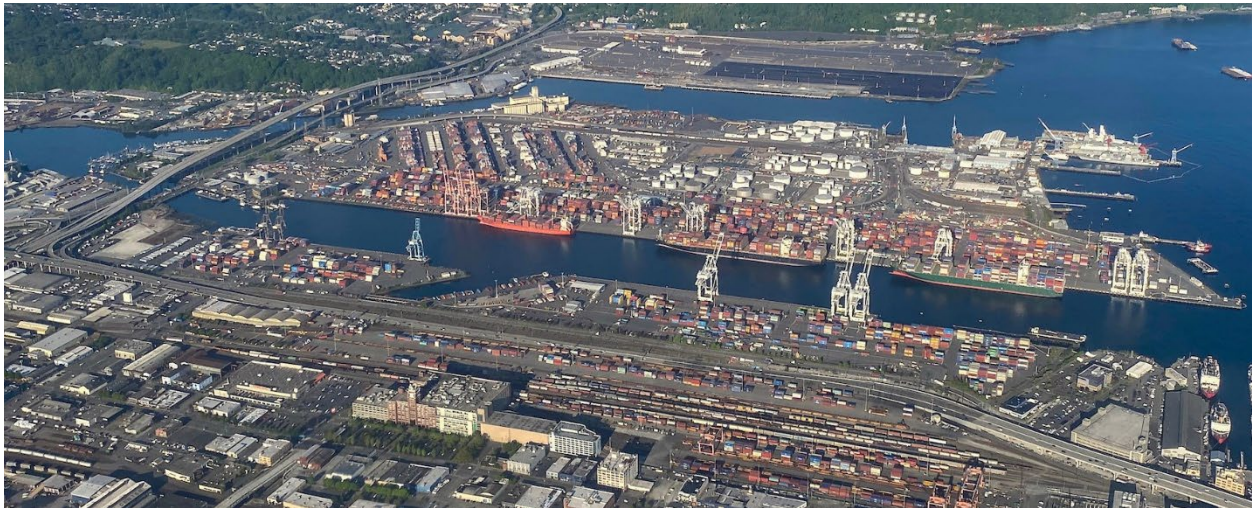


TERMINAL 5 EXPORT, EXPANSION, AND EMISSIONS REDUCTION PROJECT

SEATTLE, WASHINGTON



**U.S. DEPARTMENT OF TRANSPORTATION / MARITIME ADMINISTRATION
FY 2022 PORT INFRASTRUCTURE DEVELOPMENT PROGRAM (PIDP)
GRANT APPLICATION**

BENEFIT-COST ANALYSIS REPORT

Submitted by:
The Northwest Seaport Alliance (NWSA)



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I. OVERVIEW

The Northwest Seaport Alliance (NWSA) is requesting \$17,035,900 in FY22 Port Infrastructure Development Program (PIDP) grant funding for the Terminal 5 Export, Expansion, and Emissions Reduction Project (the Project). **The Project has a Benefit-to-Cost Ratio of 1.50**, summarized in Table 1. The Project consists of the following two project components:

1. **Construction of a new truck gate complex:** Construct 12 new inbound truck lanes and install 8 new truck scales, increasing the number of scales from 6 to 8. The new gate structure will be repositioned 930 feet further into the terminal complex, allowing an additional 100 trucks to queue inside the terminal. This will reduce or eliminate most of the truck queues on SW Spokane St and reduce roadway network traffic congestion due to port trucks. Existing gate infrastructure will be demolished when construction is completed.
2. **Construction of a cargo container storage area:** Create 6 acres of additional container yard space by demolishing the existing Container Freight Station building, building new container yard space (pavement and stormwater infrastructure), and improving the connection between the existing container yard and the extension. This additional container yard space will allow the Port and the Terminal to prioritize and pre-position just-in-time export containers and to better manage lower priority import and empty containers.



