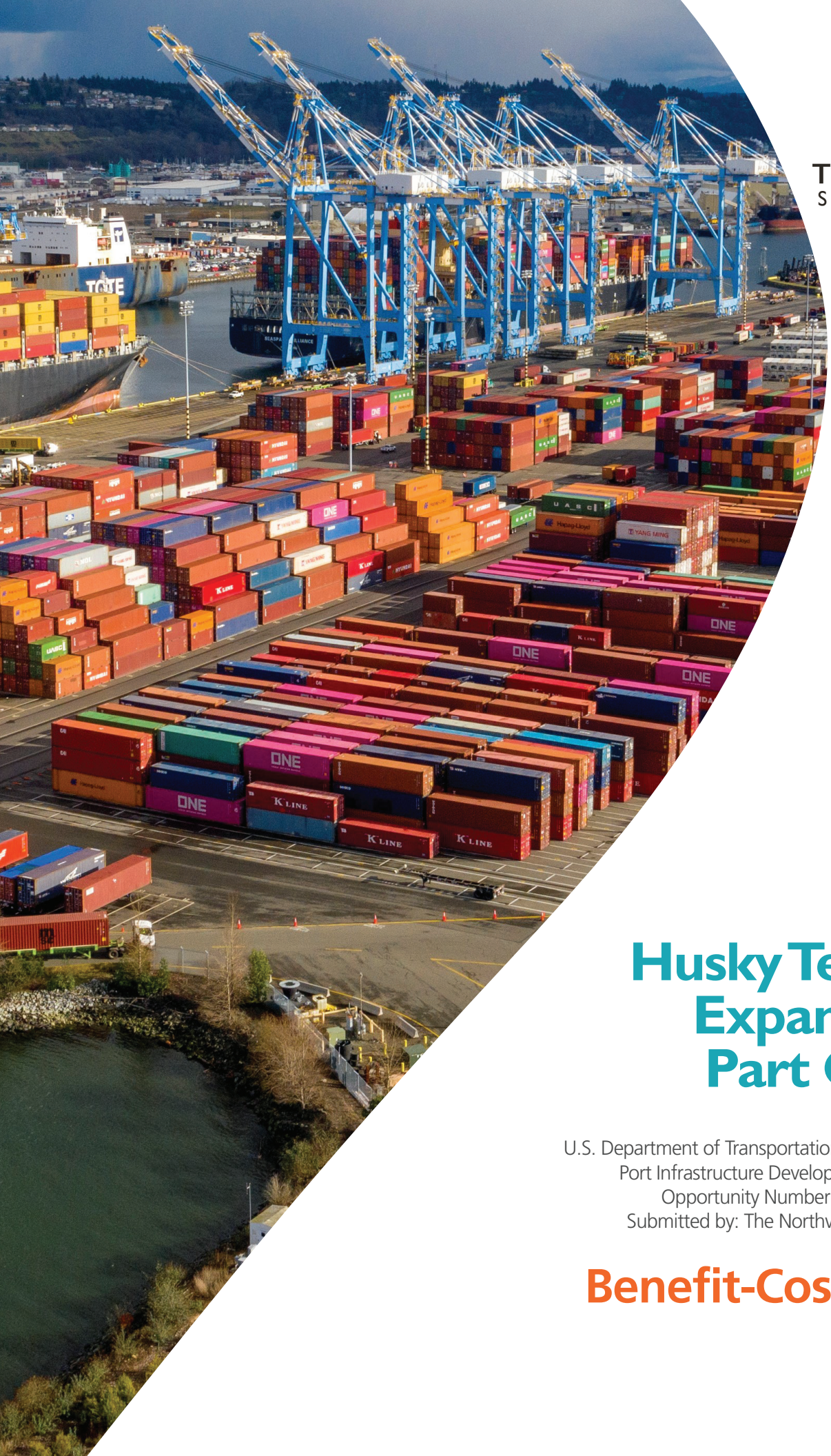

THE NORTHWEST
SEAPORT ALLIANCE
Gateway to Solutions

Husky Terminal Expansion Part One

U.S. Department of Transportation – Maritime Administration
Port Infrastructure Development Program (PIDP)
Opportunity Number MA-PID-23-001
Submitted by: The Northwest Seaport Alliance

Benefit-Cost Analysis

TABLE OF CONTENTS

I. OVERVIEW 1
II. SUMMARY OF BENEFITS 5
III. ASSUMPTIONS 6
A. Husky Volumes 6
i. Reefer Volumes & Capacity 6
ii. Avoided Increase in Truck Miles 8
B. Reduction in Port Operating Costs & Truck Turn Time 9
i. Terminal Operating Costs 9
ii. Truck Turn Times 9
C. Project Costs 12
D. Operating and Maintenance Costs 12
E. Residual Value 13
IV. CALCULATION OF BENEFITS – DETAILS 13
A. Component 1 14
i. Economic Competitiveness and Opportunity 14
ii. Environmental Sustainability 15
B. Component 2 15
i. Economic Competitveness and Opportunity 16
ii. Safety Outcomes 19
iii. Environmental Sustainability 21
C. Component 3 22
i. Economic Competitveness and Opportunity 22
ii. Environmental Sustainability 23

TABLE OF FIGURES

Figure 1: Project Components 1 & 2 2
Figure 2: Project Component 3 3
Figure 3: NWSA Husky Volume Projections 6
Figure 4: NWSA Reefer Volume Projections 7
Figure 5: Projected Diverted NWSA Reefer Volumes 8
Figure 6: Current & Future Truck Routes for Container Pick-up and Delivery 10
Figure 7: Marine Tower 11
Figure 8: RPM Portal 11
Figure 9: Old (Left) vs New (Right) Reefer Racks 20

LIST OF TABLES

Table 1: Project Component Details 1
Table 2: Summary of Benefits (PV Discounted @ 7%, in Millions) 4
Table 3: Project Component Benefits (PV Discounted @ 7% in 2021 US$, in Millions) 4
Table 4: NWSA ReeferContainer Capacity Estimate at International Terminals 7
Table 5: Avoided Increase in Truck Miles Over 20-Year Analysis Period 8
Table 6: Reduction in Operating Cost and Truck Time 9
Table 7:Average Distance Travelled (ft.) 10
Table 8: Summary of Total Project Costs (2021 US$) 12
Table 9: Summary of Total Operating & Maintenance Costs 12
Table 10: Summary of Total Residual Value (PV Discounted @ 7%, in 2021 US$) 13
Table 11: Summary of Project Benefits (PV Discounted @ 7% in 2021 US$) 14
Table 12: Summary of Project Component 1 Benefits (PV Discounted @ 7% in 2021US$) 14
Table 13: Component 1 Environmental Sustainability Benefits Summary 15
Table 14: Summary of Project Component 2 Benefits (PV Discounted @ 7% in 2021 US$) 16
Table 15: Savings in Truck Operating Costs (PV Discounted @ 7% in 2021 US$) 17
Table 16: Savings in Truck Travel Time (PV Discounted @ 7% in 2021 US$) 17
Table 17: Savings in Truck Maintenance Costs (PV Discounted @ 7% in 2021 US$) 18
Table 18: Congestion Costs Per Region Type 18
Table 19: Savings in Congestion Costs (PV Discounted @ 7% in 2021 US$) 18
Table 20: Noise Pollution Costs Per Region Type 19
Table 21: Savings in Noise Pollution Costs (PV Discounted @ 7% in 2021 US$) 19
Table 22: Expected Value of Truck Accidents Resulting in PDO, Injury, or Fatality 19
Table 23: Monetized Value of Crash by Severity Type (in 2021 US$) 20
Table 24: Avoided Increase in Truck Accidents Over 20-Year Analysis Period 20
Table 25: Avoided Increase in Truck Accidents (PV Discounted @ 7% in 2021 US$) 20
Table 26: Avoided Increase in Highway Truck Emissions (20-Year Analysis Period, Metric Tons) 21
Table 27: Avoided Increase in Highway Truck Emission Costs (PV Discounted @ 7% in 2021 US$) 22
Table 28: Summary of Project Component 3 Benefits (PV Discounted @ 7% in 2021 US$) 22
Table 29: Component 3 Environmental Sustainability Benefits Summary 23

I. OVERVIEW

The Northwest Seaport Alliance (NWSA, the Port) is requesting $56.6 million from the 2023 Port Infrastructure Development Program (PIDP) for the Husky Terminal Expansion Part One (the Project). Husky Terminal (the terminal), in Tacoma, Washington, is one of the NWSA's international container terminals. The Project will improve the safety, efficiency, and reliability of the movement of goods at the terminal. Table 1 provides details of each project component that will be addressed with the implementation of the Project.

