



South Orient Railroad (SORR) Rehabilitation &
Presidio-Ojinaga International Bridge Reconstruction Project
Appendix B: Detailed Benefit-Cost Analysis

TIGER FY16 Grant Application

April 2016

I. COST-EFFECTIVENESS ANALYSIS

A Benefit-Cost Analysis (BCA) was conducted in conformance with United States Department of Transportation (US DOT) guidance to assess the impact of the South Orient Railroad (SORR) project. The project consists of these cost-effective project components:

- Rehabilitation of track, bridge, and drainage systems along a 72 mile segment from mile post (MP) 956.7 to MP 1029 along the existing South Orient Railroad (SORR) from Presidio, Texas north to the Union Pacific Railroad crossing at Paisano Junction. This segment is located 11 miles west of Alpine, Texas. Proposed track improvements to Class II rail would result in speed increases from 10 miles per hour to 25 miles per hour.
- Construction of a new international bridge railroad crossing between Presidio, Texas and Ojinaga, Mexico.

The BCA was prepared based on an estimate of potential truck-to-rail mode shift benefits. Rail track improvements along the project corridor and construction of the international bridge at Presidio will result in existing truck freight loads shifting to the SORR. This mode shift would reduce the trip length to the nearest international point of entry at Del Rio, El Paso, Eagle Pass, or Laredo. The BCA incorporates the costs associated with all three elements. Project-specific benefits were calculated for the following classes of benefits:

- Shipping cost savings
- Reduced net emissions
- Improved net safety
- Reduced pavement maintenance costs

The BCA uses project-specific input data to calculate life-cycle costs, life-cycle benefits, annual benefits, net present values of costs and benefits, and a resulting B/C ratio. A summary of the BCA is provided in Section A of this appendix. Section B discusses the BCA inputs used for analysis of the SORR project, and Section C includes a detailed table containing the BCA results. All monetary values presented in this appendix were adjusted to 2016 dollars, unless otherwise stated. Benefit cost ratios were calculated at three percent (3%) and seven percent (7%) discount rates.

A. BENEFIT-COST ANALYSIS SUMMARY

A spreadsheet model was developed in accordance with USDOT guidance to compute the benefit/cost ratio based on project-specific inputs and industry-standard or USDOT-defined values for modal shipping costs, safety, emissions, and pavement maintenance savings.

The BCA results indicate a **positive Benefit/Cost ratio of 9.38** at a 7 percent discount rate, reflecting that the life-cycle benefits of the project exceed the estimated project-related costs.

Life-Cycle Benefits	3%	7%
Shipping Cost Savings	\$ 126.1	\$ 86.7

Reduced Net Emissions	\$ 5.2	\$ 3.6
Improved Net Safety	\$ 50.0	\$ 34.4
Reduced Pavement Maintenance Costs	\$ 25.6	\$ 17.6
Total	\$ 206.8	\$ 142.3
Life-Cycle Costs (mil. \$)		
International Bridge Replacement	\$ 7.7	\$ 7.7
Track Tie, Surfacing, and Switches	\$ 4.0	\$ 4.0
Bridge Component Replacement	\$ 0.4	\$ 0.4
Bridge Tie Replacements	\$ 0.5	\$ 0.5
Drainage Improvements	\$ 1.5	\$ 1.5
Contingency	\$ 2.1	\$ 2.1
Total	\$ 16.2	\$ 16.2
Benefit / Cost Ratio	13.36	9.38

provides a summary of the BCA results at both 3% and 7% discount rates.

Table 1: BCA Results

Life-Cycle Benefits	3%	7%
Shipping Cost Savings	\$ 126.1	\$ 86.7
Reduced Net Emissions	\$ 5.2	\$ 3.6
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Note: 2016\$, 20-year life cycle (2016-2036)

B. BCA MODEL INPUTS

The BCA model includes unique project inputs and default parameters associated with emissions, safety, and pavement maintenance costs. Project inputs and their sources are listed below:

- Existing and projected carload data provided by a previous benefit-cost analysis completed for the entire SORR in 2015.

