South Orient Rail Line Benefit Cost Analysis

Study Report

January 2015

Executive Summary

The Texas Department of Transportation (TxDOT) has commissioned a benefit-cost analysis (BCA) of their recent and forthcoming capital investments into the South Orient Rail Line (SORR), a rail line wholly owned by the State of Texas and leased to a private operator, Texas Pacifico, Ltd. (TXPF). The BCA follows a prior needs assessment recently conducted for the SORR and is intended to inform TxDOT on the value of its recent capital investments and whether future capital investments demonstrate a positive net benefit to society and the State of Texas that is greater than the estimated costs of those improvements.

The benefit-cost analysis includes an estimation of the discounted benefits and costs of four infrastructure scenarios over a 20 year analysis period beginning in 2014. To account for recent capital investments made within the past five years, the BCA also includes the years 2009 through 2013 and a no-build comparison with the railroad as it existed in 2009. The four infrastructure scenarios are tested under two demand scenarios. The infrastructure scenarios tested in the BCA include the following:

- No-Build: This scenario represents the SORR as it existed prior to the major capital investments made by TxDOT through 2012. Carload capacity is assumed at 2,000 revenue carloads annually (4,000 total railcars including backhaul of empty railcars), with Excepted Track conditions and a 10 mph speed limit.
- Baseline: The baseline includes $25.8 million in capital improvements made between 2010 and 2012. This scenario assumes a capacity of 26,000 revenue carloads annually (52,000 total railcars).
- Phase I: Includes proposed improvements from San Angelo Junction to Fort Stockton to a Class 2 standard.
- Phase IIA: Includes proposed investments in the railroad between Fort Stockton and Alpine Junction to a Class 2 standard.
- Phase IIB: Includes proposed investments in the railroad between Paisano Junction and Ojinaga, Mexico to a Class 2 standard, including the reconstruction of the Presidio-Ojinaga International Bridge.

Market forecasts were created to drive assumptions in the growth in traffic (expressed in revenue carloads). The demand scenarios are subject to the capacity constraints that exist under each infrastructure scenario against which they were tested. Two demand scenarios were developed:

- TXPF Forecast Scenario: This demand forecast reflects TXPF's forecasting for carload traffic by commodity through 2019 as well as forecasting done for TXPF on potential

Mexican traffic should the international bridge open.[1] The Engineer assumes no further growth in carload traffic beyond 2019 for domestic traffic and 2030 for Mexican traffic.

- 50,000 Max Revenue Carload Scenario: A second demand scenario includes the same traffic distribution assumptions as the TXPF Forecast, but limited by slower overall growth in demand.

A variety of benefit classes were estimated including benefits in shipping cost savings, reduced trip savings, modal shift between truck-to-rail and state of good repair. These benefits were compared over project development and construction costs to arrive at a benefit-cost ratio for each demand and infrastructure scenario. A spreadsheet based model was created to run the BCA and develop the results shown in the following sections.

No-Build Benefits

Prior to measuring the cost-benefit ratio of recent and proposed capital improvements to the SORR, the Engineer estimated the benefits to society that are provided by the railroad's existence in its pre-2009 condition and in the absence of any improvements undertaken since that time. Benefits primarily pertained to the environmental and pavement maintenance advantages of rail transportation as an alternative to trucking. Assuming that traffic levels were to remain fixed at the No-Build capacity of 2,000 revenue carloads per year in perpetuity, the no-build benefits were estimated to be as follows:

- 29.6 million annual truck-miles diverted to rail, at an annual net cost savings to shippers of $498,000 (2014 dollars).
- $112,000 in annual emission reductions (2014 dollars), not including CO_2.
- $148,000 to $215,000 in annual CO_2 emissions savings (2014 dollars; per USDOT guidelines, the real value of CO_2 emissions reductions increases over time).
- $1,136,000 in pavement maintenance savings (2014 dollars).

Benefit-Cost Analysis of Recent and Proposed Improvements

The net benefit to society, and to the State of Texas, was estimated under each of the four infrastructure scenarios and two demand scenarios described above. For each scenario, the benefits and costs are measured against the No-Build condition, and do not include the No-Build benefits described in the previous section.

Table ES-1 presents the results of the BCA, including monetized benefits for each benefit class analyzed, and estimated total capital costs, for the analysis period 2009 through 2034. The results are shown in 2014 dollars (adjusted based on the Consumer Price Index), and discounted to the present year using a 3% discount rate. Table ES-2 shows the same results using a 7% discount rate. It should be noted that these tables represent the benefits

[1] Texas A&M Transportation Institute (TTI). *Texas Pacifico Railroad Economic and Market Analysis*, August 2014

and costs to society, including the State of Texas, railroad customers, and the external beneficiaries of improvements such as air quality and highway safety. Capital costs therefore include those borne by TXPF and the State of Texas, while operating costs are not shown separately because it is assumed that these costs are passed on to shippers and are incorporated into various benefit calculations.

In a benefit-cost ratio, any number over one represents a net benefit over cost. In each infrastructure and demand scenario, benefits significantly exceeded costs, with Phase I improvements generating the greatest excess of benefits over costs under both demand scenarios at a 3 percent discount rate. A generally similar pattern exists at a 7 percent discount rate, suggesting that **Baseline and Phase I investments in the portion of the railroad with the highest traffic levels (between San Angelo Junction and Fort Stockton) have the greatest "bang for the buck"** under a range of time value of money and uncertainty assumptions.

State of Texas Perspective

To isolate the return on investment for the State of Texas, costs directly attributable to the State were isolated from TXPF's costs (including eventual replacement costs for any capital improvement funded by the State) and a separate benefit-cost ratio was computed. From a state perspective, benefit-cost ratios range from 4.20 for Phase IIB under the lower demand scenario at a 7 percent discount rate to 25.23 for the Baseline infrastructure with the higher demand scenario. These benefits are summarized in Table ES-3.

The results indicate that **the State's investments in the railroad have yielded positive benefits for society** and that **continued investment as envisioned in Phase II can be expected to do the same, although with diminishing returns**.

