

# Technical Memorandum: Benefit Cost Analysis for the Port of Oakland's Outer Harbor Intermodal Terminal

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Date: March 19, 2012  
Subject: Benefit-Cost Analysis for the Port of Oakland's Outer Harbor  
Intermodal Terminal TIGER 2012 Application

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## Project Description

The Port of Oakland's Outer Harbor Intermodal Terminal Project (hereafter "the Project") outlined in the TIGER 2012 application describes a discrete, but essential, portion of the much larger Oakland Global program. To access the current rail terminal, trains must cross through the Union Pacific Rail Road (UPRR) yard. This requires all trains accessing the Port to slow significantly (no more than 5 miles per hour) and essentially limits UPRR operations— causing significant delays to both Burlington Northern Santa Fe (BNSF) and UPRR operations at the Port. The key components of the Project described in this application include:

- Rail access improvements from UPRR mainline to the Port of Oakland
- New Joint Intermodal Terminal (JIT) lead tracks
- New Knight Yard, 7-track flat switching yard
- Fuel line and other utility relocation and protection

TIGER 2012 funds will be used for the rail and the backbone infrastructure required for the intermodal facilities. Details on the major components are provided below.

**Rail Access Improvements to the Port.** The Project includes the construction of a 6,000-foot arrival track within UPRR's existing right-of-way from just south of Powell Street to the Port's property. The improvements include a high speed turnout off the mainline, allowing trains to arrive and depart the congested Union Pacific mainline at full speed. These improvements will allow UP, BNSF and Amtrak passenger trains on the mainline to interface with Port related train traffic with minimal conflicts.

**New Joint Intermodal Terminal Lead Tracks.** Two 9,300-foot double track leads from the north end of the Port's property, across 7th Street into the existing Joint Intermodal Terminal (JIT) will also be constructed. This work requires a reconfiguration of UPRR rail tracks near 7th Street. These improvements will remove the conflict of the BNSF tracks crossing the UPRR tracks to get to the Port's rail terminal – resulting in time savings for both BNSF and UPRR trains destined for the intermodal terminal. This time savings also generates inventory savings and emission savings as the locomotives are able to reach the terminal and receivers in less time.

**Knight Yard.** Knight Yard replaces the former Oakland Army Base manifest yard with a new 7-track flat switching yard with a 200-railcar storage capacity. The through-put capacity of the yard is estimated to be between 100 and 150 railcars per day, supporting between 13,000 and 20,000 revenue railcars per year. The yard design provides an interchange connection with the UPRR's adjacent Desert Yard. The current manifest yard is operating at capacity and the Union Pacific Rail Road (UPRR) must turn away additional business. The UP mainline through Oakland is

designated as a restricted access corridor. These designated areas are, "the most operationally challenged" sections of the railroad's national network. The new yard will increase manifest capacity at the Port, allowing shippers to save on shipping costs by both significantly reducing truck drayage costs to the Port, and allowing shippers to take advantage of the overweight corridor within the Port area, shippers can stuff containers up to the maximum ocean shipping container weight, rather than a reduced amount due to gross vehicle weight limits on state highways. The overweight corridor within the Port allows shippers to move more freight per container, while maintaining the same ocean transportation freight rate. The reduction in truck drayage also generates emissions, pavement, congestion, and safety benefits due to the reduced truck VMT on interstates and highways between Stockton and the Port.

The Project represents the first phase of the larger Oakland Global Project that will revitalize the former Oakland Army Base. A subsequent second phase will be developed concurrently, if the Project moves forward. This second phase includes the build out of a City-owned 170 acre development area with trade and logistics warehousing, a new bulk marine terminal, and further improvements to serve new customers seeking access to Oakland's deep water port. Efficient rail service is a critical component of Oakland Global's master plan to revitalize the Oakland waterfront, increase international trade, and promote economic growth.

## Introduction

The Project is composed of two yard and rail access improvements: the Manifest Yard (Knight Yard) and the Intermodal Terminal and UPRR Rail Access Improvements. These two components have independent utility as they both address specific capacity and access improvements to the Port. However, congestion from the intermodal rail access (due to the BNSF track crossing the UPRR tracks) does impact the manifest yard – as all UPRR traffic slows because of the BNSF crossing. As a result, the Project combines both the manifest and intermodal components for the TIGER application, but also presents the BCA and impact matrices separately.

The impact matrix presented in Exhibit 1 summarizes the Manifest Yard portion of the Project, its benefits, and corresponding page references in the BCA technical memorandum. Exhibit 2 summarizes the Intermodal Terminal and Rail Access portion of the Project, its benefits, and corresponding page references in the BCA technical memorandum.

This technical memorandum describes whether and how the City of Oakland meets the definition of an Economically Distressed Area, estimates the job impacts associated with the construction and operation of Oakland's Outer Harbor Intermodal Terminal Project, and estimates the long-term benefits associated with the Project. The long-term benefits presented relate to the five (5) Long-term Outcomes identified in the TIGER 2012 guidance<sup>1</sup>: State of Good Repair, Economic Competitiveness, Livability, Sustainability, and Safety. The final section discounts the stream of anticipated benefits and costs and calculates a Benefit/Cost ratio for the Project.