Model inputs and their sources are listed below:

- Rail carloads forecast^{1,2}
- Truck shipping costs per truck-mile³
- Unit value of safety benefits
 - a. Fatality⁴
 - b. Injury⁵
 - c. Property damage (truck)⁶
 - d. Property damage (train)⁷
- Emissions rates by mode^{8,9}
- Emissions values¹⁰

1. Project Costs

Estimated project funding sources and the anticipated length of the construction period were entered into the BCA model. Cost categories include international bridge replacement; track tie, surfacing, and switches; bridge component and bridge tie replacement; drainage improvements and contingency costs.

These costs are presented as constant dollars and then discounted using a three percent annual rate to reflect their present value. Construction costs for the SORR project are approximately **\$14.0 million**, as described in more detail in Project Readiness Section of this application.

2. Monetized Benefits

The BCA assumes that trucks carry all existing freight market demand due to the lack of the international point of entry and the poor infrastructure of the SORR between Alpine and Presidio. Given the proposed improvements, market demand suggests that the SORR can deliver

¹ Texas Pacifico. Historical and forecasted carloads through 2014. 9/23/14.

² Projected carloads 2014-2034. HNTB Corporation, Benefit-Cost Analysis of the South Orient Railroad. 2014.

³ Average Carrier Costs per Mile, 2008-2014, from American Transportation Research Institute, An Analysis of the Operational Costs of Trucking: 2015 Update, September 2015. Available at <http://atri-online.org/wp-content/uploads/2015/09/ATRI-Operational-Costs-of-Trucking-2015-FINAL-09-2015.pdf>

⁴ TIGER Benefit-Cost Analysis (BCA) Resource Guide, updated 3/27/2015, page 3. Available at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

⁵ TIGER Benefit-Cost Analysis (BCA) Resource Guide, updated 3/27/2015, page 4. Available at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

⁶ TIGER Benefit-Cost Analysis (BCA) Resource Guide, updated 3/27/2015, page 5. Available at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

⁷ BTS National Transportation Statistics. (2013) Table 2-43

http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_statistics/html/table_02_43.html

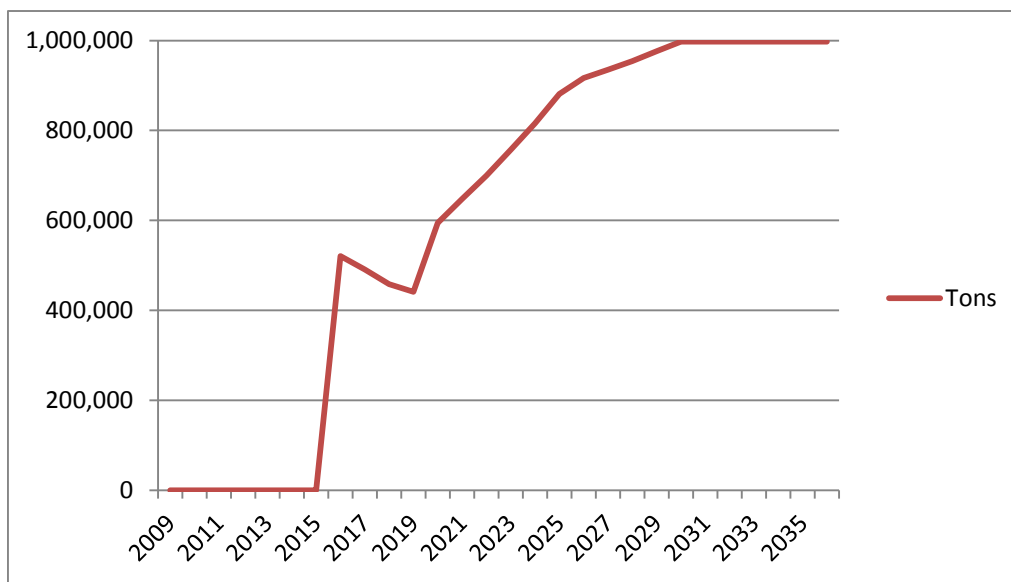
⁸ Office of Transportation and Air Quality. Environmental Protection Agency. Average In-Use Emissions from Heavy-Duty Trucks, 2008. <https://www3.epa.gov/otaq/consumer/420f08027.pdf>

⁹ Office of Transportation and Air Quality. Environmental Protection Agency. Emissions Factors for Locomotives, 2009. <https://www3.epa.gov/nonroad/locomotv/420f09025.pdf>

¹⁰ TIGER Benefit-Cost Analysis (BCA) Resource Guide, updated 3/27/2015, page 6. Available at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

up to one million tons per year as a result of freight mode shifts from truck to rail, as shown in Figure 1. The following subsections summarize data sources for each of the benefit categories.