Table ES-1: Summary of Benefit-Cost Analysis
(Net Present Value in millions of 2014 dollars, 3% discount rate)

	TXPF Forecast				50k Demand			
	Baseline	Phase I	Phase IIA	Phase IIB	Baseline	Phase I	Phase IIA	Phase IIB
No-Build Travel Time Savings	$4.3	$4.3	$4.5	$4.5	$4.3	$4.3	$4.5	$4.5
Build Capacity Improvements	$412.9	$698.4	$836.6	$836.6	$423.9	$644.4	$578.7	$498.1
Reduced Locomotive Fuel Costs	$0	$0	$0	$0	$0	$0	$0	$0
Reduced Locomotive Emissions	$0	$0	$0	$0	$0	$0	$0	$0
Reduced Net Emissions	$56.2	$98.1	$122.8	$121.3	$58.1	$90.8	$84.0	$70.1
Improved Net Safety	$233.9	$407.5	$549.5	$548.9	$237.3	$370.2	$367.5	$312.6
Reduced Pavement Maintenance Costs	$85.2	$148.5	$201.8	$201.8	$86.5	$134.6	$134.6	$114.7
Improved Safety of New Track	$0	$0	$0	$0	$0	$0	$0	$0
Residual Value	$30.4	$54.7	$81.3	$81.3	$30.4	$54.7	$81.3	$81.3
Total Benefits	**$823**	**$1,413**	**$1,796**	**$1,794**	**$841**	**$1,299**	**$1,251**	**$1,081**
Capital Cost	**$147**	**$224**	**$315**	**$324**	**$147**	**$224**	**$315**	**$324**
Benefit-Cost Ratio	**5.58**	**6.29**	**5.70**	**5.54**	**5.71**	**5.79**	**3.96**	**3.34**

Table ES-2: Summary of Benefit-Cost Analysis
(Net Present Value in millions of 2014 dollars, 7% discount rate)

	TXPF Forecast				50k Demand			
	Baseline	Phase I	Phase IIA	Phase IIB	Baseline	Phase I	Phase IIA	Phase IIB
No-Build Travel Time Savings	$3.4	$3.4	$3.5	$3.5	$3.4	$3.4	$3.5	$3.5
Build Capacity Improvements	$315.0	$509.3	$605.2	$605.2	$322.8	$462.6	$418.7	$365.5
Reduced Locomotive Fuel Costs	$0	$0	$0	$0	$0	$0	$0	$0
Reduced Locomotive Emissions	$0	$0	$0	$0	$0	$0	$0	$0
Reduced Net Emissions	$51.4	$88.4	$111.8	$110.6	$52.8	$81.3	$76.2	$64.1
Improved Net Safety	$177.9	$296.1	$393.9	$393.9	$180.7	$264.6	$262.9	$226.7
Reduced Pavement Maintenance Costs	$64.7	$107.8	$144.6	$144.6	$65.7	$96.2	$96.2	$83.1
Improved Safety of New Track	$0	$0	$0	$0	$0	$0	$0	$0
Residual Value	$13.7	$24.6	$36.5	$36.5	$13.4	$24.6	$36.5	$36.5
Total Benefits	**$626**	**$1,030**	**$1,295**	**$1,294**	**$639**	**$933**	**$894**	**$780**
Capital Cost	**$124**	**$186**	**$261**	**$269**	**$124**	**$186**	**$261**	**$269**
Benefit-Cost Ratio	**5.03**	**5.55**	**4.97**	**4.82**	**5.14**	**5.03**	**3.43**	**2.90**

Table ES-3: Benefit-Cost Ratio (State Perspective)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	25.23	17.97
Phase I	14.65	11.32
Phase IIA	10.29	8.03
Phase IIB	9.74	7.59
50k Demand		
Baseline	25.91	18.43
Phase I	13.31	10.11
Phase IIA	6.73	5.23
Phase IIB	5.33	4.20

Technical Report

1. Project Description and Purpose

1.1 Purpose of Project

Texas Pacifico Transportation, Ltd. (TXPF) operates and maintains via lease from the Texas Department of Transportation (TxDOT) the South Orient Rail Line (SORR) between San Angelo Junction (near Coleman, Texas) to Presidio, Texas at the Mexican border. There are approximately 371 mainline track miles between San Angelo Junction and Presidio. The railroad was constructed at two different times – San Angelo Junction to San Angelo in the 1800's and San Angelo to Presidio in the late 1920's to 1930's as part of the Atchison Topeka Santa Fe Railway.

TxDOT completed the acquisition of the line in 2001 and leased it to TXPF. Interchange with other railroads is at San Angelo Junction with the BNSF Railway (BNSF) and the Fort Worth and Western Railroad (FWWR), at Alpine Junction with the Union Pacific Railroad (UPRR), and at Presidio/Ojinaga, Mexico with Ferromex.

With recent oil and gas exploration throughout the area, TXPF has experienced a large increase in freight car shipments on an aging infrastructure. The line is maintained by TXPF as a Class 2 railroad with speeds typically between 10 and 25 miles per hour. TXPF has provided actual and anticipated revenue carload volumes for the line. In 2009, when oil and gas exploration in the Permian Basin began to accelerate, TXPF delivered 1,527 carloads of sand, grain, wheat and other shipments. In 2012, TXPF began shipping crude oil, accounting for 20% of the 10,649 carloads shipped that year. Through November 2014, TXPF carried 21,142 revenue carloads, with an estimated end of year count of 25,803 carloads and a 2015 estimate of 39,996 carloads. The most recent increase in freight car shipments is accelerating the degradation of the aging rail infrastructure.

This benefit-cost analysis (BCA) follows a recent needs assessment and is intended to inform TxDOT on the value of its recent capital investments in the SORR and whether future capital investments demonstrate a positive net benefit to society and the State of Texas that is greater than the estimated costs of those improvements.

1.2 Project Description

The benefit-cost analysis includes an estimation of the discounted benefits and costs of four infrastructure scenarios over a 20 year analysis period beginning in 2014. To account for recent capital investments made within the past five years, the BCA also includes the years 2009 through 2013. The four infrastructure scenarios are tested under two demand

scenarios. The infrastructure scenarios are compared to a no-build scenario which assumes no further investments in the rail line beyond maintaining a condition capable of accommodating a railway capacity of 2,000 revenue carloads per year – representing approximate carload traffic on the SORR prior to 2010.

A spreadsheet-based model was developed with inputs from many different sources, including data from TxDOT and TXPF as well as federal sources on both the benefit and cost sides. These inputs were then compared among the four infrastructure scenarios described above and projected over a 20 year time horizon from 2014 through 2034. To provide a historical context for these projections, inputs from 2009 through 2013 were analyzed as well.

The benefit classes analyzed in this study include reduced shipping costs, reduced emissions, improved safety, and reduced pavement maintenance costs associated with the reduction in the number of trucks on parallel highways. The residual value of improved railroad assets installed during the analysis period is included as a benefit as well. These benefits were compared primarily against the capital costs of the improvements. Operating and maintenance (O&M) costs were not directly considered on the cost side, because these costs were assumed to be passed along to shippers and any reduction in TXPF's O&M costs resulting from the capital improvements were reflected as a benefit to shippers.

The project costs come from TxDOT reports and TXPF annual reports dating from 2001 through 2013 and forecasts dating from 2014 to 2019. The recent needs assessment also informs costs in the areas of track, bridge, and drainage cost categories. O&M costs were derived from inputs from TXPF, primarily annual reports. These costs were broadly categorized into transportation, fuel, maintenance, and administrative costs.