Figure 1: Project Components

The truck gate complex and yard expansions will especially support U.S. agricultural and other exports. Agriculture exporters have been disproportionately impacted by the current supply chain congestion. In 2021, laden exports from the NWSA were down nearly 13% YoY – approximately 100,000 TEU – and are down 28% YTD in 2022. Historically, the NWSA is the leading export gateway for key agricultural commodities such as apples, potatoes, and pulses. Additionally, it is a leading export gateway for hay and forage.

Agriculture companies rely on export markets to remain profitable and viable. However, over the last two years, as import container volumes and demurrage have grown, it has left little space on US container terminals for exporters. Expanded gate capacity, infrastructure and yard space at Terminal 5 will support efforts to reverse this trend.

Additional gate scales and yard space will decrease truck turn times and provide additional capacity for prioritizing export loads. This will make the export process more efficient and less costly. It is estimated that, as a result truck turn times will be reduced by approximately 15 minutes on average for export containers. In addition, the quicker truck turn times will allow some truckers to do two full turns in a shift as well as deliver more export containers within the (very narrow) scheduled windows for dropping off containers prior to a vessel arrival. Export containers must be on the terminal before a ship is unloaded to avoid congestion on the terminal due to both terminal activities occurring at the same time.

By repositioning the gate, truck queues at the gate will no longer spill onto SW Spokane St. This has been a major issue in the past when the terminal had the same throughput capacity it currently does. One goal of the project is to prevent these queues from reoccurring. Truck queuing on SW Spokane St. mainly occurs during peak hours of the day. Peak hours tend to occur during the early morning hours of the day, due to export truckers attempting to do two full truck turns within their 11-to-14-hour shift¹. Therefore, if congestion during this time extends truck turn times, they can no longer deliver two export containers in one shift, adding transportation costs to exporters. Such congestion on the road causes added travel time to daily commuters. In addition, it can also pose a major issue for emergency situation response times in the corridor. Truck queues can delay fire trucks and ambulances trying to reach citizens in times of an emergency.

In total, the Project is expected to save 1.8 million hours for truckers delivering export containers to Terminal 5 over the 20-year analysis period.

While not quantified in this BCA analysis—the terminal just reopened a few months ago and is not yet fully operational – the Project will reduce the overall number of empty export containers from the Port and reduce the number of loaded export containers that miss the narrow “just-in-time” export delivery windows due to port and truck congestion.

For this analysis, the following With and Without-Project Scenario assumptions were considered:

- **With-Project Scenario:** Terminal 5 gate complex expansion with added container yard capacity, supports increased export volumes and velocity. This additional gate capacity and container yard space will allow the Port and the Terminal to prioritize and pre-

¹ <https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations>

position just-in-time export containers and to better manage lower priority import and empty containers. As a result, truck wait times will be reduced by 15 minutes on average for all export containers. The reduction in wait time during peak hours will have a significant impact on export containers originating in areas just east of the Cascade Mountains' passes. Truckers will be able to pick up and return a second container within a single shift. As a result, exporters will be able to get more containers delivered at a lower cost. In addition, the new gate location will allow for more on terminal truck queuing at the gate, reducing the likelihood of the queue overflowing onto SW Spokane St during peak hours.

- **Without-Project Scenario:** Terminal 5 does not increase its gate or container yard capacity. Congestion will worsen along the surrounding highways of the terminal as truck traffic continues to be an issue, increasing safety costs, truck operating costs, and greenhouse gas emissions. The Port's ability to support agricultural exports and other exports will not be improved as truck wait times are not alleviated (at least in part) by added gate capacity.

The BCA reflects USDOT's standard guidance regarding forecast periods and discount rates. As such, all estimates were calculated over a 20-year period, beginning in 2025 following the Project's completion in 2024 in the With-Project Scenario. Additionally, a discount rate of 7 percent was used throughout the analysis (a discount rate of 3 percent was used for CO₂ emission benefits) as suggested in USDOT BCA guidelines for 2022. **The Project has a Benefit-to-Cost Ratio of 1.50.** The results of the BCA are summarized below in Table 1.