Figure 1: Forecast Rail Tons Shipped across Border, South Orient Railroad



a) SHIPPING COST SAVINGS

The net shipping costs associated with truck to rail diversions were computed using industry data. Truck shipping costs per truck-mile were derived from annual data provided by the American Transportation Research Institute.¹¹ Rail shipping costs were obtained from Texas Pacifico, the current lessee on the SORR, and from a previous benefit-cost analysis conducted for the entire railroad in 2015. Rail operating and maintenance costs are proportioned on a car-

¹¹ Average Carrier Costs per Mile, 2008-2014, from American Transportation Research Institute, An Analysis of the Operational Costs of Trucking: 2015 Update, September 2015. Available at <http://atri-online.org/wp-content/uploads/2015/09/ATRI-Operational-Costs-of-Trucking-2015-FINAL-09-2015.pdf>

mile basis to estimate rail shipping costs on the portion of the SORR between Alpine and Presidio.

b) EMISSION REDUCTIONS

The net emissions associated with truck to rail diversions were computed using industry data. Carbon dioxide (CO₂), volatile organic compounds (VOCs), nitrogen oxides (NO_x), and particulate matter (PM) emissions rates for rail and truck were derived from Environmental Protection Agency emissions data.^{12, 13} Social cost of carbon and values of other emissions were based on current USDOT guidance.

c) SAFETY BENEFITS

Crash rates for fatality, injury, and property damage only accidents were derived from recent annual data provided by the Bureau of Transportation Statistics.¹⁴ Unit values of avoided crashes were based on current USDOT guidance.

d) PAVEMENT MAINTENANCE COST SAVINGS

Diversion of truck traffic to rail reduces costs associated with highway maintenance. The marginal cost of highway pavement deterioration was derived from information provided by the Federal Highway Administration, updated to 2016 dollars.¹⁵

C. BCA RESULTS

Table 2 provides a summary of the monetized benefits for shipping cost savings, reduced net emissions, improved net safety, and reduced pavement maintenance costs associated with truck to rail diversions over the 20-year life cycle of the project.

¹² Office of Transportation and Air Quality. Environmental Protection Agency. Average In-Use Emissions from Heavy-Duty Trucks, 2008. <https://www3.epa.gov/otaq/consumer/420f08027.pdf>

¹³ Office of Transportation and Air Quality. Environmental Protection Agency. Emissions Factors for Locomotives, 2009. <https://www3.epa.gov/nonroad/locomotv/420f09025.pdf>

¹⁴ BTS National Transportation Statistics Table 2-43
http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_02_43.html

¹⁵ Federal Highway Administration. Addendum to the 1997 Federal Highway Cost Allocation Study Final Report, 2000. Table 13, for 80 kip 5-axle rural. Available at <https://www.fhwa.dot.gov/policy/hcas/addendum.cfm>.

