APPENDIX B - BENEFIT-COST ANALYSIS AND METHODOLOGY REPORT

Executive Summary

This benefit-cost analysis (BCA) is conducted for the Port of Oakland *Phase 1 Outer Harbor Terminal Redevelopment – Building Resiliency Now and For the Future*, for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the 2022 Port Infrastructure Development Program. The analysis is conducted in accordance with the benefit-cost methodology as outlined by USDOT in the Benefit-Cost Analysis Guidance for Discretionary Grant Programs, released in March 2022 (revised). The period of analysis corresponds to 23 years and includes 3 years of construction and 20 years of benefits after operations begin in 2027.

The **Phase 1 Outer Harbor Terminal Redevelopment – Building Resiliency Now and For the Future Project** is essential to sustain the Port's future growth potential and operational efficiencies, support rural farming communities, and maintain and expand the global competitiveness of the Port and provide the Megaregion's primary connection point to world markets. This project would construct the first phase of a broader Outer Harbor Terminal (OHT) redevelopment (approximately 25 of 116 acres) providing much needed container capacity relief (particularly for refrigerated exports), and would eventually include wharf strengthening, larger container cranes, and related electrical improvements.

The Port of Oakland (Port) serves as a critical global gateway for the vast and diverse San Francisco Bay Area and Northern California Megaregion, supporting more than 500,000 jobs in the state of California (Martin Associates 2018) including the economy of the rural Central Valley farming sector, and is the second largest exporting region in the U.S. It is also the fourth busiest container port in the U.S. West Coast and one of the top ten in the U.S. with anticipated growth projections increasing from 2.45 million twenty-foot equivalent units (TEUs) in 2021 to 5.19 million TEUs in 2050[1]. Approximately 45% of the loaded TEUs are export commodities including recycled paper, nuts, fruit, meat, grains, iron/steel products, and dairy products, with these products often going to markets in Asia, primarily China, Japan and Korea.

COVID-19 revealed vulnerabilities and challenges within the supply chain, most notably in the areas of port capacity and congestion issues. Farm exports which rely heavily on the Port of Oakland have been hit particularly hard with transportation challenges and storage and handling fees. The project represents Phase 1 of modernizing the Outer Harbor Terminal area; creating a 25+/- acre (out of 116 acre total area) off-dock container support facility with truck entry/exit gates and gatehouse, an office trailer, perimeter fencing, grounded storage, wheeled storage, rubber tired gantry crane (RTG) refrigerated container (reefer) storage, RTG grounded storage, new light emitting diode (LED) high mast lighting, drainage improvements, pavement and other yard improvements, substation improvements, and battery storage and charging stations to expand the Port's electrical grid capacity and support power reliability and resiliency (see Figure 1). The project will improve the Port's ability to accommodate near-term supply chain uncertainties and surges in imports, exports, and refrigerated cargo; increase its

[1] The Tioga Group and Hackett Associates, *2019-2050 Bay Area Seaport Forecast* (Moderate Growth). SF Bay Conservation and Development Commission, 2020 (page 76). https://www.bcdc.ca.gov/seaport/2019-2050-Bay-Area-Seaport-Forecast.pdf

container handling capacity; reduce congestion and improve operational efficiencies at the Port; make it easier to fill empty shipping containers with agricultural commodities at a facility that can accommodate these transactions at the Port; and advance the Port's and State's goal of a zero-emissions freight transportation system.

The capital cost for this project is $48.8 million in undiscounted dollars (2024-2026). At a seven percent real discount rate, these costs are $34.8 million. At the end of 20-years operating period, the assets will retain a residual value of $2.9 million in undiscounted dollars and $0.5 million in discounted dollars. The residual value is included in the total benefits of the project per USDOT guidance. The project will incur new operations and maintenance (O&M) costs of $18.2 million in undiscounted dollars or $6.4 million when discounted at seven percent.

The project will generate $174.7 million through 2046 in discounted net benefits using a seven percent discount rate (not including residual value). The project will improve Port capacity allowing for a recapture of freight lost to more distant ports, which will contribute to reduced congestion, crash incidents, operating costs, and emissions. Using a seven percent discount rate, this leads to an overall project Net Present Value (including residual value of assets) of $139.9 million and a **Benefit Cost Ratio (BCR) of 5.0**.[2] The overall project benefit matrix is in Table 1.

Table 1 Phase 1 Outer Harbor Terminal Redevelopment Project Impacts and Benefits Summary, Monetary Values in Millions of Discounted 2020 Dollars

Current Status/Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Economic Benefit	Monetized Benefits, 2027-2046 ($millions at 7% discount rate)	Table Reference in BCA
Lack of container capacity limiting Port's ability to handle surges in container movement, including refrigerated containers for agricultural exports, with freight moving to other, farther away ports	Infrastructure to provide onsite storage and electricity for refrigerated containers, so Port can recapture freight lost to other ports	Travel time savings: Reclaiming containerized freight from other ports reduces trip miles and hours of travel	$58.0	A-11
		Savings in vehicle operating costs due to reduced trip miles	$85.2	
Additional miles to other ports increase truck crashes	Infrastructure to provide onsite container storage and electricity for refrigerated	Reduction in crashes: Reduction in costs associated with fatality, injury	$26.9	A-12

[2] Per USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (March 2022, Revised), savings in operations and maintenance costs are included in the numerator along with other project benefits when calculating the benefit-cost ratio.