Table 1: Summary of Project Benefits (2020 US\$, PV Discounted @ 7%)

Category	Total
Economic Competitiveness	\$25,561,817
Environmental Sustainability	\$539,959
Operating & Maintenance Costs	(\$1,269,306)
Residual Value	\$1,442,209
Total Benefits	\$26,274,678
Project Costs	\$17,534,894
Net Present Value	\$8,739,785
Benefit to Cost Ratio	1.50

II. SUMMARY OF BENEFITS

The benefits quantified to determine the Benefit-to-Cost Ratio stem from the increase in annual export container storage capacity, reduction in truck queuing time, and reduced greenhouse gas emissions. The analysis presented here quantifies the following benefits:

- **Reduction in truck waiting time.** The new gate complex and yard expansion will reduce average truck turn times by 15 minutes for export containers. Currently, the average turn time at the Terminal 5 is 70 minutes for all containers. Reduced truck waiting times will result in lower fuel consumption and time saving benefits.
- **Reduction in off-terminal truck queueing.** The repositioning of the new gate terminal will allow for 100 more trucks to wait on-terminal, thereby taking trucks off SW Spokane St. Congestion costs associated with such traffic has been considered as part of this analysis. While such congestion on the road can also pose a major issue for emergency situation response times, such benefits have not been considered as part of this analysis.

Figure 2: Truck Queue Spilling Over onto SW Spokane St



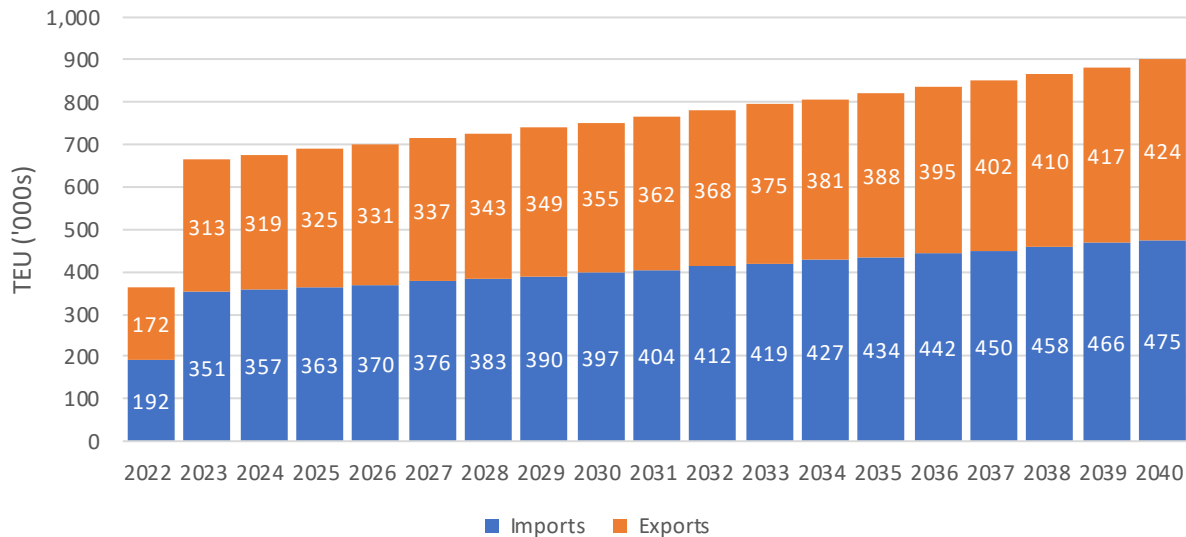
- **Reduction in trucker shifts.** The gate complex upgrade and yard expansion will allow export containers to move through Terminal 5 much faster. Therefore, for certain markets, truckers will be able to do two full truck turns(roundtrips) in a shift as opposed to just one under current congestion conditions at the gate and external roadways. Therefore, certain exporters will only require half the number of truck shifts to deliver the same number of containers to the Port.

III. ASSUMPTIONS

A. EXPORT CONTAINER VOLUMES

Figure 3 displays the forecasted annual cargo volumes over the analysis period, as developed by NWSA. The large increase in volumes between 2022 and 2023 since T-5 major upgrades were only completed this year and is in a ramp-up period.