2. Benefit-Cost Scenarios

The BCA includes four infrastructure scenarios under two demand scenarios, for a total of eight BCA scenarios. The carload capacity for each of the infrastructure scenarios represents the number of round-trip carloads that can be accommodated under each scenario. This means that for every revenue carload, there is a second return trip for the empty railcar back to its place of origin. The carload capacity assumed under each infrastructure scenario establishes a ceiling for benefits. Based on information from TXPF, under existing conditions all carloads currently enter and leave the SORR through San Angelo Junction. This assumption is altered under certain infrastructure scenarios, as described in the following sections.

2.1 Infrastructure Scenarios

The following infrastructure scenarios were developed for comparison. Each scenario establishes a total carload capacity, beyond which any forecasted demand will not be accommodated, thus establishing a ceiling for total benefits.

- No-Build: This scenario represents the SORR as it existed prior to the major capital investments made by TxDOT through 2012. Carload capacity is assumed at 2,000 revenue carloads annually (4,000 total railcars including backhaul of empty railcars).
- Baseline: The baseline includes $25.8 million in capital improvements made between 2010 and 2012. This scenario assumes a capacity of 26,000 revenue carloads annually (52,000 total railcars). While the SORR may be able to accommodate a greater carload volume in the near term without further improvements, this volume is considered to be the sustainable long-term carload traffic level that can be accommodated without the need for additional major capital improvements.
- Phase I: Includes proposed improvements from San Angelo Junction to Fort Stockton to a Class 2 standard. This scenario assumes a sustainable capacity increase to 50,000 revenue carloads annually (100,000 total railcars).
- Phase IIA: Includes proposed investments in the railroad between Fort Stockton and Alpine Junction to a Class 2 standard. This scenario assumes a sustainable capacity to 100,000 revenue carloads annually (200,000 total railcars), as well as speed improvements to 25 mph between San Angelo Junction and Alpine Junction.
- Phase IIB: Includes proposed investments in the railroad between Paisano Junction and Ojinaga, Mexico to a Class 2 standard, including the reconstruction of the Presidio-Ojinaga International Bridge. This scenario also assumes a sustainable capacity of 100,000 revenue carloads annually (200,000 total railcars) as well as speed improvements to 25 mph between Paisano Junction and Presidio, Texas.

The infrastructure scenarios were assumed to be cumulative; that is, Phase IIB includes the proposed improvements under each of the preceding phases.

2.2 Demand Scenarios

Market forecasts were created to drive assumptions in the growth in traffic (expressed in revenue carloads). As noted, these demand scenarios are subject to the capacity constraints that exist under each infrastructure scenario against which they were tested. Two demand scenarios were developed:

- TXPF Forecast Scenario: This demand forecast reflects TXPF's forecasting for carload traffic by commodity through 2019 as well as forecasting done for TXPF on potential

Mexican traffic should the international bridge open.[2] The Engineer assumes no further growth in carload traffic beyond 2019 for domestic traffic and 2030 for Mexican traffic.

TXPF has forecasted 2015 traffic by territory based on the locations of its customers. The Engineer has assumed that the relative distribution of carload traffic per territory remains constant beyond 2015, with two exceptions: (1) any new traffic crossing the border from Mexico, which is assumed to traverse the entire length of the SORR between Presidio and San Angelo Junction; and (2) any diversion of existing or forecast traffic from San Angelo Junction to Alpine, where it would interchange with the UPRR for transport to the West Coast. One quarter (25%) of sand and crude oil carload traffic originating between San Angelo Junction and Alpine Junction is assumed to be destined for the West Coast under Phase IIA and Phase IIB infrastructure scenarios.

- 50,000 Max Revenue Carload Scenario: A second demand scenario includes the same traffic distribution assumptions, but limited by slower overall growth in demand. Under the 50,000 revenue carload scenario, overall traffic grows at 6% annually beginning in 2015, until the 50,000-carload cap is reached in 2026. Under the Phase IIB infrastructure scenario, this forecast assumes that some traffic from Mexico will be accommodated if the international bridge reopens, and reduces domestic traffic in order to accommodate that Mexican traffic within the 50,000 revenue carload maximum.

2.3 Methodology and Assumptions for Benefit Calculations

Benefits are expressed as value streams in constant 2014 dollars. The stream of benefits and costs over the 2009 to 2034 analysis period have been converted to a net present value (2014 dollars) using discount rates of 3% and 7%. All benefits are estimated in accordance with USDOT guidance provided for benefit-cost analysis, where available. Where specific guidance was unavailable, the Engineer has utilized industry standards for best practices and information upon which to base the assumptions and methodology used. Methodologies were designed to be transparent and reproducible, clearly setting out basic assumptions, methods, data, and uncertainties.

(a) Carload Demand

Carloads were classified by commodity: sand, crude oil, grain, and miscellaneous. As noted above, the carload demand forecasts were constrained by actual railroad capacity under each of the four infrastructure scenarios.

Carload traffic originating from Mexico, which will only exist upon completion of the Presidio-Ojinaga International Bridge in the Phase IIB infrastructure scenario, has been accounted for

[2] Texas A&M Transportation Institute (TTI). *Texas Pacifico Railroad Economic and Market Analysis*, August 2014

using forecasted carload traffic provided by TxDOT.[3] This traffic is classified as miscellaneous and is assumed to travel through the length of the SORR from Presidio to San Angelo Junction with no intermediate destinations.

Under the TXPF demand scenario, the Mexican carload traffic forecast has been appended to the TXPF domestic demand forecast to produce a total demand forecast. Under the 50,000 carload demand scenario, the Mexican traffic was prorated in proportion to the overall reduction in traffic versus the TXPF demand scenario, and domestic traffic was estimated by subtracting the Mexican traffic from total traffic.

(b) Truck Diversions

A number of benefit classes analyzed in this BCA are based on the assumption that new growth in carload traffic on the SORR would otherwise have been accommodated in trucks if the railroad were unable to accommodate the demand. This corresponds to all railcar traffic above the no-build capacity of 2,000 revenue carloads (4,000 total railcars).

Each additional loaded railcar above the no-build volume was assumed to carry the equivalent of 4.38 truckloads for dry commodities, and 3.13 truckloads for crude oil, based on the Texas Transportation Institute's 2012 "A Modal Comparison of Domestic Freight Transportation Effects on the General Public" report.[4]

To estimate the number of truck-miles diverted, each point of origin along the SORR was assigned to a transload facility in either Odessa or Cresson, Texas. An equivalent driving distance from that point of origin to the assigned transload facility was computed, and this distance was used to calculate the miles driven per diverted truck for that point of origin. The total truck-miles of diversion were then aggregated across all points of origin along the SORR and for all commodities. For any commodities traveling across the U.S.-Mexico border, no truck diversion was assumed, as these commodities would likely have traveled by rail through other gateways had the gateway in Presidio not been available.

(c) Alpine Junction Traffic

Under the Phase IIA and Phase IIB infrastructure scenarios, the SORR is able to accommodate traffic to Alpine Junction, which allows for the possibility of some traffic interchanging with the UPRR, as compared with the current traffic pattern in which all traffic interchanges with either the BNSF or the FWWR at San Angelo Junction. To model these potential new traffic patterns, it was assumed that under Phase IIA and Phase IIB

[3] Ibid.