Current Status/Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Economic Benefit	Monetized Benefits, 2027-2046 ($millions at 7% discount rate)	Table Reference in BCA
	containers, so Port can recapture freight lost to other ports	and property damage crashes		
Air pollution	Reduction in emissions as freight is recaptured from other more distant ports	Reduced vehicular emissions due to reduced trip miles	$8.7	A-14
Noise	Reduction in noise from recaptured freight lost to more distant ports	Reduced noise due to reduced trip miles	$1.8	A-16
Residual Asset Values	Value of remaining useful life on project assets	Remaining value of assets with a service life greater than 20 years	$0.5	A-18

Source: Cambridge Systematics, Inc.

The overall Phase 1 Outer Harbor Terminal Redevelopment Project impacts are in Table 2, which shows the magnitude of the various metrics used in this analysis to quantify the project benefits.

Table 2 Project Impacts for the Phase 1 Outer Harbor Terminal Redevelopment Project, Cumulative 2027-2046

Metric	Cumulative Savings
Vehicle-Hours Traveled Saved	5.4 million hours
Vehicle Operating Costs Saved	269.4 million fewer miles driven
Accidents Avoided	422 crashes

Source: Cambridge Systematics, Inc.

1 Introduction

This benefit-cost analysis (BCA) is conducted for the Port of Oakland Phase 1 Outer Harbor Terminal Redevelopment – Building Resiliency Now and For the Future Project, for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the 2022 Port Infrastructure Development Program. The analysis is conducted in accordance with the benefit-cost methodology as outlined by USDOT in the Benefit-Cost Analysis Guidance for Discretionary Grant Programs, released in March 2022 (revised). The period of analysis corresponds to 23 years and includes 3 years of construction and 20 years of benefits after operations begin in 2027. This appendix is organized as follows:

- Section 2 contains the project description.
- Section 3 documents the BCA methodology, including key methodological components, assumptions, and the study scenarios.
- Section 4 provides freight projections, vehicle miles traveled, hours of freight travel for the project and the underlying assumptions.
- Section 5 contains a detailed explanation and calculation of the project benefits.
- Section 6 contains a detailed explanation and calculation of the project costs.
- Section 7 contains the summary results of the BCA.

2 Project Description

As shown in Figure 1 and detailed in the cost estimate in Appendix A – Benefit-Cost Analysis Spreadsheet (Construction Cost worksheet), site work for the project will include: demolition of existing pavement, RTG runway foundation grading, demolition and relocation of K-Rail for perimeter, 8-foot high chain link security fencing on the concrete K-Rail, drainage, pavement markings/striping, precast concrete (PCC) wheel stops, foundation for lighting, trenching and backfill for the substations, duct banks and conductors for the substations, and conduit and trenching to connect the charging station and reefer racks to the substations. Table 3 contains a summary of the key project components. Values are estimates based on conceptual design.

The project is in the conceptual design stage but could be designed, constructed, and operational within 36 months following availability of funding as described in the narrative, Section 5.0 Project Readiness. The project meets the PIDP grant eligibility requirements as it is located within the boundary of a port, in a designated Historically Disadvantaged Community and Opportunity Zone. It supports the program's goals of improving: the safety, efficiency, and reliability of loading and unloading of goods at the port; the movement of goods into, out of, around, and within the Port; the Port's resiliency; and reduces environmental and emissions impacts.

