pulp products can be heavy. A container loaded to the maximum weight limit (67,200 pounds gross weight of container and payload for a 40-foot high-cube container) exceeds highway weight limits on a standard (2-axel) truck chassis. These loads require a 3- or 4- axel chassis to make them highway-legal. This costs a shipper more. However, it is typically more cost-effective than breaking a load into multiple containers that meet 2-axel chassis weight restrictions.
    - 3- and 4-axel chassis are required for hauling empty containers destined to be loaded with heavy exports, because it is usually not possible to swap chassis at the load point.
    - These chassis are typically owned by the trucking companies, and they may charge between $150 and $275 for this equipment, in addition to the standard trucking price.

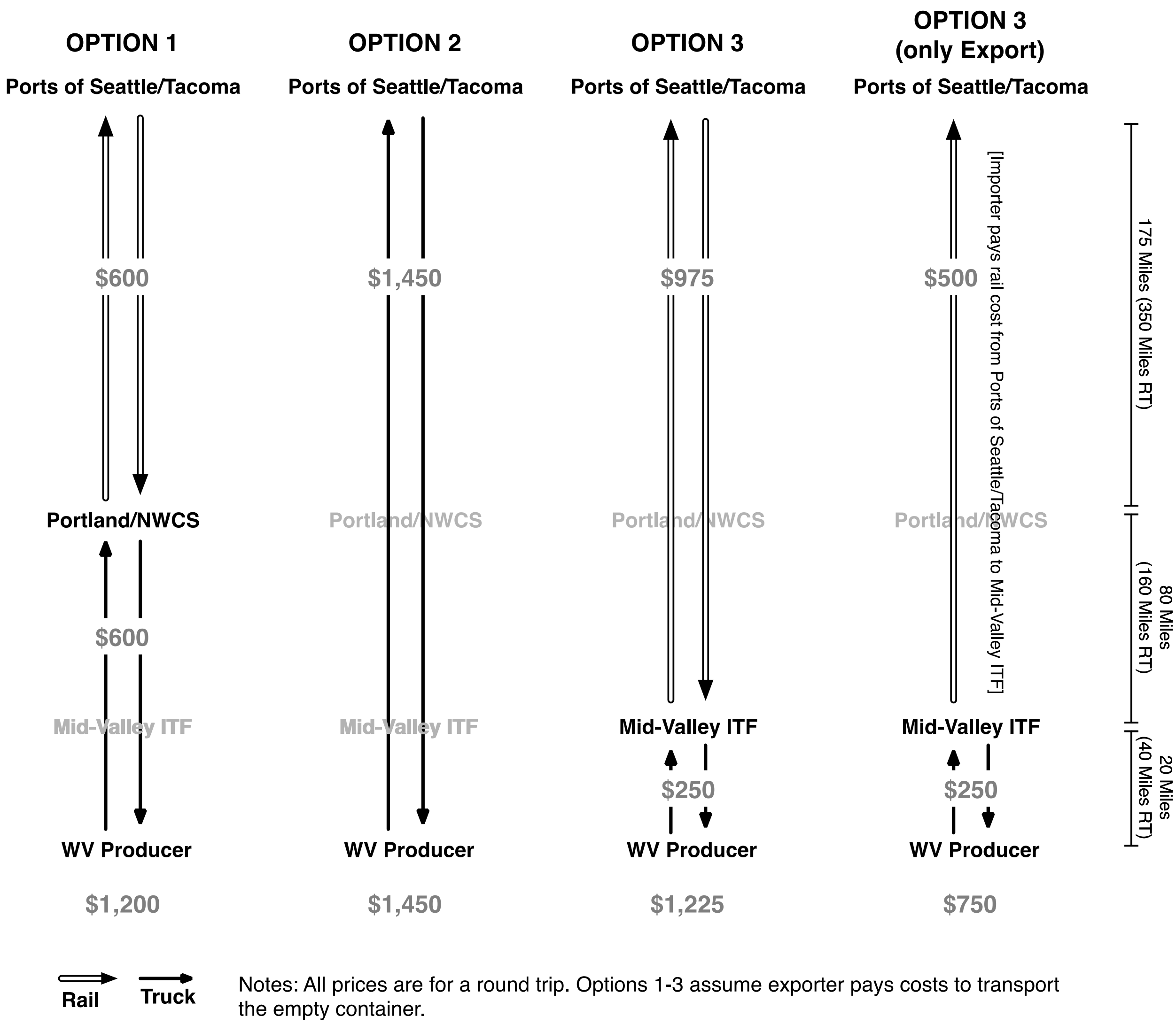
Summary and Comparison of Costs

Teasing out the transportation costs from the total costs of shipping intermodal containers is not any easy or straight-forward task. As we described above, portions of the transportation costs are usually embedded in the container cost an ocean carrier quotes a shipper. The shipper covers other portions of the transportation cost. To compare apples to apples, however, we have developed estimates of the local transportation cost alone (not including the cost of transporting the container across the ocean) for three transportation options shippers could select from, if an ITF were built in the Willamette Valley. Figure 1 illustrates the options, using a solid line for truck portions of the trip and a double line for rail portions of the trip. The three options are:

1. Option 1: Truck from Shipper to NWCS in Portland, Rail to the Ports of Seattle and Tacoma
2. Option 2: Truck from Shipper to the Ports of Seattle and Tacoma
3. Option 3: Truck from Shipper to ITF, Rail to the Ports of Seattle and Tacoma

To simplify the analysis, these options all assume the ITF is located somewhere in the mid-Willamette Valley, approximately 80 miles south of Portland, and the container is loaded at a location 20 miles away from the ITF. Trucking costs would likely increase from the amount shown if the shipper were more than 20 miles away from the ITF.

Figure 2. Estimated Costs for Three Intermodal Container Shipping Options



Notes: All prices are for a round trip. Options 1-3 assume exporter pays costs to transport the empty container.
For the purpose of this analysis only, we assume the distance between the Mid-Valley ITF and Portland is 80 miles, and the distance between the WV producer and the ITF is 20 miles.
Transportation costs would be higher for producers further away than 20 miles, for all options.
All costs are rounded.

The trucking costs associated with each option are based on estimates as reported by interviewees, assuming a round trip between the locations specified. They include all costs commonly associated with intermodal trucking, including a fuel surcharge, chassis rental, and an extra charge for extended-weight or heavy-haul weight cargo (requiring a 3- or 4-axel chassis). They do not include charges that may be incurred at the Ports of Seattle and Tacoma related to extra container lifts (chassis split charge). We cross-checked these estimates with estimates we generated from a sample of bills of lading that reported shipping charges between Portland and the Willamette Valley. We used the records to generate a formula to predict shipping charges based on the length of the trip. The two methods generated similar (though not exact) results for the longer trucking distances. They did not produce a reliable estimate for the local trucking trip between the shipper and the ITF. The cost we use for this short distance is consistent with what some interviewees reported, but depending on the relationships a shipper has with local trucking resources in the valley, could overestimate the actual cost of this leg.

We estimated rail costs based on interviews and discussions with NWCS staff and representatives of the railroads. Estimating the rail cost is challenging: many shippers have contracts with NWCS that have been in place for a long time, and may or may not reflect the current cost of service. The railroads were unable to provide detailed estimates for what service to the ITF may cost, because there are too many variables still unknown. To estimate the rail trip cost between the ITF and the Ports of Seattle and Tacoma, we calculated a per-mile cost between Portland and the Ports of Seattle and Tacoma based on the cost many interviewees reported paying for this service, increased it by 20 percent to account for cost increases related to new service agreements, and multiplied by the total distance between the ITF and the Ports of Seattle and Tacoma.

Option 1, trucking to Portland and using NWCS rail service costs the least at $1,200. Option 2, trucking the entire way, costs the most at $1,460. Option 3, trucking to the ITF and using rail to the Ports of Seattle and Tacoma, costs $1,275. Based on these cost assumptions, it is cheaper for a shipper to use the ITF than to truck containers to Seattle, by almost $200. However, the ITF would be more expensive than trucking containers to NWCS in Portland and railing them to the Ports of Seattle and Tacoma, by about $25.

We urge caution in drawing definitive and universal conclusions from this analysis, because actual costs, especially for trucking, are likely to vary by shipper, and will depend on the actual distance from the ITF. As stated above, they are also based on somewhat speculative costs associated with the rail link between the ITF and the Ports of Seattle and Tacoma, and may not adequately characterize the range of trucking costs in the Valley. Since both the rail link to the Valley and the local trucking costs apply to Option 3, the costs for that option are the most uncertain.

Options 1 through 3 all reflect round-trip costs: the shipper (exporter) pays the transportation costs to move an empty container from the Ports of Seattle and Tacoma to the Willamette Valley, and pays to haul the loaded container back to the Ports. This reflects what most export shippers currently do. If, however, an exporter is able to coordinate with an importer and use a container already located in the Willamette Valley, they do not have to pay one leg of the shipping costs. Option 3 (only Export) in Figure 1 illustrates the potential cost savings of this practice. An ITF would make it easier for exporters to use containers already positioned in the Valley from imports.

