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Cost-Benefit Analysis in Support of TIGER II Application

South Orient Rail Line

HDR | Decision Economics

August 18, 2010

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EXECUTIVE SUMMARY OF ECONOMIC BENEFITS AND COST-BENEFIT ANALYSIS RESULTS

The South Orient rail line (SORR), approximately 391 miles in length, is a state-owned facility that extends from San Angelo Junction (in Coleman County, 5 miles southwest of Coleman) through San Angelo to Presidio at the Texas/Mexico border. The SORR serves a critical transportation link for businesses located along the route, including agricultural interests, steel manufacturers, mining businesses, and energy resources, and other miscellaneous customers. It is one of five rail border crossings between Texas and Mexico.

The project area encompasses a large oil and gas development region as well as a wind turbine development area. Energy and mining companies in Fort Stockton use the line for non-hazardous, non-time sensitive materials movements. Other large energy and mining companies have expressed their interest in locating facilities in the region and are dependent upon rail transportation. Currently hazardous materials (petroleum/natural gas) movements over the SORR are limited by regulation to 5 freight cars per train due to poor track conditions, and speeds are limited to 10 mph. The condition of the tracks limits the use of the SORR for transporting hazardous materials, minerals and other traffic. The SORR must be rehabilitated to allow for train speeds of 25 mph in order to support the development of minerals and energy resources in the region, improve service to existing customers, and foster economic development opportunities.

The project will be rehabilitation work to track, bridge, and highway/rail grade crossing surface repairs. The total cost of the project is $25.9 million. The work is scheduled for 2011 and 2012. The funds requested are $19.3 million and the project results in $70.3 million in benefits (discounted at 7%). This yields a benefit to cost ratio of 3.0 to 1[1].

Transportation benefits account for 66% of the total, safety 30% and environmental benefits are 4% of the $70.3 million. These benefits are around $7 million per year in 2015 and they grow by, on average, 3%, reaching almost $13 million per year by 2032.

[1] At a 3% discount rate the project produces $116 million in benefits for a benefit to cost ratio of 4.7.

1: PROJECT DESCRIPTION FOR COST BENEFIT ANALYSIS

1.1 TIGER II Discretionary Grants

This cost-benefit analysis is prepared under the guidelines of the Transportation, Housing and Urban Development, and Related Agencies Appropriations Act for 2010, for grants to be awarded by the Department of Transportation ("DOT") for National Infrastructure Investments. The guidelines are similar, but not identical to the appropriation for the Transportation Investment Generating Economic Recovery, or TIGER Discretionary Grant, program authorized and implemented pursuant to the American Recovery and Reinvestment Act of 2009. Because of the similarity in program structure, grants for National Infrastructure Investments under the FY 2010 Appropriations Act are referred to as TIGER II Discretionary Grants.

1.2 Project Description

The South Orient rail line (SORR), approximately 391 miles in length, is a state-owned facility that extends from San Angelo Junction (in Coleman County, 5 miles southwest of Coleman) through San Angelo to Presidio at the Texas/Mexico border. The rail line was the subject of abandonment applications until 2001, when the Texas Department of Transportation (TxDOT) completed the purchase of the SORR and leased operations on the line to Texas Pacifico Transportation Company, Ltd. ("TXPF", a subsidiary of Grupo Mexico). Under the terms of the agreement, TxDOT became the railroad's permanent owner and TXPF obtained a 40-year operating lease with renewal options. TXPF has invested approximately $8 million in rehabilitation of the infrastructure.

The SORR serves numerous local and regional businesses located along the route, including agricultural interests, steel manufacturers, mining businesses, energy resources, and other miscellaneous customers. It also has one of five rail border crossings between Texas and Mexico, and one of eight between the U.S. and Mexico. Grupo Mexico owns 73% of Ferromex, the Mexican railroad company that connects with SORR at Presidio. This "sister" company relationship between TXPF & Ferromex could promote international traffic on the SORR.

The project is designed to rehabilitate the state-owned South Orient rail line (SORR) from railroad Milepost (MP) 721.52 in Tom Green County (near Knickerbocker Road west of San Angelo, Texas) to MP 882.84 (near U.S. 385 west of Fort Stockton, Texas) in Pecos County. The major activities of the project will be cross tie replacements in critical areas and an extensive rail and tie project between to replace antiquated 70# rail (current mainline track size ranges from 112# to 146# per linear yard) with larger rail and associated ballast and surfacing work as necessary to enable 25 mph track speeds. Some railroad bridge repairs and highway/rail grade crossing surface repairs and improvements are also planned.

The project area encompasses a large oil and gas development region as well as a wind turbine development area. Some energy and mining companies have already located at Fort Stockton and use the line for non-hazardous, non-time sensitive materials movements. Other large energy and mining companies have expressed their interest in locating facilities in the region and are

dependent upon rail transportation. Currently hazardous materials (petroleum/natural gas) movements over the SORR are limited by regulation to 5 freight cars per train due to poor track conditions, and speeds are limited to 10 mph from MP 868.0 to MP 882.82 (and beyond to MP 1029). Operational impacts from the condition of the tracks and speed limitations prohibit the use of the SORR for transporting hazardous materials and also make the line non-competitive with other modes of transportation for the movement of some minerals and other traffic. It is important that the SORR be rehabilitated in order to support the development of minerals and energy resources in the region, improve service to existing customers, and foster economic development opportunities. Improving the rail line will also encourage the diversion of freight from the highway to rail.

1.3 No-Build and Build Cases

The cost-benefit analysis assesses the net benefits to society of the project to improve the rail line and facilitate 25 mph track speeds relative to maintaining the South Orient rail line in its current operational state. It is forecast that undertaking the project will yield significant diversion of freight from truck to rail and provide significant public benefits.

1.4 Economic Benefit Quantification

The economic benefits of the project are derived from the diversion of freight from truck to rail. Six benefits are estimated over a 20-year time period:

- The reduction is transportation or shipping costs to shippers;
- The change in inventory costs for shippers;
- The highway congestion relief benefits;
- The highway maintenance cost savings;
- Safety benefits; and,
- Emission savings.

1.5 Economic Costs

The total cost of the project is $25.9 Million. For the cost benefit analysis quantification, these costs have been spread equally between 2011 and 2012.

Table 1: Project Costs

Cost Categories	Current $
Funds Requested	$19,310,000
Total Cost	$25,945,871
Year 2011 Cost	$12,972,936
Year 2012 Cost	$12,972,936

1.6 Report Structure

The balance of the report is structured as follows. Section 2 provides a summary of the results of the cost benefit analysis. Section 3 provides the logic and input data assumptions for the calculation of benefits for each of the six benefit categories. Section 4 provides a sensitivity analysis that illustrates how the project's Net Present Value varies with alternative variable input assumptions.

2: ECONOMIC BENEFITS RESULTS AND DISCUSSION

The SORR project has economic benefits that produce a 200% return on investment (ROI)[2].

Table 2: Summary of Project Economic Indicators

Economic Indicators	7%	3%
Total Costs	$23,455,303	$24,823,319
Total Benefits	$70,348,656	$115,648,086
NPV	$46,893,353	$90,824,767
ROI	200%	366%
B/C	3.00	4.66

Table 3: Summary of Benefits

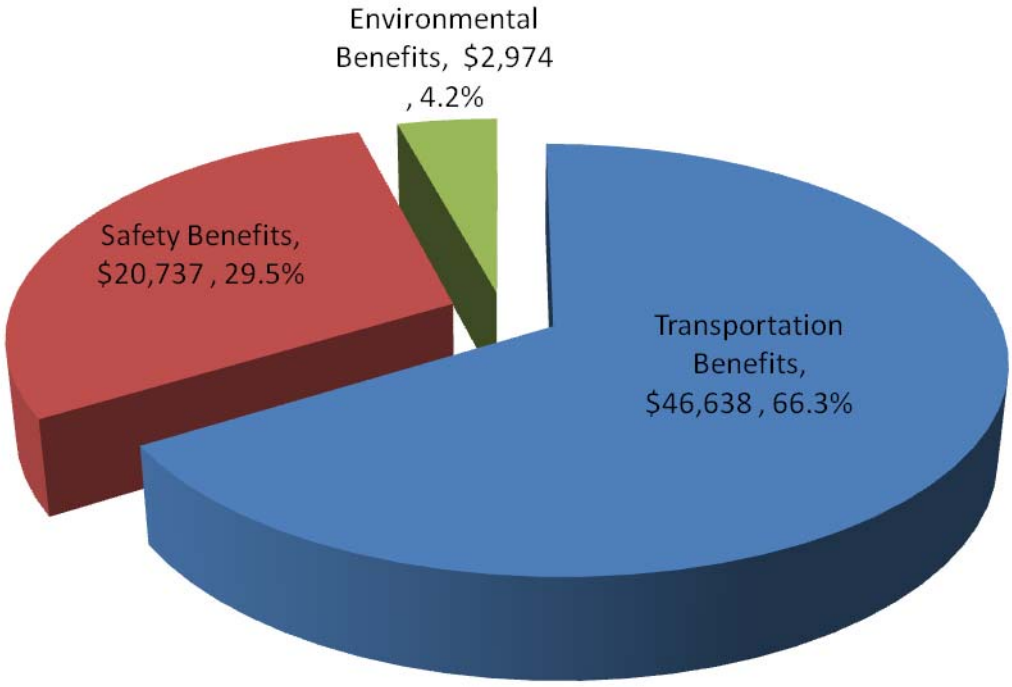
Benefit Category	Benefit #	PV Over 20 Years	
		7%	3%
Transportation cost saving from diverting trucks to rail	1	$21,529,255	$35,202,318
Increased inventory cost from diverting trucks to rail	2	-$1,144,161	-$1,870,808
Congestion cost saving from diverting trucks to rail	3	$5,189,552	$8,485,397
Maintenance cost saving from diverting trucks to rail	4	$21,063,237	$34,440,335
Safety saving from diverting trucks to rail	5	$20,736,893	$33,906,733
Emission saving from diverting trucks to rail	6	$2,973,880	$5,484,111
Total		**$70,348,656**	**$115,648,086**

The economic benefits are fairly evenly spread amongst the benefit categories analyzed. Transportation cost saving from diverting trucks to rail is the largest single category (31%) followed by maintenance cost saving from diverting trucks to rail (30%) and safety saving from diverting trucks to rail (29%).

As shown in Figure 1, aggregating the categories shows that transportation benefits account for 66% of the total, safety 30% and environmental benefits are 4% of the $70.3 million.