Figure 3: Terminal 5 Container Volume Forecasts



Many agricultural exporters utilizing NWSA originate from Eastern Washington or east of the mountain passes, as seen in Figure 4 and Figure 5. Typically, exporters need to maximize their truck capacity to fulfil the weekly targets for exported product. However, each vessel they are looking to load out may only provide two days of receiving windows. The days for receiving may also change with very little notice. Terminal congestion on receiving days may delay trucks returning to pick up a second load and in many cases make it impossible to get a second load during their legal shift. The consequence for the exporter is a missed cargo opportunity and increased cost per container. Hay, the largest single export commodity at the NWSA, is an example: It primarily originates in Ellensburg, approximately 100 miles from our terminals. Truckers deliver containers loaded in Ellensburg and must complete two trips per day in order to make exporting profitable. An expanded gate complex reduces the time for a truck to complete its delivery to the Terminal, helping that truck to complete its minimum two daily trips. This is also true for exports out of the area surrounding Quincy. With a yard dedicated to exports, laden containers could be pre-staged and when export receiving opens, a small group of yard trucks could shuttle all of the containers into the existing terminal efficiently.

Figure 4: Origins of NWSA Exports by Commodity Type

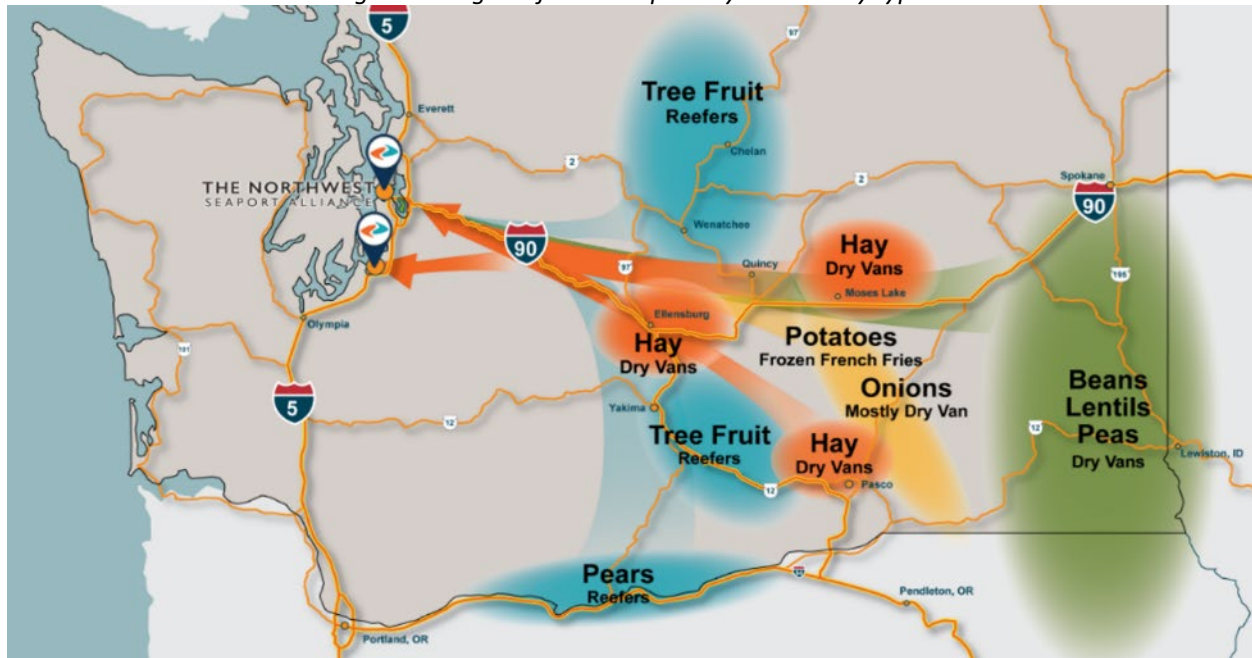
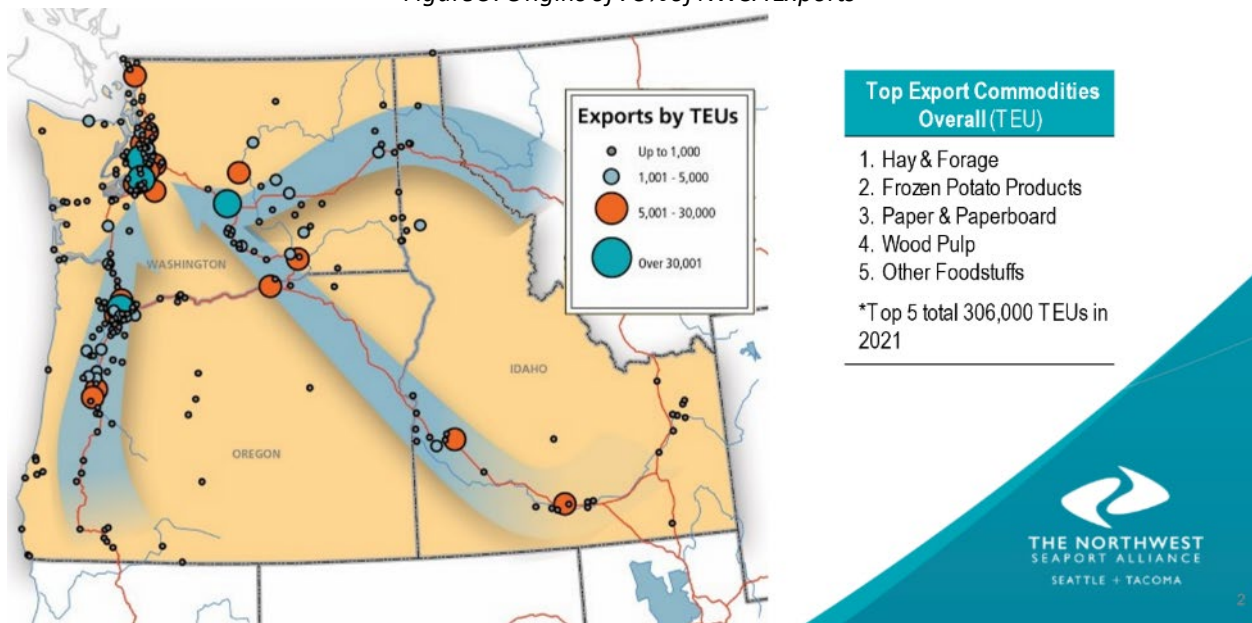