How the alternatives vary in non-price dimensions

Shippers discussed several factors other than price that influence their decision on how to coordinate container shipments. These factors are related to price, in that they likely influence shipping costs, albeit indirectly.

Reliability

Interviewees frequently identified reliability (the likelihood that a container will make it to the dock before the ocean carrier's cutoff) as one of the most important factors influencing their decision to use truck over rail:

- Although trucks handle just one container at a time, interviewees indicated that trucking allows faster turn-around times and more flexibility at the load side to meet ocean carrier schedules.
- If something goes wrong with trucking, backup service is readily available to get the container to the port in time. Drayage companies can typically send another driver or another tractor to pick up the trailer and still meet the schedule.
- Interviewees perceived trucking as more reliable than rail, even those who had no specific negative experience with rail service.
- Some interviewees had specific negative experience using rail, related to missing ocean carrier cutoffs.
- Some interviewees pointed out that the extra days must be built into the schedule to ensure rail reliability, compared to trucking, and those may compromise product quality. Some products (especially fresh products) are more sensitive to this than others.
- Some interviewees noted that reliability on rail was compromised immediately after the closure of Terminal 6, but has not been an issue more recently.
- Shippers may perceive rail as less reliable because they have less control over the shipping schedule, even if containers ultimately arrive when scheduled.
- One shipper also identified reliability as an issue if they had to wait for import containers to become available in Portland. They could not sit on inventory waiting for the right container to show up, so they chose to truck empty containers south from Seattle.

Time

Another common issue raised among interviewees was how the alternatives varied in the time required to reach their destination. If the time required doesn't vary much, reliability isn't the issue, but reliably slow transport may be unsatisfactory:

- All shippers identified timely shipments as a key factor in successful operations.
- Time was mentioned frequently related to trucking turn-around times, and regulations limiting driver hours. However, most shippers who trucked their own containers seemed to have this dialed in, and have workarounds in place when drivers would otherwise exceed their limits.
- Rail requires more lead time than trucking. For some shippers, scheduling this into the total transit time is not an option.
- Wait times for rail may affect the quality of product, especially during the summer. Sitting in a hot container for longer than expected can reduce seed germination rates for grass seed, for example. A few days' delay at the wrong time of the year may make a difference between a high quality product and a poor quality product being delivered to the customer.
- Interviewees identified time being a potential issue with a Willamette Valley ITF across several dimensions:
    - Train frequency (waiting for a scheduled train, potentially missing a train and waiting for the next, etc.)
    - Hours of operation: flexibility in delivery and pickup times is essential
    - Longer wait times for the right equipment to become available (see next factor, equipment availability)

Equipment Availability

- One of the main reason interviewees gave for choosing to truck from the Ports of Seattle and Tacoma was more certainty in equipment availability.
    - Shippers must match shipping container to carrier booked. If they book Maersk, they must find a Maersk container with the right specifications for their shipment.
    - Once a booking is made, ocean carriers don't necessarily guarantee availability of the right equipment at a specific date, time, and location. A shipper may go to pick up a scheduled empty, and might not find it for several reasons:
        - If equipment is in need for a higher-revenue generating shipment, the ocean carrier may divert it.
        - Scheduled equipment may not make it back to the yard when an ocean carrier thinks it will.

        - Rail delays may delay an empty's arrival.
    - Finding an appropriate container is all but guaranteed in a larger port like Seattle.
    - It is more difficult to manage equipment availability in the smaller pool of containers available at NWCS in Portland.
- Interviewees expressed concern that equipment availability could be a big problem at the potential ITF, and difficulty obtaining empties in the Willamette Valley would necessitate longer trips to Portland or Seattle/Tacoma anyway to pick up equipment.
- If the right equipment is not available, relying on rail to get it to the terminal may take too long, requiring rescheduling and extra fees.
- As shippers ship more volume (i.e., more containers), rail may reduce challenges associated with chassis and truck equipment availability for long hauls.

Weight Constraints

A final factor that was mentioned less frequently, but heard from several interviewees was weight constraints.

- Weight has relevance for the types of equipment required to move a container, including the chassis. An imported container often will arrive in the Valley on a standard (2-axel) chassis, but require a 3- or 4-axel chassis for the return trip to the port. If the same equipment is to be used for the trip to the port, this must be anticipated ahead of time. 3- and 4-axel chassis are not leased by ocean carriers, so an exporter may have to make special arrangements to swap the chassis, which requires an additional lift and added cost, or work with importers to pick up the extra cost of trucking imports south for the 3- or 4-axel chassis when it is not otherwise needed.
- Weight limits may constrain rail configurations and lead to greater uncertainty that a container will get bumped from a train. In general, rail accommodates heavier loads than trucks, so this is not typically a problem, but occasionally, balancing weight requirements across a train that is full of containers at maximum capacity may be problematic in some configurations.
- Heavier containers require adequate lift equipment.

The Size of the Market for Container Shipments from the Willamette Valley

Containerized Exports

Previous analyses of intermodal container exports from the Willamette Valley rely on Port Import-Export Reporting Service (PIERS) data to estimate the size of the market. The 2016 Tioga study found a total of 30,475 containers[10] attributed to the Middle Willamette and Southern Willamette areas bound for export through the Port of Portland or other ports in 2014.[11] PIERS data are notoriously challenging to use in identifying actual origination location of exports, although the Tioga study's authors made adjustments to account for some of this bias, and describe the resulting estimate as "*estimates of identifiable container flows*, rather than precise figures" of exports from a particular region.

Because the majority of exports leaving the Willamette Valley are products of the agricultural or timber industries, we were able to use a different data set to quantify container exports. The U.S. Department of Agriculture (or a designated state agency or county department) issues phytosanitary certificates for shipments of plants, plant products, and processed plant products bound for international export. While a phytosanitary certificate is not required for export, most countries require one for import, and it must be issued prior to departure. The certificate verifies to the importing country that the products have been inspected and are free from pests, pathogens, and invasive weeds. Each certificate lists the city of the applicant (usually the grower), the destination city and country, the U.S. port of export, the mode of transport, the species and common name, the quantity, the units, and the packaging.

We obtained de-identified copies of all phytosanitary certificates issued in Oregon in 2014, 2015, and 2016 to date.[12] We separated out the records where the mode of transport was ocean vessel and then separated those into one group where the packaging specifically included the word "container" and another where it didn't. We then sorted each group by commodity and used records where both the number of containers and other units (e.g., pounds, metric tons, cubic meters, thousand board feet, etc.) were specified on the certificate to develop units per container for each commodity. We then used those estimates of units per container to estimate the number of containers for records where that

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[10] Intermodal containers are often quantified in terms of "twenty-foot equivalent units" (TEUs), where one 40-foot container represents 2 TEUs. To simplify the presentation of our analysis, we focus on the relevant unit for the ITF, which is the container (whether it's a 40-foot high-cube or a 20-foot container). Therefore, we report all quantities in terms of containers, and have taken care to ensure that all numbers we report are confirmed as individual containers, rather than TEUs.

[11] The Tioga Group, Inc. 2016. *Trade and Logistics Report: Research Analysis.* February.

[12] Our analysis reported here includes only the 2015 records.

number wasn't specified and to estimate the numbers of potential containers by commodity for the records where the word "container" didn't appear. In some cases, especially for nursery stock and Christmas trees, multiple certificates applied to different species within the same container. These were grouped together based on the date, origin, and number of units.

We eliminated some records because they represented too small a quantity to be shipped by container (e.g., 5 kg of specialty seed) or a large enough quantity on one day to indicate a shipload of bulk commodity. We also eliminated some commodities as unlikely to be shipped in containers, such as telephone poles and debarked logs.

The resulting market analysis shows that a small number of agricultural commodities account for the vast majority of the containerized exports from the areas that might be served by an intermodal facility in the Willamette Valley.

Straw

The vast majority of export containers from the Willamette Valley are filled with straw. Straw is a byproduct of producing grass seeds, wheat, barley, or oats. It consists of the dried stems and leaves of the grass plants that are left over after cutting and threshing to remove the seeds. It is what comes out the back of a combine. Straw is different from hay in that hay is a nutritious animal feed and is worth around eight times as much per ton (e.g., $200 for hay v. $25 for straw).

Historically, Willamette Valley grass seed farmers burned the straw on their fields, both to dispose of the straw and to kill diseases and weed seeds in the soil. Restrictions on open field burning led farmers to remove the straw from their fields and find other uses for it. Markets were developed in Asia (particularly Japan and Korea, where straw is ground and used as fiber in livestock feed rations). Because containerized imports from Asia exceeded containerized exports, ocean carriers offered straw exporters reduced rates for containers that would otherwise go back empty.

Straw is baled in the field and bales may range in size from 60 pounds to over 1,000 pounds, depending on the equipment used. A single 40-foot high-cube container can hold 800 of the smaller half-bales, 400 120-pound full bales, or 50 990-pound double-compressed bales.

We estimate that around 25,000 40-foot containers of straw are shipped from the Willamette Valley to the Ports of Seattle and Tacoma ports each year. While straw is produced only in the summer, it is shipped throughout the year without much seasonal variation. Straw is not perishable, and while containers need to reach the port before their ship sails, it is not otherwise a problem for them to travel slowly on their way. It therefore could be a good candidate for intermodal shipping.