[4] Texas Transportation Institute. *A Modal Comparison of Domestic Freight Transportation Effects in the General Public*, 2012.

infrastructure scenarios, 25% of all sand and crude oil shipments will divert to this new traffic pattern. This does not represent additional carload traffic, but rather a corresponding reduction in the number of carloads interchanged at San Angelo Junction. This does not increase the assumed overall carload capacity of the railroad, which is applied to the combined total of San Angelo Junction and Alpine Junction traffic.

(d) Other Key Assumptions

Other assumptions made by the Engineer include:

- Carloads were converted to aggregate carload-miles based on the milepost distances between SORR stations as provided in the August 3, 2014 Timetable provided by TXPF.
- Carload-miles were converted to ton-miles based on assumed railcar capacities by commodity (110 tons per railcar for dry materials, 108 tons per railcar for crude oil) as provided in the Texas Transportation Institute's modal comparison report.[5]
- Total trains and aggregate train-hours are based on carload demand, consist length, speed, and distance. Speeds were tabulated by territory as provided in the TXPF Timetable, incorporating any assumed speed improvements under the infrastructure scenarios. TXPF data for 2014 train traffic was used to estimate an average consist length of 60 cars per train for existing operations, and this was assumed to remain constant for all future growth.

3. Benefit Classes

A total of nine benefit classes were analyzed, grouped broadly into four categories: shipping cost savings, reduced trip savings, truck-to-rail mode shift benefits, and state of good repair benefits. These classes are discussed below.

3.1 Shipping Cost Savings

Shipping cost savings as a result of travel time and capacity improvements include two benefit classes. Both benefits are assumed to accrue to TXPF customers in the form of lower shipping costs.

(a) Reduced Shipping Costs, Existing Customers

Only traffic up to the no-build capacity (2,000 revenue carloads) is evaluated for this benefit, as all other traffic is assumed to represent *new* customers, whose cost savings are accounted for in the truck-to-rail mode shift categories.

[5] Texas Transportation Institute. *A Modal Comparison of Domestic Freight Transportation Effects in the General Public*, 2012.

As the SORR is upgraded and speeds can be maintained over the railroad at 25 miles per hour, O&M costs drop as it requires fewer train-hours for an individual train to travel across the railroad; thus labor productivity increases resulting in lower costs to shippers. Because this benefit accrues only to shipments under the no-build capacity, the total benefit is similar across the eight combinations of infrastructure and demand scenarios, with a net present value (NPV) of approximately $3.4 million at a 7% discount rate over 20 years, plus the five years up to the present (See Table 1).

Table 1: Reduced Shipping Costs – Existing Customers (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$4,319	$3,397
Phase I	$4,319	$3,397
Phase IIA	$4,474	$3,502
Phase IIB	$4,474	$3,502
50k Demand		
Baseline	$4,319	$3,397
Phase I	$4,319	$3,397
Phase IIA	$4,474	$3,502
Phase IIB	$4,474	$3,502

(b) Reduced Shipping Costs Due to Capacity Improvements

This benefit category measures the total increase in TXPF's O&M costs between the no-build and build scenario, measured against the cost savings for shippers that switch from trucks to rail due to the increased capacity of the railroad. Rail O&M costs are estimated as described in Section 4.2. Truck operating costs were estimated on a per-mile-diverted basis using an average cost per mile of $1.43 (constant 2014 dollars) based on data from the American Transportation Research Institute.[6]

This benefit increases across both infrastructure and demand scenarios, as greater demand, coupled with the infrastructure to accommodate it, will take greater numbers of trucks off the road. The greatest benefits accrue if TXPF's traffic projections come to fruition

[6] American Transportation Research Institute. *An Analysis of the Operational Costs of Trucking: 2012 Update*, 2012. Unit costs for truck payments and tolls were deducted.

under the Phase IIA and IIB infrastructure scenarios (both scenarios result in the same benefit, because they differ only in the ability to accommodate Mexican traffic, which is not included in the truck diversion analysis). Under Phase II scenarios and the TXPF demand scenario, the benefit approximately doubles over the Baseline infrastructure scenario and is 18% higher than under Phase I.

Under the 50,000 carload reduced demand scenario, the maximum benefit is available during Phase I and declines during the Phase IIA and IIB infrastructure scenarios. This decline can be attributed to the fact that West Coast shipments through Alpine, which begin to occur under the Phase IIA infrastructure scenario, erode this benefit. The reason for the reduced benefit when shipping via Alpine is that, for the majority of existing carload origins and destinations on the SORR, Alpine represents a longer travel distance than San Angelo Junction, so diverting shipments from San Angelo Junction to Alpine would represent a modest increase in the average cost of shipping.

Table 2 shows benefits for build capacity improvements. Under the Phase IIB infrastructure scenario with 50k annual carload demand, the existence of Mexican railcar traffic displaces a certain number of domestic railcars, further reducing the truck diversion benefit.

Table 2: Build Capacity Improvements (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$412,925	$314,956
Phase I	$698,441	$509,304
Phase IIA	$836,591	$605,163
Phase IIB	$836,591	$605,163
50k Demand		
Baseline	$423,870	$322,749
Phase I	$644,387	$462,555
Phase IIA	$578,733	$418,681
Phase IIB	$498,066	$365,536

3.2 Reduced Trips Savings

(a) Reduced Locomotive Fuel Costs

Locomotive fuel cost savings are assumed to be passed along to shippers. These cost savings are derived from reduced fuel costs associated with reduced train-miles from higher allowable tonnage per train. Based on discussions with TXPF, Phase I and II improvements will not yield increased tonnage per train or reduced per-carload fuel consumption. The Engineer also assumes faster speeds will not reduce locomotive fuel consumption. Therefore, based upon discussions with TXPF and TxDOT, the Engineer assumes zero benefit in this category. Benefits to shippers from changes in overall O&M costs as a result of the infrastructure scenarios are reflected in Section 3.1(b)

(b) Reduced Locomotive Emissions

Reduced locomotive emissions are reductions in emissions associated with reduced diesel fuel consumption. As in Section 3.2 (a), based on discussions with TXPF and TxDOT, the Engineer assumes zero benefit in this category.

3.3 Truck-to-Rail Mode Shift Benefits

While the direct benefits to shippers that can use rail instead of truck are evaluated in the form of reduced shipping costs in Section 3.1, additional externalities, including emissions, safety, and pavement maintenance impacts, is accounted for in this section.