Figure 1 Phase 1 Outer Terminal Harbor Redevelopment Concept Diagram

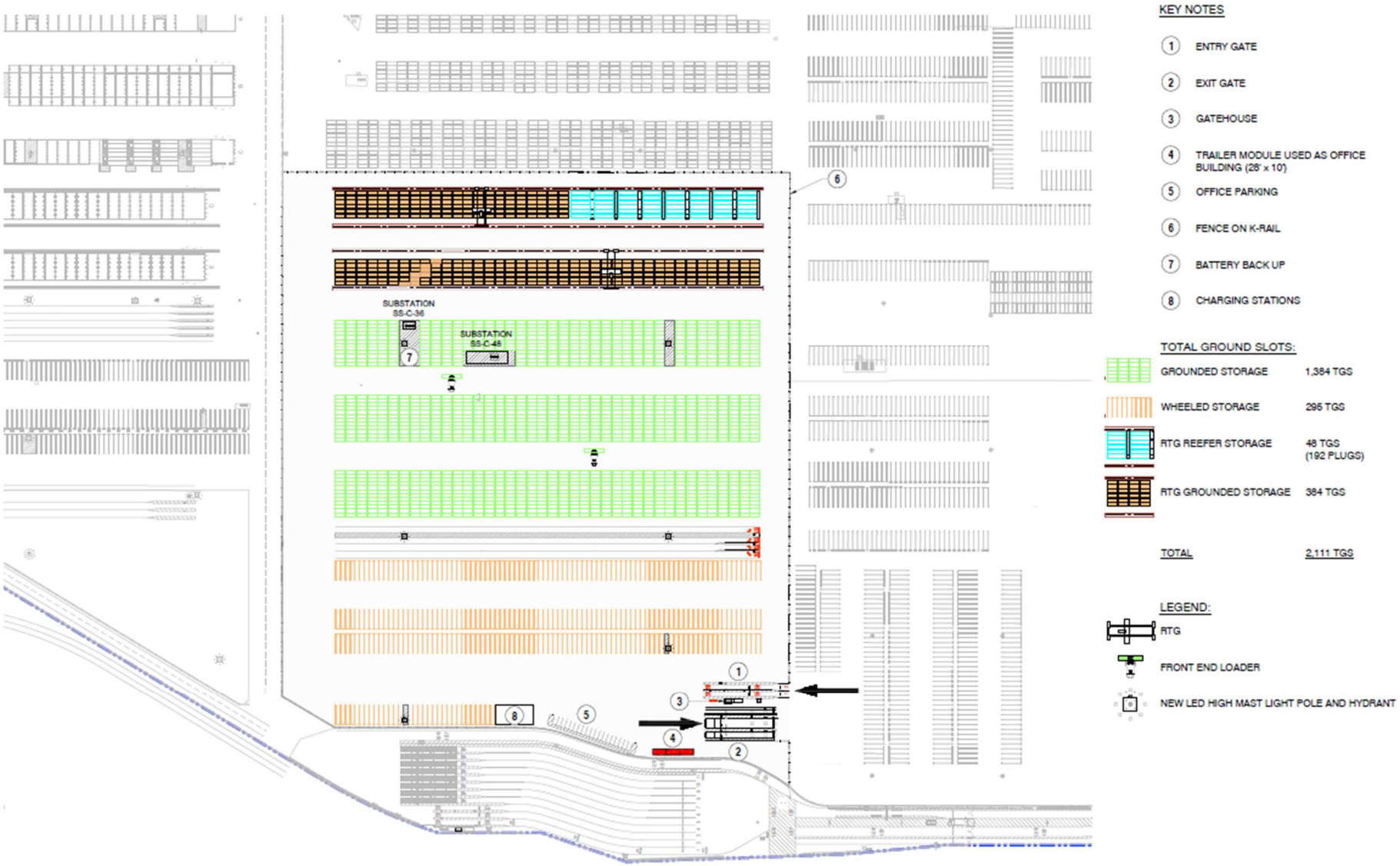

Table 3 Key Phase 1 Outer Harbor Terminal Redevelopment Project Components

Component	Units/Capacity	Description
Pavement replacement	28 acres[3]	7" asphalt concrete (AC) pavement on 17" crushed miscellaneous base (CMP) that will support container stacking and capacity for structural stability.
RTG reefer storage and plugs	48 total ground slots (TGS) with up to 192 plugs (capacity=192)	Stacked up to 4 containers high. Provides flexible reefer import or export storage capacity. Supports rural farmers and other agricultural suppliers to deliver goods to the Port with flexibility to accommodate ever-changing vessel arrivals and departures reducing potential spoilage and lost revenue. Plugs offer power reducing use of gensets (reduced pollutants).
RTG grounded storage	384 TGS (capacity= 1,536)	Flexible import, export, and empty RTG grounded container storage stacked up to 4 containers high. In line with adjacent marine terminal RTG row to accommodate future expansion/integration into existing adjacent marine terminal.
Grounded container storage	1,384 TGS (capacity = 5,536 loaded; 6,920 empty)	Flexible staging/storage area to support empties, imports, or exports depending on need. Empties can be stacked 5 containers high and loaded 4 high.
Wheeled container storage	295 TGS (capacity = 295)	Flexible import, export, and empty storage area for wheeled containers or temporary parking.
Truck exchange lanes	4	Locations to enable pick or placement of containers.
Guard house/entry lanes/exit lanes/ security gates	1/2/3/2	Facilities and equipment to restrict access to the Outer Harbor Terminal off-dock container support area. As a restricted area, these serve as a check point to verify and record entities entering or leaving the area.
Trailer modules for office building	3	To support administrative activities for the Outer Harbor Terminal off-dock support facility
LED high mast light poles and hydrants	6	Converting from common high-intensity discharge (HID) with existing lighting to LED which saves on electricity costs (resiliency) and operations and maintenance costs (O&M)
Substation modifications	2	Substation upgrades at two locations in the area, SS-C-36 and SS-C-48. Allows the Port to accommodate increased electrification demands, optimize the battery storage

[3] Additional acreage above the 25+/- acre site includes extra contingency to address driveways and periphery of the fenced area.

Component	Units/Capacity	Description
		system, and support the reefer plugs and charging station. Needed to support the Port's zero-emissions operational infrastructure.
Charging stations	2	Charging equipment for the yard zero-emissions vehicles (ZEV) trucks. Supports the Port's 2020 and Beyond Plan and West Oakland Community Action Plan (WOCAP) to transition to zero emissions cargo-handling equipment and drayage truck operations.
Battery storage system	1	Located at substation SS-C-48. Expands the Port's electrical grid capacity, allow for operations on green power, and minimize energy reliability risks to the Port.

Source: Port of Oakland

3 Benefit Cost Analysis Framework

The BCA provides an evaluation framework to assess the economic advantages (benefits) and disadvantages (costs) of a potential infrastructure project. Project benefits and costs are quantified in monetary terms to the extent possible. The overall goal of the project BCA is to assess whether the expected benefits of the project justify the costs from a national perspective. The BCA framework attempts to capture the net welfare change created by the project, including cost savings and increases in welfare (benefits), as well as disbenefits where costs can be identified (e.g., project capital costs), and welfare reductions where some groups are expected to be made worse off because of the proposed project.