There is not a large domestic market for containerized straw bales.

Hay

Approximately 3,600 40-foot high-cube containers of hay are shipped from Oregon each year. Over half of those—2,250—are grown in Eastern Oregon or Eastern Washington. The remaining 1,350 containers are from Klamath County or the Willamette Valley and could use an intermodal facility in the Willamette Valley.

Pulp

The Cascade Pacific pulp mill in Halsey has developed significant export markets for its high-grade pulp products, including White Gold™ and Oregon Gold™. When Terminal 6 was operating, they shipped approximately 400 40-foot high-cube containers per month through Terminal 6. They now ship approximately 150 40-foot high-cube containers per month through the Ports of Seattle and Tacoma and the rest as break bulk through Vancouver, WA. With a conveniently-located and cost-effective intermodal facility, they would ship at least 1,800 and up to 4,800 containers per year through the intermodal facility.

Lumber

Almost all of the lumber and plywood exported from Oregon is shipped in containers. Exporters ship approximately 5,000 40-foot containers per year. Except for approximately 500 containers of hybrid poplar lumber, much if which is milled near Boardman, almost all originates at mills in the Willamette Valley, Coast Range, or Cascades. Hardwood lumber, primarily alder, accounts for a much larger share of exports than of production. An intermodal facility in the Willamette Valley could serve all but the northern-most of these mills, or at least 3,000 containers per year. In addition, an intermodal facility could serve a significant but unquantified number of containerized lumber shipments to domestic markets.

Potatoes

Approximately 1,200 40-foot refrigerated containers of potatoes are exported from Klamath County each year. Most potatoes are shipped in tote bags that hold approximately 2,500 pounds of potatoes, with 20 bags per container. Others are shipped in 50-pound cartons or loaded in bulk into containers. All of these containers could make use of an intermodal facility in the Willamette Valley as it would reduce the distance the potatoes needed to be trucked by more than half.

Seeds and Grains

Approximately 225 containers per year of grass seeds were identified in phytosanitary certificates as being exported in containers. Approximately 2,675 additional 40-foot containers per year worth of grass, clover, and alfalfa seed are exported, almost certainly in containers. The Willamette Valley also produces a wide variety of specialty seeds, but those tend to be exported in smaller quantities than containers. We estimate that 2,500 containers of seed could make use of an intermodal facility in the Willamette Valley.

Over 3.5 million containers worth of grain, meal, and soybeans are exported from Oregon each year, though 99.8% of that is not in containers and most of the containers are not from the Willamette Valley or Southern Oregon. Corn and soybeans are shipped by rail from the Midwest, obtain phytosanitary certificates in Portland, and are loaded in bulk into ships in Portland and in Vancouver and Kalama, Washington. We did identify 300 containers per year worth of grain being shipped from the southern Willamette Valley, which could make use of an intermodal facility in the Willamette Valley.

Christmas Trees, Garlands, Wreaths, and Greens

Approximately 500 containers of Christmas trees, wreaths, and garlands are exported from Oregon in refrigerated containers each year, including "exports" to Hawaii. Few of these are likely to make use of an intermodal facility in the Willamette Valley. Shipments occur only during the holiday season and are on very tight timelines and many of the trees are cut north of where the facility might be located.

Nursery Stock

Oregon produces a wide variety of nursery stock, including landscaping shrubs, shade trees, fruit trees, and blueberry bushes. Many of these are grown to the north of where the intermodal facility might be located and while over 500,000 plants are shipped in a year, a container might hold well over 1,000 plants, so it is unlikely that a large number of nursery plant containers would make use of an intermodal facility in the Willamette valley. We did identify phytosanitary certificates for 20 40-foot containers' worth of blueberry plants shipped from the southern Willamette Valley.

Other Commodities

Other commodities, including manufactured food products, wood products, and metal products are exported from the Willamette Valley and Southern Oregon, though none of these use large numbers of containers. For example, we talked to a manufacturer of frozen foods in Eugene who ships 20 refrigerated containers per year to Asia.

Summary of Export Containers

We identified 38,170 containers being shipped to the Ports of Seattle and Tacoma out of the study area each year. The study area includes the Willamette Valley south of Salem, Southwestern Oregon, and Klamath County. This tabulation does not include small numbers of containers with other commodities.

Containerized Imports

Several distribution centers in the Willamette Valley likely account for the majority of imported containers. Lowes, Target, and Bi-Mart operate distribution centers in the Valley. Other companies import containerized goods in smaller quantities, for example smaller nurseries and garden centers, tire companies, manufacturing facilities, and grocery stores. The Tioga Group used PIERS data to estimate the number of imported containers by market area in Oregon and found almost 9,000 total containers bound for the middle Willamette and Southern Oregon areas in 2014. This is consistent with what interviewees told us: that the number of containers imported to the Willamette Valley is dwarfed by the number exported from the Valley each year.

Containerized Domestic Shipments

In addition to these 38,170 containers of export commodities from the study area, an unknown, but potentially large number of containers destined for points within the U.S. could potentially be served by an intermodal facility in the Willamette Valley. Assessing the size of this market is outside the scope of this study.

Factors Influencing the Potential Size of the Market

The size of the market the Willamette Valley ITF could capture depends largely on the specific transportation costs faced by each shipper. Each shipper faces a different set of costs, specific to their location, relationships and contracts with trucking companies, and other costs of production. Each shipper has different sensitivities to non-price factors as well.

We were unable to analyze the geographic distribution of exports from the Willamette Valley beyond the discussion included for each commodity above. Although the phytosanitary certificates identify originating location better than other sources of data, such as Port Import/Export Reporting Service (PIERS), the general location listed for many of the records was clearly not where the container would have originated. Thus, we have adjusted the size of the market based on geographic location as well as we can, based on data available at this time.

COST AND REVENUE ANALYSIS

Introduction

This is the second of two memoranda that report the results of an economic feasibility analysis of a Willamette Valley Intermodal Transfer Facility (ITF).[13] This facility has been the subject of public discussion and study for over 15 years, as exporters from the Willamette Valley explore strategies to reduce transportation costs and become more competitive in global markets. Even before the Port of Portland's Terminal 6 container operations shut down in 2015, the prospect of an intermodal terminal in the Valley was seen as a possible complementary element of a broader intermodal support system in Oregon. Others have studied the potential container volume and facility operations costs before, however none of these study efforts are publically available.[14] This study assembles existing information and new information, collected through interviews and assessment of new data sets, together to describe as completely as possible the factors relevant to the economic feasibility of the ITF.

This memorandum addresses Tasks 4 through 10 of the scope of work: the feasibility of operating such a facility, including revenues, operating costs, and capital needs. It also discusses the public investment that may be required, and the public benefits an ITF may generate. This memorandum builds on the information presented in the previous memorandum, which addressed Tasks 1 through 3 of the scope of work: the size of the potential market for services at an intermodal facility located in the Willamette Valley, if such a facility were to be built, and factors affecting demand for such a facility.

Summary of Market and Demand Analysis

Memorandum 1, which presented the results of Tasks 1 through 3 of this study, described the size of the market of intermodal container exports from the Willamette Valley. Based on an analysis of Phytosanitary Certificates issued in Oregon in 2015, as well as interviews with exporters, we identified the equivalent of 38,170 40-foot containers (mostly high-cube)[15] of goods exported from the mid-

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[13] This study previously has used the term "Intermodal Transload Facility," referring to a facility where intermodal containers are loaded from truck to train and vice-versa. In response to interviewee suggestions, we have changed the name to "Intermodal Transfer Facility", because for many in the industry, transloading means repacking goods from one type of container or truck to another. Because the facility will not include or involve this service, we recommend the term "transloading" not be used in relation to this facility.

[14] We gained knowledge of these studies through our interviews and gleaned useful information from those who have thought about this before, but none of the interviewees were willing to share completed studies or findings.

[15] Intermodal containers are often quantified in terms of "twenty-foot equivalent units" (TEUs), where one 40-foot container represents 2 TEUs. To simplify the presentation of our analysis, we

and southern Willamette Valley, Southern Oregon, and the Oregon Coast, via the Ports of Seattle and Tacoma per year. The actual size of the market is likely greater than this, because we did not have data to estimate the number of container exports of processed agricultural products, or non-agricultural containerized exports, such as metal and manufactured goods. Intermodal container imports arrive bound for distribution centers in the mid-Willamette Valley, as well as manufacturers and stores throughout the Valley. Actual volume of imports to the Willamette Valley is at least 9,000 containers per year, and potentially more.

Actual demand for the ITF would depend on the facility price, price for rail services, price and availability of alternatives, and non-price preferences of shippers. We describe each of these factors and how it might influence demand in Memorandum 1. Demand for the ITF is likely to start small, and increase over time as service becomes established and predictable and shippers have time and opportunities to adjust their operations to utilize Willamette Valley ITF services.