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<sup>1</sup> [http://www.dot.gov/tiger/docs/fy12\\_tiger\\_nofa.pdf](http://www.dot.gov/tiger/docs/fy12_tiger_nofa.pdf)

**Exhibit 1: Impact Matrix for Manifest Yard**

Current Status/Baseline & Problem to be Addressed	Changes to Baseline/ Alternatives	Type of Impacts	Population Affected by Impacts	Economic Benefit	Summary of Results	Page Reference in BCA
<i>Manifest Components</i>						
<p>Current Manifest Yard is operating at capacity and turning away business. This results in manifest goods being trucked into/out of the Port.</p>	<p>Build a new Manifest Yard that would have additional capacity</p>	<p>Remove truck trips/VMT from regional highways and interstates annually, reducing shipping costs as well as reducing emissions, accidents, pavement wear and tear, and congestion on highways</p>	<p>Shippers (shipping costs); regional highway users including residents, visitors, and other trucks (congestion and accidents); people residing in the region (emissions); and state and local governments responsible for highway maintenance (pavement)</p>	<p>Monetized value of reduced shipping, emissions, accidents, pavement, and congestion costs</p>	<p>Estimated dollar value (NPV) of reduced shipping savings, emissions savings, pavement savings, congestion savings, and safety benefits</p>	<p>pp. 9-14</p>

**Exhibit 2: Impact Matrix for Intermodal Yard and Rail Access Improvements**

Current Status/Baseline & Problem to be Addressed	Changes to Baseline/ Alternatives	Type of Impacts	Population Affected by Impacts	Economic Benefit	Summary of Results	Page Reference in BCA
<i>Intermodal Components</i>						
<p>Current BNSF intermodal trains must cross over UPRR tracks to access Port Facilities, resulting in significant delays. UPRR trains are reduced from two tracks to one track while the BNSF crosses over, and both BNSF and UPRR trains must slow from 35 miles/hr to 5 miles/hr.</p>	<p>Build new intermodal support yard and rail access improvements, including new lead tracks, arrival track, and rail junction configuration</p>	<p>Remove the conflict of the BNSF tracks crossing the UPRR tracks to get to the Port's rail terminal, resulting in time savings for both BNSF and UPRR that yield operating, inventory, and emissions cost savings</p>	<p>Shippers (reduced operating costs and inventory costs associated with time savings) and people residing in the region (reduced rail emissions associated with time savings)</p>	<p>Monetized value of rail operating cost, inventory, and emissions cost savings</p>	<p>Estimated dollar value (NPV) of reduced rail operating cost savings, rail inventory savings, and emissions savings</p>	<p>pp. 9-13</p>

## Economically Distressed Area

The definition of an Economically Distressed Area is provided in the Public Works and Economic Development Act of 1965 (42 U.S.C. 3161). According to the act, to qualify for this designation, an area generally must (1) have a per capita income of 80% or less of the national average or (2) have an unemployment rate that is, for the most recent 24-month period for which data are available, at least 1.0% greater than the national average unemployment rate. For areas that do not meet one of these two criteria, the Secretary of Commerce has the authority to determine that an area has experienced or is about to experience a special need arising from actual or threatened severe unemployment or economic adjustment problems resulting from severe short term or long-term changes in economic conditions.<sup>2</sup> The study area considers Oakland City and the Oakland-Fremont-Hayward, CA Metropolitan Division.

### Per Capita Income

Currently, the most recent per capita income data available for the U.S., the State of California, and its cities is that of 2009. The per capita income for the metropolitan division is 130% of the per capita income for the United States, as reported in the Bureau of Economic Analysis' (BEA) Regional Economic Information Service as shown in the exhibit below. Based on these 2009 data, the study area does not meet the per capita income threshold for Economic Distress as defined in the Act.

**Exhibit 3: Per Capita Personal Income as a Percentage of U.S. Per Capita Personal Income**

	<b>2009 Per Capita Income</b>	<b>Ratio to U.S. Per Capita Income</b>
Oakland-Fremont-Hayward, CA Metropolitan Division	\$51,580	<b>130%</b>
United States	\$39,635	100%

Source: Bureau of Economic Analysis (U.S. Department of Commerce), Table CA1-3 – Personal Income Summary

### Local Unemployment Rates

The second criterion for documenting Economic Distress is an unemployment rate whose average has exceeded the national average rate by at least 1.0% over the preceding 24 months. As with income data, information for local areas lags that for the U.S. as a whole. As a result, at the time this analysis was completed the most recent non-preliminary data point for local unemployment was November 2011; the 24-month period thus spans from December 2009 to November 2011. This is the most current and complete information available at the time of this analysis and application, but individual values are subject to revision in coming months as new information becomes available. As a result, copies of the downloaded unemployment data are provided for the reviewers' verification in the supplementary documentation (see Economic Distress.xlsx).