Table 1: Project Component Details

Project Component	Construction Element
Component #1 **Re-Configuration of Container Storage Yard**	• Demolish rubber-tired gantry (RTG) runs • Relocate utilities, slot drains, light poles, fire hydrants • Pave and adjust/level terminal grade • Stripe pavement
Component #2 **Installation of Additional Refrigerated Cargo (Reefer) Racks and Power Supply**	• Increase off-terminal power supply to support reefer rack & other future terminal power needs • Install 40 reefer racks & power for reefer racks • Reconfigure existing reefer area • Install utilities, fire protection systems, and pavement
Component #3 **Relocation of Terminal Support Facilities**	• Demolish scale & security buildings, install utilities, construct modular office complex • Demolish North Intermodal Yard (NIM) Tower • Demolish Pier 3 Marine Tower • Relocate Customs & Border Protection (CBP) Radiation Portal Monitors (RPMs)

The Project will more than triple refrigerated container (reefer) capacity at the terminal, increase terminal operating cost efficiency by approximately 6%, and reduce truck turn times by approximately 8 minutes per gate move without increasing the footprint of the terminal. The capacity increases, operating efficiencies, and truck turn time reductions are broken out by component below. The Project consists of three components:

- **Component 1 – Reconfiguration of Container Yard / Decking Area**: Husky Terminal's uplands layout is still based on a previous, angled two-wharf configuration, not the single 3,000 ft continuous wharf configuration now in place. With Component 1, Husky will straighten the southern portion of the container yard to run parallel with the berth. The resulting more efficient layout will reduce truck turn times by eliminating circuitous truck routes and will improve on-terminal yard tractor transit times from vessel to yard and back, which will increase vessel production. In total, reconfiguring the container yard/decking area is likely to reduce port operating costs at the terminal by approximately 3.4% and turn times for trucks picking up or delivering containers by 5 minutes per truck move.
- **Component 2 – Installation of Additional Reefer Racks and Power Supply**: The installation of additional power supply and reefer racks will more than triple reefer capacity at the

terminal. If reefer container and related power capacity is not increased within the port, the region could reach the upper limits of its reefer capacity by 2030. As a result, incremental imports and exports would need to be diverted to alternate ports (i.e. Vancouver BC, Oakland CA, Hueneme CA), increasing truck miles and truck operating costs and reducing overall transportation efficiency. Additionally, new reefer racks will improve safety for mechanics by replacing ladders with stairs and catwalks for more efficient reefer maintenance and general access. Currently, reefer containers are accessed using ladders, which poses safety risks. Figure 1 illustrates Components 1 and 2:

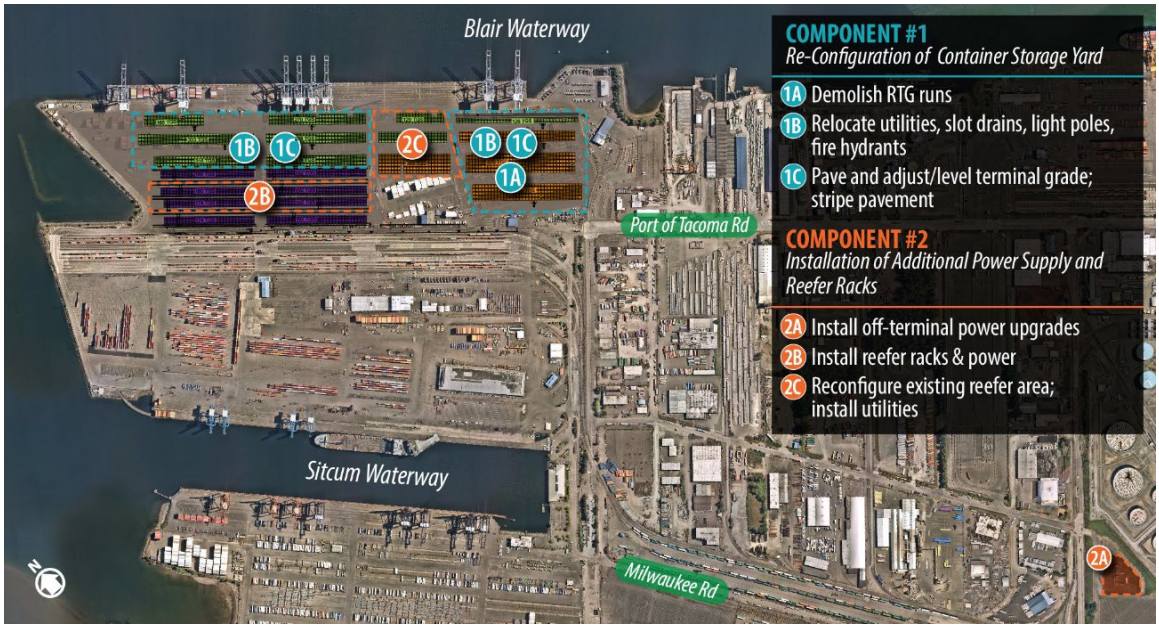

Figure 1: Project Components 1 & 2

- **Component 3 – Relocation of Terminal Support Facilities**: The current locations of the North Intermodal Yard (NIM) Tower, Marine Tower, and the Customs and Border Protection (CBP) Radiation Portal Monitors (RPMs) create traffic hazards and terminal operating inefficiencies affecting both trucks and yard tractors. The Marine Tower's proximity to new crane rails limits service to the new larger vessels the cranes are designed to service. In addition, the RPM and Marine Tower locations create unprotected intersections and increase the risk of accidents. Relocating these facilities will allow the terminal to work two 10,000+ TEU vessels simultaneously current capacity is one larger (10k+) and one smaller ship (6-8k). The Project will improve yard tractor transit times from vessel to yard and back, and improve truck gate operations. In total, relocating terminal support facilities is likely to reduce terminal operating costs by approximately 2.5% and truck turn times by 3 minutes per truck. Figure 2 illustrates the changes to the terminal.