The BCA framework involves defining a Base or "No Build" scenario, which is compared to the "Build" scenario. The BCA assesses the incremental difference between the "Build" scenario and the "No Build" scenario, which represents the net change in welfare. BCAs are forward-looking exercises which seek to assess the incremental change in welfare over a project life cycle. The importance of future changes is determined through discounting, which is meant to reflect the time value of money.

Key Methodological Components

The project BCA is conducted in accordance with the benefit-cost methodology recommended by the USDOT.[4] The methodology includes the following key components:

- Defining existing and future conditions under the "Build" scenario versus "No Build";
- Assessing the project benefits with respect to each of the primary selection criteria defined by the USDOT over the 20 years of operations beyond the project completion when benefits accrue and using USDOT recommended values to monetize changes in travel time, vehicle operating costs,

[4] U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised).

quality of life benefits, emissions and traffic crashes by severity while relying on best practices for monetization of other benefits or disbenefits;

- Estimating the project capital costs during project construction and project operation and maintenance costs over the 20 years of operations beyond the project completion when benefits accrue; and
- Discounting project benefits and costs to 2020 dollars using a real discount rate of 7 percent consistent with USDOT guidance.

Key Assumptions

The assessment of the project benefits and costs associated with the Phase 1 Outer Harbor Terminal Redevelopment Project involve the following key assumptions:

- The evaluation period includes the design and engineering, right of way acquisitions, and construction during which capital expenditures are made plus 20 years of operations beyond the project completion within which to evaluate ongoing benefits and costs.
- The construction phase of the project will begin in 2024 ending in approximately 2026, at which point the project is complete.
- The project will open to the public in 2027 and the 20-year operational period will conclude in 2046. Project benefits begin in the calendar year immediately following final construction occurs.
- All project benefits and costs are assumed to occur at the end of each calendar year for purposes of present value discounting.
- Monetary values of project costs and benefits are in constant, year-end 2020 dollars.

"Build" and "No Build" Scenarios

The analysis of the Phase 1 Outer Harbor Terminal Redevelopment Project considered how the balance of costs and benefits resulting from the construction of the project would result in long-term benefits by comparing the "Build" scenario relative to the "No-Build" scenario.

- The "No Build" (Base) scenario would consist of leaving the facilities as they currently stand.
- The "Build" scenario would consist of the components described in Section 2. Project Description above.

4 Freight Projections, Vehicle Miles and Hours of Freight Travel

Table 4 shows the number of TEUs lost to the Los Angeles/Long Beach (2,858,194) and Seattle/Tacoma (26,773) ports. The Port of Oakland estimated that, conservatively, 10 percent of those lost TEUs can be recaptured because of the proposed Port improvements. That would be 285,819 TEUs and 2,678 TEUS recaptured from Los Angeles/Long Beach and Seattle/Tacoma, respectively.

Table 4 Annual TEUs Lost to Ports in Los Angeles/Long Beach and Seattle/Tacoma (2022)

Summary Potential Container Market for Oakland - Truck Market

	Imports		Exports	Total	Laden Moves (tons)	Laden TEUS	Empty TEUs	Additional TEUS
Lost to LA (tons)	13,648,678		9,032,759	22,681,436	1,334,202			
Laden TEUS Lost	*1,429,097*		*945,783*			*2,374,880*		
Estimated Empties (TEUS)							*483,314*	
Total Lost to LA								2,858,194
Lost to Seattle (tons)	39,867		127,848	167,715	9,866			
Laden TEUS	*4,174*		*13,386*			*17,561*		
Estimated Emptiesc(TEUS)							*9,212*	
Total Lost to Seattle								26,773
Total Lost TEUS by Truck- Potential Market								***2,884,967***

Source: Port of Oakland[5]

[5] 2022 analysis performed by Martin Associated using S&P Transearch data.

This equates to 142,910 container trips and 1,339 container trips recaptured from Los Angeles and Tacoma, respectively, assuming 2 TEUs per container.

The difference in trip distance is approximately 61 miles for freight recaptured from Los Angeles/Long Beach and 770 miles from Seattle/Tacoma. Multiplying the number of recaptured containers by the trip length provides a baseline of trip miles saved because of the Port improvements. These 2022 baseline miles saved are:

- Recaptured from Los Angeles/Long Beach 8,717,492 miles less traveled
- Recaptured from Seattle/Tacoma 1,030,761 miles less traveled
- Total Miles saved 9,748,252 miles less traveled

Assuming a travel speed of 50 miles per hour, the baseline hours of travel saved are calculated as 194,965 hours in 2022.

The compound annual growth rate for cargo at the Port of Oakland between 2018 and 2050 is projected to be 2.2% for the Moderate Growth scenario in the 2019-2050 Bay Area Seaport Forecast[6]. This percent is used to grow the baseline estimates to calculate reduced miles and travel time for the operational period (2027-2046). Table 5 presents the estimated vehicle miles traveled (VMT) and vehicle hours traveled (VHT) savings resulting from the Port improvements.