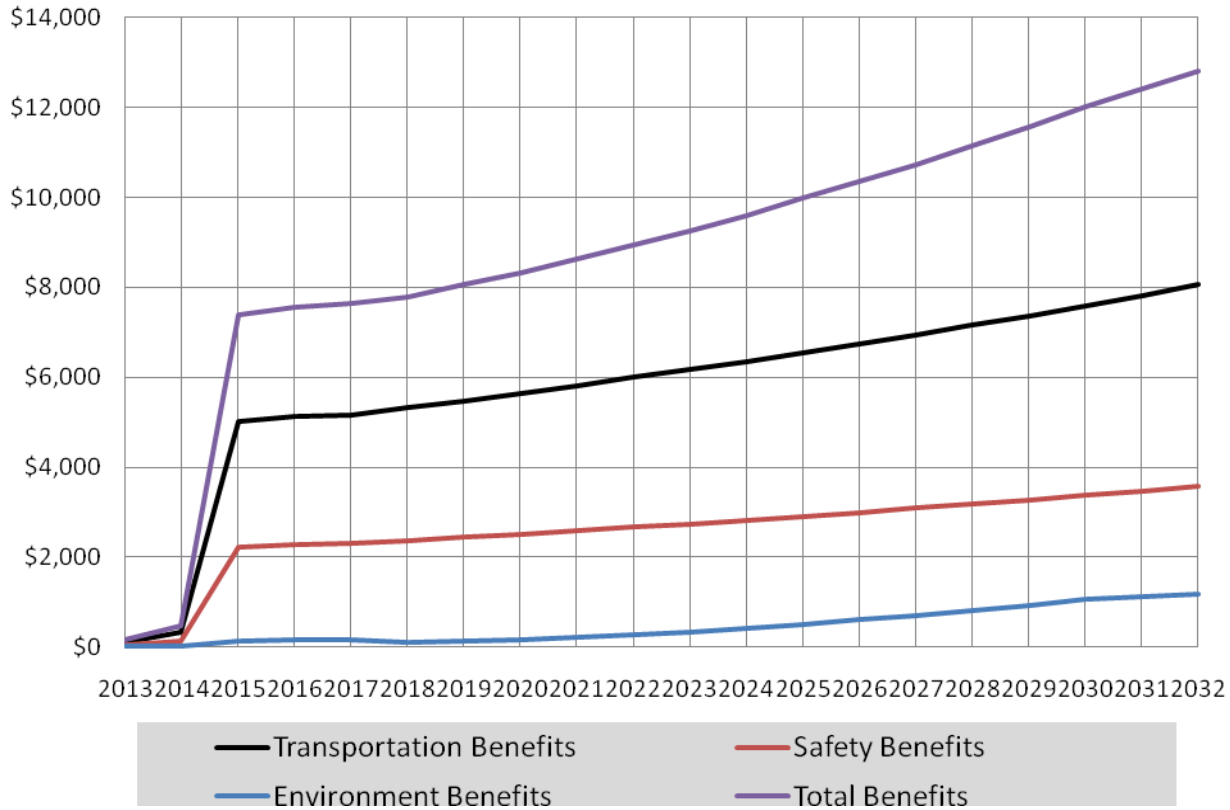
[2] At a 7% discount rate. At 3% the ROI is 366%.

Figure 1: Present Value of Benefits by Category, in $000'(20 Years) - 7% Discount Rate



As shown in Figure 2 and Table 4, economic benefits are around $7 million per year in 2015 and they grow by, on average, 3%, reaching almost $13 million per year by 2032.

Figure 2: Undiscounted Annual Benefits by Category ($000's)



The project's benefits are determined by the increase in the number of carloads on the SORR after the rehabilitation of the line (the build or alternative case), relative to the no build or base case. The carloads are shown in Figure 3:

Figure 3: Number of Carloads on SORR - Base and Alternative Cases

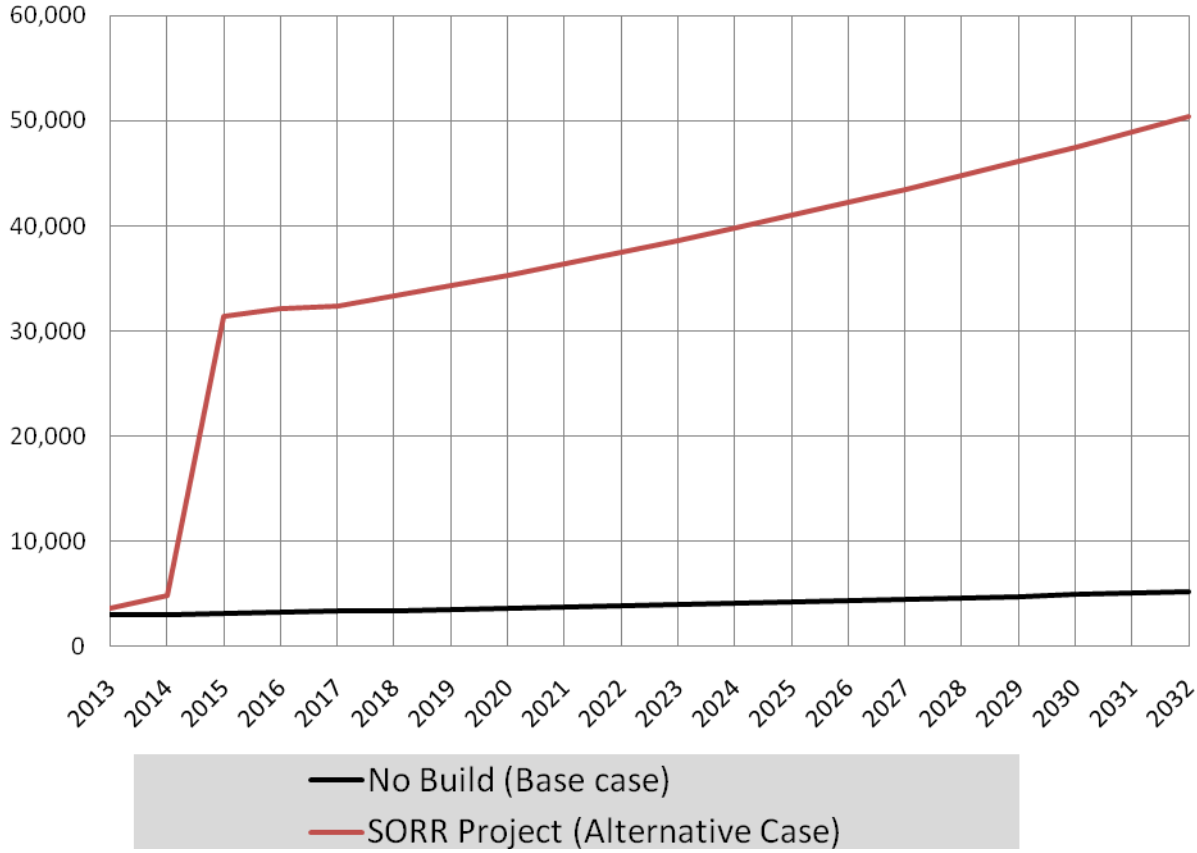


Table 4: Undiscounted Benefits of SORR Rehabilitation, by Year

Benefit Category	Ben #	Sum	Years																			
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Transportation cost saving from diverting trucks to rail	1	**$52,977,955**	$52,836	$148,828	$2,320,506	$2,370,698	$2,385,542	$2,457,108	$2,530,822	$2,606,746	$2,684,949	$2,765,497	$2,848,462	$2,933,916	$3,021,933	$3,112,591	$3,205,969	$3,302,148	$3,401,212	$3,503,249	$3,608,346	$3,716,597
Increased inventory cost from diverting trucks to rail	2	**-$2,815,485**	-$2,808	-$7,909	-$123,322	-$125,989	-$126,778	-$130,582	-$134,499	-$138,534	-$142,690	-$146,971	-$151,380	-$155,921	-$160,599	-$165,417	-$170,379	-$175,491	-$180,756	-$186,178	-$191,764	-$197,517
Congestion cost saving from diverting trucks to rail	3	**$12,770,152**	$12,736	$35,874	$559,350	$571,449	$575,027	$592,277	$610,046	$628,347	$647,198	$666,613	$686,612	$707,210	$728,427	$750,279	$772,788	$795,971	$819,850	$844,446	$869,779	$895,873
Maintenance cost saving from diverting trucks to rail	4	**$51,831,203**	$51,692	$145,606	$2,270,277	$2,319,382	$2,333,905	$2,403,922	$2,476,040	$2,550,321	$2,626,831	$2,705,636	$2,786,805	$2,870,409	$2,956,521	$3,045,217	$3,136,573	$3,230,670	$3,327,590	$3,427,418	$3,530,241	$3,636,148
Safety saving from diverting trucks to rail	5	**$51,028,155**	$50,892	$143,350	$2,235,102	$2,283,447	$2,297,745	$2,366,677	$2,437,677	$2,510,808	$2,586,132	$2,663,716	$2,743,627	$2,825,936	$2,910,714	$2,998,035	$3,087,977	$3,180,616	$3,276,034	$3,374,315	$3,475,545	$3,579,811
Emission saving from diverting trucks to rail	6	**$9,009,977**	$9,687	$14,215	$126,884	$149,387	$164,639	$104,117	$141,100	$172,871	$220,476	$276,873	$329,630	$417,241	$514,099	$602,920	$694,511	$806,752	$933,871	$1,052,953	$1,109,125	$1,168,627
Total		**$174,801,958**	**$175,036**	**$479,964**	**$7,388,796**	**$7,568,373**	**$7,630,078**	**$7,793,520**	**$8,061,185**	**$8,330,558**	**$8,622,894**	**$8,931,364**	**$9,243,756**	**$9,598,790**	**$9,971,095**	**$10,343,626**	**$10,727,438**	**$11,140,667**	**$11,577,803**	**$12,016,203**	**$12,401,272**	**$12,799,539**

Table 5: Discounted Benefits of SORR Rehabilitation, by Year, 7 Percent Discount Rate

Benefit Category	Ben #	Present Value	Years																			
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Transportation cost saving from diverting trucks to rail	1	**$21,529,255**	$43,130	$113,540	$1,654,489	$1,579,696	$1,485,596	$1,430,059	$1,376,599	$1,325,138	$1,275,600	$1,227,914	$1,182,010	$1,137,823	$1,095,288	$1,054,342	$1,014,928	$976,986	$940,464	$905,306	$871,463	$838,885
Increased inventory cost from diverting trucks to rail	2	**-$1,144,161**	-$2,292	-$6,034	-$87,927	-$83,952	-$78,951	-$76,000	-$73,159	-$70,424	-$67,791	-$65,257	-$62,817	-$60,469	-$58,208	-$56,032	-$53,938	-$51,921	-$49,980	-$48,112	-$46,313	-$44,582
Congestion cost saving from diverting trucks to rail	3	**$5,189,552**	$10,396	$27,368	$398,809	$380,780	$358,098	$344,711	$331,824	$319,420	$307,479	$295,984	$284,920	$274,268	$264,015	$254,146	$244,645	$235,499	$226,695	$218,221	$210,063	$202,210
Maintenance cost saving from diverting trucks to rail	4	**$21,063,237**	$42,196	$111,082	$1,618,676	$1,545,502	$1,453,439	$1,399,105	$1,346,802	$1,296,454	$1,247,988	$1,201,335	$1,156,425	$1,113,194	$1,071,579	$1,031,520	$992,959	$955,839	$920,106	$885,710	$852,599	$820,726
Safety saving from diverting trucks to rail	5	**$20,736,893**	$41,543	$109,361	$1,593,597	$1,521,557	$1,430,920	$1,377,427	$1,325,935	$1,276,367	$1,228,653	$1,182,722	$1,138,508	$1,095,947	$1,054,977	$1,015,538	$977,574	$941,029	$905,851	$871,987	$839,390	$808,011
Emission saving from diverting trucks to rail	6	**$2,973,880**	$7,908	$10,844	$90,466	$99,543	$102,529	$60,597	$76,749	$87,879	$104,747	$122,935	$136,785	$161,813	$186,333	$204,230	$219,864	$238,689	$258,223	$272,103	$267,868	$263,774
Total		**$70,348,656**	**$142,881**	**$366,162**	**$5,268,110**	**$5,043,127**	**$4,751,629**	**$4,535,900**	**$4,384,750**	**$4,234,833**	**$4,096,675**	**$3,965,632**	**$3,835,830**	**$3,722,576**	**$3,613,984**	**$3,503,744**	**$3,396,032**	**$3,296,121**	**$3,201,359**	**$3,105,215**	**$2,995,070**	**$2,889,024**