Methodology

All data presented in this memorandum were collected through the interviews conducted and reported on in Memorandum 1, from information presented in feasibility studies of other intermodal facilities, and prices and equipment specifications reported on industry and manufacturer websites. We worked closely with staff from Northwest Container Services (NWCS) to describe potential ITF operations, based on existing operations at intermodal facilities in Portland and Boardman, Oregon. To estimate facility construction costs, we relied heavily on summaries of bid estimates prepared for the Boardman facility in 2010. We adjusted these estimates for facility size and inflation. Throughout, we relied on other feasibility studies, peer-reviewed literature, and government reports to confirm and verify data from our interview sources.

Potential Operating Scenarios, Volumes, and Capacities

ITF Rail Options

There are several possible operating scenarios whereby rail carriers could transport containers from the Valley to the Ports of Seattle and Tacoma. We have had preliminary discussions with Union Pacific Railroad, Portland & Western Railroad, and NWCS to understand the logistical requirements and challenges. There are two Class I carriers that could be involved (Union Pacific [UP] and

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focus on the relevant unit for the ITF, which is the container (whether it's a 40-foot high-cube or a 20-foot container). Therefore, we report all quantities in terms of containers, and have taken care to ensure that all numbers we report are confirmed as individual containers, rather than TEUs.

Burlington Northern Santa Fe [BNSF]), and two short-line carriers that already serve the Willamette Valley (Albany and Eastern [A&E] and Portland and Western [P&W]). UP operates mainline service through the Valley, but does not currently offer intermodal service to shippers located in the Valley. UP operates an intermodal terminal in Portland, and currently hauls intermodal containers from the NWCS facility in Portland to the Ports of Seattle and Tacoma. BNSF's freight yards are located in Northwest Portland and Vancouver, Washington. BNSF does not operate trains through the Valley. Instead, P&W operates on leased BNSF right-of-way south of Salem, where the ITF would likely be located, and has the capability to deliver freight to the BNSF yards. P&W also can interchange with UP at several points in the Valley and in Portland. However, P&W currently operates under a "paper barrier" that prevents them from transferring cars from BNSF right of way to UP. P&W does not currently operate intermodal service anywhere in its service area. The other short-line carrier in the Valley is the A&E, which operates on the east side of I-5, and has the capability of interchanging with both BNSF and UP via P&W, and regularly coordinates with P&W on interchanges.

Thus, providing rail service to an ITF is logistically possible via several arrangements. If the Class I carriers are not interested in providing service at the ITF itself, P&W could provide the short-haul service to Portland or Vancouver, perhaps in cooperation with A&E. Under this arrangement, the short-line railroad could deliver trains from the ITF to existing yards in Portland or Vancouver, where intermodal containers from the ITF could either be comingled with existing intermodal traffic bound for the Ports of Seattle and Tacoma, or hauled as assembled directly to the Ports of Seattle and Tacoma. Cooperation with one or both of the Class I carriers is essential to the success of the project, because they would be required to haul trains from Portland to the Ports of Seattle and Tacoma. Each rail scenario would have a different set of costs and logistical challenges to address. Our cursory conversations indicate both UP and P&W have a willingness to explore the options.[16]

ITF Operating Scenarios

Based on the market characterization reported in Memorandum 1 and summarized above, as well as the potential feasibility of using either a short-line or a Class I rail carrier to transport containers out of the Valley, we identified four operating scenarios. The scenarios vary by volume of containers, including the number of containers per train and number of trains per week. The range of volumes reflects the facility's potential capability to scale up over time. Scenario 1, using the short-line carrier, would be able to start comparatively smaller than Scenario 3, using the Class I Carrier, because the Class I Carrier indicated a full double-stack unit train (200 containers or more) was likely the minimum they

[16] We did not successfully connect with BNSF representatives.

would be willing to consider hauling from the ITF. Alternative 4 represents the likely upper-end of facility operating volumes, based on the market assessment.

1. **Scenario 1: Short-Line Rail 3-Day/Week Service**. Under this scenarios, a short-line rail carrier would haul 50 containers northbound per week distributed across three train runs (approximately 17 containers per haul). From the Portland-Vancouver area, these containers would be hauled by a Class I carrier to the Ports of Seattle and Tacoma. Assumes an equal number of imports or empty containers would run south each trip. This equates to 2,600 container exports and the same number of container imports or empty containers per year, for a total of 5,200 containers handled through the ITF per year.
2. **Scenario 2: Short-Line Rail 5-Day/Week Service.** Under this scenario, a short-line rail carrier would haul 600 containers northbound per week distributed across five train runs (approximately 120 containers per haul). From the Portland-Vancouver area, these trains would be hauled by a Class I carrier to the Ports of Seattle and Tacoma. It assumes an equal number of imports or empty containers would run south each trip. This equates to 31,200 container exports and the same number of container imports or empty containers per year, for a total of 62,400 containers handled through the ITF per year.[17]
3. **Scenario 3: Class I Rail 1-Day/Week Service.** Under this scenario, Union Pacific Railroad would haul 200 containers northbound from the ITF each week on one 200-container (double stack) train, and an equal number of imports or empty containers south per week. This is the minimum frequency needed to feasibly accommodate shippers, and the minimum size train Union Pacific would operate. This equates to 10,400 container exports and the same number of container imports or empty containers per year, for a total of 20,800 containers handled through the ITF per year.
4. **Scenario 4: Class I Rail 3-Day+/Week Service.** Under this scenario, Union Pacific Railroad would haul approximately 733 containers northbound from the ITF each week on three or more 200-container (double stack) trains, and an equal number of imports or empty containers south per week. This is the number of containers identified in the market analysis, spread over three trains meeting Union Pacific's minimum train size per week. The service could operate either 3 trains per week with approximately 245 containers per train, or 4 trains per week with approximately 183 containers per train, however in the below analysis, we assume 3 trains per week. This equates to 38,170 container

[17] The high end of this range exceeds the number of container exports we accounted for in the market analysis reported in Memorandum 1. This number of containers is not out of the question if domestic exports are included in the market.

exports and the same number of container imports or empty containers per year, for a total of 76,340 containers handled through the ITF per year.

Table 1. Scenario Descriptions and Associated Volumes

	Description	Trains/ Week	Containers/ Train	Total Containers/ Year[1]	Total Containers/ Month[1]
Scenario 1	Short-line RR, Low	3	17	5,200	433
Scenario 2	Short-line RR, High	5	120	62,400	5,200
Scenario 3	UP RR, Capacity-Low	1	200	20,800	1,733
Scenario 4	UP RR, Capacity-High	3	244	76,340	6,353

Note: [1] Assumes balanced exports and imports or empty container backhaul.

For perspective and comparison, the Port of Portland's Terminal 6 has the capacity to handle 400,000 containers each year. In 2014, the Port of Portland handled about 25 percent of that volume, or 100,000 containers.[18] Just prior to the last two major ocean carriers terminating service in 2015, the Port of Portland was handling about 48,000 to 54,000 containers per year.[19] Northwest Container Services handles between 60,000 and 96,000 containers per year.

ITF Site Configuration

Each scenario involves the same ITF site configuration. This is because a facility of this type requires a certain level of operational capability regardless of volume. Variable inputs, such as labor and lift equipment, would be scaled to container volume. **Table 2** shows the facility design characteristics. **Figure 3** shows the general layout and dimensions of the ITF.

Table 2. ITF Design Characteristics

Acres	Approximately 14 (13.77)
Length	4,000 linear feet
Width	150 linear feet
Asphalt Paved Area (vs. Gravel)	100 percent
Fenced Perimeter (4 sides)	8,300 linear feet
Office Building	1,500 square feet
Storage/Work Building	5,000 square feet
Track	2 working tracks, each 3,000 linear feet
Gates	3 (Main in-gate and out-gate, service gate)

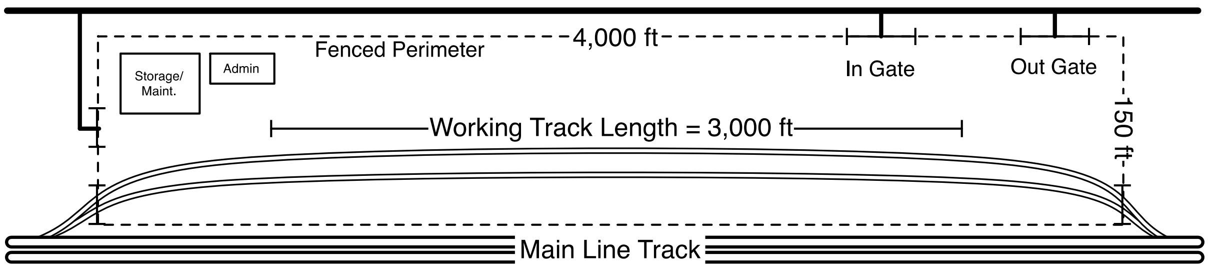
This basic ITF design and configuration could accommodate up to 2,000 containers at one time, and would allow truck turntimes of less than 30 minutes once inside the gate. To accommodate the higher volumes in Scenarios 2 and 4, additional equipment (e.g., reach stackers) and operators would be required. Based on interviews with shippers, freight forwarders, and NWCS operators, we understand that there is limited seasonal variation in container shipments. At the volumes reported in **Table 1**, the containers handled per day (assuming 5-day per week operation) would range from approximately 20 in Scenario 1 to almost 300

[18] The Tioga Group. 2016. *Trade and Logistics Report: Concepts and Business Case Analysis.* February.