Table 5 Annual VMT and VHT Reductions Resulting from the Phase 1 Outer Harbor Terminal Redevelopment Project

Year	VMT Reduction (miles)	VHT Reduction (hours)
2027	10,868,791	217,376
2028	11,107,904	222,158
2029	11,352,278	227,046
2030	11,602,028	232,041
2031	11,857,273	237,145
2032	12,118,133	242,363
2033	12,384,732	247,695
2034	12,657,196	253,144
2035	12,935,654	258,713
2036	13,220,239	264,405
2037	13,511,084	270,222

[6] The Tioga Group and Hackett Associates, 2019-2050 Bay Area Seaport Forecast, Prepared for SF Bay Conservation and Development Commission, 2020 (https://www.bcdc.ca.gov/seaport/2019-2050-Bay-Area-Seaport-Forecast.pdf)

Year	VMT Reduction (miles)	VHT Reduction (hours)
2038	13,808,328	276,167
2039	14,112,111	282,242
2040	14,422,577	288,452
2041	14,739,874	294,797
2042	15,064,151	301,283
2043	15,395,563	307,911
2044	15,734,265	314,685
2045	16,080,419	321,608
2046	16,434,188	328,684
Total	**269,406,790**	**5,388,136**

Source: Cambridge Systematics, Inc.

5 Project Benefits

Economic Competitiveness - Travel Time and Vehicle Operating Cost Savings

The Phase 1 Outer Harbor Terminal Redevelopment Project would contribute to increasing the economic competitiveness of the Port of Oakland by increasing capacity and efficiency of the port. The project will reduce the miles traveled and travel times for container shipments by diverting approximately 144,000 containers per year from the Central California areas to/from the Ports of Los Angeles, Long Beach, Seattle, and Tacoma to the Port of Oakland which reduces truck VMT by an average of 13.5 million per year. This results in an average of 269,000 hours per year worth $8.6 million per year in travel time savings for truck drivers and an average of $12.6 million per year in vehicle-operating costs (VOC) savings from fuel, maintenance, tires, and depreciation.

Travel time savings are calculated by multiplying the number of travel hours saved by the value of travel time (VOTT) of $32.00 per hour for truck drivers, per U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised). The Vehicle Operating Cost (VOC) benefit is calculated by multiplying the number of VMT saved by $0.94 per VMT for commercial trucks per U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised). The VOTT and VOC benefits are presented in Table 6. In total VOC savings are $253.2 million undiscounted and $85.2 million discounted. VOTT savings are $172.4 million undiscounted and $58.0 million discounted.

Table 6 Annual Travel Time and Vehicle Operating Cost Savings Resulting from the Phase 1 Outer Harbor Terminal Redevelopment Project

	VOC Savings		VOTT Savings	
Year	Nominal	Discounted ($2020)	Nominal	Discounted ($2020)
2027	$10,216,663	$6,362,425	$6,956,026	$4,331,864
2028	$10,441,430	$6,077,007	$7,109,059	$4,137,537
2029	$10,671,142	$5,804,394	$7,265,458	$3,951,928
2030	$10,905,907	$5,544,010	$7,425,298	$3,774,645
2031	$11,145,837	$5,295,307	$7,588,655	$3,605,315
2032	$11,391,045	$5,057,760	$7,755,605	$3,443,581
2033	$11,641,648	$4,830,870	$7,926,228	$3,289,103
2034	$11,897,764	$4,614,158	$8,100,605	$3,141,554
2035	$12,159,515	$4,407,168	$8,278,819	$3,000,625
2036	$12,427,024	$4,209,463	$8,460,953	$2,866,017
2037	$12,700,419	$4,020,627	$8,647,094	$2,737,448
2038	$12,979,828	$3,840,263	$8,837,330	$2,614,647
2039	$13,265,384	$3,667,989	$9,031,751	$2,497,354
2040	$13,557,223	$3,503,444	$9,230,450	$2,385,324
2041	$13,855,482	$3,346,280	$9,433,519	$2,278,318
2042	$14,160,302	$3,196,167	$9,641,057	$2,176,113
2043	$14,471,829	$3,052,787	$9,853,160	$2,078,493
2044	$14,790,209	$2,915,840	$10,069,930	$1,985,253
2045	$15,115,594	$2,785,036	$10,291,468	$1,896,195
2046	$15,448,137	$2,660,100	$10,517,880	$1,811,132
Total	**$253,242,382**	**$85,191,094**	**$172,420,345**	**$58,002,447**

Source: Cambridge Systematics, Inc.

Crash Cost Savings

The safety benefits assessed in this analysis include a reduction in truck crashes and resulting reduction in fatalities and injuries, as well as a reduction in other property damage because of reduced VMT enabled by the Phase 1 Outer Harbor Terminal Redevelopment Project.

Safety benefits are calculated by multiplying the fatal, injury and property damage only crash rates for large trucks per 100 million miles from the Federal Motor Carrier Safety Administration[7] by the reduced VMT, multiplied by the unit cost of crashes, per U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised). This is calculated each year and then summed across the years.

Table 7 presents the unit costs and the crash rates used for the safety benefit calculations. Table 8 presents the motor vehicle crash reduction benefits. In total, the reduction in crashes reduce crash costs by $80.0 million nominal and $26.9 million discounted to 2020 dollars over the 20-year operational period.