<sup>2</sup> [http://frwebgate.access.gpo.gov/cgi-bin/usc.cgi?ACTION=RETRIEVE&FILE=\\$\\$xa\\$\\$busc42.pt2.wais&start=3526303&SIZE=4289&TYPE=PDF](http://frwebgate.access.gpo.gov/cgi-bin/usc.cgi?ACTION=RETRIEVE&FILE=$$xa$$busc42.pt2.wais&start=3526303&SIZE=4289&TYPE=PDF)

**Exhibit 4: Unemployment as a Percentage of U.S. Unemployment Rate**

	<b>Oakland City</b>	<b>Oakland-Fremont-Hayward, CA Metropolitan Division</b>
Local 24-Month Average (Dec 2009 - Nov 2011)	16.37%	10.90%
US 24-Month Average (Dec 2009 - Nov 2011)	9.34%	9.34%
<b>Percent Different From US Average</b>	<b>75.20%</b>	<b>16.73%</b>
<b>Percentage Point Difference from US Average</b>	<b>7.02</b>	<b>1.56</b>

Source: Bureau of Labor Statistics (U.S. Department of Labor), Local Area Unemployment Statistics

With a 24-month unemployment rate of 16.37% and 10.90% for Oakland City and the metropolitan division respectively, the 24-month averages are 7.02 and 1.56 percentage points above the comparable U.S. average of 9.34%. Similarly, Oakland City and the metropolitan division have unemployment rates that are 75.2% and 16.73% greater than the U.S. average, respectively. Thus, based on the most recent available 24-month data comparison, the two areas qualify as Economically Distressed.

**Project Timeline for Recovery Benefits**

**Near-term Impacts: Construction Expenditures and Job Creation**

The quarterly construction schedule and direct, on-project jobs created in the San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area (MSA) for the Project’s construction period are shown in Exhibit 5.<sup>3</sup> The construction costs shown in the tables are for the project planning services and construction activities only—broken out by construction and professional services. The Project does not include any purchase of right-of-way or rail vehicles.

<sup>3</sup> The direct employment impacts were estimated using the quarterly construction expenditures RIMS II multipliers for the San Francisco-Oakland-Fremont, CA MSA. Given the multiplier relationships, the final-demand employment multiplier divided by the direct-effect employment multiplier yields an estimate of the initial (or direct) employment per \$1 million final demand.

**Exhibit 5: Quarterly Project Capital Expenditures and Direct Jobs Created (in job years)**

	2013				2014				Total
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Construction Expenditures (Millions 2012\$)		\$ 4.80	\$ 4.80	\$ 4.80	\$ 4.80	\$ 4.80	\$ 4.80	\$ 4.80	\$ 33.57
Professional Services Expenditures (Millions 2012\$)		\$ 1.35	\$ 1.35	\$ 1.35	\$ 1.35	\$ 1.35	\$ 1.35	\$ 1.35	\$ 9.43
Direct Employment		37	37	37	37	37	37	37	259
Total Earnings (Millions 2012\$)		\$ 3.53	\$ 3.53	\$ 3.53	\$ 3.53	\$ 3.53	\$ 3.53	\$ 3.53	\$ 24.73
Discounted @ 7%		\$ 3.30	\$ 3.30	\$ 3.30	\$ 3.09	\$ 3.09	\$ 3.09	\$ 3.09	\$ 22.25
Discounted @ 3%		\$ 3.43	\$ 3.43	\$ 3.43	\$ 3.33	\$ 3.33	\$ 3.33	\$ 3.33	\$ 23.61
Total Employment		73	73	73	73	73	73	73	511

The Outer Harbor Intermodal Terminal Project represents a large capital investment in the economically distressed City of Oakland as well as the regional economy.<sup>4</sup> This spending will increase employment and earnings in the City and the region for the duration of the construction process. Construction is estimated to support or create over 500 jobs of one-year’s duration, including 259 direct jobs, as detailed in Exhibit 5 above. A job for one person that lasts three years would be equivalent to three person year jobs. These jobs are temporary; they last for the duration of the construction period, ramping up and down with the construction cycle.<sup>5</sup>

<sup>4</sup> The Project construction and operation occur within the Oakland city limits; and therefore, many of the employment and earnings impacts will benefit the economically distressed city. However, the RIMS II multipliers are not available at the city level; therefore, impacts are estimated for the San Francisco-Oakland-Fresno, CA MSA.

<sup>5</sup> The economic impacts from the construction of the Project are estimated for the San Francisco-Oakland-Fremont, CA MSA based on the construction and professional services expenditures and the construction and professional services RIMS II multipliers for the region. The Final Demand construction RIMS II multipliers are 0.5360 (earnings) and 11.1141 (employment) for the MSA. The Final Demand professional services RIMS II multipliers are 0.7146 (earnings) and 12.9941 (employment). Please note that to use the final demand multipliers for employment, the costs were deflated to 2008 dollars using GDP deflator for non-defense direct capital because the RIMS II multipliers are based on 2008 data.

### **On-Going Benefits: Project Operation Job Creation**

The Project will not create any new jobs at the Manifest and Intermodal Rail Yards directly. However, the long-term job creation resulting from Project operations primarily will result from the market's response to the increased capacity and improved service that the Project supports. Without the Project, the rail terminal and private investments in the commercial uses at the Port will be limited.

These rail terminal and private investments will create opportunities for residents of the City of Oakland to have access to high quality, skilled jobs at the Port facilities. In anticipation of the project's implementation, the city has begun an outreach initiative with the Oakland community and other key stakeholders to ensure that local residents share in the economic prosperity created by the investment. Still in development, the package of benefits, once adopted by the City's Agency Board will apply to all developers and will be supported by all key project stakeholders, including Community Coalitions. Some of the key guidelines and goals, subject to coordination with any required federal regulations, identified to date include:

- All new apprentices at the Port are required to be City of Oakland residents.
- 50% (plus one) work hours for Oakland residents, craft by craft.
- Additional priority for local hire given to West Oakland residents and Enterprise Zone residents (or another proxy for areas of low-income, high unemployment etc.)
- Locating a Jobs Center in West Oakland that will be readily accessible and will serve as a resource for contractors, employers, and job seekers during Construction and Operations phases.
- The Center will connect job seekers with job training, education and other support services, such as transportation.
- A Young Adult/Re-entry Employment Program also is being developed.