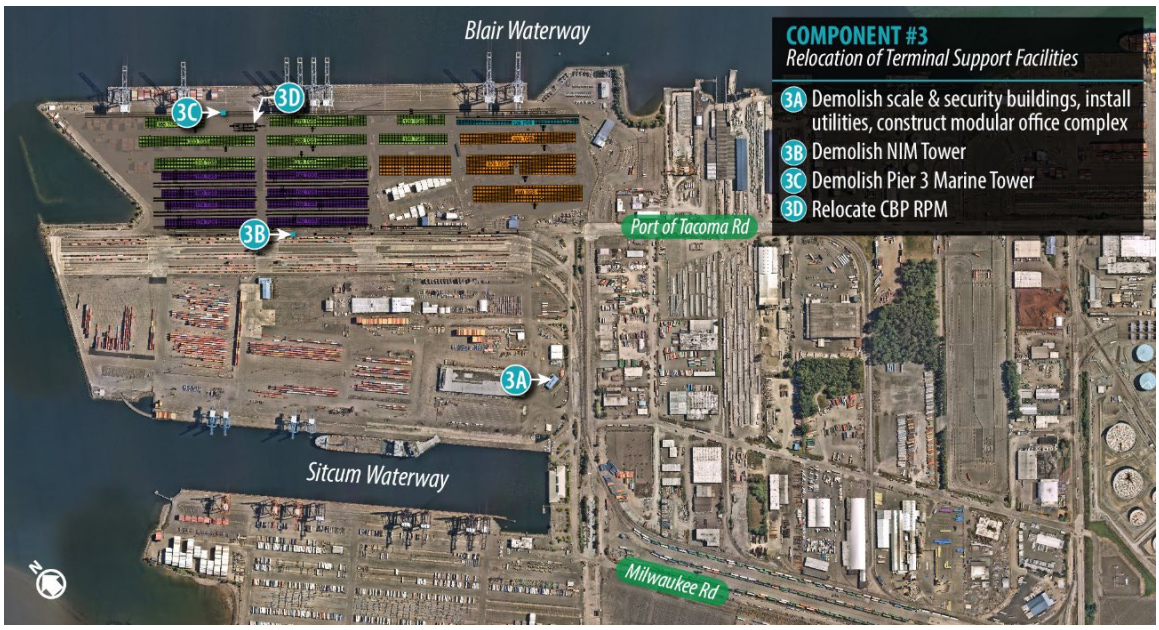

Figure 2: Project Component 3

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

- **With-Project Scenario:** Husky Terminal is reconfigured, increasing terminal capacity and efficiency and reducing operating costs. The terminal will have the ability to work two 10,000+ TEU vessels at the berth simultaneously, and the more efficient layout will have a significant reduction on both the yard tractor transit time from vessel to yard and the turn times of trucks delivering or picking up containers. The installation of reefer racks will allow the terminal to stack containers 5-high, up from current 2-high, increasing reefer capacity. This increase in reefer capacity will avoid the need for trucks to make longer trips to alternate ports for refirigerated cargo imports and exports due to capacity constraints at NWSA. The reefer racks will also reduce safety risks by replacing ladders with stairs and catwalks to access the reefers for maintenance.
- **Without-Project Scenario:** Husky Terminal remains in its current condition and layout, misaligned with the newly straightened berth. The locations of the NIM and Marine Towers and CBP Radiation Portal Monitors continue to cause disruptions in terminal operations efficiency and prevent the terminal from working larger vessels at berth simultaneously. Without the increase in reefer capacity, the NWSA will reach reefer capacity by 2030, diverting trucks to alternate ports for reefer imports and exports. The terminal will continue to stack reefer containers no more than 2-high due to limited maintenance and power access to reefers with the use of ladders and their related safety risks.

The Benefit-Cost Analysis (BCA) reflects the US Department of Transportation's (USDOT) standard guidance[1] regarding forecast periods and discount rates. As such, all estimates were calculated over a 20-year period, beginning in 2026 following completion of Project Component's 1 and 3 in 2025. Project Component 2 is expected to be completed in 2026. Additionally, a discount rate of 7% was used throughout the analysis (a discount rate of 3% was used for CO_2 emission benefits) as suggested in USDOT BCA guidelines for 2023[1]. **Husky Terminal Expansion Part One has an overall Benefit-to-Cost Ratio of 1.5.** The results of the BCA are summarized in Table 2. Table 3 provides the results for each Component.

Table 2: Summary of Benefits (PV Discounted @ 7%, in Millions)

Category	Present Value (2021 US$)
Economic Competitiveness	$88.10
Safety	$9.44
Environmental Sustainability	$39.80
Operating & Maintenance Costs	($9.60)
Residual Value	$12.12
Total Benefits	**$139.87**
Project Costs	$92.00
Net Present Value	$47.86
Benefit to Cost Ratio	**1.5**

Table 3: Project Component Benefits (PV Discounted @ 7% in 2021 US$, in Millions)

Category	Component 1	Component 2	Component 3
Economic Competitiveness	$29.54	$45.55	$13.01
Safety	$0.00	$9.44	$0.00
Environmental Sustainability	$1.06	$38.11	$0.63
Operating & Maintenance Costs	($2.57)	($6.03)	($0.99)
Residual Value	$2.99	$7.98	$1.15
Total Benefits	**$31.02**	**$95.05**	**$13.80**
Project Costs	$24.30	$58.32	$9.38
Net Present Value	$6.72	$36.72	$4.42
Benefit to Cost Ratio	**1.3**	**1.6**	**1.5**

[1] Benefit-Cost Analysis Guidance for Discretionary Grant Programs | US Department of Transportation

II. SUMMARY OF BENEFITS

This analysis quantifies the following benefits:

- **Reduction in terminal operating costs.** The terminal container yard layout is still based on a previous angled, two-wharf configuration, not the current single linear 3,000 ft continuous berth configuration. By straightening the eastern portion of the container yard to match the realigned berth and relocating key terminal buildings, a more efficient layout will reduce yard tractor transit times from vessel to yard and back. Additionally, this will allow the terminal to work two 10,000+ TEU vessels at the same time, increasing capacity from the current ability to service one smaller (6-8k) and one larger (10k+) ship.

- **Savings in truck turn times.** The reconfiguration of the terminal and relocation of key buildings will result in more efficient operations and shorter routes for truck drivers delivering or picking up a container, leading to reduced truck turn times at the terminal.

- **Avoided increase in truck miles.** Without the Project, it is expected that NWSA will reach reefer capacity by 2030. By reconfiguring the current layout of the terminal's reefer areas and installing reefer racks, the terminal will be able to handle the expected increase in reefer volumes for the Port. This will avoid the need to divert reefer imports and exports to alternative ports, providing savings in truck highway operating costs, safety, and emissions.

- **Increased terminal safety.** The new reefer racks will improve safety for the terminal's mechanics by replacing ladders with stairs and catwalks to access reefers more efficiently for maintenance, power, and general access.

III. ASSUMPTIONS

A. HUSKY VOLUMES

Figure 3 displays the forecasted annual terminal volumes over the analysis period. Forecasts assume that Husky volumes will recover to peak 2020 volumes by 2025, before continuing with trend line growth of approximately 2.5% going forward.

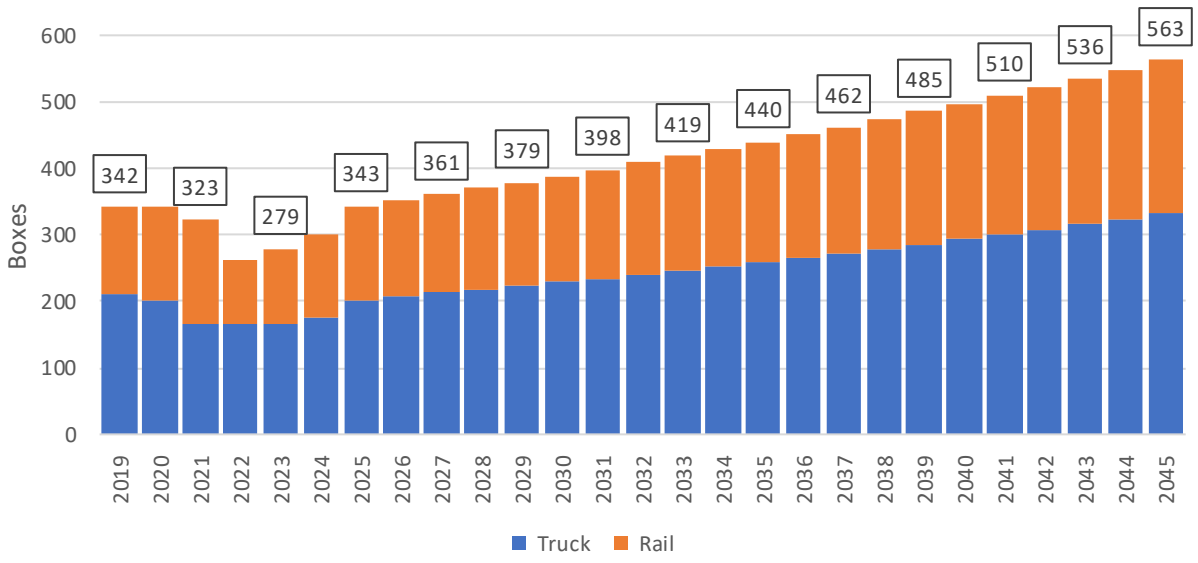

Figure 3: NWSA Husky Volume Projections

i. Reefer Volumes & Capacity

Figure 4 shows the projected international reefer volumes at NWSA over the analysis period. These volumes show similar growth profile as total volumes, with volumes expected to recover to 2020 levels by 2025. Going forward, international reefer volumes are expected to outpace total volumes with an expected trend growth of 3.0%. This reflects general trends in the region and initiatives at the Port.