Table 6: Discounted Benefits of SORR Rehabilitation, by Year, 3 Percent Discount Rate

Benefit Category	Ben #	Present Value	Years																			
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Transportation cost saving from diverting trucks to rail	1	**$35,202,318**	$48,353	$132,232	$2,001,689	$1,985,422	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664	$1,939,664
Increased inventory cost from diverting trucks to rail	2	**-$1,870,808**	-$2,570	-$7,027	-$106,379	-$105,514	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082	-$103,082
Congestion cost saving from diverting trucks to rail	3	**$8,485,397**	$11,655	$31,874	$482,500	$478,579	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549	$467,549
Maintenance cost saving from diverting trucks to rail	4	**$34,440,335**	$47,306	$129,369	$1,958,361	$1,942,446	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678	$1,897,678
Safety saving from diverting trucks to rail	5	**$33,906,733**	$46,573	$127,365	$1,928,019	$1,912,351	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277	$1,868,277
Emission saving from diverting trucks to rail	6	**$5,484,111**	$8,865	$12,630	$109,451	$125,109	$133,866	$82,191	$108,141	$128,632	$159,277	$194,193	$224,462	$275,846	$329,981	$375,720	$420,191	$473,882	$532,574	$582,994	$596,209	$609,898
Total		**$115,648,086**	**$160,182**	**$426,442**	**$6,373,641**	**$6,338,393**	**$6,203,952**	**$6,152,277**	**$6,178,227**	**$6,198,718**	**$6,229,362**	**$6,264,279**	**$6,294,548**	**$6,345,931**	**$6,400,066**	**$6,445,805**	**$6,490,276**	**$6,543,968**	**$6,602,659**	**$6,653,080**	**$6,666,295**	**$6,679,983**

3: MODEL LOGIC DIAGRAMS AND INPUT VARIABLES

3.1 Truck Diversion: Heavy Truck Diversion to Railroad after Rehabilitation

SORR has limited capacity. The state of the infrastructure limits speed. Improvements would allow freight that is currently sent by truck to be diverted to rail. This calculation is an important input into the analysis and it captures the number of tons of freight that will be diverted from truck by year as a result of the improvements.

Figure 4: Calculation #1 – Structure and Logic Diagram

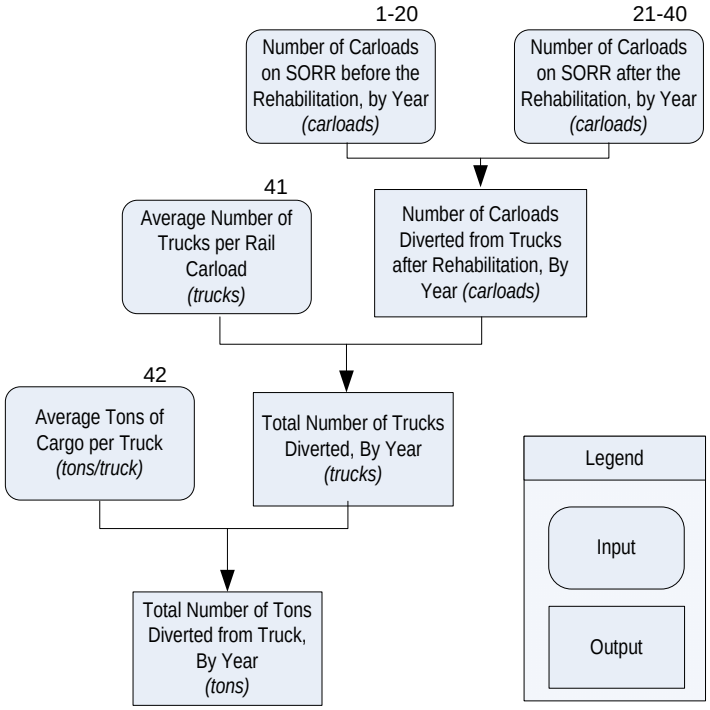


Table 7: Calculation #1 – Input Values and Sources

Input #	Input Name	Units	Value	Source/Comment
1	Number of Carloads on SORR - Base Case - 2013	carloads	2,974	
2	Number of Carloads on SORR - Base Case - 2014	carloads	3,063	
3	Number of Carloads on SORR - Base Case - 2015	carloads	3,155	
4	Number of Carloads on SORR - Base Case - 2016	carloads	3,250	
5	Number of Carloads on SORR - Base Case - 2017	carloads	3,347	
6	Number of Carloads on SORR - Base Case - 2018	carloads	3,448	
7	Number of Carloads on SORR - Base Case - 2019	carloads	3,551	
8	Number of Carloads on SORR - Base Case - 2020	carloads	3,658	
9	Number of Carloads on SORR - Base Case - 2021	carloads	3,767	HDR calculation based on (i) 2013 carloads of 2974, (ii) carload grows at 3% annually from 2014-2032 (SORR, Annual Reports)
10	Number of Carloads on SORR - Base Case - 2022	carloads	3,880	
11	Number of Carloads on SORR - Base Case - 2023	carloads	3,997	
12	Number of Carloads on SORR - Base Case - 2024	carloads	4,117	
13	Number of Carloads on SORR - Base Case - 2025	carloads	4,240	
14	Number of Carloads on SORR - Base Case - 2026	carloads	4,367	
15	Number of Carloads on SORR - Base Case - 2027	carloads	4,498	
16	Number of Carloads on SORR - Base Case - 2028	carloads	4,633	
17	Number of Carloads on SORR - Base Case - 2029	carloads	4,772	
18	Number of Carloads on SORR - Base Case - 2030	carloads	4,916	
19	Number of Carloads on SORR - Base Case - 2031	carloads	5,063	
20	Number of Carloads on SORR - Base Case - 2032	carloads	5,215	
21	Number of Carloads on SORR - Alternative Case - 2013	carloads	3,617	HDR calculation based on: (i) 50% of first 5 years railcars projection from "POTENTIAL ECONOMIC IMPACTS OF AN IMPROVED SOUTH ORIENT RAILROAD" - Alliance Transportation Group Inc. (2007)", and (ii) assumes a 3% growth rate (same as base case) from 2018-2032.
22	Number of Carloads on SORR - Alternative Case - 2014	carloads	4,873	
23	Number of Carloads on SORR - Alternative Case - 2015	carloads	31,373	
24	Number of Carloads on SORR - Alternative Case - 2016	carloads	32,078	
25	Number of Carloads on SORR - Alternative Case - 2017	carloads	32,356	
26	Number of Carloads on SORR - Alternative Case - 2018	carloads	33,327	
27	Number of Carloads on SORR - Alternative Case - 2019	carloads	34,326	
28	Number of Carloads on SORR - Alternative Case - 2020	carloads	35,356	
29	Number of Carloads on SORR - Alternative Case - 2021	carloads	36,417	
30	Number of Carloads on SORR - Alternative Case - 2022	carloads	37,509	
31	Number of Carloads on SORR - Alternative Case - 2023	carloads	38,635	
32	Number of Carloads on SORR - Alternative Case - 2024	carloads	39,794	
33	Number of Carloads on SORR - Alternative Case - 2025	carloads	40,988	
34	Number of Carloads on SORR - Alternative Case - 2026	carloads	42,217	
35	Number of Carloads on SORR - Alternative Case - 2027	carloads	43,484	
36	Number of Carloads on SORR - Alternative Case - 2028	carloads	44,788	
37	Number of Carloads on SORR - Alternative Case - 2029	carloads	46,132	
38	Number of Carloads on SORR - Alternative Case - 2030	carloads	47,516	
39	Number of Carloads on SORR - Alternative Case - 2031	carloads	48,941	

Input #	Input Name	Units	Value	Source/Comment
40	Number of Carloads on SORR - Alternative Case - 2032	carloads	50,410	
41	Average Number of Trucks per Rail Carload	trucks	3.0	FHWA Highway Cost Allocation Study (May 2008)
42	Average Tons of Cargo per Truck	tons/truck	17.5	Highway Economic Requirements (HERS) Model - FHWA

On average, there are 125,000 trucks per year diverted as a result of the project (Table 8).

Table 8: Calculation #1 - Total Truck Diversion

Year	Total Truck Diversion	Year	Total Truck Diversion
2013	1,928	**2023**	103,914
2014	5,429	**2024**	107,031
2015	84,654	**2025**	110,242
2016	86,485	**2026**	113,549
2017	87,026	**2027**	116,956
2018	89,637	**2028**	120,465
2019	92,326	**2029**	124,079
2020	95,096	**2030**	127,801
2021	97,949	**2031**	131,635
2022	100,887	**2032**	135,584

3.2 Benefit #1: Transportation Cost Saving from Diverting Trucks to Rail

This benefit category captures the cost savings experienced by businesses as they ship by rail instead of truck. A given amount of cargo is typically more expensive to ship by truck than by rail. The increased rail capacity stemming from the project allows cargo to be diverted from truck to rail freight, and thus shipped at a lower cost.