Figure 5: Origins of 75% of NWSA Exports



As noted in the figure above, there is a cluster of hay and tree fruit exporters around Ellensburg and Quincy, which is approximately 2.0 to 2.5 hours from the Port. Approximately 25% of all NWSA agricultural exports come from this region. Additionally, approximately 10% of such volumes will be able to make two truck turns as a direct result of this Project, whereas they would not be able to without it. These are the truckers finding themselves in current peak gate congestion. As a result, truck turn times are currently significantly above average for many export

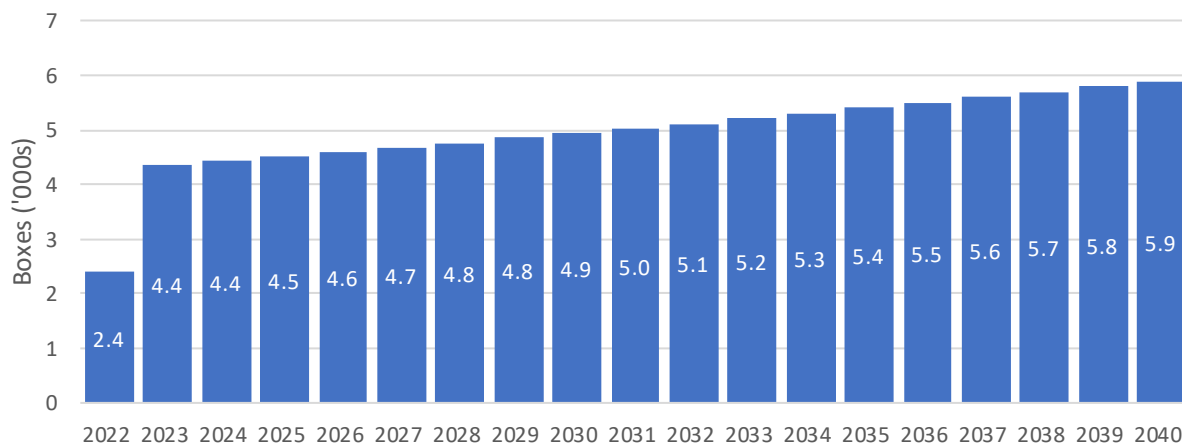
truckers, making it impossible for them to make two truck turns in a 12-hour shift². However, with the new gate and added scales, truck turn (roundtrip) times are going to significantly improve, specifically for exporters trying to drop off a container during peak hours. For these truckers truck turn times in the morning shift will improve from 120 minutes (2.0 hours) to the average of 55 minutes (70 minutes (current average) – 15 minutes (time saved with Project)), or 0.9 hours. With truck turn times at an hour on average, more truckers in the Ellensburg / Quincy region can now make two round trips, as shown in Table 2.

Table 2: Truck Turn Times for Exporters near Ellensburg / Quincy

	Time (Hours)	
	Without-Project	With-Project
Pick up export container	1.0	1.0
Ellensburg / Quincy to Seattle	2.5	2.5
Turn Time (Peak Hours)	2.0	0.9
Seattle to Ellensburg / Quincy	2.5	2.5
Pick up export container	0.5	0.5
Ellensburg / Quincy to Seattle	2.5	2.5
Turn Time	0.9	0.9
Leaving Port	0.5	0.5
TOTAL	12.4	11.3

With approximately 25% of export containers coming from the Ellensburg / Quincy area, and an expected 10% of exporters being able to make two truck turns per shift with the Project, an estimated (25% x 10% =) 2.50% of export volumes will be able to be handled via one 12-hour trucker shift vs two shifts.

Table 3: Exports Unable to Make Two-Truck Turns due to Wait Times – Without-Project Scenario



² Shift-length utilized in BCA model – falls within the cited 11-to-14 shift range

While there will undoubtedly be more export containers and truckers directly impacted by the reduction of truck turn times in relation to operating efficiency, this subset of eastern Washington export containers is the most impacted by current market conditions.

B. REDUCTION IN TRUCK QUEUING TIME

Currently, average truck turn times are 70 minutes. The new gate system will have the capacity to provide a “quick gate” for the near dock “just-in-time” exports and allow those trucks to bypass the congestion. Each gate pedestal in the new configuration will complete an average of 250 transactions per day, and one or more “quick gates” will be dedicated to “just-in-time” exports with narrow delivery windows—principally perishables and agricultural exports originating east of the mountain passes. Other exporters may use the expanded storage area to pre-position their export containers and benefit from the shorter truck turn times.

With the added gate capacity, new scales, and dedicated yard space for exports, it is expected that average truck turn (roundtrip) times for exports will improve by 15 minutes as a direct result of the Project.

C. PROJECT COSTS

The total cost of the Project is estimated to be \$26.26 million in 2023 US\$, or \$22.65 million in 2020 US\$, as shown in Table 4, and has a present value of \$17.53 million (present value discounted at 7 percent in 2020 US\$). Design and permitting of the truck gate complex will be completed in 2022, while design and permitting of the yard expansion will be completed in 2023. Construction of both project components will begin and end in 2024.