For the purposes of this analysis, focus was placed on banana imports and frozen potato and fresh apple exports, a focus that reflects the importance of these trade flows to reefer supply chains in the region. These volumes account for roughly half of all reefer volumes, and the other half of reefer volumes have historically followed the same growth pattern Therefore, this analysis is somewhat conservative in nature.

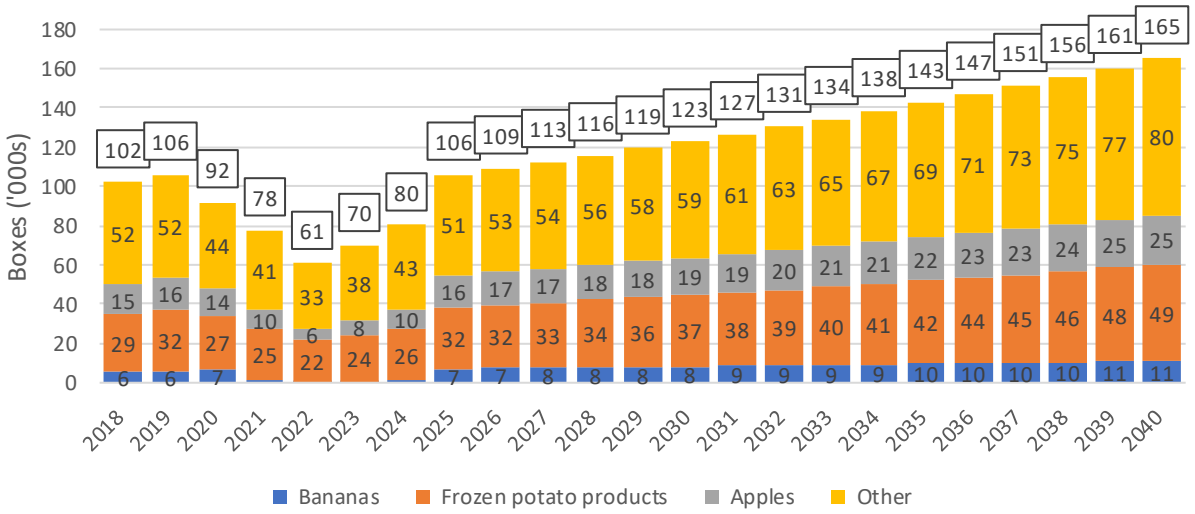

Figure 4: NWSA Reefer Volume Projections

Currently, the NWSA has an annual reefer handling capacity of roughly 126,000 reefer containers, as shown in Table 4. With the implementation of the Project, NWSA's reefer handling capacity will be increased to 151,000 reefer containers (Table 4). Currently, the terminal has 360 reefer plugs. Project Component 2 more than triples the reefer capacity through the addition of 40 5-high reefer racks, or 1,200 plugs. The standard estimate for annual reefer capacity is based on the number of reefer plugs multiplied by 40[2]. The terminal's annual reefer handling capacity will increase from 10,800 containers to 36,000 containers.

Capacity estimates at NWSA are based on the number of reefer plugs at each terminal. However, due to the seasonal surges in volumes dependent on commodity type (e.g. fresh apples peak between August and April) it is estimated that the actual reefer capacity is about 75% of the theoretical capacity provided by Table 4.

Table 4: NWSA ReeferContainer Capacity Estimate at International Terminals

	International Terminal	Reefer Plugs	Current Annual Capacity	Capacity With Project
South Harbor	East Sitcum Terminal	300	9,000	9,000
	Husky Terminal	**360 → 1,200**	**10,800**	**36,000**
	Washington United Terminal	884	26,520	26,520
	Pierce County Terminal	654	19,620	19,620
North Harbor:	Terminal 18	1,227	36,810	36,810
	Terminal 5	600	18,000	18,000
	Terminal 30	184	5,520	5,520
Total		**4,209 → 5,049**	**126,270**	**151,470**

[2] 6.0 days dwell; 1.4 peaking factor

Based on the assumed growth in reefer volumes at NWSA and the terminal, the Port is expected to reach its reefer capacity by 2030, and future import and export reefer volumes will need to be diverted to alternate ports (i.e. Hueneme, CA, Oakland, CA, or Vancouver BC). Figure 5 shows the projected increase in diverted reefer volumes from NWSA beginning in 2031. Diverted volumes are capped at 25,200 containers for the purposes of this analysis since benefits above the added capacity would not be related to the Project. In reality, exporters in the NWSA region are already forced to divert volumes to alternative ports due to capacity and scheduling issues.

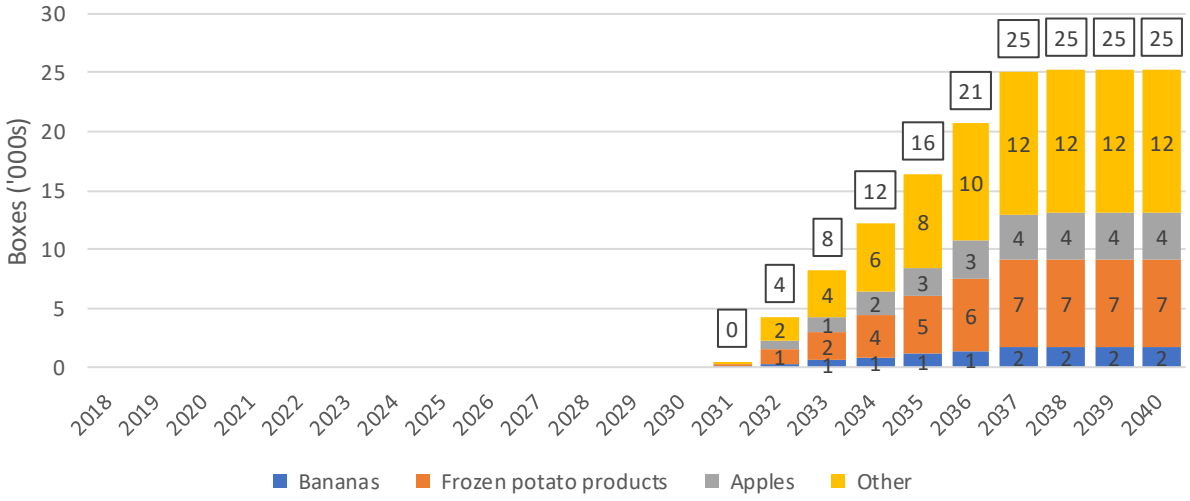

Figure 5: Projected Diverted NWSA Reefer Volumes

ii. Avoided Increase in Truck Miles

If the Port does not increase its reefer capacity, there will be a significant increase in truck miles due to cargo being diverted to/from Oakland, CA, Hueneme, CA and Vancouver, BC.

The Port has already seen loss of reefer imports to other West Coast ports due to capacity issues. For example, in 2020 the NWSA imported over 7,000 reefer containers of bananas. In 2021 these volumes began to shift to the Port of Hueneme to be trucked north for local consumption due to capacity issues at the NWSA. With added capacity, these volumes would likely shift back to the NWSA and reduce truck miles travelled due to the diversion.

Additionally, without the Project, exports could be diverted to either Oakland or Vancouver BC. Based on the projected reefer volumes, the Project will avoid over 83.65 million truck miles over the analysis period, reflected in Table 5.