[19] Phillips, Erica. 2016. "Port of Portland Loses Last Container Ship Service." *The Wall Street Journal.* May 19.

in Scenario 4. While the facility could accommodate that many containers moving through, it would require more reach stackers and employees to move containers from trucks and onto railcars.

Figure 3. ITF Site Diagram



Note: Illustration not to scale. Intended to show site elements but not specific site design or layout.

ITF Siting Criteria and Site Requirements

To operate most efficiently, the ITF would need to be as close to a major highway as possible. Minimizing the local trucking costs for as many shippers as possible would improve the ITF's appeal compared to existing alternatives, and locating close to I-5 may achieve that. Locating the ITF on an existing main rail line is necessary. The rail line may influence the range of rail carrier options available, so working on the railroad involvement concurrent with site selection is essential.

Non-highway streets to the facility need to be able to accommodate heavy trucks at the volumes detailed in the scenarios. Should street improvements be required, this would add to the overall cost of the facility, whether or not this cost is covered by a public entity. Interactions between surface streets and new track placement should also be considered; new crossings would also increase the total cost of the facility, and may create additional public costs or controversy.

The facility design characteristics described above call for the entire surface area to be paved. This is because the wear and tear on a gravel surface would require constant maintenance, given the quantity and weight of the vehicles involved, especially during the winter month**Table 1**s. For example, UP has recently paved the majority of its Intermodal Rail Facility in Portland, citing very high maintenance costs for the gravel surfaces. Paving the surface of the facility would trigger stormwater management requirements, which would likely vary by jurisdiction.

Expected ITF Revenues by Scenario

The basic activity measure of an intermodal facility is called a 'lift,' which is defined as the movement of one container through the yard, [20] or moving a container from truck to a rail car or vice versa.[21] Although technically a container may be lifted more than once while moving through the ITF, the ITF typically only counts one revenue lift in a standard drop-off or pick-up situation. For example, a container that arrives by rail empty, is lifted off the rail car and onto the ground, then lifted onto a truck chassis when the shipper arrives is technically two lifts but would be counted as one for the purposes of this analysis, and according to common definitions in the industry. To simplify the discussion in the rest of this analysis, we refer to a per-container fee instead of a per-lift fee.

The available information from the literature suggest that average revenue per lift at intermodal terminals can vary widely, from around $20 per container to up to $100 per container.[22] Rail lift charges at the Port of Tacoma, South Intermodal yard in 2016 are $71.50 per container, and secondary lift fees (those requested by shippers, not included in the line haul rates) charged at intermodal terminals by the Class I railroads (UP and CSX) are around $50 per container.[23] **Table 3** shows the annual revenue based on a range from $20 to $50 per-lift revenues, likely a reasonable range given the services provided at the ITF, multiplied by the container volumes reported in **Table 1**.[24]

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[20] Lindhjem, C. *Intermodal Yard Activity and Emissions Evluations.* Retrieved November 15, 2016, from https://www3.epa.gov/ttnchie1/conference/ei17/session11/lindhjem.pdf

[21] R² Freight and Logistics Inc. "Intermodal Terms & Definitions." Retrieved November 15, 2016, from http://www.r2freight-logistics.com/intermodal-glossary

[22] North Dakota State University, Upper Great Plains Transportation Institute. 2007. *Feasibility of a Logistics Center Including Container/Trailer Intermodal Transportation in the Fargo/Moorhead Area.* September. 1996 dollars converted to 2016 using the GDP price deflator.; Florida East Coast Railway. 2016. *Intermodal Service Directory.* August 5. Retrieved November 30, 2016, from https://www.fecrwy.com/sites/default/files/FEC%20Intermodal%20Service%20Directory.pdf; AECOM. 2015. *West Virginia Intermodal Facility: Economic and Transportation Impacts Study.* Roanoke Valley-Alleghany Regional Commission and West Virginia Office of Intermodal Planning and Investment. Final Report. June. Retrieved November 30, 2016, from http://rvarc.org/wp-content/uploads/2015/09/Western-Virginia-Intermodal-Study-Final_RoanokeReport_LessAppendices-Final-Report-06-25-2015.pdf

[23] Northwest Seaport Alliance. 2016. *Notice of Tariff Changes, Effective July 2, 2016.* Retrieved November 30, 2016, from https://www.nwseaportalliance.com/sites/default/files/20160602-NoticeTariffChanges.PDF; Union Pacific. 2016. *Union Pacific Flip Policy.* Retrieved November 30, 2016, from https://www.up.com/customers/intermodal/intmap/flip-policy/index.htm; CSX. 2016. *Intermodal Lift Payment.* Retrieved November 30, 2016, from https://shipcsx.com/pub_sx_itopsinfopublic_jct/sx.itopsinfopublic/LiftPublic.PaymentSearch

[24] The facility may generate additional revenue through charging to use reefer hookups, and providing other associated services. These are not included in revenue estimates, however in the case of reefer hookups, the costs are included in the analysis below.

Table 3. Potential Operating Revenues at Different Lift Fees, by Scenario

Scenario	Description	Containers/ Year[1]	Total Revenue (Container Fee of $20)	Total Revenue (Container Fee of $50)
Scenario 1	Short-line RR, Low	5,200	$104,000	***$260,000***
Scenario 2	Short-line RR, High	62,400	$1,248,000	$3,120,000
Scenario 3	UP RR, Capacity-Low	20,800	$416,000	$1,040,000
Scenario 4	UP RR, Capacity-High	76,340	***$1,524,000***	$3,810,000

Note: [1] Assumes balanced exports and imports or empty container backhaul.
[2] This number of containers exceeds the quantified number of containers in the study area market (38,170) plus the same number of imports (total of 76,340). The difference could potentially be made up by domestic exports and imports, but it likely represents a volume of containers that would be difficult to achieve.
[3] Revenues highlighted in bold-italics represent the likely realistic range of revenue, based on shippers' willingness to pay (see discussion below).

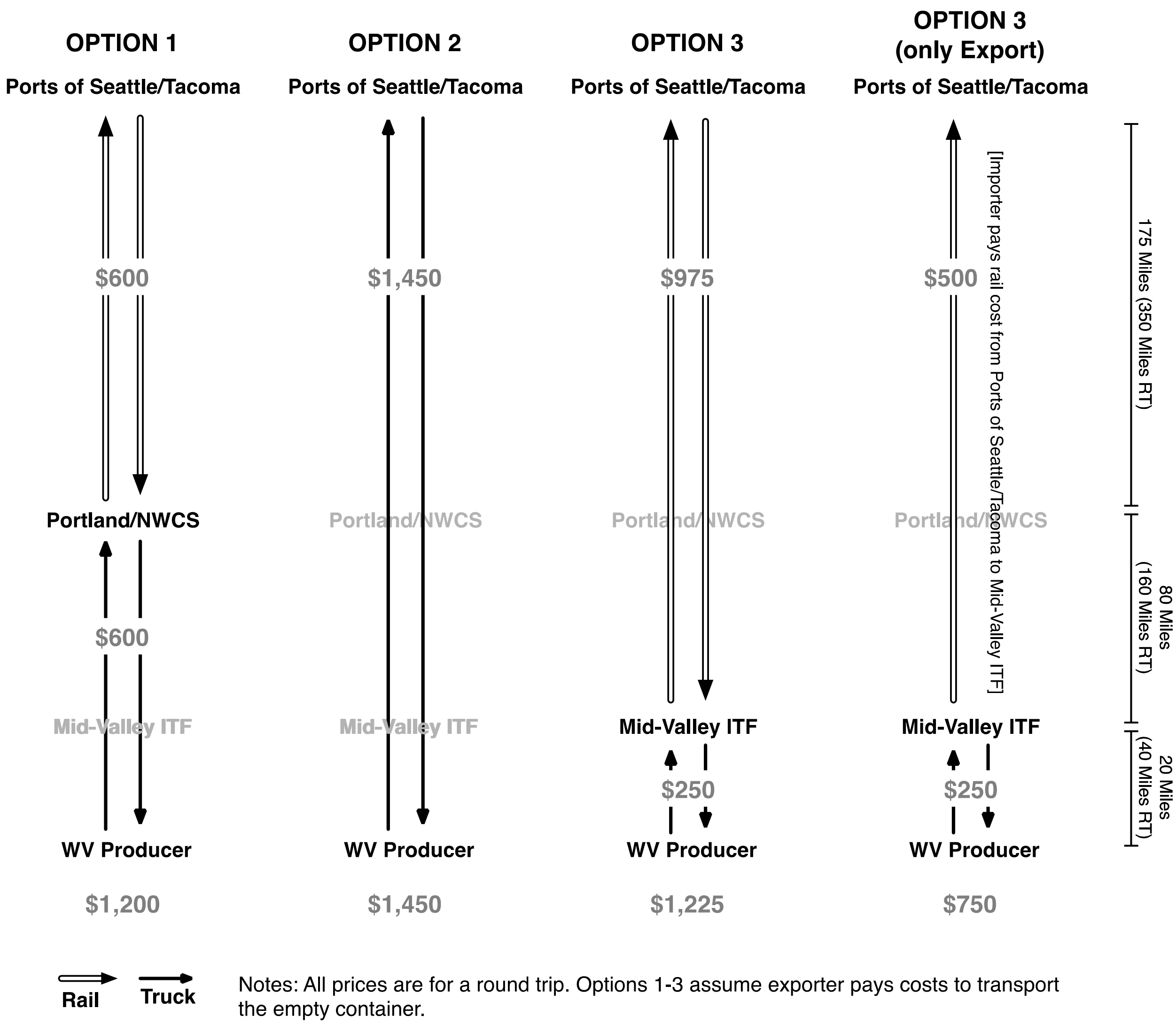
The price to charge shippers is crucially related to their willingness to pay: the ITF could charge $90 per lift, but if nobody uses the facility at that price, revenue would be zero. Determining willingness to pay is not always straightforward, but one way to gain insight is to look at the cost differentials between the transportation options available to shippers. Theoretically, shippers could be willing to pay up to the difference in price between shipping through the ITF and the next most expensive shipping option.[25] In Memorandum 1 we outline the costs associated with three round-trip options for shipping goods from the Willamette Valley (and points south and west) to the Ports of Seattle and Tacoma:

4. Option 1: Truck from Shipper to NWCS in Portland, Rail to the Ports of Seattle and Tacoma
5. Option 2: Truck from Shipper to the Ports of Seattle and Tacoma
6. Option 3: Truck from Shipper to ITF, Rail to the Ports of Seattle and Tacoma

Figure 4 shows the costs associated with each of these options. The costs are estimated assuming the ITF's general location is somewhere in the mid-Willamette Valley, approximately 80 miles south of Portland. Costs would vary depending on the actual location of the ITF, the location where the container is loaded, and the specific trucking costs each shipper faces (for example, some shippers own their own trucks, which potentially reduce trucking costs).

[25] As discussed in Memorandum 1, non-price considerations also influence shippers' decisions to use an ITF.

Figure 4. Transportation Options and Costs



Notes: All prices are for a round trip. Options 1-3 assume exporter pays costs to transport the empty container.
For the purpose of this analysis only, we assume the distance between the Mid-Valley ITF and Portland is 80 miles, and the distance between the WV producer and the ITF is 20 miles. Transportation costs would be higher for producers further away than 20 miles, for all options.
All costs are rounded.

Based on these cost assumptions, it is cheaper for a shipper to use the ITF than to truck containers all the way to Seattle, by more than $200. But the ITF is potentially more expensive than trucking containers to NWCS in Portland and railing them to the Ports of Seattle and Tacoma. This suggests that there is not likely much of a margin to charge shippers for the use of the ITF. Some shippers would not use the ITF at all, continuing to use NWCS. Other shippers may find the ITF option feasible, especially if their local trucking costs are less than those indicated in **Figure 4**.

As stated in Memorandum 1, we urge caution in drawing definitive and universal conclusions from this analysis, because actual costs, especially for trucking, are likely to vary by shipper, and will depend on the actual distance from the ITF. They are also based on somewhat speculative costs associated with the rail link between the ITF and the Ports of Seattle and Tacoma, and may not adequately characterize the range of trucking costs in the Willamette Valley. The two most uncertain pieces of this analysis relate to the ITF option. If the rail and/or trucking costs are overestimated, it may be the cheapest option for the majority of shippers. If, however, the costs are underestimated, the margin between the ITF option and Option 2, trucking to Seattle, may decrease to the point where shippers would not have any incentive to choose the ITF option.

The actual impact of the ITF charges on shippers may not be so transparent. Ocean carriers often absorb at least a portion of the cost of lift fees. For example, the ocean carriers currently pay the rail lift charge assessed per container by the Northwest Seaport Alliance for use of the South Intermodal Yard.[26] Sometimes, lift charges are built into rail transportation costs: UP Line haul intermodal rates cover one container lift-on at the point of origin and one container lift-off at the destination, assuming both origin and destination are UPRR terminals.[27] NWCS also includes the lift onto rail as part of the rail charge to the shipper.

Despite the uncertainties noted above, the most important conclusions from this analysis are:

- The ITF appears to not be the cheapest option for most shippers. ITF costs charged to shippers as lift fees will further increase its cost relative to Option 1, trucking to NWCS in Portland, increasing the likelihood shippers will continue to use that option.
- The ITF could charge up to about $100 per lift (assuming lifts are required on each end of the round trip) and still be cheaper than Option 2, trucking between the Valley and the Ports of Seattle and Tacoma.
- From our interviews, we know that shippers don't always choose the least-cost transportation option. Sometimes they are willing to pay more for increased reliability and levels of service.
- To be a realistic option for a majority of shippers, the ITF would likely have to be less expensive and be competitive in terms of schedule and reliability for most shippers.

It is likely that lower revenues would capture higher volumes of containers, because more shippers would be willing to pay a lower container fee, and fewer would be able to pay a higher fee. Therefore, the estimate a likely revenue range

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[26] The Tioga Group. 2016. *Trade and Logistics Report: Concepts and Business Case Analysis.* February.

[27] Union Pacific. 2016. *Union Pacific Flip Policy.* Retrieved November 30, 2016, from https://www.up.com/customers/intermodal/intmap/flip-policy/index.htm

for the facility of approximately $250,000 to $1.5 million, we take the lowest container fee and the highest volume, and the highest container fee and the lowest volume indicated in **Table 3**.

ITF Operating Costs by Scenario

Table 4 presents the fixed and variable operating costs for the facility by scenario. Under each scenario, we assume the ITF would be open 5 days per week for approximately 10 hours (6:30 to 4:30), during which time shippers may drop off and pick up containers. This operational level is needed to provide adequate service to shippers, even when a train may run just once per week. We also assume the facility characteristics, including size and basic services described in **Table 2** are the same across all scenarios. Total operating cost per container for Scenarios 2, 3, and 4, are well within the lower lift charges that may generate higher volumes, as discussed above. At the lower container volumes associated with Scenario 1, facility operating costs alone come close to the fee the facility may be able to charge per container.

Table 4. Summary of Fixed and Variable Operating Costs (Annual in 2016 Dollars)

	Description	Fixed Operating Costs	Variable Operating Costs	Total Operating Costs Per Container[1]
Scenario 1	Short-line RR, Low	$221,274	$13,511	$45
Scenario 2	Short-line RR, High	$221,274	$197,407	$7
Scenario 3	UP RR, Capacity-Low	$221,274	$46,844	$13
Scenario 4	UP RR, Capacity-High	$221,274	$288,867	$7

Note: [1] Per-container costs are rounded.

Table 5 shows the detailed break-down of fixed operating costs, which are the same across all scenarios: approximately $221,000 per year in 2016 dollars. These costs include facility maintenance and utilities, property tax, security services, and insurance. They also include fixed labor costs, representing the minimum staffing levels required to run the ITF. This minimum staffing level includes one facility manager and one operator. The costs associated with these employees include salary (for the manager) and wages (for the operator), payroll taxes, health benefits, and other benefits (including sick time, paid time off, and safety bonuses). The last category of fixed operating costs are administrative and overhead costs.

Table 4, column four, shows the total variable operating cost by scenario. Variable operating costs include categories that scale with container volume. As volume increases, more reach stackers are needed to ensure containers are loaded on trains on schedule. Additional lift equipment requires additional operators and additional parts and materials, fuel, and maintenance and repair. Variable operating costs range from approximately $13,500 for the lowest volume scenario, to around $290,000 for the highest volume scenario.

Table 5. Fixed Annual Operating Costs Detail (in 2016 Dollars)

Fixed Operating Cost Category	Unit	Unit Price	Quantity	Total
Facility (Fixed)				
Maintenance	Cost	$2,500	1	$2,500
Utilities	Cost	$5,000	1	$5,000
Property Tax	Cost per $1,000	$12.88	$2,410	$31,035
Security	Cost	$500	1	$500
Insurance	Cost	$1,620	1	$1,620
Total Facility				**$40,655**
Labor (Fixed)				
Manager-Salary	Cost per Employee	$62,400	1	$62,400
Operator-Wage	Cost per Employee	$42,000	1	$42,000
Payroll Taxes	Cost per $ Labor	$0.08	$104,400	$8,352
Health Benefits	Cost per Employee	$9,714	2	$19,427
Other Benefits	Cost per $ Labor	$0.10	$104,400	$10,440
Total Labor				**$142,619**
Overhead (Inc. Admin) (Fixed)	Cost	$38,000	1	$38,000
Total Fixed Operating Costs				**$221,274**

ITF Capital Costs by Scenario

Table 6 summarizes the capital costs by scenario. Total capital costs include materials and construction costs for buildings, surface improvements, storm water and other utility systems, fencing and gates, lights, and rail infrastructure (both on-site and off-site to connect with the existing mainline). These costs do not vary by scenario, because we assume all scenarios require the same facility and site specifications. Capital costs also include equipment investments, which vary by the container volume of the scenario. We annualize capital costs assuming a 20-year facility life and a 4 percent interest rate. Annualized capital costs include the carrying cost of the land, calculated assuming a 4 percent interest rate. Capital costs per lift range from almost $9 for the highest volume scenario to about $120 for the lowest volume scenario.