These components are designed to build skills in the local community and provide employment and higher-income opportunities for the economically distressed residents in the City of Oakland.

### **Long-term Outcomes**

The project described in the TIGER 2012 will support the region's economy over the long term through the construction and operation of the following:

- New Knight Yard, 7-track flat switching yard
- New JIT/intermodal leads
- Track work required on UPRR property to improve access to the Port of Oakland

These improvements generate numerous benefits in the City of Oakland and the larger San Francisco-Oakland-Fremont region, including state of good repair benefits (pavement savings and residual value), economic competitiveness (intermodal operating savings, intermodal inventory savings, manifest shipping savings, and manifest congestion savings), environmental sustainability (intermodal and manifest emissions savings), and safety benefits (manifest accidents avoided savings).

The balance of this discussion describes the assumptions and methods used to develop the benefit-cost analysis and estimates the value of the long-term benefits generated by the Project. Project construction will be fully-complete in 2014. As directed in the TIGER 2012 guidance, the useful life of the Project's capital investment has been estimated over a 20-year analysis horizon (2015 through 2034). The stream of benefits and costs over time are converted to present value using the required 7% discount rate. The equivalent results are also shown at a 3% discount rate. All benefits are estimated in accordance with guidance provided by US DOT for benefit cost analysis. If no DOT guidance applied to the estimate, the project team consulted industry

research for the best practice and information on which to base the assumptions and methodology. The section concludes with a summary table, Exhibit 9, which aggregates the benefits and compares them to the costs for the Project. In addition, Exhibit 10 provides a summary table of benefits and costs for the manifest components only, and Exhibit 11 summarizes the benefits and costs for the intermodal components only.

## **State of Good Repair**

### ***Manifest – Pavement Savings***

The manifest components of the Project will reduce truck drayage between Stockton and the Port of Oakland by 12,000 trucks per year as soon as the project is complete. Currently, the UPRR is turning away rail manifest business at the terminal due to capacity constraints. As a result, these goods are trucked into the Port. HDR has estimated that 4,000 additional rail cars will now be able to enter the Port, reducing the truck trips from Stockton to the Port (70 miles) by 12,000 (assumes that it takes three truck loads to fill one manifest train car). The derivation of this estimate can be found in the supporting materials (Tiger IV\_Train Trip Times(rev1)03\_13\_2012.xlsx, Manifest Train Improvements tab).

This reduction in truck trips removes 840,000 vehicle miles traveled (VMT) annually from regional interstates and highways, thereby reducing the truck wear and tear on the pavement. The FHWA Highway Cost Allocation Study, 2000 Addendum<sup>6</sup>, estimates the marginal pavement costs per VMT to be 18.1 cents (in 2000\$) or 19.5 cents (2012\$)<sup>7</sup> for a 60 kip 4-axle US Truck on an Urban Interstate. ***Applying this marginal pavement cost to the annual truck VMT avoided and discounting at 7% yields a total pavement cost savings of \$1.51 million.***

### ***Manifest and Intermodal – Residual Value***

Additionally, the Project will replace the existing Manifest Yard and upgrade and restore the intermodal yard and UPRR rail access to a state of good repair. The useful life of the rail yard components of the Project is 38 years according to BEA guidance<sup>8</sup>. Thus, the Project's new assets will have value beyond the 20-year analysis period used in this study. In order to estimate the residual value of these assets, the capital investments in rail yards/rail replacement track were depreciated (straight-line) over the full life of the assets. The first 20 years of the series were excluded from the residual estimation; this is the basis of the benefits estimation reported elsewhere. The remaining 18 years of the series were discounted back at a 7% rate and summed. ***The value of the remaining useful life for the Project assets discounted is \$1.18 million, including \$0.79 million for the intermodal components, and \$0.39 million for the manifest components.***

## **Economic Competitiveness**

### ***Manifest – Shipping Savings***

By providing additional manifest rail capacity to the Port, the Project eliminates the need for freight to be trucked to the Port. Currently, containers traveling to or from the Port of Oakland must travel by truck to/from the nearest intermodal facilities in Stockton—more than 70 miles away. With the Project, additional manifest rail tracks and facilities will be located at the Port, eliminating the truck drayage costs. The drayage savings per truck load was estimated to be \$300 by the Port of Oakland, and with 12,000 trucks annually making the trip (see Tiger IV\_Train

<sup>6</sup> <http://www.fhwa.dot.gov/policy/hcas/addendum.htm>, Table 13

<sup>7</sup> Escalated to 2012\$ using GDP deflator for Capital Non-defense. See Final BCA Port of Oakland.xlsx in the supporting materials for details.