Table 5: Avoided Increase in Truck Miles Over 20-Year Analysis Period

Commodity Type	Import / Export	Alternate Port	Distance to Alternate Port	Avoided Increase in Truck Miles
Bananas	Import	Hueneme	1,125	21,829,637
Frozen Potato Products	Export	Oakland / Vancouver BC	475	40,778,148
Apples	Export	Oakland / Vancouver BC	475	21,047,191
			Total	**83,654,976**

B. Reduction in Port Operating Costs & Truck Turn Time

Current terminal yard layout causes on-terminal congestion. With the Project, the terminal's yard layout will be reconfigured to match the new linear berth alignment (Component 1) and key terminal buildings in locations that affect terminal operations will be relocated (Component 3) to accommodate the expected increase in truck gate volumes, improving terminal efficiency and port capacity. In total, Components 1 and 3 will provide savings in port operating costs of $10 per container and reduction in truck time of 8 minutes per gate move at the terminal, as shown in Table 6.[3]

Table 6: Reduction in Operating Cost and Truck Time

Category	Component 1	Component 3	Unit
Port Operating Cost Savings	$7.87	$2.13	$ /container
Savings in Truck Time	5	3	min / gate move

i. Terminal Operating Costs

The Port anticipates up to 25% increase in terminal vessel production with an improved terminal layout, densification, yard tractor and truck traffic optimization, and technology included in the Project. Current vessel production averages 25 moves per hour. Current cranes canoutperform container yard (CY) equipment, causing cranes to idle between container moves waiting for equipment to return to the hook. Yard tractors working the vessel are hindered by on-terminal truck congestion, a circuitous terminal layout, long travel distances, and small container bays that require frequent transit of container handling equipment to new work areas. Through a combination of densification, reduced travel distance, and optimized traffic patterns, the terminal can reduce the crane idle time between moves from 40-50 seconds to approximately 10 seconds in between lifts, which would increase productivity by as much as 6 moves per hour, or 25%.

This translates into a reduction in operating costs of approximately $10 per container. It is estimated that Project Component 1 is responsible for $7.87 per container in cost reduction, while Project Component 3 is responsible for $2.13 per container.[3]

ii. Truck Turn Times

As shown in Table 7 and Figure 6, truck container delivery and pick-up distances will be reduced by 35%, or 2,700 ft, with the Project. Current truck turn times are on average 43 minutes per truck, with delays caused by the current inefficient terminal lay-out. In total, the Project is estimated to reduce truck turn times by 8 minutes per truck (Component 1 = 5 min. reduction + Component 3 = 3 min. reduction). With the Project, average truck turn times will be reduced from 43 minutes to 35 minutes per truck.

[3] Please do not publish or make this information available without prior NWSA approval.

Table 7:Average Distance Travelled (ft.)

	Before	After	Reduction
Import	5,050	4,600	(9)%
Export	3,650	3,300	(10)%
Empty	5,330	1,200	(77)%
Reefer	1,700	1,700	-
Exit	3,100	2,050	(34)%
Total	**7,800**	**5,100**	**(35)%**

Project Component 1, and the straightening of the southern yard (right in the graphic below), will reduce on-terminal truck congestion and related back-ups at the truck gate, comprising the bulk of the truck turn times savings. As shown in Figure 6, a truck entering the terminal today to drop off an export container and/or pick up an import, has to travel a long distance to complete a full turn. The Project will provide a more efficient terminal layout and reduce truck turn times. In total, Project Component 1 will reduce truck turn time by approximately 5 minutes per truck.



Figure 6: Current & Future Truck Routes for Container Pick-up and Delivery[4]

[4] Blue in the "future" image refers to RTG work Husky will be pursuing regardless of grant award; green and purple portions indicate grant work

Project Component 3 will relocate terminal buildings that currently cause on-terminal congestion by removing the pinch points caused by these buildings. This will eliminate friction points among trucks and yard tractors, improving truck turn times. Figures 7 and 8 illustrate the locations of two of these buildings.

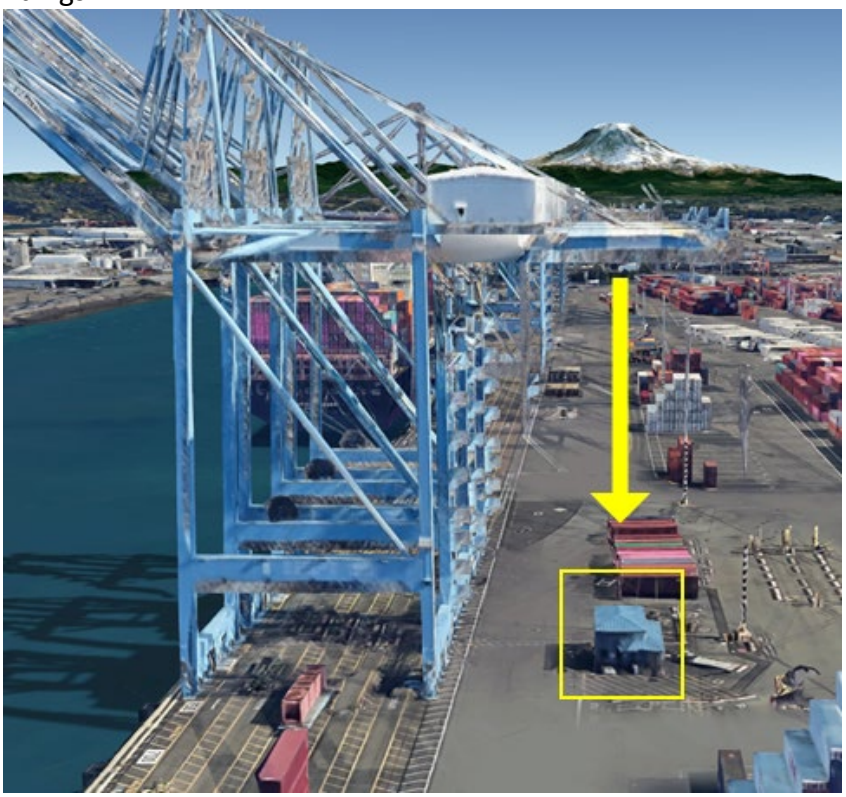

Figure 7: Marine Tower



Figure 8: RPM Portal

C. Project Costs

The total cost of the Project is estimated to be $125.95 million in 2021 US$, as shown in Table 8, and has a present value of $92.00 million (discounted at 7%). Project Components 1 and 3 are assumed to be completed in 2025, while Component 2 will be completed in 2026.

Table 8: Summary of Total Project Costs (2021 US$)

Project Component	Project Cost	PV
Component 1		
Demolish rubber-tired gantry (RTG) runs	$4,550,000	$3,471,173
Pave and adjust / level terminal grade	$6,100,000	$4,653,661
Relocate utilities, slot drains, light poles, fire hydrants	$20,300,000	$15,486,773
Pavement striping	$900,000	$686,606
Subtotal	**$31,850,000**	**$24,298,213**
Component 2		
Install 40 reefer racks & power for reefer racks	$68,500,000	$48,839,553
Tacoma Power Infrastructure Project	$9,700,000	$6,915,966
Reconfigure part of central yard reefers & pavement, utilities and fire protection systems	$3,600,000	$2,566,750
Subtotal	**$81,800,000**	**$58,322,269**
Component 3		
Relocate Customs & Border Protection RPM	$1,300,000	$991,764
Demo NIM Tower	$300,000	$228,869
Demo site & construct modular buildings (NWSA)	$10,600,000	$8,086,689
Demolish Pier 3 Marine Tower	$100,000	$76,290
Subtotal	**$12,300,000**	**$9,383,611**
Total Project Cost	**$125,950,000**	**$92,004,093**

D. Operating and Maintenance Costs

Ongoing maintenance costs of the Project are expected to be approximately $1.26 million (present value discounted at 7% in 2021 US$) over the 20-year analysis period. This assumes that annual operating and maintenance costs are approximately 1.0% of total project costs. The breakdown of expected operating and maintenance costs over the analysis period are represented in Table 9.