Table 6. Annualized Capital Costs (in 2016 Dollars)

	Description	Capital Costs (Not Including Land)	Annualized Capital Cost (Including Carrying Cost of Land)	Capital Cost per Container[1]
Scenario 1	Short-line RR, Low	$7,175,405	$624,398	$120
Scenario 2	Short-line RR, High	$7,475,405	$646,472	$10
Scenario 3	UP RR, Capacity-Low	$7,175,405	$624,398	$30
Scenario 4	UP RR, Capacity-High	$7,788,680	$669,523	$9

Note: [1] Per-container costs are rounded.

Table 7 shows the detailed capital costs, including per unit values. All costs except equipment are the same for all scenarios; equipment needs increase as volume increases. The assumptions for each of these cost items are described in more detail below.

Table 7. Capital Costs Detail (in 2016 Dollars)

Fixed Operating Cost Category	Unit	Unit Price	Quantity	Total
Site				
Land	Acres	$175,000	13.77	$2,410,468
Clearing/Grading	Acres	$1,350	13.77	$18,595
Site Improvements				
Gravel Area	Acres	$40,000	-	$-
Paved Area	Acres	$152,460	13.77	$2,100,000
Fencing	Linear Feet	$13	4,300	$55,685
Gates	Number	$1,950	3	$5,850
Work Lights	Number	$30,000	1	$30,000
Office	Square Feet	$82	1,500	$122,250
Outbuilding	Square Feet	$29	5,000	$142,500
Utilities-Water	Cost	$3,250	1	$3,250
Utilities-Septic	Cost	$10,000	1	$10,000
Utilities-Stormwater	Cost	$700,000	1	$700,000
Utilities-Electrical	Cost	$100,000	1	$100,000
Rail Infrastructure				
Onsite Track	Linear Feet	$229	6,000	$1,374,000
Signaling/Offsite Trackwork	Cost	$1,500,000	1	$1,500,000
Equipment				
Reach Stacker/Lift	Number	$300,000	1-3	$300,000-$900,000
Yard Hostler	Number	$67,500	0	$-
Chassis	Number	$17,500	0	$-
Scale	Number	$67,500	0	$-
Reefer Hookup	Number	$2,655	5-10	$13,275-$26,550
Mobilization/Permitting/Surveying	Cost			$200,000
Engineering/Design	Cost			$500,000

Land

Land prices are based on currently available sites located in the Willamette Valley, as listed for development on Oregon Zoomprospector. We filtered the results to include only sites greater than 12 acres with rail access in the Willamette Valley. Per-acre prices range from $50,000 to $300,000. We calculated an average price of $175,000 per acre to give a rough estimate of the value of a site appropriate for ITF development. In the analysis of capital costs, however, we only include the annual carrying costs of the land, assuming an interest rate of 4 percent. Annual property taxes on the land are included in operating costs.

Clearing/Grading

This cost would be highly site-specific, depending on the existing use, topography, and condition of a site. Some sites marketed for development may already be cleared and graded, largely eliminating this cost. We estimated clearing and grading costs at $1,350 per acre, based on prices from the literature on the low end to per-acre costs included in the Boardman bid for the high end.

Site Improvements

We assume a site would be paved to accommodate activity in wet conditions for much of the year. This minimizes maintenance costs associated with gravel under wet conditions. We assume standard asphalt paving for the whole site and estimate paving costs between $2.00 and $5.00 per square foot. We assume the entire site is fenced with a 6-foot chain-link fence. Three large gates manage truck traffic, and two smaller gates span the tracks to secure the entire fenced perimeter while allowing the train to arrive and depart. We assume the ITF would require an office and administrative building at 1,500 square feet, and a metal storage and maintenance shelter at 5,000 square feet. Cost estimates for these elements are drawn from estimates for facilities in Boardman and North Dakota (both of which had similar specifications). We assume only one work light is needed, because operations will be limited primarily to daytime hours.

Rail Infrastructure

Rail infrastructure improvements would be needed within the site footprint and at the connection points with the main line. The owner of the main line (e.g., Union Pacific) would be responsible for making the improvements where they intersect with the main line, and these improvements would include track, switches, and signals. The cost of these improvements would be passed to the owners of the ITF. We use the cost of off-site rail improvements at the Boardman facility, assuming the configuration and level of effort would be similar. Onsite track work would include construction of two sidings, each 3,000 feet long, for a total of 6,000 linear feet of working track. We use a range of track costs from approximately $130 to $330, drawn from the Boardman facility costs and costs associated with other feasibility studies.

Equipment

The most critical piece of equipment needed to operate the ITF is a reach stacker, used to lift containers on to and off of trucks to rail cars. Reach stackers list for between $100,000 and $500,000, depending on specifications and condition (for used equipment). We assume the same average price of $300,000 for each piece of equipment needed. The number of reach stackers needed depends on how efficiently the facility operates. Assuming efficiencies similar to current operations at NWCS in Portland, we assume a maximum of three reach stackers would be needed for the highest volume scenarios.

Feasibility studies of larger-scale intermodal facilities typically include other equipment, including yard hostlers (small trucks that can move chassis around a site), chassis, and a scale. NWCS staff suggested the ITF could operate efficiently without this equipment, so to minimize costs, we do not include it in this analysis. We do include reefer hookups in this category, though they are not technically stand-alone equipment. We include 5 hookups for the lower-volume scenarios, and 10 hookups for the highest volume scenarios 2b and 4.

Other Construction Costs

Based on the Boardman bid, we include mobilization, permitting, surveying, and engineering and design costs required to construct the ITF as a separate category. These costs total $700,000 in our analysis.

ITF Cost Summary

Table 8 shows the total operating costs (both fixed and variable) and annualized capital costs (including the carrying cost of land). These costs may be added together for a total annual cost, which when divided by annual number of containers shows the total cost per container for each operating scenario. The total costs per container range from over $15 at the highest container volume in Scenario 4 to over $165 per lift for the lowest volume in Scenario 1.

Table 8. Summary of Annual Capital and Operating Costs (in 2016 Dollars)

	Description	Annualized Capital Cost (Including Carrying Cost of Land)	Annual Operating Costs	Total Annual Capital and Operating Costs[1]	Total Cost per Container[1]
Scenario 1	Short-line RR, Low	$624,398	$234,785	$859,000	$165
Scenario 2	Short-line RR, High	$646,472	$418,681	$1,065,000	$17
Scenario 3	UP RR, Capacity-Low	$624,398	$268,118	$893,000	$43
Scenario 4	UP RR, Capacity-High	$669,523	$510,140	$1,180,000	$16

Note: [1] Costs are rounded.

ITF Cost and Revenue Comparison

Table 9 shows the operating, capital, and total costs per container. The total cost per container can be compared to the potential per-container charges described above in the revenue discussion, to illustrate the break-even potential, where revenues are equal or greater to costs. Scenario 1 costs exceed revenues at both potential charges of $20 and $50 per container.

Table 9. Summary of Costs per Container, Ordered by Container Volume (in 2016 Dollars)

	Description	Containers per Year[1]	Operating Cost Per Container[1]	Capital Cost per Container[1]	Total Cost per Container[1]
Scenario 1	Short-line RR, Low	5,200	$45	$120	$165
Scenario 3	UP RR, Capacity-Low	20,800	$13	$30	**$43**
Scenario 2	Short-line RR, High	62,400	$7	$10	**$17**
Scenario 4	UP RR, Capacity-High	76,340	$7	$9	**$16**

Note: [1] Costs are rounded.

At a per-container charge of $20, Scenarios 2, and 4 produce revenues greater than costs. These scenarios both depend on volumes that approach the maximum number of containers in the market currently. In other words, to achieve these volumes (and per-container costs), most, if not all (in the case of Scenario 4), of the shippers in the study area currently exporting intermodal containers would have to decide to use the ITF. At a charge of $50 per container, Scenario 3 also produces revenues greater than costs. The higher charge would likely yield a lower volume of shippers willing to use the ITF, which is generally consistent with volumes in Scenario 3. However, it is unclear given available data if at this fee enough shippers would choose the ITF at a $50 container charge to meet the specific volume requirements identified in Scenario 3.

Thus, **Table 9** indicates that the ITF may be feasible without public investment for Scenarios 2 through 4, at potentially realistic container charges, if the ITF can capture sufficient volume to operate at these levels. It is unlikely that sufficient volume would materialize immediately: at a minimum, shippers would need time to test the facility and adjust their operations before committing long-term. Given the small margin in cost between other transportation options available to most shippers, and importance of non-cost factors, it is possible that many shippers would not choose the ITF until its benefits were proven first by other shippers, which may further delay adoption.

Required Public Investment

Public investment would be required to support an ITF in the Willamette Valley. **Table 9** illustrates that container volume is critical to the financial independence of the ITF. At lower volumes that may be typical of a start-up phase, (i.e., Scenario 1), the per-container operating costs alone are close to the potential upper-end of revenue that may be generated per container, leaving nothing to cover the capital costs. Other Scenarios with higher volumes of containers yield lower per-container costs, and greater potential to generate sufficient revenue to cover both operating and capital costs. However, these per-container costs are only achievable at volumes that approach the potential size of the market in the study area under current conditions.