<sup>8</sup> BEA Rates of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wyckoff categories, Table C, [http://www.bea.gov/scb/account\\_articles/national/wlth2594/tableC.htm](http://www.bea.gov/scb/account_articles/national/wlth2594/tableC.htm)

Trip Times(rev1)03\_13\_2012.xlsx, Manifest Train Improvements tab in the supporting materials for details), the savings at full build is expected to be \$3.6 million annually. **Annualizing and applying a discount rate of 7%, the total shipping savings is \$33.28 million over the analysis period.**

### **Manifest – Congestion Savings**

Additionally, by removing 12,000 trucks from the region's interstates and highways, annual VMT is reduced by 840,000 annually, thereby reducing the marginal cost of congestion on other vehicles traveling these roads. The FHWA Highway Cost Allocation Study, 2000 Addendum<sup>9</sup>, estimates the marginal congestion costs per VMT to be 32.6 cents (in 2000\$) or 42.0 cents (2012\$)<sup>10</sup> for a 60 kip 4-axle US Truck on an Urban Interstate. **Applying this marginal congestion cost to the annual truck VMT avoided and discounting at 7% yields a total congestion cost savings of \$3.26 million.**

### **Intermodal – Operating Savings**

By improving the UPRR's rail access to the intermodal terminal by adding additional tracks and removing the delay associated with the BNSF trains having to cross over the UPRR tracks, significant time savings are realized by both the BNSF and the UPRR. HDR has estimated the intermodal delay savings associated with the Project to be between 22,154 minutes (or 369 hours) in 2011 and first year of operations and 23,950 minutes (or 399 hours) in 2035. The derivation of this estimate can be found in the supporting materials (Tiger IV\_Train Trip Times(rev1)03\_13\_2012.xlsx, Intermodal Train Improvements tab). The delay savings in hours is interpolated between 2015 and 2035 using a straight-line methodology.

The annual value of this delay savings is a recurring benefit for the railroads. The components of the delay cost can be calculated by summing four elements: unproductive locomotive costs; idling fuel costs; car/equipment costs; and crew costs. However, it is important to note that this method underestimates the true value as it does not capture the cost to the railroad of the interruption to its schedule and the impact that the delay has on other parts of its operating network. This approach also excludes costs to shippers from having their deliveries delayed. It is provided here as a means of providing a firm lower bound on the cost of the current delays experienced at the intermodal terminal. A recent estimate by one Class 1 railroad is that train delay costs approximately \$261 per train-hour (2008\$)<sup>11,12</sup> or approximately \$274 (2012\$)<sup>13</sup>. **Multiplying the conservative train delay cost by the interpolated hours of delay and discounting at 7% yields a total operating cost savings of \$0.96 million.**

### **Intermodal – Inventory Savings**

Additionally, removing the intermodal rail delay currently experienced at the terminal also yields an inventory savings for shippers as they are able to deliver these goods more quickly. The inventory savings associated with the Project is proxied by the opportunity cost of holding assets in inventory rather than using them for another purpose. As a result, it is based on the annual value of the goods shipped by intermodal train daily, annual hours of delay avoided, and an

<sup>9</sup> <http://www.fhwa.dot.gov/policy/hcas/addendum.htm>, Table 13

<sup>10</sup> Escalated to 2012\$ using GDP deflator. See Final BCA Port of Oakland.xlsx in the supporting materials for details.

<sup>11</sup> Lai, Y.C. Increasing Railway Efficiency and Capacity through Improved Operations, Control and Planning, Ph.D. Dissertation, Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, 2008, as cited in Dingler, Mark and Y-C (Rex) Lai and Christopher P.L. Barkan. TRB Paper 09-2652, "Impact of Operating Heterogeneity on Railway Capacity," 2009.

<sup>12</sup> This value is also very similar to the value applied in the successful TOWER 55 TIGER application, p. 42, line 63, <http://www.tradecorridors.com/tower55/pdf/Appendix%20A%20-%20CBA.pdf>. This cost is conservative as it assumes only one locomotive, while most trains entering and existing the Port have at least two, if not three locomotives.

<sup>13</sup> Escalated to 2012\$ using GDP deflator. See Final BCA Port of Oakland.xlsx in the supporting materials for details.

hourly commercial discount rate. This benefit is only estimated for current and planned trains without the Project, not the additional capacity offered by the Project.

The annual value of goods shipped by intermodal train daily at the intermodal terminal is estimated as follows. UB Universal (a shipper currently using the Port) estimates the value of the goods per car load to be \$37,500<sup>14</sup>. The number of trains per day in the opening year is 9.8 and this number is expected to grow to 14.6 by 2035<sup>15</sup>, even without the Project. The number of trains per day is interpolated between 2015 and 2035 using a straight-line methodology. Additionally, the number of cars per train today is 22, but this number is expected to increase to 25 in 2020, resulting in just over 78,000 carloads per year in 2015 and growing to almost 130,000 carloads per year in 2034 (assuming 362 rail working days per year).

The annual hours of delay avoided due to the Project were estimated and described as part of the Intermodal Operating Savings discussed above.