Table 9: Summary of Total Operating & Maintenance Costs

Project Component	Project Construction Cost	% of Project Cost	Annual Operating & Maintenance Cost
Component 1	$31,850,000	1.00 %	$318,500
Component 2	$81,800,000	1.00 %	$818,000
Component 3	$12,300,000	1.00 %	$123,000
Total O&M Cost	**$125,950,000**		**$1,259,500**

E. Residual Value

Component 1 has an estimated construction cost of $31.85 million in 2021 US$. At the end of the BCA's 20-year analysis period, it is projected to have a remaining life of 30 years. Using a linear depreciation method, the estimated remaining life of the Project at the end of the BCA's analysis period is $19.11 million. As a result, Component 1 has a residual value of $2.99 million (present value discounted at 7% in 2021 US$) when considering future maintenance and operating costs.

Component 2 has an estimated construction cost of $81.80 million in 2021 US$. At the end of the BCA's 20-year analysis period, it is projected to have a remaining life of 30 years. Using a linear depreciation method, the estimated remaining life of the Project at the end of the BCA's analysis period is $50.72 million. As a result, Component 2 has a residual value of $7.98 million (present value discounted at 7% in 2021 US$) when considering future maintenance and operating costs.

Component 3 has an estimated construction cost of $12.30 million in 2021 US$. At the end of the BCA's 20-year analysis period, it is projected to have a remaining life of 30 years**.** Using a linear depreciation method, the estimated remaining life of the Project at the end of the BCA's analysis period is $7.38 million. As a result, Component 3 has a residual value of $1.15 million (present value discounted at 7% in 2021 US$) when considering future maintenance and operating costs.

In total, the Project has a residual value of $12.12 million (present value discounted at 7% in 2021 US$) when including future maintenance and operating costs at the end of the 20-year analysis period.

Table 10: Summary of Total Residual Value (PV Discounted @ 7%, in 2021 US$)

Project Component	Project Construction Cost	Projected Remaining Life	Residual Value
Component 1	$31,850,000	30	$2,988,293
Component 2	$81,800,000	31	$7,977,533
Component 3	$12,300,000	30	$1,154,035
Total Residual Value	**$125,950,000**		**$12,119,861**

IV. Calculation of Benefits – Details

Husky Terminal Expansion Part One is composed of three components, each generating its own stream of benefits. The benefits associated with each Project Component are outlined in this section of the report. Table 11 highlights the benefits of each Project Component over the 20-year analysis period.

Table 11: Summary of Project Benefits (PV Discounted @ 7% in 2021 US$)

Project Component	Economic Competitiveness & Opportunity	Safety Outcome	Environmental Sustainability	Total Benefits
Component 1	$29,544,404	$0	$1,057,478	**$30,601,882**
Component 2	$45,549,402	$9,436,459	$38,110,153	**$93,096,015**
Component 3	$13,010,473	$0	$634,487	**$13,644,960**
Total Project Benefits	**$88,104,280**	**$9,436,459**	**$39,802,118**	**$137,342,857**

A. Component 1

Project Component 1, which includes the reconfiguration and densificiation of the standard container stacks on the terminal, and alignment of the terminal with the new linear 3,000 ft single berth, will reduce truck turn times by 5 minutes for each truck entering the terminal gate and reduce port and terminal operating costs by $7.87 per container**Error! Bookmark not defined.**. As a result, Project Component 1 will provide $30.60 million (present value discounted at 7% in 2021 US$) in benefits, due to reduced port operating costs and truck turn time over the 20-year analysis period, shown in Table 12.

Table 12: Summary of Project Component 1 Benefits (PV Discounted @ 7% in 2021US$)

Category	PV of Benefits
Economic Competitiveness & Opportunity	
Reduction in port operating costs	$24,067,242
Reduction in truck wait time	$5,477,162
Subtotal	**$29,544,404**
Environmental Sustainability	
Reduction in truck emissions	$1,057,478
Subtotal	**$1,057,478**
Total Benefits of Component 1	**$30,601,882**

i. Economic Competitiveness and Opportunity

Reduction in Terminal Operating Costs

Due to Project Component 1, terminal operating costs are expected be reduced by $7.87 per container.[5] Multiplying the reduction in per-container operating costs by Husky Terminal's total volumes determines the total savings in terminal operating costs with the reconfiguration of the terminal's layout in Project Component 1. As a result, Component 1 will save $24.07 million (present value discounted at 7% in 2021 US$) in reduced terminal operating costs over the 20-year analysis period.

Reduction in Truck Wait Time Costs

[5] Please do not publish or make this information available without prior NWSA approval.

Component 1 and the more efficient terminal layout are also expected to reduce truck turn time by 5 minutes per container. USDOT's BCA guidance[1] value of $32.40 (in 2021 US$) was used to monetize truck operator time within the terminal gates. Multiplying the monetized value of truck operator time by the average savings in truck turn time under Project Component 1 determined the total turn time savings for each truck entering the terminal. Based on this analysis, Component 1 will save $5.48 million (present value discounted at 7% in 2021 US$) in truck fuel costs over the analysis period.

ii. Environmental Sustainability

Reduction in On-terminal Truck Emissions

Component 1 will reduce truck turn times at the terminal, reducing emissions. The emission rate for CO_2 was provided by the U.S. Environmental Protection Agency (10,180 grams of CO_2 per gallon of diesel burned[6]), while emission rates for NO_X, $PM_{2.5}$, and SO_x were provided by the 2021 Emission Factor (EMFAC 2021) for trucks. For this analysis, it is assumed that trucks average a speed of 5 miles per hour when inside the terminal. Multiplying truck speed by the average savings in truck turn time and by the emission rates for trucks will provide the estimated decrease in truck emissions within the terminal. Emission costs from the USDOT BCA guidance[1] were used in this analysis. Applying USDOT emission costs to the avoided increase in emissions determined that Component 1 will save $1.06 million (present value discounted at 7% and 3% for CO2 in 2021 US$) in truck emissions due to reduced truck turn time over the 20-year analysis period, as shown in Table 13.

Table 13: Component 1 Environmental Sustainability Benefits Summary

Category	Emission Savings (Metric Tons)	Emission Cost Savings (2021 US$)
CO_2	22,487	$1,027,951
NO_x	1.75	$12,606
$PM_{2.5}$	0.05	$16,429
SO_x	0.02	$492
Total Emission Savings of Component 1		**$1,057,478**

B. Component 2

Currently, reefer capacity at the terminal is limited by a lack of reefer plugs and storage racks that densify the reefer area. Without the Project, NWSA is expected to reach its maximum reefer capacity by 2030. If the terminal's reefer container capacity is not increased, reefer imports and exports will then be diverted to alternate ports (i.e. Hueneme, CA; Vancouver, BC; and Oakland, CA), increasing truck miles. With the installation of 40 reefer racks, reefers can be stacked 5- instead of 2-high. By increasing reefer capacity by 25,200 containers – up from 10,800 containers to 36,000 containers annually, the Port expects to remove the need for trucks to travel to alternate ports. To be conservative, the analysis focused on three alternatve ports: Hueneme and Okland in California, and Vancouver, BC, and three leading reefer commodities: Apples, frozen

[6] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

potato products, and bananas. In addition, the new reefer racks will improve the safety for mechanics by replacing ladders with stairs and catwalks to access reefers more efficiently. Project Component 2 is expected to provide $93.10 million (present value discounted at 7% in 2021 US$) in benefits over the 20-year analysis period, as shown in Table 14.