(a) Reduced Net Emissions

Reduced net emissions are associated with the reduction in the number of trucks on parallel highways resulting from the truck-to-rail mode shift as a result of the investments made in the SORR under the various scenarios. The Engineer examined emission rates for truck and rail modes for volatile organic compounds (VOC), nitrogen oxide (NO_x), particulate matter of ten micrometers or less (PM_{10}), and carbon dioxide (CO_2). Rail emissions were estimated on a per-horsepower-hour basis and converted to grams-per-ton-mile.[7] [8] [9] Ton-miles were converted to railcar miles using the factors described in the assumptions section above. Truck emissions were estimated on a per-mile basis, multiplied by the aggregate truck-miles

[7] Environmental Protection Agency. *Average In-Use Emissions from Heavy-Duty Trucks*. http://www.epa.gov/otaq/consumer/420f08027.pdf. Referenced December 2014.

[8] Environmental Protection Agency. *Greenhouse Gas Emissions from a Typical Passenger Vehicle (EPA-420-F-11-041).* December 2011. http://nnsa.energy.gov/sites/default/files/nnsa/08-14-multiplefiles/EPA%202011c.pdf. Referenced December 2014.

[9] Environmental Protection Agency. *Emissions Factors for Locomotives*. http://www.epa.gov/nonroad/locomotv/420f09025.pdf. Referenced December 2014.

of traffic diverted to rail, based on the truck-to-rail conversion factors described in the assumptions section. Net change in emissions was monetized using values from the USDOT's *TIGER Benefit-Cost Analysis Resource Guide*.[10]

The benefits scale up under the TXPF demand scenario as infrastructure is phased in, although it declines slightly during Phase IIB, as shown in Table 3. Under the lower 50,000 carloads demand scenario, benefits peak during Phase I and decline as Phase II is implemented. The decline in benefits under Phase II can be attributed to growth in Mexican shipments and shipments to Alpine Junction, which both represent longer travel distances, and thus greater train emissions, than domestic shipments to San Angelo Junction. This is particularly noticeable in the 50,000 carload demand scenario, where Mexican traffic displaces some domestic shipments, resulting in fewer trucks diverted to rail.

Table 3 : Reduced Net Emissions (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$56,226	$51,350
Phase I	$98,172	$88,439
Phase IIA	$122,815	$111,799
Phase IIB	$121,255	$110,622
50k Demand		
Baseline	$58,064	$52,876
Phase I	$90,803	$81,253
Phase IIA	$83,988	$76,247
Phase IIB	$70,081	$64,104

(b) Improved Net Safety

Safety benefits include reduction in fatalities, injuries, and property damage resulting from the shift from truck to rail. Truck-to-rail diversion quantities calculated for the emissions benefit were applied to national crash rates for both heavy trucks and trains, obtained from NHTSA and the Bureau of Transportation Statistics, respectively. Safety improvements were monetized using values from the USDOT's *TIGER Benefit-Cost Analysis Resource Guide*.

[10] U.S. Department of Transportation. *TIGER Benefit-Cost Analysis (BCA) Resource Guide*. March, 2014. http://www.dot.gov/sites/dot.gov/files/docs/TIGER_BCARG_2014.pdf

Safety benefits increase across the infrastructure scenarios, doubling in Phase II over the Baseline infrastructure scenario and approximately 25% higher than in Phase I (Table 4). Safety benefits are reduced under the 50,000 carload scenario as demand is reduced and there is a drop in benefits under Phase IIB, declining 17% between IIA and IIB due to Mexican traffic and traffic to Alpine Junction. Safety benefits decline marginally between IIA and IIB under the TXPF demand scenario, but the benefit is largely maintained because of the high volumes of traffic expected.

Table 4: Improved Net Safety (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$233,874	$177,901
Phase I	$407,491	$296,081
Phase IIA	$549,477	$393,945
Phase IIB	$548,869	$393,528
50k Demand		
Baseline	$237,832	$180,719
Phase I	$370,162	$264,615
Phase IIA	$367,501	$262,861
Phase IIB	$312,620	$226,731

(c) Reduced Pavement Maintenance Costs

Reduced pavement maintenance costs are associated with the reduction in number of trucks on parallel highways along the SORR. Truck-miles diverted (calculated previously) were applied to an assumed unit cost of highway pavement deterioration per truck mile, based on the Federal Highway Cost Allocation Study.[11]

This is a positive net benefit across the infrastructure and demand scenarios, but like other benefits reliant on truck to rail diversions, benefits peak at Phase IIA and decline in Phase IIB, particularly under the 50,000 carload demand scenario (see Table 5).

[11] Addendum to the 1997 Federal Highway Cost Allocation Study Final Report, 2000. Table 13, for 80 kip 5-axle truck, rural highway.

Table 5: Reduced Pavement Maintenance Costs (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$85,160	$64,735
Phase I	$148,497	$107,848
Phase IIA	$201,800	$144,562
Phase IIB	$201,800	$144,562
50k Demand		
Baseline	$86,453	$65,655
Phase I	$134,629	$96,199
Phase IIA	$134,629	$96,199
Phase IIB	$114,711	$83,094

3.4 State of Good Repair

State of Good Repair benefits are classified in terms of improved safety as a result of new infrastructure and the residual value of the railroad's assets.

(a) Improved Safety of New Track

The Engineer assumes that some benefit of improved safety will accrue from increased capital investment in the railroad. As an example, TXPF experienced a derailment caused by a broken rail in 2014 at a location where the Phase 1 report recommends rail replacement. As track ages and wear increases from increased carload traffic, such incidents are likely to occur again. Conversely, the frequency of such incidents can be expected to decline following infrastructure improvements under each scenario. However, safety benefits cannot be defensively estimated as the Engineer is unable to determine the extent that improved condition of a section of track would result in a reduction of derailments on the railroad, or the associated monetary benefit of those reduced derailments, given the data available. No quantitative benefit is included in the BCA results.

(b) Residual Value

Residual value is the remaining value after depreciation of all assets on the rail line, beyond the horizon year of the BCA. The Engineer classifies assets into broad categories based on TXPF documentation and the current needs assessment. Within the analysis, life cycle

replacement for the assets is considered and applied appropriately throughout the 20 year time horizon. Table 6 shows the residual value of SORR assets by demand and infrastructure scenarios.

In both demand scenarios, the residual value of assets along the SORR is the same for a given infrastructure scenario, increasing as additional infrastructure investments are included. The opening of the railroad south from Fort Stockton in Phase II increases the residual value of the rail line by approximately 50% in each demand scenario, due in large part to the long expected life of the international bridge.

Table 6: Residual Value (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$30,411	$13,663
Phase I	$54,726	$24,588
Phase IIA	$81,289	$36,522
Phase IIB	$81,342	$36,546
50k Demand		
Baseline	$30,411	$13,663
Phase I	$54,726	$24,588
Phase IIA	$81,289	$36,522
Phase IIB	$81,342	$36,546

4. Costs

The cost side of the benefit-cost analysis is driven by two sets of costs: capital cost, including project development and construction costs; and operations and maintenance (O&M) costs.

4.1 Capital Costs

Capital expenditures are measured by known and projected expenditures by TXDOT and TXPF as well as known costs associated with the needs assessment in track, bridge, and drainage cost categories. Forecasting expenditures out over the 20 year time horizon, the Engineer has accounted for the replacement costs of the railroad asset categories accordingly.