The inventory cost associated with the annual carloads and annual hours of delay is based on the commercial discount rate – the opportunity cost associated with holding assets in inventory rather than using them for another purpose. The analysis uses a commercial discount rate of 4.25%<sup>16</sup>. Assuming 8,760 hours in a year (365 days \* 24 hours), this yields an hourly discount rate of 0.00049%. Multiplying this hourly discount rate by the annual number of carloads, the value per carload, and the hours of delay avoided yields the annual value of inventory savings. **Applying a discount rate of 7%, this results in a total inventory savings of \$64.40 million.**

### Livability

Although the benefit cannot be monetized directly, the Project will significantly benefit the livability of the Oakland community. As explained in the Sustainability section below, the shift from trucks to rail will reduce truck traffic in the vicinity of the port, making the port a better neighbor. It will also have a positive impact on the air quality of West Oakland and is factored into the estimated value of the improved air quality associated with the diversions from trucks to rail and the intermodal rail time savings.

### Sustainability

#### **Manifest – Emissions Savings**

By providing additional manifest rail capacity to the Port, the Project eliminates the need for freight to be trucked to the Port. As a result, the region will experience a reduction in truck VMT—840,000 annually—and the associated air pollutants. The VMT estimate is based on the number of truck trips and the distance between the Port and Stockton (see Tiger IV\_Train Trip Times(rev1)03\_13\_2012.xlsx, Manifest Train Improvements tab in the supporting materials for details).

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<sup>14</sup> Additional research was performed to verify this estimate. It is located in the “Carload Value Data” tab of the Final BCA Port of Oakland.xlsx, which is provided in the supplemental materials. With inflation, this estimate is conservative compared the average intermodal weight per carload (AAR, Railroad Facts, 2004) and the average intermodal value per pound (Arizona 2005 TRANSEARCH data).

<sup>15</sup> HDR, Tiger IV\_Train Trip Times(rev1)03\_13\_2012.xlsx, Intermodal Train Improvements tab available in the supporting materials.

<sup>16</sup> The commercial discount rate applied in the analysis falls on the conservative side of the 7% to 3% discount rate applied in the TIGER analysis. Additionally, the successful TOWER 55 TIGER application applied the same discount rate for shipping inventory cost. <http://www.tradecorridors.com/tower55/pdf/Appendix%20A%20-%20CBA.pdf>

This reduction in VMT decreases the amount of Carbon Monoxide (CO), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC), Particulate Matter (PM2.5 and PM10), Sulfur Dioxide (SO2), and Carbon Dioxide (CO2) in the atmosphere. Federal Motor Carrier Safety Administration guidance for the pollutant factors (g/VMT) associated with truck drayage from the Hours of Service Environmental Assessment were applied to the annual VMT reduced.<sup>17</sup> The grams were converted to long tons for CO, NOx, VOC, PM, and SO2 and metric tons for CO2.

The economic benefit of the decreased emissions is estimated by applying the economic cost of air emissions to the reduction of CO, NOx, PM2.5, PM10, SO2, and VOC as recommended in the US DOT TIGER BCA guidance.<sup>18</sup> **Applying USDOT guidance for the pollutant factors and discounted at 7%, the estimated value of the improved air quality associated with these diversions is \$0.35 million.** Alternately, using the Interagency Working Group on Social Cost of Carbon guidance<sup>19</sup>, the value of carbon dioxide benefits are discounted at 3%, which **yields a total savings of \$0.27 million in greenhouse gas (or climate change) benefits.**

### **Intermodal – Emissions Savings**

By improving access to the intermodal terminal at the Port and reducing the hours of delay associated with the BNSF trains crossing over the UPRR tracks, the Project reduces the hours of locomotive travel, and therefore, the associated air pollutants. The annual hours of delay avoided due to the Project were estimated and described as part of the Intermodal Operating Savings discussed under Economic Competitiveness and the details can be found in the supporting materials (Tiger IV\_Train Trip Times(rev1)03\_13\_2012.xlsx, Manifest Train Improvements tab).

This reduction in train delay hours decreases the amount of CO, NOx, and VOC in the atmosphere. The US Environmental Protection Agency's (EPA) Office of Transportation and Air Quality published switch rail engine emission rates (g/brake horsepower hour) for various Tiers based on the year the locomotive was built.<sup>20</sup> Tier 0 locomotives apply to most locomotives built prior to 2001. The average age of UPRR switching locomotives is 31 years<sup>21</sup>, while the average age of BNSF locomotives is 15 years<sup>22</sup>. Therefore, the Tier 0 rates were applied in the analysis. Additionally, the analysis conservatively assumes that all trains coming into and out of the Port have two locomotives. This is conservative because many trains that have traveled the Donner Pass require 3 locomotives.

Since the emission rates are based on horsepower hours, the median horsepower associated with the UP and BNSF locomotives in California (1,643)<sup>23</sup> were multiplied by the annual hours of delay, two locomotives, and the emissions factors yielding the annual grams of CO, NOx, and VOC avoided. The grams were converted to long tons for CO, NOx, and VOC.

The economic benefit of the decreased emissions is estimated by applying the economic cost of air emissions to the reduction of CO, NOx, and VOC as recommended in the US DOT TIGER

<sup>17</sup> FMCSA, *Hours of Service (HOS) Environmental Assessment, Appendix A: Analysis of Air Quality Impacts*, Dec 2010.

<sup>18</sup> The economic costs of air emissions are taken from Chapter VIII of the Final Regulatory Impact Analysis of the National Highway Traffic Safety Administration's rulemaking on Corporate Average Fuel Economy for MY 2012-2016 Passenger Cars and Light Trucks.