Table 14: Summary of Project Component 2 Benefits (PV Discounted @ 7% in 2021 US$)

Category	PV of Benefits
Economic Competitiveness & Opportunity	
Avoided increase in truck operating costs	$24,653,518
Avoided increase in truck travel time	$14,379,370
Avoided increase in truck maintenance costs	$4,012,840
Avoided increase in congestion	$2,328,659
Avoided increase in noise pollution	$175,016
Subtotal	**$45,549,402**
Safety Outcome	
Avoided increase in truck accidents	$7,860,201
Reduction in ladder accidents	$1,576,258
Subtotal	**$9,436,459**
Environmental Sustainability	
Avoided increase in CO2 emissions	$37,264,817
Avoided increase in NOx emissions	$359,718
Avoided increase in NOx emissions	$471,968
Avoided increase in PM2.5 emissions	$13,650
Subtotal	**$38,110,153**
Total Benefits of Component 2	**$93,096,015**

i. Economic Competitveness and Opportunity

With the Project, the installation of reefer racks will increase reefer capacity at the terminal, avoiding an increase in truck miles resulting from diverted cargo. Project Component 2 will avoid increases in highway costs such as truck operating and travel time as well as highway congestion, noise pollution, and maintenance.

Avoided Increase in Truck Operating Costs

The Project will provide savings in operating costs for truckers moving refrigerated cargo that would have otherwise been diverted to/from the Ports of Hueneme, CA, Oakland, CA, or Vacouver, BC. Based on the USDOT BCA guidance[1], truck operating costs are $1.01 per mile. (See Table 5 above for mileage assumptions.) By applying truck operating costs to the avoided increase in truck miles, Component 2 will save $24.65 million (present value discounted at 7% in 2021 US$) in operating costs over the 20-year analysis period, for the commodities shown in Table 15. Using these commodities, comprising approximately half of NWSA refrigerated exports, reflects a conservative approach to estimated savings.

Table 15: Savings in Truck Operating Costs (PV Discounted @ 7% in 2021 US$)

Reefer Commodity	Savings in Operating Costs
Bananas	$6,433,297
Frozen Potato Products	$12,017,514
Apples	$6,202,707
Total Savings in Operating Costs	**$24,653,518**

Avoided Increase in Highway Truck Travel Time

Component 2 will provide savings in truck travel time because it avoids refrigerated container diversion to other ports (e.g. Hueneme, CA; Vancouver, BC; and Oakland, CA, see Table 5 above for mileage assumptions). An average truck speed of 55 miles per hour was applied to the avoided increase in truck miles to determine hours of truck travel time saved. Component 2 will save nearly 1.52 million truck hours over the 20-year analysis period.

Using USDOT's BCA guidance[1] for average truck ocucupancy (one driver) and truck travel time savings ($32.40 per hour), the monetized value of truck travel time savings with the Project was determined. Component 2 will provide $14.38 million (present value discounted at 7% in 2021 US$) in over-the-road truck travel time savings over the analysis period, as shown in Table 16. Using these commodities that comprise approximately half of NWSA refrigerated exports reflect a conservative approach to these estimated savings.

Table 16: Savings in Truck Travel Time (PV Discounted @ 7% in 2021 US$)

Reefer Commodity	Avoided Truck Hours	Savings in Travel Time Costs
Bananas	396,902	$3,752,274
Frozen Potato Products	741,421	$7,009,315
Apples	382,676	$3,617,781
Total Truck Travel Time Savings	**1,521,000**	**$14,379,370**

Avoided Increase in Highway Maintenance Costs

Pavement costs for urban and rural interstates were considered in this analysis. Based on Federal Highway Administration[7] values represented in 1994 dollars, pavement costs for trucks in urban areas were $0.10 per mile, while rural interstates had no pavement costs. Taking the weighted average of the urban and rural pavement costs by share of region type and inflating the pavement cost to 2021 dollars resulted in a pavement maintenance cost of $0.16 per mile for trucks. Multiplying pavement maintenance costs by the avoided increase in truck miles determined that Component 2 will provide $4.01 million (present value discounted at 7% in 2021 US$) in highway maintenance savings over the 20-year analysis period, as shown in Table 17. Using these commodities, comprising approximately half of NWSA refrigerated exports, reflects a conservative approach to estimated savings.

[7] https://www.fhwa.dot.gov/policy/hcas/addendum.cfm

Table 17: Savings in Truck Maintenance Costs (PV Discounted @ 7% in 2021 US$)

Reefer Commodity	Savings in Maintenance Costs
Bananas	$1,047,144
Frozen Potato Products	$1,956,084
Apples	$1,009,611
Total Savings in Truck Maintenance Costs	**$4,012,840**

Avoided Increase in Highway Congestion Costs for Trucks

Increased highway congestion costs from the USDOT BCA guidance[1] were considered in this analysis for urban and rural regions, shown in Table 18. Given that the majority of truck miles saved would be on rural highways between ports and origins and destinations of refrigerated containers, the analysis assumed 90% of highways are in rural areas.

Table 18: Congestion Costs Per Region Type

Region Type	Share of Highway	Congestion Cost (2021 US$ / mile)
Urban	10%	0.3240
Rural	90%	0.0700
Congestion Cost		**0.0954**

After multiplying congestion costs by the avoided increase in truck miles, Component 2 will save $2.33 million (present value discounted at 7% in 2021 US$) in congestion costs over the analysis period, as shown in Table 19. Using these commodities, comprising approximately half of NWSA refrigerated exports reflects a conservative approach to these estimated savings.

Table 19: Savings in Congestion Costs (PV Discounted @ 7% in 2021 US$)

Reefer Commodity	Savings in Congestion Costs
Bananas	$607,660
Frozen Potato Products	$1,135,120
Apples	$585,879
Total Savings in Congestion Costs	**$2,328,659**

Avoided Increase in Truck Related Highway Noise Pollution

USDOT BCA guidance[1] noise pollution costs for trucks in urban and rural regions, shown in Table 20, was used to calculate the avoided increase in truck noise pollution costs due to the Project. Given that the majority of truck miles saved would be on rural highways between Ports and origins and destinations of refrigerated containers, the analysis assumed 90% of highways are in rural areas.

Table 20: Noise Pollution Costs Per Region Type

Region Type	Share of Highway	Noise Pollution (2021 US$ / mile)
Urban	10%	0.0411
Rural	90%	0.0034
Noise Pollution Cost		**0.0072**

Multiplying noise pollution costs by the avoided increase in truck miles, Component 2 will provide $175,016 (present value discounted at 7% in 2021 US$) in savings in noise pollution over the 20-year analysis period, as shown in Table 21. Using these commodities, comprising approximately half of NWSA refrigerated exports, reflects a conservative approach to estimated savings.

Table 21: Savings in Noise Pollution Costs (PV Discounted @ 7% in 2021 US$)

Reefer Commodity	Savings in Noise Pollution Costs
Bananas	$45,670
Frozen Potato Products	$85,312
Apples	$44,033
Total Savings in Noise Pollution Costs	**$175,016**

ii. Safety Outcomes

Avoided Increase in Highway Truck Accidents

Diverting cargo from the NWSA to alternate ports will increase highway safety risks for truckers. By avoiding this increase in truck miles, Project Component 2 will reduce the probability of truck accidents. Table 22 shows the expected values – in incidents per 100 million vehicle miles traveled (VMT) – for a highway accident resulting in property damage only (PDO), an injury, or a fatality used in this analysis, as provided by USDOT NHTSA[8].

Table 22: Expected Value of Truck Accidents Resulting in PDO, Injury, or Fatality

Accident Severity Type	Expected Value (incidents / 100 million VMT)
PDO	141
Injury	85
Fatality	1.2

Multiplying the expected number of accidents by the avoided increase in truck miles provides the estimated reduction in truck accidents With the Project. The monetized value for each crash severity type was provided by USDOT's BCA guidance[1], shown in Table 23.