Table 7 Unit Costs and Rates of Large Truck Crashes by Crash Severity

Variable	Unit	Value	Source
Fatal Crash	$/Crash	$12,837,400	U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, (March 2022 - Revised)
Injury Crash	$/Crash	$302,600	U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, (March 2022 - Revised); DOT VSL Guidance - 2021 Update.pdf (transportation.gov)
Property Damage Only Accident (No Injury)	$/Crash	$4,600 per vehicle x 1.748 vehicles per crash = $8,041 per PDO crash	U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, (March 2022 - Revised)), May 2015[8]
Fatal Crash	Crashes/ 100 million Miles of Travel	1.43	U.S. Department of Transportation, National Highway Traffic Safety Administration, The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (Revised), May 2015[9]
Injury Crash	Crashes/ 100 million Miles of Travel	34.1	Federal Motor Carrier Safety Administration, Large Truck; Large Truck and Bus Crash Facts[10]
Property Damage Only Accident (No Injury)	Crashes/ 100 million Miles of Travel	121.2	Federal Motor Carrier Safety Administration, Large Truck; Large Truck and Bus Crash Facts[11]

[7] https://www.fmcsa.dot.gov/safety/data-and-statistics/large-truck-and-bus-crash-facts

[8] https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812013

[9] https://www.fmcsa.dot.gov/safety/data-and-statistics/trends-table-4-large-truck-fatal-crash-statistics-1975-2019

[10] https://www.fmcsa.dot.gov/safety/data-and-statistics/trends-table-7-large-truck-injury-crash-statistics-1999-2019

[11] https://www.fmcsa.dot.gov/safety/data-and-statistics/trends-table-10-large-truck-property-damage-only-pdo-crash-statistics-6

Table 8 Crash Reduction Benefits Resulting from the Phase 1 Outer Harbor Terminal Redevelopment Project

	Total Crash Cost	
Year	Nominal $	Discounted ($2020)
2027	$3,229,074	$2,010,905
2028	$3,300,113	$1,920,696
2029	$3,372,716	$1,834,534
2030	$3,446,915	$1,752,237
2031	$3,522,748	$1,673,632
2032	$3,600,248	$1,598,553
2033	$3,679,453	$1,526,842
2034	$3,760,401	$1,458,349
2035	$3,843,130	$1,392,927
2036	$3,927,679	$1,330,441
2037	$4,014,088	$1,270,757
2038	$4,102,398	$1,213,752
2039	$4,192,651	$1,159,303
2040	$4,284,889	$1,107,297
2041	$4,379,157	$1,057,624
2042	$4,475,498	$1,010,179
2043	$4,573,959	$964,862
2044	$4,674,586	$921,579
2045	$4,777,427	$880,237
2046	$4,882,530	$840,750
Total	**$80,039,661**	**$26,925,455**

Source: Cambridge Systematics, Inc.

Environmental Sustainability Benefits

This analysis focuses on environmental sustainability as measured by reduction in motor vehicle emissions. Net change in environmental costs is estimated based on the changes in motor vehicle emissions because of reduced VMT as freight is recaptured from other, more distant ports. This analysis applies the running emission rates pertaining to Nitrogen Oxides (NOx), Particulate Matter (PM2.5), Carbon Dioxide (CO2) and Sulfur Dioxide (SO2) for trucks. Running emissions rates

(assuming 50 miles per hour travel speed) in grams per VMT for trucks are based on the Caltrans Cal-B/C 2022 INFRA/RAISE Sketch Model v8.1.12.

The environmental cost per mile for each pollutant was calculated by multiplying the pollutant emission rate by the corresponding pollutant unit emission cost shown in Table 9, per USDOT guidance. This estimation involves converting grams to metric tons for the emissions. The summation of the environmental cost per mile for each of these pollutants represents the emission cost per VMT. This value multiplied by the VMT savings resulting from the Port project

Table 9 Unit Emission Cost Used in the Monetization of the Environmental Sustainability Benefits – Cost Per Metric Ton

Year	CO2	NOX	SOX	PM2.5
2027	$58	$17,100	$46,500	$827,400
2028	$60	$17,400	$47,300	$840,600
2029	$61	$17,700	$48,200	$854,000
2030	$62	$18,100	$49,100	$867,600
2031	$63	$18,100	$49,100	$867,600
2032	$64	$18,100	$49,100	$867,600
2033	$65	$18,100	$49,100	$867,600
2034	$66	$18,100	$49,100	$867,600
2035	$67	$18,100	$49,100	$867,600
2036	$69	$18,100	$49,100	$867,600
2037	$70	$18,100	$49,100	$867,600
2038	$72	$18,100	$49,100	$867,600
2039	$72	$18,100	$49,100	$867,600
2040	$73	$18,100	$49,100	$867,600
2041	$74	$18,100	$49,100	$867,600
2042	$75	$18,100	$49,100	$867,600
2043	$77	$18,100	$49,100	$867,600
2044	$78	$18,100	$49,100	$867,600
2045	$79	$18,100	$49,100	$867,600
2046	$80	$18,100	$49,100	$867,600

[12] https://dot.ca.gov/programs/transportation-planning/division-of-transportation-planning/data-analytics-services/transportation-economics#:~:text=Cal%2DB/C%202022%20INFRA/%20RAISE%20Corridor%20Model%20v8.1%20(XLSM)

Overall, the Phase 1 Outer Harbor Terminal Redevelopment Project lifecycle's environmental sustainability benefits are $15.2 million in undiscounted dollars and $8.7 million in 2020 dollars at a discounted rate of seven percent (3% for CO2 emissions) over the 20-year operational period (Table 10).