The highest capital costs are associated with the infrastructure scenario Phase IIB, which includes the reopening of the Presidio-Ojinaga International Bridge, as well as the cumulative costs of other scenarios.

Capital costs are estimated using the Engineer's assessment of order of magnitude costs for various asset classes such as track and bridge/drainage. These cost estimates were assigned to the Phase I, Phase IIA, and Phase IIB infrastructure scenarios based on their location along the railroad. Previous capital investments completed in 2012, as well as TXPF's proposed capital expenditures through 2019, are also included under the Baseline infrastructure scenario. The incremental costs of each phase, in total 2014 dollars, were as follows:

- Baseline 2012 TXDOT expenditures of $25.2 million (adjusted to 2014 dollars)
- TXPF planned expenditures of $83.0 million between 2014 and 2019 (included in the Baseline infrastructure scenario)
- Phase I costs of $61.6 million
- Phase IIA costs of $75.5 million
- Phase IIB costs of $8.8 million

Table 7 summarizes the net present value of these expenditures, in thousands of 2014 dollars.

Table 7: Capital Costs (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$147,363	$124,334
Phase I	$224,353	$185,515
Phase IIA	$315,437	$260,528
Phase IIB	$323,936	$268,673
50k Demand		
Baseline	$147,363	$124,334
Phase I	$224,353	$185,515
Phase IIA	$315,437	$260,528
Phase IIB	$323,936	$268,673

4.2 Operations and Maintenance

O&M costs are the annual costs to operate and maintain the SORR. A simplified O&M cost allocation model was constructed to estimate TXPF's future O&M costs as carload traffic grows in the future. The O&M cost model was developed using data from TXPF's annual reports from 2009 through 2013. Total O&M costs are divided into four cost categories, with each category assumed to be directly associated with a "cost driver":

- Transportation (including labor), driven by total train-hours.
- Locomotive fuel, driven by total ton-miles.
- Maintenance, driven by total carload-miles.
- General administration, driven by total locomotive fleet size.

Unit costs for each cost category were computed based on past annual reports, and these unit costs were then applied to the future traffic forecast to estimate the O&M cost in future years.

O&M costs were a key input to several other benefit calculations, but were not shown as a direct cost in the BCA. This is because the various other benefits were estimated as benefits to shippers and society, with the assumption that TXPF's O&M cost savings would be passed along to shippers. Showing O&M costs as a direct input into the BCA would therefore double-count these costs.

5. Results

Results of the benefit-cost analysis are presented from two perspectives. For society, all benefits and costs are reflected, regardless of who pays. To reflect the narrower perspective of the State of Texas's investment in the SORR, the benefits (net of TXPF's costs passed along to shippers) are also presented in comparison to the State's share of the investment.

5.1 Societal Perspective

Summarizing the benefit classes at the discount rates of 3% and 7%, Table 8 displays the following total benefits for each scenario:

Table 8: Total Benefits (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$822,915	$626,001
Phase I	$1,411,455	$1,029,435
Phase IIA	$1,796,446	$1,295,493
Phase IIB	$1,794,331	$1,293,923
50k Demand		
Baseline	$840,948	$639,060
Phase I	$1,299,026	$932,605
Phase IIA	$1,250,615	$894,012
Phase IIB	$1,081,295	$779,513

Total benefits overall are maximized at the completion of Phase IIA, which extends capital improvements to Alpine Junction, thus allowing crude oil shipments to the West Coast.

Under a lower demand level capped at 50,000 carloads annually, the maximum benefit accrues at the end of Phase I, which extends capital investments to Fort Stockton. However, the difference is limited, with 4% fewer benefits in Phase IIA than Phase I.

A summary of capital costs by TXPF and the State of Texas including life cycle replacement is shown in Table 9.

Table 9: Total Costs (2014 dollars, in thousands)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	$147,363	$124,334
Phase I	$224,353	$185,515
Phase IIA	$315,437	$260,528
Phase IIB	$323,936	$268,673
50k Demand		
Baseline	$147,363	$124,334
Phase I	$224,353	$185,515
Phase IIA	$315,437	$260,528
Phase IIB	$323,936	$268,673

Here, capital costs are the same over the infrastructure scenarios regardless of demand. As expected, capital costs are highest with the extension of capital investment to Presidio and the opening of the Presidio-Ojinaga International Bridge in Phase IIB. Under the most expensive infrastructure scenario, Phase IIB, costs represent about 29% of total benefits in the TXPF demand scenario and 34% of total benefits in the reduced 50,000 annual railcars scenario.

Dividing total net present value of benefits by corresponding costs generates the benefit-cost ratio. A benefit-cost ratio greater than one describes a project in which the benefits associated with the implementation of the project exceed its costs. A benefit-cost ratio of less than one describes a project in which the project implementation costs exceed benefits. Below, Table 10 displays the benefit-cost ratios for each of the demand and infrastructure scenarios.

Table 10: Benefit-Cost Ratio (Societal Perspective)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	5.58	5.03
Phase I	6.29	5.55
Phase IIA	5.70	4.97
Phase IIB	5.54	4.82
50k Demand		
Baseline	5.71	5.14
Phase I	5.79	5.03
Phase IIA	3.96	3.43
Phase IIB	3.34	2.90

The benefit-cost ratios for each of the scenarios demonstrate that every dollar invested in the SORR results in positive net benefits for society. For example, Phase IIB infrastructure under the TXPF demand scenario, with a 3% discount rate, generates $5.56 for every dollar invested.

Overall, the highest benefit compared to costs in both demand scenarios is the completion of Phase I improvements, which result in bringing the SORR up to 25 miles per hour from San Angelo Junction to Fort Stockton as well as other capacity improvements. Given that this segment is where the majority of the existing carload traffic occurs, investments in this area provide the greatest benefit.

However, benefits are positive across all scenarios, showing that the State of Texas can achieve positive net benefits if demand on the line increases only to 50,000 cars annually and/or if the capital investments are extended to Presidio and the International Bridge.

5.2 State of Texas Perspective

An alternative benefit-cost ratio has been developed from the perspective of the State of Texas. In the leasing and operating agreement between the State of Texas and TXPF, it is stated that any capital improvement that the State invests into the SORR must be maintained over the life of the lease by the lessee, TXPF. Therefore, the State assumes no replacement costs for assets on the railroad.

The Engineer has broken out replacement costs and has treated TXPF capital costs as operating and maintenance costs passed along to shippers to isolate the benefit of the funding that the State of Texas is investing into the SORR. From this perspective, the State of Texas realizes these benefit-cost ratios in Table 11:

Table 11: Benefit-Cost Ratio (State Perspective)

Scenario	NPV at 3%	NPV at 7%
TXPF Demand		
Baseline	25.23	17.97
Phase I	14.65	11.32
Phase IIA	10.29	8.03
Phase IIB	9.74	7.59
50k Demand		
Baseline	25.91	18.43
Phase I	13.31	10.11
Phase IIA	6.73	5.23
Phase IIB	5.33	4.20

Under this State perspective benefit-cost ratio, the baseline infrastructure scenario provided the most benefit and each additional infrastructure phase lowers the overall benefit. However, each additional phase of infrastructure investment still yields a positive net benefit to the State.