[8] https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812806

Table 23: Monetized Value of Crash by Severity Type (in 2021 US$)

Accident Severity Type	Monetized Value of Crash Severity
PDO	$4,000
Injury	$213,900
Fatality	$11,600,000

By avoiding additional truck miles due to diversion to other ports, Component 2 will prevent more than 190 truck accidents, as shown in Table 24. This is expected to provide $7.86 million (present value discounted at 7% in 2021 US$) in truck safety benefits over the analysis period, shown in Table 25. Using these commodities, comprising approximately half of NWSA refrigerated exports, reflects a conservative approach to estimated savings.

Table 24: Avoided Increase in Truck Accidents Over 20-Year Analysis Period

Category	PDO	Injury	Fatality	Total
Bananas	31	19	0	**50**
Frozen Potato Products	57	35	0	**93**
Apples	30	18	0	**48**
Total Avoided Increse in Truck Accidents	**118**	**71**	**1**	**190**

Table 25: Avoided Increase in Truck Accidents (PV Discounted @ 7% in 2021 US$)

Category	PDO	Injury	Fatality	Total
Bananas	$35,925	$1,158,089	$857,094	**$2,051,107**
Frozen Potato Products	$67,108	$2,163,331	$1,601,066	**$3,831,505**
Apples	$34,637	$1,116,579	$826,373	**$1,977,589**
Total Avoided Increse in Truck Accidents	**$137,669**	**$4,437,999**	**$3,284,532**	**$7,860,201**

Reduction in Ladder Accidents

The installation of 40 reefer racks in Component 2 will improve terminal safety for mechanics at the terminal. Today, reefer containers are stacked two-high and mechanics must climb mobile ladders to plug in power and service them. As shown in Figure 9, the use of ladders to access reefers poses safety concerns.



Figure 9: Old (Left) vs New (Right) Reefer Racks

According to BLS[9], in 2020 there were 22,710 injuries where the primary source of the injury was a ladder. Assuming that half of all reefer imports at the terminal need to be accessed by ladder (stacked container), that means a mechanic needs to make use of a ladder at least 5,000 times per year. This is based on an estimate for an annual throughput volume of 10,800 reefers. (See Table 15.)

For the purposes of this analysis it was assumed that the use of reefer racks will eliminate the risk of ladder accidents at the terminal. Given the lack of data on such risks, and for simplicity, it was assumed that in total Component 2 will eliminate one (1) ladder accident per year. Based on USDOT unknown severity injury costs of $213,900 per incident, it is estimate that Component 2 will provide $1.58 million present value discounted at 7% in 2021 US$) in safety benefits over the 20-year analysis period.

iii. Environmental Sustainability

Avoided Increase in Truck Emissions

Diverting refrigerated cargo from the NWSA to alternate ports will increase truck emissions due to increased truck miles. The emission types analyzed in this study to calculate the environmental benefits of Project Component 2 were CO_2, NO_X, $PM_{2.5}$, and SO_x. For CO_2, a rate of 10,180 grams of CO_2 per gallon of diesel burned was used[10]. The remaining emissions types utilized metrics provided by EMFAC[11].

Based on USDOT's BCA guidance[1] recommendations, benefits associated with CO_2 emissions were discounted at 3%, while benefits associated with NO_X, $PM_{2.5}$, and SO_x emissions were discounted at 7%. USDOT emission costs were applied to the avoided increase in greenhouse gas emissions to determine the overall savings in emissions of Project Component 2. As a result, Component 2 will save $38.11 million (present value discounted at 7% and 3% for CO_2 in 2021 US$) in truck emissions due to avoided truck trips to other, more distant ports over the 20-year analysis period, as shown in Table 26 and Table 27. Using these commodities, comprising approximately half of NWSA refrigerated exports, reflects a conservative approach to estimated savings.

Table 26: Avoided Increase in Highway Truck Emissions (20-Year Analysis Period, Metric Tons)

Category	CO_2	NO_X	$PM_{2.5}$	SO_X	Total
Bananas	222,226	17	0	0	222,243
Frozen Potato Products	415,122	32	1	0	415,155
Apples	214,260	16	0	0	214,277
Avoided Increse in Truck Emissions	**851,608**	**65**	**2**	**1**	**851,675**

[9] https://www.bls.gov/opub/ted/2022/fatal-injuries-from-ladders-down-in-2020-nonfatal-ladder-injuries-were-essentially-unchanged.htm
[10] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
[11] https://arb.ca.gov/emfac/

Table 27: Avoided Increase in Highway Truck Emission Costs (PV Discounted @ 7% in 2021 US$)

Category	CO_2	NO_X	$PM_{2.5}$	SO_X	Total
Bananas	$9,724,196	$93,868	$123,159	$3,562	9,944,785
Frozen Potato Products	$18,164,971	$175,347	$230,064	$6,654	18,577,036
Apples	$9,375,649	$90,503	$118,745	$3,434	9,588,332
Avoided Increase in Truck Emission Costs	**$37,264,817**	**$359,718**	**$471,968**	**$13,650**	**$38,110,153**

C. Component 3

Project Component 3 will reduce terminal truck turn times by 3 minutes per trip per container and reduce terminal operating costs by $2.13 per container.[12] As a result, Project Component 3 will provide $13.64 million (present value discounted at 7% in 2021 US$) in savings in terminal operating costs and truck wait time at Husky Terminal over the 20-year analysis period, as shown in Table 28.

Table 28: Summary of Project Component 3 Benefits (PV Discounted @ 7% in 2021 US$)

Category	PV of Benefits
Economic Competitiveness & Opportunity	
Reduction in port operating costs	$9,724,176
Reduction in truck wait time	$3,286,297
Subtotal	**$13,010,473**
Environmental Sustainability	
Reduction in truck emissions	$634,487
Subtotal	**$634,487**
Total Benefits of Component 1	**$13,644,960**

i. Economic Competitveness and Opportunity

Reduction in Port Operating Costs

For this analysis, it is assumed that terminal operating costs will be reduced by $2.13 per container due to the relocation of terminal functions that prohibit efficient truck and yard tractor movement provided by Project Component 3.[12] The reduction in terminal operating costs was then multiplied by Husky volumes to determine the total savings in terminal operating costs with the more efficient terminal layout in Project Component 3. As a result, Component 3 will save $9.72 million (present value discounted at 7% in 2021 US$) in reduced terminal operating costs over the analysis period.

Reduction in Truck Turn Time

Component 3 and the more efficient temrinal layout will reduce truck turn time by an average of 3 minutes per trip for each truck entering the gate. The combined turn time reduction for all

[12] Please do not publish or make this information available without prior NWSA approval.

trucks was monetized using USDOT's BCA guidance[1] value of $32.40 (in 2021 US$) per truck operating hour. In addition, Component 3's truck turn time reduction will save $3.29 million (present value discounted at 7% in 2021 US$) in fuel costs over the 20-year analysis period.

ii. Environmental Sustainability

Reduction in Truck Turn Time Emissions

Component 3 will reduce truck turn times at the terminal, reducing emissions. The emission rate for CO_2 was provided by the U.S. Environmental Protection Agency (10,180 grams of CO_2 per gallon of diesel burned[13]), while emission rates for NO_X, $PM_{2.5}$, and SO_x were provided by the 2021 Emission Factor (EMFAC 2021) for trucks. For this analysis, it is assumed that trucks average an on-terminal operating speed of 5 miles per hour. Multiplying truck speed by the savings in truck turn time with the emission rates for trucks provides the estimated decrease in truck emissions on the terminal. Based on USDOT BCA guidance for emission costs, Component 3 is expected to save $634,487 (present value discounted at 7% and 3% for CO_2 in 2021 US$) in truck emissions over the 20-year analysis period, as shown in Table 29.

Table 29: Component 3 Environmental Sustainability Benefits Summary

Category	Emission Savings (Metric Tons)	Emission Cost Savings (2021 US$)
CO_2	13,492	$616,771
NO_x	1.05	$7,564
$PM_{2.5}$	0.03	$9,857
SO_x	0.01	$295
Total Emission Savings of Component 3		**$634,487**

[13] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references