Table 10 Environmental Sustainability Benefits Resulting from the Phase 1 Outer Harbor Terminal Redevelopment Project

	Emissions Benefits	
Year	Nominal $	7% Discount (3% for CO2) ($2020)
2027	$726,306	$567,244
2028	$737,890	$548,031
2029	$741,479	$529,934
2030	$745,976	$512,932
2031	$746,010	$503,229
2032	$746,424	$487,997
2033	$747,201	$473,963
2034	$748,322	$458,767
2035	$749,772	$444,596
2036	$759,715	$431,347
2037	$761,782	$418,928
2038	$772,323	$407,256
2039	$766,759	$401,237
2040	$769,642	$390,705
2041	$772,773	$385,426
2042	$776,141	$371,251
2043	$787,945	$362,230
2044	$791,758	$353,623
2045	$795,776	$345,392
2046	$799,991	$341,570
Total	**$15,243,985**	**$8,735,656**

Source: Cambridge Systematics, Inc.

Noise Benefits

This analysis considers the noise benefit from the reduced VMT from trucks diverting from the Ports of Los Angeles/Long Beach and Seattle/Tacoma to the closer Port of Oakland as a result of the project. The noise reduction benefit is calculated by multiplying the estimated VMT saving by $0.0197 per VMT per U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 (Revised).Table 11 presents the annual noise benefits from the project.

Table 11 Noise Reduction Benefit Resulting from the Phase 1 Outer Harbor Terminal Redevelopment Project

	Noise Reduction Benefits	
Year	Nominal $	Discounted ($2020)
2027	$214,115	$133,340
2028	$218,826	$127,359
2029	$223,640	$121,645
2030	$228,560	$116,188
2031	$233,588	$110,976
2032	$238,727	$105,998
2033	$243,979	$101,243
2034	$249,347	$96,701
2035	$254,832	$92,363
2036	$260,439	$88,220
2037	$266,168	$84,262
2038	$272,024	$80,482
2039	$278,009	$76,872
2040	$284,125	$73,423
2041	$290,376	$70,129
2042	$296,764	$66,983
2043	$303,293	$63,979
2044	$309,965	$61,109
2045	$316,784	$58,367
2046	$323,754	$55,749
Total	**$5,307,314**	**$1,785,388**

Source: Cambridge Systematics, Inc.

Project Benefits Summary

The benefits of the Phase 1 Outer Harbor Terminal Redevelopment Project can be described as user benefits, such as travel time savings, and social benefits, such as emissions reductions and the reduction in damage to property and humans resulting from crash incidents. The analysis covers the following benefit categories:

- Travel Time Savings
- Vehicle Operating Cost Savings
- Crash Cost Savings
- Environmental Sustainability Benefits
- Noise Reduction Benefits

The analysis uses standardized factors provided by governmental and industry sources to efficiently determine the monetized value of user and social benefits resulting from the project improvements. Table 12 shows the Phase 1 Outer Harbor Terminal Redevelopment Project long-term benefits.

Table 12 Project Benefits by Long-Term Outcome Category, Millions of Dollars

Long-Term Outcome	Benefit (Disbenefit) Category	Benefit (Disbenefit) Description	Benefits (Millions of $)	Benefits 7% Discount (Millions of $2020)
Economic Competitiveness	Travel Time Savings	Reduction in travel time due to reduced VMT	$172.4	$58.0
	Vehicle Operating Costs	Reduced VOC because of reduced VMT	$253.2	$85.2
Safety	Reduced Crash Incidents	Reduction in traffic fatalities/injuries and PDO crashes	$80.0	$26.9
Environmental Sustainability	Reduced Emissions	Enhancement of the natural environment from reduced VMT	$15.2	$8.7
Noise	Reduced Noise	Reduction in noise from reduced VMT	$5.3	$1.8
Total			**$526.3**	**$180.6**

Source: Cambridge Systematics, Inc.

6 Project Costs

Capital Costs

The schedule and capital costs associated with the Phase 1 Outer Harbor Terminal Redevelopment Project (Tables 13 and 14) are primarily associated with the actual construction. Construction costs will total of $34.8 million in nominal dollars.

Table 13 Project Schedule and Costs

Variable	Value	Unit
Construction Start	2024	year
Construction End	2026/2027	year
Construction Duration	3	years
Project Opening	2027	year

Source: Port of Oakland

Residual Value of Assets

Some of the assets built under this project will have a useful life exceeding the 20-year BCA time horizon. Therefore, per USDOT guidance, assets with useful lives beyond 20 years are valued for the remaining useful life and discounted at the 20-year discount value. The calculated residual value of the "hard" assets such as Reefer Racks, Guard Booth and Office, and Storm Drainage is $2.9 million (undiscounted) and $0.5 million when discounted at seven percent.

Operations and Maintenance

Based on data provided by the Port of Oakland, the Operations and Maintenance costs (O&M) for the assets constructed under this project will range from $900,000 to $946,000 per year. Per USDOT Guidance, O&M costs will be included in the benefit-cost numerator as a "negative" benefit. Table 14 summarizes the life-cycle project costs.