There are several strategies public agencies may consider to support the development of the ITF. Some involve financial support, such as:

- **Providing land**. This would reduce the capital costs shown in **Table 8**, by removing the carrying cost of the land, and in turn would reduce the per-container cost in **Table 9** somewhat.
- **Guaranteeing bonds**. This would reduce the capital costs shown in Table 8 by securing a lower financing cost.
- **Subsidizing capital costs**. This would directly lower the capital costs shown in **Table 8**, and in turn would reduce the per-container cost in **Table 9**.
- **Subsidizing operating costs in early years.** This would directly lower the capital costs and operating costs shown in **Table 8**, and in turn would reduce the per-container cost in **Table 9**.

Other strategies may involve providing political support:

- **<u>Coordinating with the Railroads:</u>** This may be essential in garnering the cooperation necessary to make the ITF a reality. If the Class I railroads are not interested in the business generated by the ITF, the ITF is not possible. Assuming there is interest, political support may also involve negotiating solutions to remove the paper barriers that currently narrow the options for the flow of rail traffic, and providing leadership for evaluating solutions for potential infrastructure upgrades that may be required on certain routes.
- **<u>Coordination with the Ocean Carriers:</u>** Public officials may be able to play a role in discussing service options for the ITF with ocean carriers. Securing the support of ocean carriers for servicing the ITF may reduce some of the uncertainty shippers perceive in committing to the ITF, particularly surrounding issues of cost and equipment availability.
- **<u>Coordination with Large Importers:</u>** If importers shift their current shipping practices to utilize the ITF, there is greater potential for exporters to be able to access containers already positioned in the Valley, reducing their total shipping costs. Public officials may be able to facilitate discussions with businesses that increase overall imports into the Valley by intermodal container, as well as facilitating ways to coordinate equipment needs (container and chassis) between importers and exporters.

Public Benefits Associated with the ITF

Intermodal container transportation produces public benefits, which are often used to justify public investment in intermodal infrastructure.[28] The transportation industry has adopted intermodal containers, in part, because they are able to take advantage of efficiencies associated with each form of transportation. These efficiencies produce private cost benefits, as well as benefits that accrue to the public, including reduced pollution, congestion, and highway wear and tear.

Air Pollution and Greenhouse Gas Reduction

Shifting intermodal containers from trucks to rail produces less air pollution. Rail can transport cargo further per ton mile of gas. The Texas Transportation Institute estimated railroads moved approximately one ton of cargo 478 miles per gallon of fuel. In comparison, trucks only moved one ton of cargo 150 miles

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[28] Casavant, K., E. Jessup, and A. Monet. 2004. *Determining the Potential Economic Viability of Inter-Modal Truck-Rail Facilities in Washington State.* Washington State Transportation Commission, Washington State Department of Transportation, U.S. Department of Transportation Federal Highway Administration. December.

per gallon.[29] These estimates show that trains are more efficient at transporting cargo per ton mile than trucks. As a result, rail transportation also produces fewer greenhouse gases: railroads produce approximately 21.13 metric tons of greenhouse gases per million ton-miles, whereas trucks produce 171.82 metric tons.[30] Sulbaran and Sarder (2013) provide EPA greenhouse gas emission data from various forms of transportation across the United States. In 2006, freight railroads contributed 2.6% to the total greenhouse gas emissions created by transportation, whereas trucking contributed 20.8% to the national transportation total.[31] A 2016 report released by the Association of American Railroads reported that in 2015, railroads moved a ton of freight an average of 473 miles per gallon of fuel: moving freight by rail instead of truck reduces greenhouse gas emissions by 75 percent.[32]

An air quality benefits study was conducted for the Alameda Corridor, which is located in the Los Angeles region. The project "consolidated four separate at-grade rail lines into a single grade separated rail corridor running from the Los Angeles and Long Beach Ports to downtown Los Angeles."[33] Using locomotive data as well as vehicle day reduction benefits (quantity of vehicle and their respective delay times dues to rail obstruction), the authors estimated the following cumulative reductions in pollutants (in tons) over the 2002-2004 period as a result of the project: 253.9 ROG (reactive organic gases); 2,371.9 CO (Carbon monoxide); 1,170.2 NOx (Nitrogen oxide); 48.4 PM10 (particle matter 10 micrometers or less); and 20.4 SOx (Sulphur oxide).[34]

Congestion Cost Reduction

Shifting intermodal containers from the highway to railways also affects highway congestion by reducing the number of trucks on the road. This benefits other highway traffic, particularly passenger vehicles. Because trucks occupy more space than other types of traffic (e.g., passenger vehicles), the benefit of removing trucks from the road can reduce congestion more effectively than other strategies. Sulbaran and Sarder (2013) state, "… freight trains are capable of carrying loads equivalent of 280 trucks in a single haul making space for 1,000 or

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[29] Kruse, J. C., Protopapas, A., Olson, L. E. (2012). *A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001-2009*. College Station, TX: Texas Transportation Institute, The Texas A&M University System. Retrieved from: http://nationalwaterwaysfoundation.org/study/FinalReportTTI.pdf.

[30] *Ibid*.

[31] Sulbaran, T., Sarder, MD. (2013). *Logistical impact of intermodal facilities*. American Society for Engineering Education Conference, 2013. Retrieved from: http://se.asee.org/proceedings/ASEE2013/Papers2013/183.PDF.

[33] Weston Solutions, Inc. (2005). *Alameda Corridor Air Quality Benefits Final Report*. Retrieved from: http://www.acta.org/newsroom/Releases/Alameda_Corridor_AQ_Benefits_Report_061005.pdf.

[34] *Ibid*.

more passenger automobiles."[35] Reducing congestion produces benefits for every commuter on the road, by reducing the amount of time spent driving, allowing people to do other things. It also has the potential to make business more efficient, by reducing travel times for employees who drive on the job. A 2014 report on the economic impacts of congestion in Oregon found that businesses have already implemented strategies to avoid and mitigate current congestion issues, and expected increases in congestion would impose direct costs, including reduced service levels (e.g., fewer deliveries per day), which would have an increasing negative impact on Oregon's economy.[36]

Reduced Highway Maintenance Costs

Freight rail advocates argue that increased rail freight movement significantly reduces highways infrastructure maintenance and expansion costs.[37] Trucks are substantially heavier than private passenger vehicles. A GAO report states, "Although a five-axle tractor-trailer loaded to the current 80,000-pound Federal weight limit weighs about the same as 20 automobiles, the impact of the tractor-trailer is dramatically higher … a tractor-trailer has the same impact on an interstate highway as at least 9,600 automobiles…"[38] Costs summarized from Federal Highway Cost Allocation Studies suggest that automobiles create roadway wear and tear equivalent to approximately $0.035, whereas single unit trucks cost $0.146 and combination trucks cost the most at $0.202.[39] The export containers that would use the ITF are among the heavier loads conveyed on Oregon's highways. Diverting them to rail would relieve a disproportionately high share of road wear and tear, reducing public maintenance costs over time.

[35] Sulbaran and Sarder, 2013.

[36] Economic Development Research Group, Inc. 2014. *Economic Impacts of Congestion in Oregon.* Final Report. February.

[37] Sulbaran and Sarder, 2013.

[38] Comptroller General's Report to Congress. *Excessive Truck Weight: An Expensive Burden We Can No Longer Support*. Washington, DC: U.S. Government Accountability Office. Retrieved from: http://archive.gao.gov/f0302/109884.pdf.

[39] Victoria Transport Policy Institute. (2016). *Transportation Cost and Benefit Analysis II – Roadway Costs*. Retrieved from: http://www.vtpi.org/tca/tca0506.pdf.

Appendices

Appendix A

Completed Interviews

Mark Arkills, Production Manager, Holiday Tree Farm

Brenda Barnes, Export Account Manager, Geo S. Bush International Trade

Angie Blacker, Executive Director, Oregon Seed Association

Shelly Boshart Davis, VP International Sales and Marketing, Bossco Trading/Boshart Trucking

Gary Cardwell, Division VP, Northwest Container Services

Sandy Christiansen, Network and Industrial Development, Union Pacific Railroad

Terry Fasel, Trade Development Manager, Oregon Department of Agriculture

Randy Fischer, Senior Research Analyst, Port of Portland

Steven Gallaher, Senior Business Director, Intermodal Team, Union Pacific Railroad

Stephanie Gibson, Lochmead Dairy

Vanessa Han, Imports Manager, KWE

Jim Irvin, Portland & Western Railroad

Phill Lindgren, Logistics Manager, Grassland Oregon

Jannie McKibben, Cascade Pacific Pulp

Bob Melbo, Oregon Department of Transportation

Brian Ostlund, Pacific Northwest Christmas Tree Association

Lisa Petersen, Director of International Services, Independent Dispatch, Inc.

Ginny Wood, Director of Operations and Administration, Albany & Eastern Railroad