Table 2: Benefit-Cost Analysis Summary

A	B	Ben1a	Ben2a	Ben2b	Ben2c	C	C7	C3	Cost1a	D	D7	D3	E	F	G	H	I	J	K	L	M
Year	Calendar Year	Net O&M Cost for Expanded Demand (truck to rail diversion)	Reduced Net Emissions	Improved Net Safety	Reduced Pavement Maintenance Costs	Non-CO ₂ Benefits (2016\$)	7% NPV Non-CO ₂ Benefits [C/(1.07^A)]	3% NPV Non-CO ₂ Benefits [C/(1.03^A)]	Capital Costs	Non-CO ₂ Costs (2016\$)	7% NPV Non-CO ₂ Costs [D/(1.07^A)]	3% NPV Non-CO ₂ Costs [D/(1.03^A)]	Net Non-CO ₂ Benefits [C+D]	7% NPV Non-CO ₂ Net Benefits [E/(1.07^A)]	3% NPV Non-CO ₂ Net Benefits [E/(1.03^A)]	CO ₂ Reduced (Metric Tons)	3% SCC (2016\$)	Undiscounted CO ₂ Benefits @ 3% Avg SCC [H*I]	NPV CO ₂ Benefits @ 3% Avg SCC [J/(1.03^A)]	7% NPV Total Net Benefits [F+K]	3% NPV Total Net Benefits [G+K]
0	2016	\$4,964,214	\$217,578	\$2,103,737	\$1,077,077	\$8,362,606	\$8,362,606	\$8,362,606	-\$14,000,000	-\$14,000,000	-\$14,000,000	-\$14,000,000	-\$5,637,394	-\$5,637,394	-\$5,637,394	7,692	\$44.86	\$345,055	\$345,055	-\$5,292,339	-\$5,292,339
1	2017	\$4,793,079	\$205,142	\$1,983,497	\$1,015,517	\$7,997,234	\$7,474,050	\$7,764,305	\$0	\$0	\$0	\$0	\$7,997,234	\$7,474,050	\$7,764,305	7,252	\$45.90	\$332,899	\$323,203	\$7,797,253	\$8,087,508
2	2018	\$4,589,485	\$191,710	\$1,853,622	\$949,023	\$7,583,840	\$6,624,019	\$7,148,496	\$0	\$0	\$0	\$0	\$7,583,840	\$6,624,019	\$7,148,496	6,778	\$46.94	\$318,172	\$299,908	\$6,923,927	\$7,448,404
3	2019	\$4,528,968	\$184,438	\$1,783,313	\$913,026	\$7,409,746	\$6,048,560	\$6,780,967	\$0	\$0	\$0	\$0	\$7,409,746	\$6,048,560	\$6,780,967	6,521	\$47.99	\$312,906	\$286,353	\$6,334,913	\$7,067,320
4	2020	\$6,102,168	\$248,690	\$2,404,554	\$1,231,091	\$9,986,503	\$7,618,655	\$8,872,878	\$0	\$0	\$0	\$0	\$9,986,503	\$7,618,655	\$8,872,878	8,792	\$49.03	\$431,083	\$383,012	\$8,001,667	\$9,255,890
5	2021	\$6,643,323	\$270,768	\$2,618,030	\$1,340,387	\$10,872,507	\$7,751,947	\$9,378,720	\$0	\$0	\$0	\$0	\$10,872,507	\$7,751,947	\$9,378,720	9,573	\$49.03	\$469,354	\$404,869	\$8,156,817	\$9,783,590
6	2022	\$7,172,545	\$292,356	\$2,826,764	\$1,447,255	\$11,738,921	\$7,822,139	\$9,831,161	\$0	\$0	\$0	\$0	\$11,738,921	\$7,822,139	\$9,831,161	10,336	\$50.07	\$517,558	\$433,447	\$8,255,586	\$10,264,608
7	2023	\$7,761,924	\$316,402	\$3,059,262	\$1,566,290	\$12,703,878	\$7,911,337	\$10,329,415	\$0	\$0	\$0	\$0	\$12,703,878	\$7,911,337	\$10,329,415	11,186	\$52.16	\$583,465	\$474,411	\$8,385,748	\$10,803,826
8	2024	\$8,368,078	\$341,131	\$3,298,364	\$1,688,706	\$13,696,279	\$7,971,359	\$10,811,970	\$0	\$0	\$0	\$0	\$13,696,279	\$7,971,359	\$10,811,970	12,060	\$53.20	\$641,649	\$506,523	\$8,477,883	\$11,318,493