5.3 No-Build Benefits

In addition to measuring the cost-benefit ratio of proposed capital improvements to the SORR, it is also possible to estimate the benefits to society that are provided by the railroad's existence even in the absence of these improvements. As with the build scenarios, many of the benefits of the SORR in its no-build condition pertain to the ability to move freight by rail that would otherwise be moved by truck, at higher cost and environmental impact.

Using the same methodologies described above, the Engineer estimates that under a no-build condition accommodating 2,000 revenue carloads annually, the SORR provided the following benefits:

- 29.6 million annual truck-miles diverted to rail, at an annual net cost savings to shippers of $498,000 (2014 dollars).
- $112,000 in annual emission reductions (2014 dollars), not including CO_2.
- $148,000 to $215,000 in annual CO_2 emissions savings (2014 dollars; per USDOT guidelines, the real value of CO_2 emissions reductions increases over time).
- $1,136,000 in pavement maintenance savings (2014 dollars)

Appendix

The appendix contains the summary of all annual benefits and costs evaluated in the benefit-cost analysis for each of the eight demand and infrastructure scenarios.

TXPF Demand Scenario; Baseline Infrastructure Scenario

		I. Long-Term Outcomes											
		A. Benefits										B. Costs	
		1. Shipping Cost Savings		2. Reduced Trips Savings		3. Truck to Rail Mode Shift			4. State of Good Repair			1. Project Development and Construction	
		Ben1a	*Ben1b*	*Ben2a*	*Ben2b*	*Ben3a*	*Ben3b*	*Ben3c*	*Ben4a*	*Ben4b*		*Cost1a*	
Project Year	Calendar Year	No-Build Travel Time Savings	Build Capacity Improvements	Reduced Locomotive Fuel Costs	Reduced Locomotive Emissions*	Reduced Net Emissions*	Improved Net Safety	Reduced Pavement Maintenance Costs	Improved Safety of New Track	Residual Value	**Total Benefits**	Capital Costs	**Total Costs**
-5	2009	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	**$0**
-4	2010	$30	$1,382	$0	$0	$272	$1,115	$400	$0	$0	**$3,197**	$0	**$0**
-3	2011	$107	$2,045	$0	$0	$276	$1,119	$401	$0	$0	**$3,948**	$0	**$0**
-2	2012	$339	$7,895	$0	$0	$1,189	$5,022	$1,813	$0	$0	**$16,258**	$25,139	**$25,139**
-1	2013	$200	$23,935	$0	$0	$2,935	$12,359	$4,466	$0	$0	**$43,895**	$0	**$0**
0	2014	$203	$28,379	$0	$0	$3,672	$14,517	$5,216	$0	$0	**$51,986**	$11,877	**$11,877**
1	2015	$229	$23,373	$0	$0	$2,991	$13,364	$4,875	$0	$0	**$44,841**	$11,400	**$11,400**
2	2016	$229	$23,373	$0	$0	$3,032	$13,364	$4,875	$0	$0	**$44,873**	$13,592	**$13,592**
3	2017	$229	$23,373	$0	$0	$3,073	$13,364	$4,875	$0	$0	**$44,914**	$15,992	**$15,992**
4	2018	$229	$23,373	$0	$0	$3,115	$13,364	$4,875	$0	$0	**$44,955**	$15,692	**$15,692**
5	2019	$229	$23,373	$0	$0	$3,156	$13,364	$4,875	$0	$0	**$44,996**	$16,184	**$16,184**
6	2020	$229	$23,373	$0	$0	$3,197	$13,364	$4,875	$0	$0	**$45,038**	$1,884	**$1,884**
7	2021	$229	$23,373	$0	$0	$3,238	$13,364	$4,875	$0	$0	**$45,079**	$2,784	**$2,784**
8	2022	$229	$23,373	$0	$0	$3,279	$13,364	$4,875	$0	$0	**$45,120**	$1,884	**$1,884**
9	2023	$229	$23,373	$0	$0	$3,321	$13,364	$4,875	$0	$0	**$45,161**	$2,784	**$2,784**
10	2024	$229	$23,373	$0	$0	$3,362	$13,364	$4,875	$0	$0	**$45,202**	$1,884	**$1,884**
11	2025	$229	$23,373	$0	$0	$3,444	$13,364	$4,875	$0	$0	**$45,285**	$2,784	**$2,784**
12	2026	$229	$23,373	$0	$0	$3,444	$13,364	$4,875	$0	$0	**$45,285**	$1,884	**$1,884**
13	2027	$229	$23,373	$0	$0	$3,485	$13,364	$4,875	$0	$0	**$45,326**	$2,784	**$2,784**
14	2028	$229	$23,373	$0	$0	$3,527	$13,364	$4,875	$0	$0	**$45,367**	$1,884	**$1,884**
15	2029	$229	$23,373	$0	$0	$3,568	$13,364	$4,875	$0	$0	**$45,408**	$10,434	**$10,434**
16	2030	$229	$23,373	$0	$0	$3,609	$13,364	$4,875	$0	$0	**$45,450**	$4,134	**$4,134**
17	2031	$229	$23,373	$0	$0	$3,650	$13,364	$4,875	$0	$0	**$45,491**	$6,834	**$6,834**
18	2032	$229	$23,373	$0	$0	$3,691	$13,364	$4,875	$0	$0	**$45,532**	$8,134	**$8,134**
19	2033	$229	$23,373	$0	$0	$3,733	$13,364	$4,875	$0	$0	**$45,573**	$8,434	**$8,434**
20	2034	$229	$23,373	$0	$0	$3,774	$13,364	$4,875	$0	$0	**$45,614**	$7,342	**$7,342**
Residual	2035	$0	$0	$0	$0	$0	$0	$0	$0	$56,573	**$56,573**	$0	**$0**
NPV at	3%	$4,319	$412,925	$0	$0	$56,226	$233,874	$85,160	$0	$30,411	**$822,915**	$147,363	**$147,363**
NPV at	7%	$3,397	$314,956	$0	$0	$51,350	$177,901	$64,735	$0	$13,663	**$626,001**	$124,334	**$124,334**

C. Benefit-Cost Ratio		
B/C at	3%	**5.58**
B/C at	7%	**5.03**

* Emissions benefits shown are annual values used for 3% discount rate calculations.