Figure 5: Benefit #1 – Structure and Logic Diagram

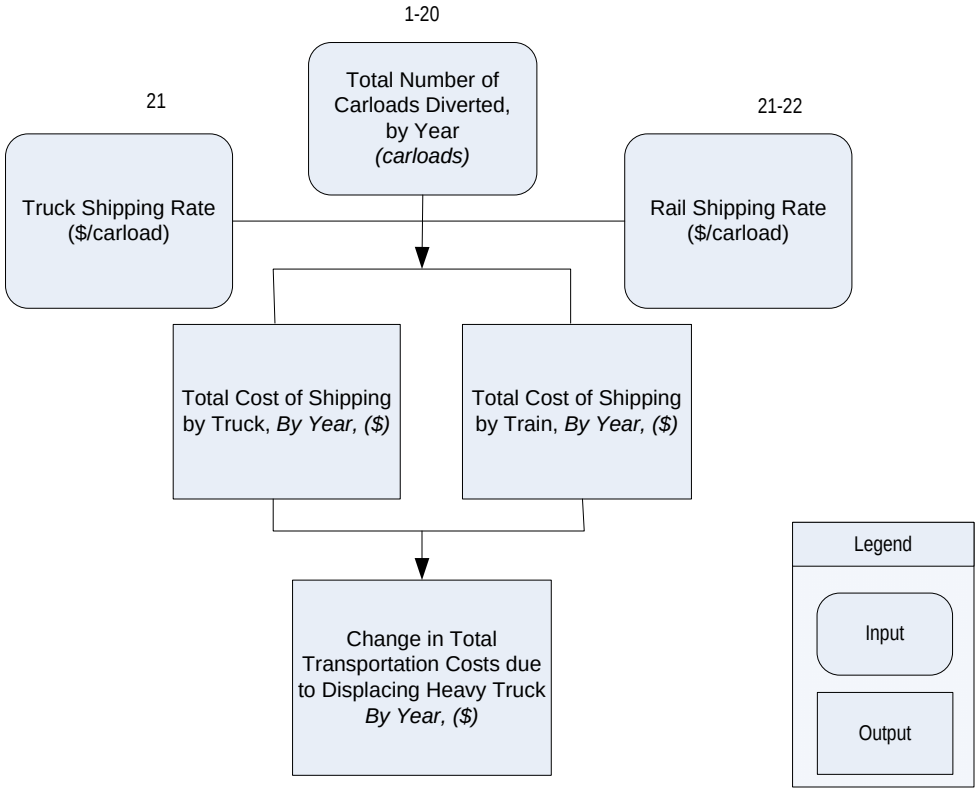


Table 9: Benefit #1 – Input values and Sources

Input #	Input Name	Units	Value	Source/Comment
1	Total Number of Carloads Diverted - 2013	carloads	643	HDR calculation based on carload diversion in Calculation #1
2	Total Number of Carloads Diverted - 2014	carloads	1,810	
3	Total Number of Carloads Diverted - 2015	carloads	28,218	
4	Total Number of Carloads Diverted - 2016	carloads	28,828	
5	Total Number of Carloads Diverted - 2017	carloads	29,009	
6	Total Number of Carloads Diverted - 2018	carloads	29,879	
7	Total Number of Carloads Diverted - 2019	carloads	30,775	
8	Total Number of Carloads Diverted - 2020	carloads	31,699	
9	Total Number of Carloads Diverted - 2021	carloads	32,650	
10	Total Number of Carloads Diverted - 2022	carloads	33,629	
11	Total Number of Carloads Diverted - 2023	carloads	34,638	
12	Total Number of Carloads Diverted - 2024	carloads	35,677	
13	Total Number of Carloads Diverted - 2025	carloads	36,747	
14	Total Number of Carloads Diverted - 2026	carloads	37,850	
15	Total Number of Carloads Diverted - 2027	carloads	38,985	
16	Total Number of Carloads Diverted - 2028	carloads	40,155	
17	Total Number of Carloads Diverted - 2029	carloads	41,360	
18	Total Number of Carloads Diverted - 2030	carloads	42,600	
19	Total Number of Carloads Diverted - 2031	carloads	43,878	
20	Total Number of Carloads Diverted - 2032	carloads	45,195	
21	Average Shipping Rate per Carload by Rail	2010$/ carload	$466	HDR derived from TXPF Customer Carloads and Revenue
22	Transportation cost savings from rail relative to truck	%	15%	HDR calculation based on haul rates

Table 10: Benefit #1 – Present Values of Benefits

Benefit Category	PV Over 20 Years	
	7%	3%
Transportation cost saving from diverting trucks to rail	$21,529,255	$35,202,318

3.3 Benefit #2: Increase in Inventory Costs from Diverting Trucks to Rail

This benefit category captures the change in shipping time and resulting inventory cost that arises from the diversion of freight from truck to rail. The less time the cargo spends in transit, the quicker it is put to productive use. In this case, the benefit is calculated as a net cost in Table 11 because, while cheaper, the rail trip is expected to take longer.

Figure 6: Benefit #2 – Structure and Logic Diagram

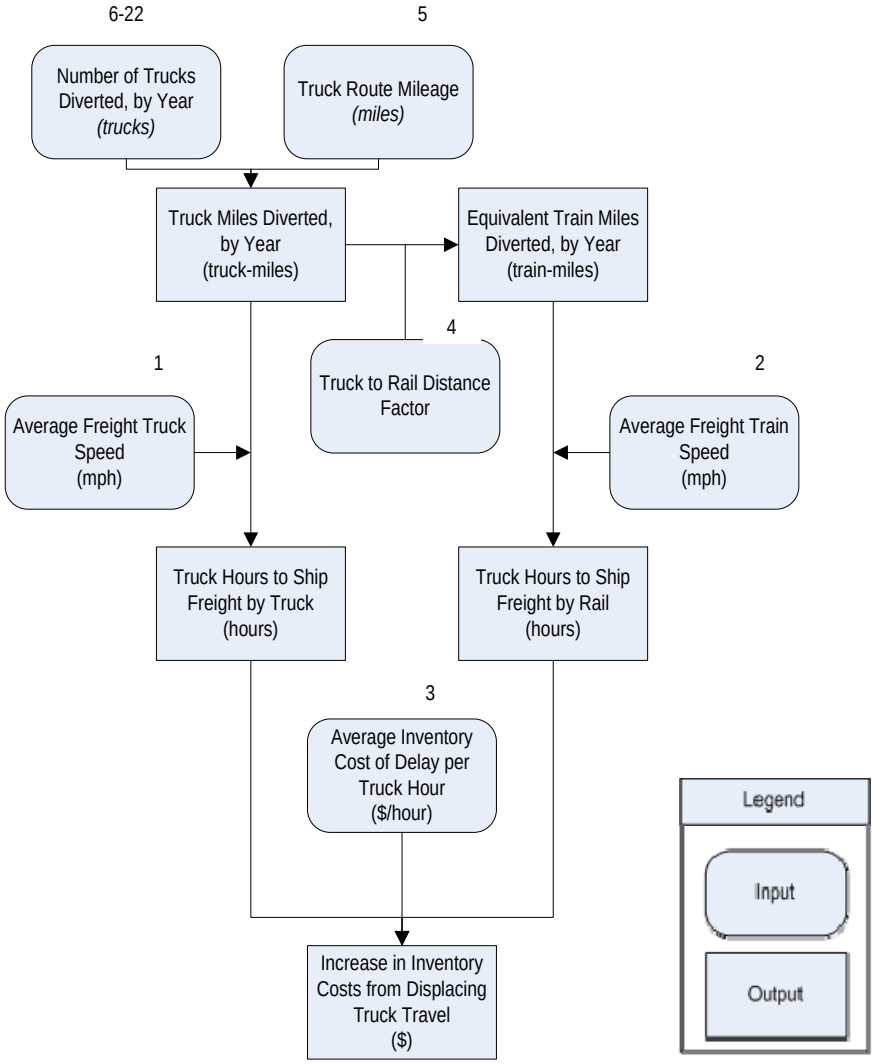


Table 11: Benefit #2. Increase in Inventory Costs from Diverting Trucks to Rail

Input #	Input Name	Units	Value	Source/Comment
1	Average Freight Truck Speed	mph	30	Federal Highway Administration (FHWA)
2	Average Freight Train Speed	mph	18	Surface Transportation Board (STB) - 2007
3	Average Inventory Cost of Delay per Truck Hour	2010$/hour	$0.18	HDR Calculation based on a 4.25% Discount Rate
4	Truck to Rail Distance Factor	Truck Mile per Rail Mile	0.83	National Cooperative Highway Research Program (NCHRP) Report 388, "A Guidebook for Forecasting Freight Transportation Demand", 1997. We assume this figure includes dray distances. This factor is applied to account for relatively longer rail routes for the same origin-destination (O-D) pair.
5	Truck Route Mileage	miles	237.80	SORR
6	Total Number of Trucks Diverted - 2013	trucks	1,928	HDR calculation based on diverted carloads and average equivalent trucks per carload of 3.0
7	Total Number of Trucks Diverted - 2014	trucks	5,429	
8	Total Number of Trucks Diverted - 2015	trucks	84,654	
9	Total Number of Trucks Diverted - 2016	trucks	86,485	
10	Total Number of Trucks Diverted - 2017	trucks	87,026	
11	Total Number of Trucks Diverted - 2018	trucks	89,637	
12	Total Number of Trucks Diverted - 2019	trucks	92,326	
13	Total Number of Trucks Diverted - 2020	trucks	95,096	
14	Total Number of Trucks Diverted - 2021	trucks	97,949	
15	Total Number of Trucks Diverted - 2022	trucks	100,887	
16	Total Number of Trucks Diverted - 2023	trucks	103,914	
17	Total Number of Trucks Diverted - 2024	trucks	107,031	
18	Total Number of Trucks Diverted - 2025	trucks	110,242	
19	Total Number of Trucks Diverted - 2026	trucks	113,549	
20	Total Number of Trucks Diverted - 2027	trucks	116,956	
21	Total Number of Trucks Diverted - 2028	trucks	120,465	
22	Total Number of Trucks Diverted - 2029	trucks	124,079	
23	Total Number of Trucks Diverted - 2030	trucks	127,801	
24	Total Number of Trucks Diverted - 2031	trucks	131,635	
25	Total Number of Trucks Diverted - 2032	trucks	135,584	

Table 12: Benefit #2 – Present Values of Benefits

Benefit Category	PV Over 20 Years	
	7%	3%
Increased inventory cost from diverting trucks to rail	-$1,144,161	-$1,870,808

3.4 Benefit #3: Congestion Cost Saving from Diverting Trucks to Rail

As freight is diverted from truck to rail transit because of the project, truck travel will decrease in the region, *ceteris paribus.* A truck takes up more physical space on the road than a car, and reducing the amount of truck travel will lead to a decrease in highway congestion and an increase in time savings for the regional population. The structure and logic of the decreased congestion benefit is presented below.

Figure 7: Benefit #3 – Structure and Logic Diagram

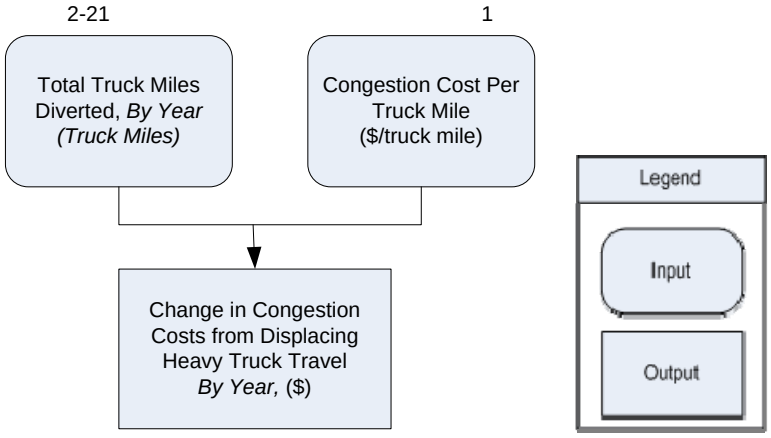


Table 13: Benefit #3 – Input Values and Sources

Input #	Input Name	Units	Value	Source/Comment
1	Congestion Cost per Truck Mile	2010$/mile	$0.0278	HDR Calculations based on the Addendum to the 1997 Federal Highway Cost Allocation Study, Final Report, U.S. Department of Transportation and Federal Highway Administration, May 2000.
2	Total Diverted Truck-miles - 2013	truck-miles	458,360	HDR calculation based on diverted trucks and average truck route mileage
3	Total Diverted Truck-miles - 2014	truck-miles	1,291,097	
4	Total Diverted Truck-miles - 2015	truck-miles	20,130,638	
5	Total Diverted Truck-miles - 2016	truck-miles	20,566,059	
6	Total Diverted Truck-miles - 2017	truck-miles	20,694,833	
7	Total Diverted Truck-miles - 2018	truck-miles	21,315,678	
8	Total Diverted Truck-miles - 2019	truck-miles	21,955,148	
9	Total Diverted Truck-miles - 2020	truck-miles	22,613,803	
10	Total Diverted Truck-miles - 2021	truck-miles	23,292,217	
11	Total Diverted Truck-miles - 2022	truck-miles	23,990,983	
12	Total Diverted Truck-miles - 2023	truck-miles	24,710,713	