<sup>19</sup> Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, February 2010

<sup>20</sup> FMCSA US EPA, Office of Transportation and Air Quality, Emissions Factors for Locomotives, EPA-420-F-09-025, April 2009, p.2, <http://www.epa.gov/nonroad/locomotv/420f09025.pdf>

<sup>21</sup> UPRR 2010 Fact Book, <http://www.up.com/investors/factbooks/2010/disclosure.shtml>

<sup>22</sup> BNSF 2008 Annual Report, p.6, <http://www.bnsf.com/about-bnsf/financial-information/annual-reports-and-proxy-statements/pdf/2008annrpt.pdf>

<sup>23</sup> [http://www.arb.ca.gov/railyard/ted/tedr\\_loco\\_options.pdf](http://www.arb.ca.gov/railyard/ted/tedr_loco_options.pdf), p.35.

BCA guidance.<sup>24</sup> **Applying USDOT guidance for the pollutant factors and discounted at 7%, the estimated value of the improved air quality associated with these diversions is \$2.71 million.**

**Safety**

**Manifest – Accident Reduction Savings**

By providing additional manifest rail capacity to the Port, the Project eliminates the need for freight to be trucked to the Port. As a result, drayage will no longer be necessary, yielding a reduction in annual truck VMT of 840,000. This reduces the rate or likelihood of crashes and associated deaths, injuries and property damage on regional interstates and highways because fewer trucks will be traveling between the Port and Stockton. To convert the annual truck VMT avoided into crashes avoided, the following crash rates from the Bureau of Transportation Statistics were applied.

**Exhibit 6: BTS Accident Rates per 100,000,000 VMT, 2009**

Fatalities	1.144675318	per 100,000,000 VMT
Injured persons	75.06345185	per 100,000,000 VMT
Crashes	186.3889501	per 100,000,000 VMT

Source: 2009 BTS Motor Vehicle Safety Data Table 2-17 (from 2011 National Transportation Statistics)

[http://www.bts.gov/publications/national\\_transportation\\_statistics/#chapter\\_2](http://www.bts.gov/publications/national_transportation_statistics/#chapter_2)

These crash reduction factors were then converted to the Maximum Abbreviated Injury Scale (MAIS) accident types in order to apply US DOT Guidance on the value of avoiding an accident. The conversion is based on the NHTSA KABCO-AIS Conversion Table (July 2011) provided on page 12 of the TIGER 2012 Benefit-Cost Analysis Resource Guide for Injury (severity unknown) and No Injury accidents<sup>25</sup>.

**Exhibit 7: Annual Projected Crashes Avoided by MAIS Crash Type**

Fatalities	0.0096
MAIS 5	0.0066
MAIS 4	0.0028
MAIS 3	0.0245
MAIS 2	0.0687
MAIS 1	0.5091
PDO	1.5846

The values shown above are projections of annual **fatalities and injuries avoided** because the BTS crash types are based on fatalities, injuries, and damage per 100,000,000 VMT, which takes into consideration vehicle occupancy. Based on the number of fatalities, injuries, and property damage incidents, their total annual value is found from the US DOT Guidance and the National Highway Safety Council estimates for the value of avoiding an accident. The estimates applied in this analysis are summarized in Exhibit 8 below.

<sup>24</sup> The economic costs of air emissions are taken from Chapter VIII of the Final Regulatory Impact Analysis of the National Highway Traffic Safety Administration’s rulemaking on Corporate Average Fuel Economy for MY 2012-2016 Passenger Cars and Light Trucks.

<sup>25</sup> [http://www.dot.gov/tiger/docs/tiger-12\\_bca-resourceGuide.pdf](http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf)

**Exhibit 8: Value of One Person Avoiding a Crash, Millions of 2012\$**

Crash Type	Value of Avoiding Crash	Source
Value of Statistical Life (VSL)	\$6.286	Based on 2011 OST Guidance
MAIS 5 Critical (0.593) Fraction of VSL	\$3.728	Based on 2011 OST Guidance
MAIS 4 Severe (0.266) Fraction of VSL	\$1.672	Based on 2011 OST Guidance
MAIS 3 Serious (0.0575) Fraction of VSL	\$0.660	Based on 2011 OST Guidance
MAIS 2 Moderate (0.047) Fraction of VSL	\$0.295	Based on 2011 OST Guidance
MAIS 1 Minor (0.003) Fraction of VSL	\$0.019	Based on 2011 OST Guidance
PDO \$3,285 (2010\$)	\$0.003	NHTSA, Economic Impact of Motor Vehicle Crashes, 2000

Note: Values were escalated to 2012\$ using GDP Price Index Deflators. See Final BCA Port of Oakland.xlsx in the supporting materials for details.

Applying the crash costs in Exhibit 8 to the projections of crash reductions provided in Exhibit 7 yields the annual savings. **Applying a discount rate of 7%, the total projected accidents avoided savings are \$1.30 million.**

**Summary**

***TIGER 2012 Project***

Exhibit 9 below summarizes the discounted value of the economic benefits discussed in this memorandum. Taken in total and using a 7% discount rate, the state of good repair, economic competitiveness, sustainability, and safety benefits from the Port of Oakland's Outer Harbor Intermodal Terminal provide over \$109 million of benefits over the 20-year analysis period. Compared to similarly discounted cost estimates, the Benefit Cost Ratio for the Project is 2.60, an excellent return on investment. This ratio rises to 3.72 when benefits and costs are discounted at 3%.