Table 4: Summary of Total Project Costs

Project Component	Cost (2023 US\$)	Cost (2020 US\$)
Truck Gate Complex		
Design, Permitting, Construction Mgmt.	\$1,922,500	\$1,658,140
Construction	\$13,668,000	\$11,788,531
Truck Gate Complex Total	\$15,590,500	\$13,446,670
Yard Expansion		
Design, Permitting, Construction Mgmt.	\$2,163,000	\$1,865,569
Construction	\$8,506,000	\$7,336,351
Yard Expansion Total	\$10,669,000	\$9,201,920
TOTAL	\$26,259,500	\$22,648,590

As cost estimates were provided in 2023 US dollars, costs were put in constant dollars by removing inflation. Inflation estimates were based on IMF³ CPI percent changes of 1.25% in 2020, 4.68% in 2021, 7.68% in 2022, and 2.86% in 2023.

³ <https://knoema.com/kyaewad/us-inflation-forecast-2022-2023-and-long-term-to-2030-data-and-charts>

D. OPERATING AND MAINTENANCE COSTS

Ongoing maintenance costs of the Project are expected to be approximately \$1.27 million (present value discounted at 7 percent in 2020 US\$) over the 20-year analysis period. This assumed that annual operating and maintenance costs are approximately 1.0% of Truck Gate Complex and 0.5% of Yard Expansion project costs. Due to technology and efficiency upgrades, the annual operating costs will be slightly less than current operational costs.

E. RESIDUAL VALUE

The proposed Terminal 5 gate complex project has a design life of 30-years, while the yard expansion has a design life of 50-years.

The gate complex has an estimated construction cost of \$11.79 million in 2020 US\$. At the end of the BCA's analysis period, it is projected to have a remaining life of 10 years. Using a linear depreciation method, the estimated remaining life value of the Project at the end of the BCA's analysis period is \$3.93 million. As a result, the gate complex has a residual value of \$611,457 (present value in 2020 US\$ discounted at 7 percent) when considering future maintenance and operating costs.

The yard expansion has an estimated construction cost of \$7.83 million in 2020 US\$. At the end of the BCA's analysis period, it is projected to have a remaining life of 30 years. Using a linear depreciation method, the estimated remaining life value of the Project at the end of the BCA's analysis period is \$4.70 million. As a result, the yard expansion has a residual value of \$830,752 (present value in 2020 US\$ discounted at 7 percent) when considering future maintenance and operating costs.

In total, the Project has a residual value of \$1.44 million (present value in 2020 US\$ discounted at 7 percent) when considering future maintenance and operating costs.

IV. CALCULATION OF BENEFITS – DETAILS

A. ECONOMIC COMPETITIVENESS & OPPORTUNITY

i. Reduction in Truck Wait Time

Truck queuing time will be reduced for export containers with the implementation of the Project, providing truck travel time savings for truck operators moving through Terminal 5. USDOT's BCA guidance value of \$32.00 (in 2020 US\$) was used to monetize truck operator waiting time at the terminal gates. Multiplying the monetized value of truck operator time by the average savings in truck wait time (15 minutes per export container) under the With-Project Scenario determined the total savings in truck wait time at the terminal. Therefore, the Project will save \$13.36 million (present value discounted at 7 percent in 2020 US\$) in fuel costs during truck wait time over the 20-year analysis period in the With-Project Scenario.

ii. Reduction in Highway Congestion Costs on SW Spokane St.

With the Project allowing an additional 100 trucks to queue on-terminal, the likelihood of trucks to spill over onto SW Spokane St. during peak hours is basically eliminated. The daily peak hour

truck volumes were estimated using industry standard peaking factors on total volumes and a total of 60 gate operating hours per week. An example of the calculation is provided below based on 2025 volumes.

Table 5: Summary of Calculation for Truck Queue on SW Spokane St.

Step	Values	Units
2025 volume (TEU)	688,119	TEU
TEU (twenty-foot equivalent unit) per container	1.80	TEU / container
2025 volume (containers)	382,288	containers
Average containers per week	7,352	containers
Gate peak hour	1.25	factor
Gate operating hours per week	60	hours
Peak hour volume	153	trucks
Truck capacity - Without-Project	100	trucks
Trucks on SW Spokane St. daily peak hour	53	trucks

Therefore, it is calculated that approximately 53 trucks will wait idling on SW Spokane St. at some point each day given the current location of the gate, adding congestion costs to the surrounding highways.