Input #	Input Name	Units	Value	Source/Comment
13	Total Diverted Truck-miles - 2024	truck-miles	25,452,034	
14	Total Diverted Truck-miles - 2025	truck-miles	26,215,595	
15	Total Diverted Truck-miles - 2026	truck-miles	27,002,063	
16	Total Diverted Truck-miles - 2027	truck-miles	27,812,125	
17	Total Diverted Truck-miles - 2028	truck-miles	28,646,489	
18	Total Diverted Truck-miles - 2029	truck-miles	29,505,883	
19	Total Diverted Truck-miles - 2030	truck-miles	30,391,060	
20	Total Diverted Truck-miles - 2031	truck-miles	31,302,791	
21	Total Diverted Truck-miles - 2032	truck-miles	32,241,875	

Table 14: Benefit #3 – Present Values of Benefits

Benefit Category	PV Over 20 Years	
	7%	3%
Congestion cost saving from diverting trucks to rail	$5,189,552	$8,485,397

3.5 Benefit #4: Maintenance Cost Saving from Diverting Trucks to Rail

Heavy trucks put a great deal of physical wear and tear on roads, and the roads must be maintained at the taxpayer's expense. Diverting freight from truck to rail and reducing the amount of truck travel will lead to less required highway maintenance and associated costs. This cost reduction benefit is quantified by taking the difference between the highway maintenance costs avoided if freight is diverted from truck to rail and the expected incremental railroad maintenance costs associated with the increased rail activity.

Figure 8: Benefit #4 – Structure and Logic Diagram

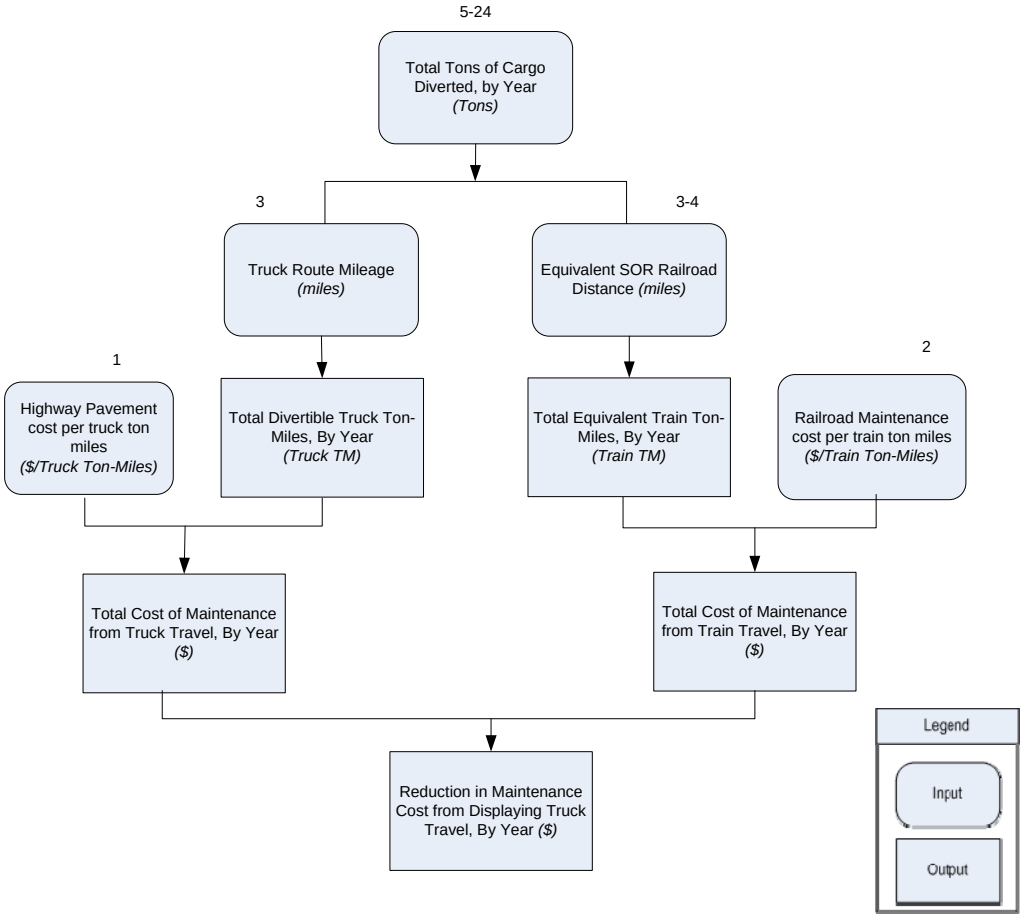


Table 15: Benefit #4 – Input Values and Sources

Input #	Input Name	Units	Value	Source/Comment
1	Pavement maintenance cost per truck ton-mile	2010$/ton-mile	$0.0091660	HDR Calculations based on the Addendum to the 1997 Federal Highway Cost Allocation Study, Final Report, U.S. Department of Transportation and Federal Highway Administration, May 2000.
2	Pavement maintenance cost per train ton-mile	2010$/ton-mile	$0.0022589	HDR Calculations based on George Avery Grimes, Ph.D., P.E.1; and Christopher P. L. Barkan, Ph.D. "Cost-Effectiveness of Railway Infrastructure Renewal Maintenance".
3	Truck Route Mileage	miles	237.80	SORR
4	Truck to Rail Distance Factor	Truck Mile per Rail Mile	0.83	National Cooperative Highway Research Program (NCHRP) Report 388, "A Guidebook for Forecasting Freight Transportation Demand", 1997. We assume this figure includes dray distances. This factor is applied to account for relatively longer rail routes for the same origin-destination (O-D) pair.
5	Total Tons of Diverted Heavy Truck Freight - 2013	tons	33,731	HDR calculation based on truck diversion and 17.5 average tons per truck
6	Total Tons of Diverted Heavy Truck Freight - 2014	tons	95,013	
7	Total Tons of Diverted Heavy Truck Freight - 2015	tons	1,481,439	
8	Total Tons of Diverted Heavy Truck Freight - 2016	tons	1,513,482	
9	Total Tons of Diverted Heavy Truck Freight - 2017	tons	1,522,959	
10	Total Tons of Diverted Heavy Truck Freight - 2018	tons	1,568,647	
11	Total Tons of Diverted Heavy Truck Freight - 2019	tons	1,615,707	
12	Total Tons of Diverted Heavy Truck Freight - 2020	tons	1,664,178	
13	Total Tons of Diverted Heavy Truck Freight - 2021	tons	1,714,103	
14	Total Tons of Diverted Heavy Truck Freight - 2022	tons	1,765,527	

Input #	Input Name	Units	Value	Source/Comment
15	Total Tons of Diverted Heavy Truck Freight - 2023	tons	1,818,492	
16	Total Tons of Diverted Heavy Truck Freight - 2024	tons	1,873,047	
17	Total Tons of Diverted Heavy Truck Freight - 2025	tons	1,929,238	
18	Total Tons of Diverted Heavy Truck Freight - 2026	tons	1,987,116	
19	Total Tons of Diverted Heavy Truck Freight - 2027	tons	2,046,729	
20	Total Tons of Diverted Heavy Truck Freight - 2028	tons	2,108,131	
21	Total Tons of Diverted Heavy Truck Freight - 2029	tons	2,171,375	
22	Total Tons of Diverted Heavy Truck Freight - 2030	tons	2,236,516	
23	Total Tons of Diverted Heavy Truck Freight - 2031	tons	2,303,612	
24	Total Tons of Diverted Heavy Truck Freight - 2032	tons	2,372,720	

Table 16: Benefit #4 – Present Values of Benefits

Benefit Category	PV Over 20 Years	
	7%	3%
Maintenance cost saving from diverting trucks to rail	$21,063,237	$34,440,335

3.6 Benefit #5: Safety Saving from Diverting Trucks to Rail

Regardless of the mode of transportation utilized, accidents will occur while shipping cargo. Although highway accidents should diminish as freight is diverted from trucks to railcars, rail accidents should increase in turn. Rail and truck travel have their own respective accident frequency and associated cost levels, and thus the change in safety resulting from the project is monetized according to the diagram below.

Figure 9: Benefit #5 – Structure and Logic Diagram

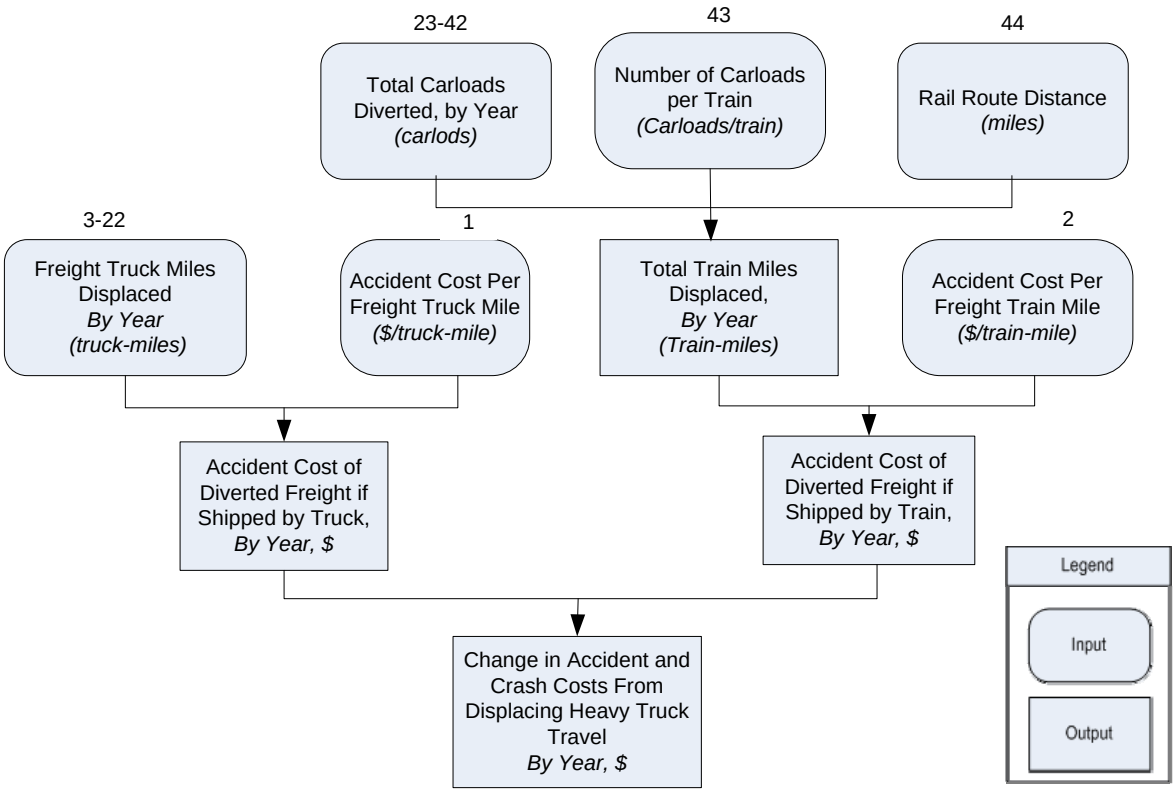


Table 17: Benefit #5 – Input Values and Sources

Input #	Input Name	Units	Value	Source/Comment
1	Accident Cost per Truck Mile	2010$/truck miles	$0.311	HDR Calculations based on Tiger II Guidelines for Accident Values, National Highway Traffic Safety Administration (NHTSA) for accident data and mileage statistics.