**Exhibit 9: Benefit Cost Analysis of the Port of Oakland’s Outer Harbor Intermodal Terminal**

	Intermodal and Manifest	
	20 Year Total in Millions 2012\$	
	Discounted at 7%	Discounted at 3%
<u>Benefits</u>		
Intermodal Facility		
Operating Savings	\$ 0.96	\$ 1.47
Emissions	\$ 2.71	\$ 4.13
Inventory Savings	\$ 64.40	\$ 101.49
Manifest Facility		
Shipping Savings	\$ 33.28	\$ 50.43
Emissions	\$ 0.35	\$ 0.50
CO2*	\$ 0.27	\$ 0.27
Safety	\$ 1.30	\$ 1.98
Pavement	\$ 1.51	\$ 2.29
Congestion	\$ 3.26	\$ 4.94
Residual	\$ 1.18	\$ 3.73
Total Benefits	\$ 109.24	\$ 171.23
<u>Costs</u>		
Construction	\$ 38.69	\$ 41.05
Operations	\$ 3.28	\$ 4.97
Total Costs	\$ 41.96	\$ 46.03
Benefit-Cost Ratio	2.60	3.72

\*Climate Change benefits are only discounted at 3% per Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, Feb 2010

***Manifest Only***

Exhibit 10 below summarizes the discounted value of the economic benefits discussed in this memorandum for the manifest components of the Project. Taken in total and using a 7% discount rate, the state of good repair, economic competitiveness, sustainability, and safety benefits from the manifest components of Port of Oakland’s Outer Harbor Intermodal Terminal provide just over \$40 million of benefits over the 20-year analysis period. Compared to similarly discounted cost estimates, the Benefit Cost Ratio for the manifest components of the Project is 2.65, an excellent return on investment. This ratio rises to 3.70 when benefits and costs are discounted at 3%.

**Exhibit 10: Benefit Cost Analysis of the Manifest Components of the Port of Oakland's Outer Harbor Intermodal Terminal (\$2012 M)**

	Manifest Only	
	20 Year Total in Millions 2012\$	
	Discounted at 7%	Discounted at 3%
<u>Benefits</u>		
Intermodal Facility		
Operating Savings	na	na
Emissions	na	na
Inventory Savings	na	na
Manifest Facility		
Shipping Savings	\$ 33.28	\$ 50.43
Emissions	\$ 0.35	\$ 0.50
CO2*	\$ 0.27	\$ 0.27
Safety	\$ 1.30	\$ 1.98
Pavement	\$ 1.51	\$ 2.29
Congestion	\$ 3.26	\$ 4.94
Residual	\$ 0.39	\$ 1.23
Total Benefits	\$ 40.37	\$ 61.65
<u>Costs</u>		
Construction	\$ 14.15	\$ 15.02
Operations	\$ 1.08	\$ 1.64
Total Costs	\$ 15.24	\$ 16.66
Benefit-Cost Ratio	2.65	3.70

\*Climate Change benefits are only discounted at 3% per Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, Feb 2010

***Intermodal Only***

Exhibit 11 below summarizes the discounted value of the economic benefits discussed in this memorandum for the intermodal components of the Project. Taken in total and using a 7% discount rate, the state of good repair, economic competitiveness, and sustainability benefits from the intermodal components of Port of Oakland's Outer Harbor Intermodal Terminal provide almost \$69 million of benefits over the 20-year analysis period. Compared to similarly discounted cost estimates, the Benefit Cost Ratio for the intermodal components of the Project is 2.58, an excellent return on investment. This ratio rises to 3.73 when benefits and costs are discounted at 3%.

**Exhibit 11: Benefit Cost Analysis of the Intermodal Components of the Port of Oakland's Outer Harbor Intermodal Terminal (\$2012 M)**

	Intermodal Only	
	20 Year Total in Millions 2012\$	
	Discounted at 7%	Discounted at 3%
<u>Benefits</u>		
Intermodal Facility		
Operating Savings	\$ 0.96	\$ 1.47
Emissions	\$ 2.71	\$ 4.13
Inventory Savings	\$ 64.40	\$ 101.49
Manifest Facility		
Shipping Savings	na	na
Emissions	na	na
CO2*	na	na
Safety	na	na
Pavement	na	na
Congestion	na	na
Residual	\$ 0.79	\$ 2.50
Total Benefits	\$ 68.87	\$ 109.58
<u>Costs</u>		
Construction	\$ 24.53	\$ 26.03
Operations	\$ 2.19	\$ 3.33
Total Costs	\$ 26.73	\$ 29.36
Benefit-Cost Ratio	2.58	3.73

\*Climate Change benefits are only discounted at 3% per Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, Feb 2010

## **List of Attachments and Supporting Information**

AECOM, Economic Distress.xlsx (Excel spreadsheet with supporting data)

AECOM, Final BCA Port of Oakland.xlsx (Excel spreadsheet with BCA calculations by benefit type and summary)

HDR, Tiger IV\_Train Trip Times(rev1)03\_13\_2012.xlsx (Excel spreadsheet with Intermodal and Manifest Train Improvement Calculations)

CCIG Oakland Global, 2.17.12 TIGER IV Project Budget.pdf (PDF of capital costs)