Based on a study conducted by ATRI⁴, the average annual congestion cost per truck was \$6,478 (2018 US\$, or \$6,962 in 2020 US\$). Therefore, in sticking with the previous example, the Project will save \$370,128 (2020 US\$) in truck congestion costs in 2025 in the With-Project Scenario. In total, the Project will save \$4.19 million (present value discounted at 7 percent in 2020 US\$) in congestion costs over the 20-year analysis period in the With-Project Scenario.

iii. Reduction in Truck Shifts

As previously explained, approximately 25% of NWSA exports come from areas where two truck turns (roundtrips) are possible considering optimal wait times at the terminal. In addition, 10% of these volumes are expected to be able to make the two truck turn times as a direct result of the Project. Continuing with the example of 2025 volumes, the below calculation summarizes how a reduction in truck shifts was determined for the purpose of this analysis.

⁴ <https://truckingresearch.org/wp-content/uploads/2018/10/ATRI-Cost-of-Congestion-to-the-Trucking-Industry-2018-Update-10-2018.pdf>

Table 6: Summary of Calculation for Trucker Shift Reduction

Step	Values	Units
2025 export volume (TEU)	324,817	TEU
TEU per container	1.80	TEU / container
2025 export volume (containers)	180,454	containers
Share of volumes from Ellensburg / Quincy	25%	Percent
Share of Ellensburg / Quincy volumes impacted by Project	10%	Percent
Export volume delivered in one shift vs two	4,511	containers
Decrease in number of shifts	2,256	containers
Hours per shift	12	hours / shift
Reduction in truck hours	27,068	hours

Therefore, it is calculated that approximately 27,068 truck hours will be saved in 2025 in the With-Project scenario.

Based on USDOT's BCA guidance value of \$32.00 (in 2020 US\$) and the previous example, the Project will save \$866,179 (2020 US\$) in trucker operating time costs in 2025 in the With-Project Scenario. In total, the Project will save \$8.02 million (present value discounted at 7 percent in 2020 US\$) in trucker operating time costs over the 20-year analysis period in the With-Project Scenario.

B. ENVIRONMENTAL SUSTAINABILITY

i. Reduction in Truck Queuing Time

With the Project, environmental sustainability benefits that primarily stem from the reduction in truck queuing (waiting) time will save \$539,959 (present value discounted at 7 percent in 2020 US\$ with CO₂ discounted at 3 percent) in truck emission benefits over the 20-year analysis period. The emission rate for CO₂ was provided by the U.S. Environmental Protection Agency, while emission rates for NO_x, PM_{2.5}, and SO_x were provided by the 2021 Emission Factor (EMFAC2021) for trucks. For this analysis, it is assumed that trucks idle at a speed of 5 miles per hour and burn 1 gallon per hour while idling⁵. Multiplying truck speed during idling by the average savings in truck wait time at the terminal gates from the With-Project Scenario, and then multiplying by the emission rates for trucks will provide the estimated decrease in highway emissions. Emission costs from the USDOT BCA guidance were used in this analysis.

⁵ [Furthering Your Fuel Economy \(truckstop.com\)](https://www.truckstop.com/furthering-your-fuel-economy)

Table 7: Summary of Vehicle Emission Factors (2020 US\$)

Emission Type	Emission Rate ⁶	Unit	US\$ / Metric Ton ⁷
CO ₂	10,180	grams / gallon	67
NO _x	0.80	grams / mile	17,850
PM _{2.5}	0.02	grams / mile	857,610
SO _x	0.01	grams / mile	48,455

Table 8: Summary of Highway Truck-Mile Emission Savings (Present Value 2020 US\$)

Emission Type	Emission Savings (tons)	PV of Benefits
CO ₂	12,076	\$470,115
NO _x	4.28	\$29,905
PM _{2.5}	0.12	\$38,768
SO _x	0.06	\$1,171
Total		\$539,959

⁶ For NO_x, PM_{2.5}, and SO_x, emission rates are averages for 20-year period between 2025 and 2044.

⁷ Emission costs are averages for 20-year period between 2025 and 2044