Input #	Input Name	Units	Value	Source/Comment
2	Accident Cost per Train Mile	2010$/train miles	$13.503	HDR Calculations based on Tiger II Guidelines for Accident Values, National Highway Traffic Safety Administration (NHTSA) for accident data, and U.S. Department of Transportation, Bureau of Transportation Statistics for mileage statistics.
3	Total Diverted Truck Miles - 2013	truck miles	643	HDR calculations based on (i) number of trucks diverted, (ii) average length of haul for truck
4	Total Diverted Truck Miles - 2014	truck miles	1,810	
5	Total Diverted Truck Miles - 2015	truck miles	28,218	
6	Total Diverted Truck Miles - 2016	truck miles	28,828	
7	Total Diverted Truck Miles - 2017	truck miles	29,009	
8	Total Diverted Truck Miles - 2018	truck miles	29,879	
9	Total Diverted Truck Miles - 2019	truck miles	30,775	
10	Total Diverted Truck Miles - 2020	truck miles	31,699	
11	Total Diverted Truck Miles - 2021	truck miles	32,650	
12	Total Diverted Truck Miles - 2022	truck miles	33,629	
13	Total Diverted Truck Miles - 2023	truck miles	34,638	
14	Total Diverted Truck Miles - 2024	truck miles	35,677	
15	Total Diverted Truck Miles - 2025	truck miles	36,747	
16	Total Diverted Truck Miles - 2026	truck miles	37,850	
17	Total Diverted Truck Miles - 2027	truck miles	38,985	
18	Total Diverted Truck Miles - 2028	truck miles	40,155	
19	Total Diverted Truck Miles - 2029	truck miles	41,360	
20	Total Diverted Truck Miles - 2030	truck miles	42,600	
21	Total Diverted Truck Miles - 2031	truck miles	43,878	
22	Total Diverted Truck Miles - 2032	truck miles	45,195	
23	Total Number of Carloads Diverted - 2013	carloads	643	
24	Total Number of Carloads Diverted - 2014	carloads	1,810	
25	Total Number of Carloads Diverted - 2015	carloads	28,218	
26	Total Number of Carloads Diverted - 2016	carloads	28,828	
27	Total Number of Carloads Diverted - 2017	carloads	29,009	
28	Total Number of Carloads Diverted - 2018	carloads	29,879	
29	Total Number of Carloads Diverted - 2019	carloads	30,775	
30	Total Number of Carloads Diverted - 2020	carloads	31,699	

Input #	Input Name	Units	Value	Source/Comment
31	Total Number of Carloads Diverted - 2021	carloads	32,650	
32	Total Number of Carloads Diverted - 2022	carloads	33,629	
33	Total Number of Carloads Diverted - 2023	carloads	34,638	
34	Total Number of Carloads Diverted - 2024	carloads	35,677	
35	Total Number of Carloads Diverted - 2025	carloads	36,747	
36	Total Number of Carloads Diverted - 2026	carloads	37,850	
37	Total Number of Carloads Diverted - 2027	carloads	38,985	
38	Total Number of Carloads Diverted - 2028	carloads	40,155	
39	Total Number of Carloads Diverted - 2029	carloads	41,360	
40	Total Number of Carloads Diverted - 2030	carloads	42,600	
41	Total Number of Carloads Diverted - 2031	carloads	43,878	
42	Total Number of Carloads Diverted - 2032	carloads	45,195	
44	Average Number of Carloads per Train	carloads/ train	27.1	HDR calculation based on distance weighted average of (i) 48 cars/train between San Angelo Junction to San Angelo, and (ii) 17 cars/train between San Angelo to Fort Stockton
46	Train Route Mileage	miles	286.5	HDR calculation based on (i) truck route mileage of 238.7 miles and (ii) truck and rail distance factor of 0.83

Table 18: Benefit #5 – Present Values of Benefits

Benefit Category	PV Over 20 Years	
	7%	3%
Safety saving from diverting trucks to rail	$20,736,893	$33,906,733

3.6 Benefit #6: Emission Saving from Diverting Trucks to Rail

This benefit category captures the emissions quantities that result from the diversion of truck freight to rail. Standard U.S. EPA and TIGER II guidance inputs were used.

Figure 10: Benefit #6 – Structure and Logic Diagram

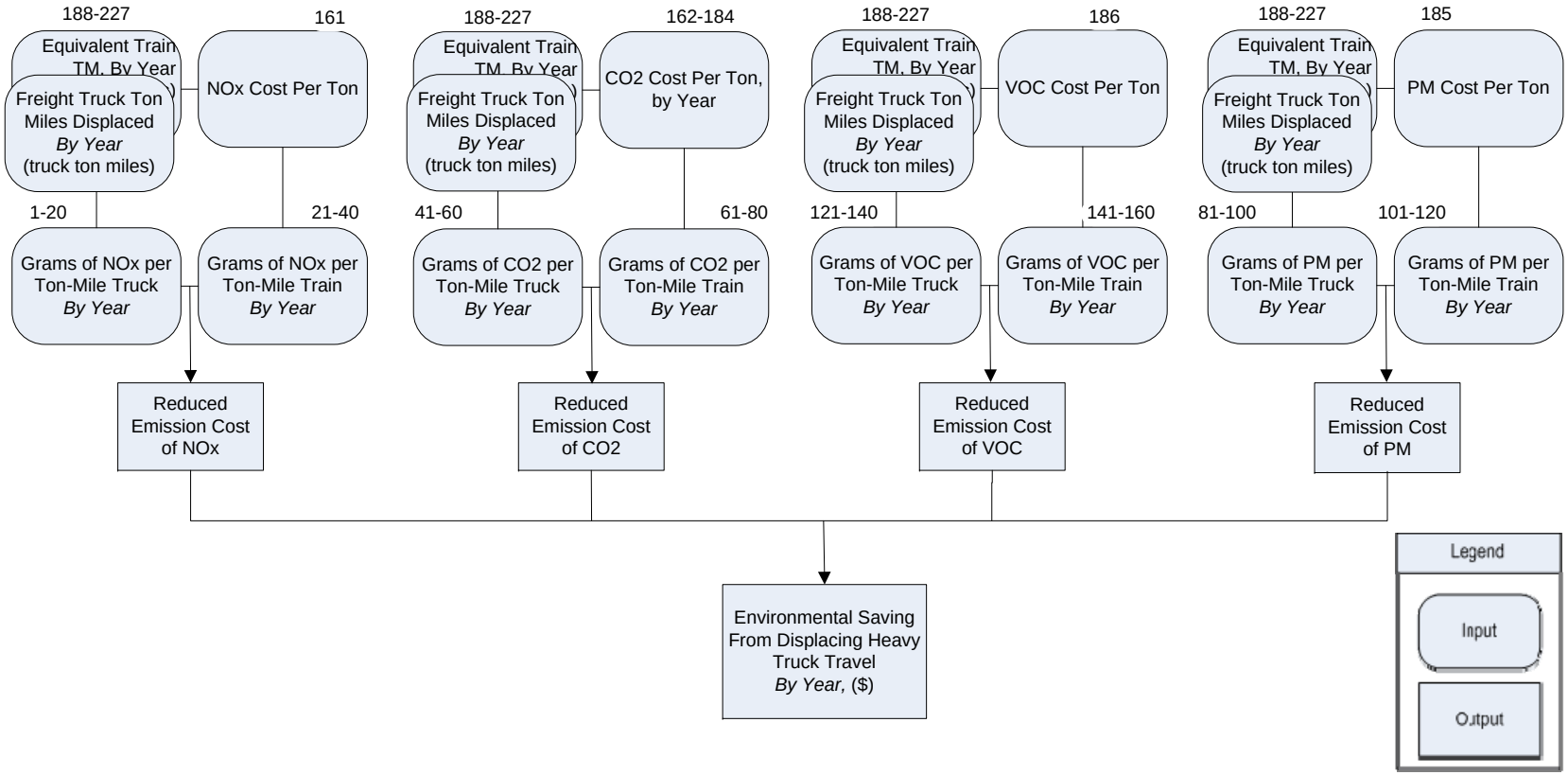


Table 19: Benefit #6 – Input Values and Sources

Input #	Input Name	Units	Value	Source/Comment
1	Grams of NOx per truck ton-mile - 2013	grams/ton mile (TM)	0.47	Mobile 6.2. Calculated grams/gallon emission factors converted to grams/ton-mile by dividing by an average efficiency of 130 freight ton miles per gallon, per the Rocky Mountain Institute, Transformational Trucking Charette. This calculation assumes a current tractor-trailer combination loaded to the legal 80,000-lb.-GVW limit and getting 6.5 mpg. No empty backhaul is assumed.
2	Grams of NOx per truck ton-mile - 2014	grams/TM	0.40	
3	Grams of NOx per truck ton-mile - 2015	grams/TM	0.34	
4	Grams of NOx per truck ton-mile - 2016	grams/TM	0.31	
5	Grams of NOx per truck ton-mile - 2017	grams/TM	0.26	
6	Grams of NOx per truck ton-mile - 2018	grams/TM	0.22	
7	Grams of NOx per truck ton-mile - 2019	grams/TM	0.19	
8	Grams of NOx per truck ton-mile - 2020	grams/TM	0.17	
9	Grams of NOx per truck ton-mile - 2021	grams/TM	0.15	
10	Grams of NOx per truck ton-mile - 2022	grams/TM	0.13	
11	Grams of NOx per truck ton-mile - 2023	grams/TM	0.11	
12	Grams of NOx per truck ton-mile - 2024	grams/TM	0.10	
13	Grams of NOx per truck ton-mile - 2025	grams/TM	0.09	
14	Grams of NOx per truck ton-mile - 2026	grams/TM	0.08	
15	Grams of NOx per truck ton-mile - 2027	grams/TM	0.07	
16	Grams of NOx per truck ton-mile - 2028	grams/TM	0.06	
17	Grams of NOx per truck ton-mile - 2029	grams/TM	0.06	
18	Grams of NOx per truck ton-mile - 2030	grams/TM	0.06	
19	Grams of NOx per truck ton-mile - 2031	grams/TM	0.06	
20	Grams of NOx per truck ton-mile - 2032	grams/TM	0.06	
21	Grams of NOx per train ton-mile - 2013	grams/TM	0.28	Source for Tables 3-71 and 3-81 is "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder" Gram/ton-mile values are converted to grams/ton-mile by dividing an average efficiency 480 freight ton miles per gallon. (2009 U.S. average data source in "The Economic Impact of America's Freight Railroads", Association of American Railroad (AAR), May 2010.) In addition, a conservative 1% improvement in fuel efficiency is assumed per year. EPA cited a 16% improvement in rail industry-wide fuel efficiency over the
22	Grams of NOx per train ton-mile - 2014	grams/TM	0.27	
23	Grams of NOx per train ton-mile - 2015	grams/TM	0.26	
24	Grams of NOx per train ton-mile - 2016	grams/TM	0.24	
25	Grams of NOx per train ton-mile - 2017	grams/TM	0.23	
26	Grams of NOx per train ton-mile - 2018	grams/TM	0.21	
27	Grams of NOx per train ton-mile - 2019	grams/TM	0.20	
28	Grams of NOx per train ton-mile - 2020	grams/TM	0.19	
29	Grams of NOx per train ton-mile - 2021	grams/TM	0.18	
30	Grams of NOx per train ton-mile - 2022	grams/TM	0.17	
31	Grams of NOx per train ton-mile - 2023	grams/TM	0.16	
32	Grams of NOx per train ton-mile - 2024	grams/TM	0.15	
33	Grams of NOx per train ton-mile - 2025	grams/TM	0.14	
34	Grams of NOx per train ton-mile - 2026	grams/TM	0.13	
35	Grams of NOx per train ton-mile - 2027	grams/TM	0.12	
36	Grams of NOx per train ton-mile - 2028	grams/TM	0.11	
37	Grams of NOx per train ton-mile - 2029	grams/TM	0.10	
38	Grams of NOx per train ton-mile - 2030	grams/TM	0.09	