9	2025	\$9,041,328	\$368,602	\$3,563,971	\$1,824,693	\$14,798,592	\$8,049,454	\$11,341,889	\$0	\$0	\$0	\$0	\$14,798,592	\$8,049,454	\$11,341,889	13,031	\$54.25	\$706,913	\$541,790	\$8,591,244	\$11,883,679
10	2026	\$9,404,932	\$383,451	\$3,707,547	\$1,898,201	\$15,394,131	\$7,825,596	\$11,454,679	\$0	\$0	\$0	\$0	\$15,394,131	\$7,825,596	\$11,454,679	13,556	\$55.29	\$749,533	\$557,723	\$8,383,319	\$12,012,402
11	2027	\$9,590,396	\$391,040	\$3,780,924	\$1,935,769	\$15,698,129	\$7,458,068	\$11,340,662	\$0	\$0	\$0	\$0	\$15,698,129	\$7,458,068	\$11,340,662	13,825	\$56.33	\$778,790	\$562,614	\$8,020,682	\$11,903,277
12	2028	\$9,783,759	\$398,953	\$3,857,434	\$1,974,941	\$16,015,087	\$7,110,890	\$11,232,660	\$0	\$0	\$0	\$0	\$16,015,087	\$7,110,890	\$11,232,660	14,104	\$57.38	\$809,263	\$567,601	\$7,678,491	\$11,800,261
13	2029	\$10,012,131	\$408,300	\$3,947,808	\$2,021,211	\$16,389,450	\$6,801,039	\$11,160,418	\$0	\$0	\$0	\$0	\$16,389,450	\$6,801,039	\$11,160,418	14,435	\$57.38	\$828,223	\$563,980	\$7,365,019	\$11,724,397
14	2030	\$10,228,502	\$417,157	\$4,033,444	\$2,065,055	\$16,744,158	\$6,493,673	\$11,069,861	\$0	\$0	\$0	\$0	\$16,744,158	\$6,493,673	\$11,069,861	14,748	\$58.42	\$861,574	\$569,602	\$7,063,275	\$11,639,463
15	2031	\$10,228,502	\$417,157	\$4,033,444	\$2,065,055	\$16,744,158	\$6,068,853	\$10,747,438	\$0	\$0	\$0	\$0	\$16,744,158	\$6,068,853	\$10,747,438	14,748	\$60.51	\$892,345	\$572,762	\$6,641,615	\$11,320,200
16	2032	\$10,228,502	\$417,157	\$4,033,444	\$2,065,055	\$16,744,158	\$5,671,825	\$10,434,405	\$0	\$0	\$0	\$0	\$16,744,158	\$5,671,825	\$10,434,405	14,748	\$61.55	\$907,730	\$565,667	\$6,237,493	\$11,000,073
17	2033	\$10,228,502	\$417,157	\$4,033,444	\$2,065,055	\$16,744,158	\$5,300,771	\$10,130,491	\$0	\$0	\$0	\$0	\$16,744,158	\$5,300,771	\$10,130,491	14,748	\$62.59	\$923,115	\$558,500	\$5,859,271	\$10,688,990
18	2034	\$10,228,502	\$417,157	\$4,033,444	\$2,065,055	\$16,744,158	\$4,953,992	\$9,835,428	\$0	\$0	\$0	\$0	\$16,744,158	\$4,953,992	\$9,835,428	14,748	\$63.64	\$938,500	\$551,270	\$5,505,262	\$10,386,698
19	2035	\$10,228,502	\$417,157	\$4,033,444	\$2,065,055	\$16,744,158	\$4,629,899	\$9,548,959	\$0	\$0	\$0	\$0	\$16,744,158	\$4,629,899	\$9,548,959	14,748	\$64.68	\$953,886	\$543,988	\$5,173,887	\$10,092,947
20	2036	\$10,228,502	\$417,157	\$4,033,444	\$2,065,055	\$16,744,158	\$4,327,008	\$9,270,834	\$0	\$0	\$0	\$0	\$16,744,158	\$4,327,008	\$9,270,834	14,748	\$65.72	\$969,271	\$536,662	\$4,863,670	\$9,807,496
Total		\$174,355,841	\$7,138,656	\$69,022,936	\$35,338,571	\$285,856,005	\$142,275,741	\$206,848,241	-\$14,000,000	-\$14,000,000	-\$14,000,000	-\$14,000,000	\$271,856,005	\$128,275,741	\$192,848,241	252,377		\$14,271,285	\$10,148,940	\$138,424,681	\$202,997,181

Benefit Cost Ratio	
7% Discount Rate	10.89 [(C7+K)/D7]
3% Discount Rate	15.50 [(C3+K)/D3]