Table 14 Phase 1 Outer Harbor Terminal Redevelopment Project – Life Cycle Project Costs

	Capital Costs		Operating and Maintenance Costs	
Year	Undiscounted	Discounted	Undiscounted	Discounted
2024	$16,263,500	$12,407,346	$0	$0
2025	$16,263,500	$11,595,651	$0	$0
2026	$16,263,500	$10,837,057	$0	$0
2027	$0	$0	$900,000	$560,475
2028	$0	$0	$900,000	$523,808
2029	$0	$0	$900,000	$489,540

	Capital Costs		Operating and Maintenance Costs	
Year	Undiscounted	Discounted	Undiscounted	Discounted
2030	$0	$0	$900,000	$457,514
2031	$0	$0	$936,000	$444,687
2032	$0	$0	$900,000	$399,611
2033	$0	$0	$900,000	$373,468
2034	$0	$0	$900,000	$349,036
2035	$0	$0	$900,000	$326,201
2036	$0	$0	$936,000	$317,056
2037	$0	$0	$900,000	$284,917
2038	$0	$0	$900,000	$266,278
2039	$0	$0	$900,000	$248,857
2040	$0	$0	$900,000	$232,577
2041	$0	$0	$946,000	$228,471
2042	$0	$0	$900,000	$203,142
2043	$0	$0	$900,000	$189,852
2044	$0	$0	$900,000	$177,432
2045	$0	$0	$900,000	$165,824
2046	$0	$0	$936,000	$161,175
Total	**$48,791,000**	**$34,840,411**	**$18,154,000**	**$6,399,922**

Source: Cambridge Systematics, Inc.

7 Summary of Results

Evaluation Measures

The BCA converts potential gains (benefits) and losses (costs) from the Phase 1 Outer Harbor Terminal Redevelopment Project into monetary units and compares them. The following common benefit-cost evaluation measures included in this BCA:

- Net Present Value (NPV): NPV compares the net benefits (benefits minus costs) after being discounted to present values using the real discount rate assumption. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today's dollar terms.
- Benefit Cost Ratio (BCR): The present value of incremental benefits is divided by the present value of incremental costs to yield the BCR. The BCR expresses the relation of discounted benefits to

discounted costs as a measure of the extent to which a project's benefits either exceed or fall short of the costs.

BCA Results

Table 15 presents the evaluation results for the Phase 1 Outer Harbor Terminal Redevelopment Project. Results are presented in undiscounted and discounted at seven percent. All benefits and costs are over an evaluation period extending 20 years beyond system completion in 2026 (starting in 2027). The total benefits from the project improvements within the analysis period represent **$174.7 million** (including the O&M costs and asset residual value) when discounted at seven percent. The total capital costs, including engineering and construction, etc. are calculated to be **$34.8 million** when discounted at seven percent. The difference of the discounted benefits and costs equal a NPV of **$139.9 million**, resulting in a BCR of **5.0:1.**

Table 16 summarizes the results of the BCA by year. The full spreadsheet model is attached with the application.

Table 15 Phase 1 Outer Harbor Terminal Redevelopment Project – Benefit-Cost Analysis Summary

	Project Lifecycle	
BCA Metric	**Undiscounted**	**7% Discount ($2020)**
Benefits		
• Travel Time Savings	$172,420,345	$58,002,447
• Vehicle Operating Cost Savings	$253,242,382	$85,191,094
• Safety Crash Cost Reductions	$80,039,661	$26,925,455
• Environmental Sustainability	$15,243,985	$8,735,656
• Noise Reductions	$5,307,314	$1,785,388
• Maintenance & Operations Costs	($18,154,000)	($6,399,922)
• Residual Asset Value	$2,937,933	$505,899
Total Benefits	**$511,037,621**	**$174,746,017**
Total Costs	**$48,790,500**	**$34,840,054**
Benefit/Cost Ratio	**10.5**	**5.0**
Net Present Value	**$462,247,121**	**$139,905,964**

Source: Cambridge Systematics, Inc.

Table 16 Phase 1 Outer Harbor Terminal Redevelopment Project – Life-Cycle Costs and Benefits

	Undiscounted		Discounted 7% ($2020)	
Year	Costs	Benefits	Costs	Benefits
2024	$16,263,500	$0	$12,407,346	$0
2025	$16,263,500	$0	$11,595,651	$0
2026	$16,263,500	$0	$10,837,057	$0
2027	$0	$20,442,184	$0	$12,845,302
2028	$0	$20,907,317	$0	$12,286,822
2029	$0	$21,374,434	$0	$11,752,894
2030	$0	$21,852,656	$0	$11,242,498
2031	$0	$22,300,837	$0	$10,743,772
2032	$0	$22,832,050	$0	$10,294,279
2033	$0	$23,338,510	$0	$9,848,553
2034	$0	$23,856,440	$0	$9,420,493
2035	$0	$24,386,068	$0	$9,011,478
2036	$0	$24,899,810	$0	$8,608,432
2037	$0	$25,489,551	$0	$8,247,106
2038	$0	$26,063,903	$0	$7,890,121
2039	$0	$26,634,553	$0	$7,553,898
2040	$0	$27,226,328	$0	$7,227,615
2041	$0	$27,785,307	$0	$6,909,306
2042	$0	$28,449,762	$0	$6,617,551
2043	$0	$29,090,186	$0	$6,332,499
2044	$0	$29,736,448	$0	$6,059,971
2045	$0	$30,397,050	$0	$5,799,403
2046	$0	$33,974,226	$0	$6,054,024
Total	**$48,790,500**	**$511,037,621**	**$34,840,411**	**$174,746,017**

Source: Cambridge Systematics, Inc.