Input #	Input Name	Units	Value	Source/Comment
39	Grams of NOx per train ton-mile - 2031	grams/TM	0.09	
40	Grams of NOx per train ton-mile - 2032	grams/TM	0.09	
41	Grams of CO2 per truck ton-mile - 2013	grams/TM	78.57	Mobile 6.2. Calculated grams/gallon emission factors converted to grams/ton-mile by dividing by an average efficiency of 130 freight ton miles per gallon, per the Rocky Mountain Institute, Transformational Trucking Charette. This calculation assumes a current tractor-trailer combination loaded to the legal 80,000-lb.-GVW limit and getting 6.5 mpg. No empty backhaul is assumed.
42	Grams of CO2 per truck ton-mile - 2014	grams/TM	78.50	
43	Grams of CO2 per truck ton-mile - 2015	grams/TM	78.44	
44	Grams of CO2 per truck ton-mile - 2016	grams/TM	78.40	
45	Grams of CO2 per truck ton-mile - 2017	grams/TM	78.36	
46	Grams of CO2 per truck ton-mile - 2018	grams/TM	78.33	
47	Grams of CO2 per truck ton-mile - 2019	grams/TM	78.30	
48	Grams of CO2 per truck ton-mile - 2020	grams/TM	78.28	
49	Grams of CO2 per truck ton-mile - 2021	grams/TM	78.28	
50	Grams of CO2 per truck ton-mile - 2022	grams/TM	78.28	
51	Grams of CO2 per truck ton-mile - 2023	grams/TM	78.28	
52	Grams of CO2 per truck ton-mile - 2024	grams/TM	78.28	
53	Grams of CO2 per truck ton-mile - 2025	grams/TM	78.28	
54	Grams of CO2 per truck ton-mile - 2026	grams/TM	78.28	
55	Grams of CO2 per truck ton-mile - 2027	grams/TM	78.28	
56	Grams of CO2 per truck ton-mile - 2028	grams/TM	78.28	
57	Grams of CO2 per truck ton-mile - 2029	grams/TM	78.28	
58	Grams of CO2 per truck ton-mile - 2030	grams/TM	78.28	
59	Grams of CO2 per truck ton-mile - 2031	grams/TM	78.28	
60	Grams of CO2 per truck ton-mile - 2032	grams/TM	78.28	
61	Grams of CO2 per train ton-mile - 2013	grams/TM	20.23	Source for Tables 3-71 and 3-81 is "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder" Gram/ton-mile values are converted to grams/ton-mile by dividing an average efficiency 480 freight ton miles per gallon. (2009 U.S. average data source in “The Economic Impact of America’s Freight Railroads”, Association of American Railroad (AAR), May 2010.) In addition, a conservative 1% improvement in fuel efficiency is assumed per year. EPA cited a 16% improvement in rail industry
62	Grams of CO2 per train ton-mile - 2014	grams/TM	20.02	
63	Grams of CO2 per train ton-mile - 2015	grams/TM	19.81	
64	Grams of CO2 per train ton-mile - 2016	grams/TM	19.60	
65	Grams of CO2 per train ton-mile - 2017	grams/TM	19.39	
66	Grams of CO2 per train ton-mile - 2018	grams/TM	19.18	
67	Grams of CO2 per train ton-mile - 2019	grams/TM	18.97	
68	Grams of CO2 per train ton-mile - 2020	grams/TM	18.75	
69	Grams of CO2 per train ton-mile - 2021	grams/TM	18.54	
70	Grams of CO2 per train ton-mile - 2022	grams/TM	18.33	
71	Grams of CO2 per train ton-mile - 2023	grams/TM	18.12	
72	Grams of CO2 per train ton-mile - 2024	grams/TM	17.91	
73	Grams of CO2 per train ton-mile - 2025	grams/TM	17.70	
74	Grams of CO2 per train ton-mile - 2026	grams/TM	17.49	
75	Grams of CO2 per train ton-mile - 2027	grams/TM	17.28	
76	Grams of CO2 per train ton-mile - 2028	grams/TM	17.07	
77	Grams of CO2 per train ton-mile - 2029	grams/TM	16.86	

Input #	Input Name	Units	Value	Source/Comment
78	Grams of CO2 per train ton-mile - 2030	grams/TM	16.65	
79	Grams of CO2 per train ton-mile - 2031	grams/TM	16.44	
80	Grams of CO2 per train ton-mile - 2032	grams/TM	16.23	
81	Grams of PM per truck ton-mile - 2013	grams/TM	0.009	Mobile 6.2. Calculated grams/gallon emission factors converted to grams/ton-mile by dividing by an average efficiency of 130 freight ton miles per gallon, per the Rocky Mountain Institute, Transformational Trucking Charette. This calculation assumes a current tractor-trailer combination loaded to the legal 80,000-lb.-GVW limit and getting 6.5 mpg. No empty backhaul is assumed.
82	Grams of PM per truck ton-mile - 2014	grams/TM	0.007	
83	Grams of PM per truck ton-mile - 2015	grams/TM	0.006	
84	Grams of PM per truck ton-mile - 2016	grams/TM	0.006	
85	Grams of PM per truck ton-mile - 2017	grams/TM	0.006	
86	Grams of PM per truck ton-mile - 2018	grams/TM	0.005	
87	Grams of PM per truck ton-mile - 2019	grams/TM	0.005	
88	Grams of PM per truck ton-mile - 2020	grams/TM	0.005	
89	Grams of PM per truck ton-mile - 2021	grams/TM	0.005	
90	Grams of PM per truck ton-mile - 2022	grams/TM	0.004	
91	Grams of PM per truck ton-mile - 2023	grams/TM	0.004	
92	Grams of PM per truck ton-mile - 2024	grams/TM	0.004	
93	Grams of PM per truck ton-mile - 2025	grams/TM	0.004	
94	Grams of PM per truck ton-mile - 2026	grams/TM	0.004	
95	Grams of PM per truck ton-mile - 2027	grams/TM	0.004	
96	Grams of PM per truck ton-mile - 2028	grams/TM	0.004	
97	Grams of PM per truck ton-mile - 2029	grams/TM	0.004	
98	Grams of PM per truck ton-mile - 2030	grams/TM	0.004	
99	Grams of PM per truck ton-mile - 2031	grams/TM	0.004	
100	Grams of PM per truck ton-mile - 2032	grams/TM	0.004	
101	Grams of PM per train ton-mile - 2013	grams/TM	0.009	Source for Tables 3-71 and 3-81 is "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder" Gram/ton-mile values are converted to grams/ton-mile by dividing an average efficiency 480 freight ton miles per gallon. (2009 U.S. average data source in “The Economic Impact of America’s Freight Railroads”, Association of American Railroad (AAR), May 2010.) In addition, a conservative 1% improvement in fuel efficiency is assumed per
102	Grams of PM per train ton-mile - 2014	grams/TM	0.009	
103	Grams of PM per train ton-mile - 2015	grams/TM	0.008	
104	Grams of PM per train ton-mile - 2016	grams/TM	0.008	
105	Grams of PM per train ton-mile - 2017	grams/TM	0.007	
106	Grams of PM per train ton-mile - 2018	grams/TM	0.007	
107	Grams of PM per train ton-mile - 2019	grams/TM	0.006	
108	Grams of PM per train ton-mile - 2020	grams/TM	0.006	
109	Grams of PM per train ton-mile - 2021	grams/TM	0.005	
110	Grams of PM per train ton-mile - 2022	grams/TM	0.005	
111	Grams of PM per train ton-mile - 2023	grams/TM	0.005	
112	Grams of PM per train ton-mile - 2024	grams/TM	0.004	
113	Grams of PM per train ton-mile - 2025	grams/TM	0.004	
114	Grams of PM per train ton-mile - 2026	grams/TM	0.004	
115	Grams of PM per train ton-mile - 2027	grams/TM	0.003	
116	Grams of PM per train ton-mile - 2028	grams/TM	0.003	

Input #	Input Name	Units	Value	Source/Comment
117	Grams of PM per train ton-mile - 2029	grams/TM	0.003	
118	Grams of PM per train ton-mile - 2030	grams/TM	0.002	
119	Grams of PM per train ton-mile - 2031	grams/TM	0.002	
120	Grams of PM per train ton-mile - 2032	grams/TM	0.002	
121	Grams of VOC per truck ton-mile - 2013	grams/TM	0.013	Mobile 6.2. Calculated grams/gallon emission factors converted to grams/ton-mile by dividing by an average efficiency of 130 freight ton miles per gallon, per the Rocky Mountain Institute, Transformational Trucking Charette. This calculation assumes a current tractor-trailer combination loaded to the legal 80,000-lb.-GVW limit and getting 6.5 mpg. No empty backhaul is assumed.
122	Grams of VOC per truck ton-mile - 2014	grams/TM	0.013	
123	Grams of VOC per truck ton-mile - 2015	grams/TM	0.012	
124	Grams of VOC per truck ton-mile - 2016	grams/TM	0.011	
125	Grams of VOC per truck ton-mile - 2017	grams/TM	0.011	
126	Grams of VOC per truck ton-mile - 2018	grams/TM	0.011	
127	Grams of VOC per truck ton-mile - 2019	grams/TM	0.011	
128	Grams of VOC per truck ton-mile - 2020	grams/TM	0.010	
129	Grams of VOC per truck ton-mile - 2021	grams/TM	0.010	
130	Grams of VOC per truck ton-mile - 2022	grams/TM	0.010	
131	Grams of VOC per truck ton-mile - 2023	grams/TM	0.010	
132	Grams of VOC per truck ton-mile - 2024	grams/TM	0.010	
133	Grams of VOC per truck ton-mile - 2025	grams/TM	0.010	
134	Grams of VOC per truck ton-mile - 2026	grams/TM	0.010	
135	Grams of VOC per truck ton-mile - 2027	grams/TM	0.010	
136	Grams of VOC per truck ton-mile - 2028	grams/TM	0.009	
137	Grams of VOC per truck ton-mile - 2029	grams/TM	0.009	
138	Grams of VOC per truck ton-mile - 2030	grams/TM	0.009	
139	Grams of VOC per truck ton-mile - 2031	grams/TM	0.009	
140	Grams of VOC per truck ton-mile - 2032	grams/TM	0.009	
141	Grams of VOC per train ton-mile - 2013	grams/TM	0.014	Source for Tables 3-71 and 3-81 is "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder" Gram/ton-mile values are converted to grams/ton-mile by dividing an average efficiency 480 freight ton miles per gallon. (2009 U.S. average data source in “The Economic Impact of America’s Freight Railroads”, Association of American Railroad (AAR), May 2010.) In addition, a conservative 1% improvement in fuel
142	Grams of VOC per train ton-mile - 2014	grams/TM	0.013	
143	Grams of VOC per train ton-mile - 2015	grams/TM	0.012	
144	Grams of VOC per train ton-mile - 2016	grams/TM	0.010	
145	Grams of VOC per train ton-mile - 2017	grams/TM	0.009	
146	Grams of VOC per train ton-mile - 2018	grams/TM	0.009	
147	Grams of VOC per train ton-mile - 2019	grams/TM	0.008	
148	Grams of VOC per train ton-mile - 2020	grams/TM	0.007	
149	Grams of VOC per train ton-mile - 2021	grams/TM	0.007	
150	Grams of VOC per train ton-mile - 2022	grams/TM	0.006	
151	Grams of VOC per train ton-mile - 2023	grams/TM	0.006	
152	Grams of VOC per train ton-mile - 2024	grams/TM	0.006	
153	Grams of VOC per train ton-mile - 2025	grams/TM	0.005	
154	Grams of VOC per train ton-mile - 2026	grams/TM	0.005	
155	Grams of VOC per train ton-mile - 2027	grams/TM	0.004	

Input #	Input Name	Units	Value	Source/Comment
156	Grams of VOC per train ton-mile - 2028	grams/TM	0.004	
157	Grams of VOC per train ton-mile - 2029	grams/TM	0.004	
158	Grams of VOC per train ton-mile - 2030	grams/TM	0.003	
159	Grams of VOC per train ton-mile - 2031	grams/TM	0.003	
160	Grams of VOC per train ton-mile - 2032	grams/TM	0.003	
161	NOx cost per ton	2010$/short ton	$5,590	National Highway Traffic Safety Administration, "Corporate Average Fuel Economy for FY 2011 Passenger Cars and Light Trucks", March 2009
162	CO2 cost per ton - 2010	2010$/short ton	$20.49	Interagency Working Group on Social Cost of Carbon, US Government for Regulatory Impact Analysis under Executive Order 12866. 2010
163	CO2 cost per ton - 2011	2010$/short ton	$20.92	
164	CO2 cost per ton - 2012	2010$/short ton	$21.36	
165	CO2 cost per ton - 2013	2010$/short ton	$21.81	
166	CO2 cost per ton - 2014	2010$/short ton	$22.27	
167	CO2 cost per ton - 2015	2010$/short ton	$22.74	
168	CO2 cost per ton - 2016	2010$/short ton	$23.21	
169	CO2 cost per ton - 2017	2010$/short ton	$23.70	
170	CO2 cost per ton - 2018	2010$/short ton	$24.20	
171	CO2 cost per ton - 2019	2010$/short ton	$24.71	
172	CO2 cost per ton - 2020	2010$/short ton	$25.22	
173	CO2 cost per ton - 2021	2010$/short ton	$25.78	
174	CO2 cost per ton - 2022	2010$/short ton	$26.35	
175	CO2 cost per ton - 2023	2010$/short ton	$26.93	
176	CO2 cost per ton - 2024	2010$/short ton	$27.52	
177	CO2 cost per ton - 2025	2010$/short ton	$28.12	
178	CO2 cost per ton - 2026	2010$/short ton	$28.74	
179	CO2 cost per ton - 2027	2010$/short ton	$29.38	
180	CO2 cost per ton - 2028	2010$/short ton	$30.02	

Input #	Input Name	Units	Value	Source/Comment
181	CO2 cost per ton - 2029	2010$/short ton	$30.68	
182	CO2 cost per ton - 2030	2010$/short ton	$31.36	
183	CO2 cost per ton - 2031	2010$/short ton	$31.92	
184	CO2 cost per ton - 2032	2010$/short ton	$32.50	
185	PM cost per ton	2010$/short ton	$306,092	National Highway Traffic Safety Administration, "Corporate Average Fuel Economy for FY 2011 Passenger Cars and Light Trucks", March 2009
186	VOC cost per ton	2010$/short ton	$1,377	National Highway Traffic Safety Administration, "Corporate Average Fuel Economy for FY 2011 Passenger Cars and Light Trucks", March 2009
187	Grams per Short Ton	grams	907,185	HDR
188	Total Divertible Truck Ton-miles - 2013	truck-TM	8,021,291	HDR calculations based on (i) number of trucks diverted, (ii) average tons per truck, and (iii) length of haul
189	Total Divertible Truck Ton-miles - 2014	truck-TM	22,594,198	
190	Total Divertible Truck Ton-miles - 2015	truck-TM	352,286,165	
191	Total Divertible Truck Ton-miles - 2016	truck-TM	359,906,036	
192	Total Divertible Truck Ton-miles - 2017	truck-TM	362,159,575	
193	Total Divertible Truck Ton-miles - 2018	truck-TM	373,024,362	
194	Total Divertible Truck Ton-miles - 2019	truck-TM	384,215,093	
195	Total Divertible Truck Ton-miles - 2020	truck-TM	395,741,545	
196	Total Divertible Truck Ton-miles - 2021	truck-TM	407,613,792	
197	Total Divertible Truck Ton-miles - 2022	truck-TM	419,842,206	
198	Total Divertible Truck Ton-miles - 2023	truck-TM	432,437,472	
199	Total Divertible Truck Ton-miles - 2024	truck-TM	445,410,596	
200	Total Divertible Truck Ton-miles - 2025	truck-TM	458,772,914	
201	Total Divertible Truck Ton-miles - 2026	truck-TM	472,536,101	
202	Total Divertible Truck Ton-miles - 2027	truck-TM	486,712,184	
203	Total Divertible Truck Ton-miles - 2028	truck-TM	501,313,550	
204	Total Divertible Truck Ton-miles - 2029	truck-TM	516,352,956	
205	Total Divertible Truck Ton-miles - 2030	truck-TM	531,843,545	
206	Total Divertible Truck Ton-miles - 2031	truck-TM	547,798,851	
207	Total Divertible Truck Ton-miles - 2032	truck-TM	564,232,817	
208	Total Equivalent Train Ton-miles - 2013	train-TM	9,664,206	HDR calculations based on (i) number of trucks ton-miles diverted, (ii) truck and rail distance factor of 0.83, and (iii) SOR railroad distance
209	Total Equivalent Train Ton-miles - 2014	train-TM	27,221,926	
210	Total Equivalent Train Ton-miles - 2015	train-TM	424,441,163	
211	Total Equivalent Train Ton-miles - 2016	train-TM	433,621,730	

Input #	Input Name	Units	Value	Source/Comment
212	Total Equivalent Train Ton-miles - 2017	train-TM	436,336,837	
213	Total Equivalent Train Ton-miles - 2018	train-TM	449,426,942	
214	Total Equivalent Train Ton-miles - 2019	train-TM	462,909,750	
215	Total Equivalent Train Ton-miles - 2020	train-TM	476,797,043	
216	Total Equivalent Train Ton-miles - 2021	train-TM	491,100,954	
217	Total Equivalent Train Ton-miles - 2022	train-TM	505,833,983	
218	Total Equivalent Train Ton-miles - 2023	train-TM	521,009,002	
219	Total Equivalent Train Ton-miles - 2024	train-TM	536,639,272	
220	Total Equivalent Train Ton-miles - 2025	train-TM	552,738,450	
221	Total Equivalent Train Ton-miles - 2026	train-TM	569,320,604	
222	Total Equivalent Train Ton-miles - 2027	train-TM	586,400,222	
223	Total Equivalent Train Ton-miles - 2028	train-TM	603,992,229	
224	Total Equivalent Train Ton-miles - 2029	train-TM	622,111,995	
225	Total Equivalent Train Ton-miles - 2030	train-TM	640,775,355	
226	Total Equivalent Train Ton-miles - 2031	train-TM	659,998,616	
227	Total Equivalent Train Ton-miles - 2032	train-TM	679,798,574	

Table 20: Benefit #6 – Present Values of Benefits

Benefit Category	PV Over 20 Years	
	7%	3%
Emission Saving from Diverting Trucks to Rail	$2,973,880	$5,484,111

4 MODEL SENSITIVITIES

The values in the cost-benefit analysis model that have the biggest impact on the economic benefits and Net Present Value results are provided in the table below. The data that is most influential are the number of carloads on the SORR (the percentage of difference between actual carloads on rail in base and alternative cases) and the relative cost of shipping by rail and truck (the percentage rail shipping premium below truck). The sensitivity analysis reveals how much these values would have to change for the project Net Present Value to equal zero (and a benefit cost ratio of 1.0). The sensitivity analysis indicates that these key assumptions must be reduced by large amounts in order for the Net Present Value to equal zero at a 7 percent discount rate revealing the strength of the project from an economic value perspective.

Table 21: Sensitivity Analysis of Key Model Variables

Variable	Base Value	Value Required for NPV = 0	% Change Required for NPV = 0
Percentage reduction in diverted carloads	0%	67%	-67%
Transportation cost savings from rail relative to truck	15%	-26%	-273%
Trucks per rail Car	3.00	1.37	-54%

5 GLOSSARY

Carbon Dioxide (CO_2): Carbon dioxide is a heavy colorless gas that is a by-product of the combustion of hydrocarbon fuels. Carbon dioxide is linked to climate change.

Discounted Value: The discounted value is the present value of a future cash amount. The present value is determined by reducing its future value by the appropriate discount rate for each unit of time between the time when the cash flow is to be valued to the time of the cash flow. To calculate the present value of a single cash flow, it is divided by one plus the interest rate (discount rate) for each period of time that will pass. This is expressed mathematically as raising the divisor to the power of the number of units of time.

Nitrogen Oxides (NO_X): Nitrogen oxides include a number of gases that are composed of oxygen and nitrogen. In the presence of sunlight these substances can transform into acidic air pollutants such as nitrate particles. The nitrogen oxides family of gases can be transported long distances in our atmosphere. Nitrogen oxides play a key role in the formation of smog (ground-level ozone). At elevated levels, NO_X can impair lung function, irritate the respiratory system and, at very high levels, make breathing difficult, especially for people who already suffer form asthma or bronchitis.

Particulate Matter (PM): Particulate matter refers to tiny particles of solid or liquid suspended in a gas. Sources of particulate matter can be man made or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols.

Volatile Organic Compound (VOC): Volatile organic compounds (VOCs) are a large and diverse family of chemicals that contain carbon and hydrogen. They can be emitted into indoor air from a variety of sources including cigarette smoke, household products like air fresheners, furnishings, vehicle exhaust and building materials such as paint, varnish and glues.

Ton: In the context of this document, is a short ton equivalent to 2,000 lbs.

Train Mile: A train mile is the one mile distance traveled by a train.

Train Ton-Mile (TM): One train ton-mile is equivalent to transporting one ton of materials via train a distance of one mile.

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