TXPF Demand Scenario; Phase I Infrastructure Scenario

		I. Long-Term Outcomes											
		A. Benefits										B. Costs	
		1. Shipping Cost Savings		2. Reduced Trips Savings		3. Truck to Rail Mode Shift			4. State of Good Repair			1. Project Development and Construction	
		Ben1a	*Ben1b*	*Ben2a*	*Ben2b*	*Ben3a*	*Ben3b*	*Ben3c*	*Ben4a*	*Ben4b*		*Cost1a*	
Project Year	Calendar Year	No-Build Travel Time Savings	Build Capacity Improvements	Reduced Locomotive Fuel Costs	Reduced Locomotive Emissions*	Reduced Net Emissions*	Improved Net Safety	Reduced Pavement Maintenance Costs	Improved Safety of New Track	Residual Value	**Total Benefits**	Capital Costs	**Total Costs**
-5	**2009**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	**$0**
-4	**2010**	$30	$1,382	$0	$0	$272	$1,115	$400	$0	$0	**$3,197**	$0	**$0**
-3	**2011**	$107	$2,045	$0	$0	$276	$1,119	$401	$0	$0	**$3,948**	$0	**$0**
-2	**2012**	$339	$7,895	$0	$0	$1,189	$5,022	$1,813	$0	$0	**$16,258**	$25,139	**$25,139**
-1	**2013**	$200	$23,935	$0	$0	$2,935	$12,359	$4,466	$0	$0	**$43,895**	$0	**$0**
0	**2014**	$203	$28,379	$0	$0	$3,672	$14,517	$5,216	$0	$0	**$51,986**	$11,877	**$11,877**
1	**2015**	$229	$27,768	$0	$0	$3,589	$16,037	$5,850	$0	$0	**$53,483**	$13,125	**$13,125**
2	**2016**	$229	$32,163	$0	$0	$4,245	$18,709	$6,825	$0	$0	**$62,172**	$33,770	**$33,770**
3	**2017**	$229	$36,559	$0	$0	$4,917	$21,382	$7,800	$0	$0	**$70,888**	$36,170	**$36,170**
4	**2018**	$229	$40,955	$0	$0	$5,606	$24,055	$8,776	$0	$0	**$79,620**	$35,870	**$35,870**
5	**2019**	$229	$45,350	$0	$0	$6,312	$26,728	$9,751	$0	$0	**$88,369**	$16,184	**$16,184**
6	**2020**	$229	$45,350	$0	$0	$6,394	$26,728	$9,751	$0	$0	**$88,451**	$1,884	**$1,884**
7	**2021**	$229	$45,350	$0	$0	$6,476	$26,728	$9,751	$0	$0	**$88,533**	$2,784	**$2,784**
8	**2022**	$229	$45,350	$0	$0	$6,559	$26,728	$9,751	$0	$0	**$88,616**	$1,884	**$1,884**
9	**2023**	$229	$45,350	$0	$0	$6,641	$26,728	$9,751	$0	$0	**$88,698**	$2,784	**$2,784**
10	**2024**	$229	$45,350	$0	$0	$6,724	$26,728	$9,751	$0	$0	**$88,781**	$1,884	**$1,884**
11	**2025**	$229	$45,350	$0	$0	$6,888	$26,728	$9,751	$0	$0	**$88,945**	$2,784	**$2,784**
12	**2026**	$229	$45,350	$0	$0	$6,888	$26,728	$9,751	$0	$0	**$88,945**	$1,934	**$1,934**
13	**2027**	$229	$45,350	$0	$0	$6,971	$26,728	$9,751	$0	$0	**$89,028**	$2,834	**$2,834**
14	**2028**	$229	$45,350	$0	$0	$7,053	$26,728	$9,751	$0	$0	**$89,110**	$1,934	**$1,934**
15	**2029**	$229	$45,350	$0	$0	$7,136	$26,728	$9,751	$0	$0	**$89,193**	$10,434	**$10,434**
16	**2030**	$229	$45,350	$0	$0	$7,218	$26,728	$9,751	$0	$0	**$89,275**	$5,461	**$5,461**
17	**2031**	$229	$45,350	$0	$0	$7,300	$26,728	$9,751	$0	$0	**$89,357**	$17,383	**$17,383**
18	**2032**	$229	$45,350	$0	$0	$7,383	$26,728	$9,751	$0	$0	**$89,440**	$19,324	**$19,324**
19	**2033**	$229	$45,350	$0	$0	$7,465	$26,728	$9,751	$0	$0	**$89,522**	$18,983	**$18,983**
20	**2034**	$229	$45,350	$0	$0	$7,548	$26,728	$9,751	$0	$0	**$89,605**	$7,342	**$7,342**
Residual	**2035**	$0	$0	$0	$0	$0	$0	$0	$0	$101,807	**$101,807**	$0	**$0**
NPV at	3%	$4,319	$698,441	$0	$0	$98,172	$407,491	$148,497	$0	$54,726	**$1,411,647**	$224,353	**$224,353**
NPV at	7%	$3,397	$509,304	$0	$0	$88,439	$296,081	$107,848	$0	$24,588	**$1,029,656**	$185,515	**$185,515**

C. Benefit-Cost Ratio		
B/C at	3%	**6.29**
B/C at	7%	**5.55**

* Emissions benefits shown are annual values used for 3% discount rate calculations.

TXPF Demand Scenario; Phase IIA Infrastructure Scenario

		I. Long-Term Outcomes											
		A. Benefits										B. Costs	
		1. Shipping Cost Savings		2. Reduced Trips Savings		3. Truck to Rail Mode Shift			4. State of Good Repair			1. Project Development and Construction	
		Ben1a	*Ben1b*	*Ben2a*	*Ben2b*	*Ben3a*	*Ben3b*	*Ben3c*	*Ben4a*	*Ben4b*		*Cost1a*	
Project Year	Calendar Year	No-Build Travel Time Savings	Build Capacity Improvements	Reduced Locomotive Fuel Costs	Reduced Locomotive Emissions*	Reduced Net Emissions*	Improved Net Safety	Reduced Pavement Maintenance Costs	Improved Safety of New Track	Residual Value	**Total Benefits**	Capital Costs	**Total Costs**
-5	**2009**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	**$0**
-4	**2010**	$30	$1,382	$0	$0	$272	$1,115	$400	$0	$0	**$3,197**	$0	**$0**
-3	**2011**	$107	$2,045	$0	$0	$276	$1,119	$401	$0	$0	**$3,948**	$0	**$0**
-2	**2012**	$339	$7,895	$0	$0	$1,189	$5,022	$1,813	$0	$0	**$16,258**	$25,139	**$25,139**
-1	**2013**	$200	$23,935	$0	$0	$2,935	$12,359	$4,466	$0	$0	**$43,895**	$0	**$0**
0	**2014**	$203	$28,379	$0	$0	$3,672	$14,517	$5,216	$0	$0	**$51,986**	$11,877	**$11,877**
1	**2015**	$231	$34,599	$0	$0	$4,637	$21,120	$7,718	$0	$0	**$68,315**	$35,638	**$35,638**
2	**2016**	$233	$38,423	$0	$0	$5,333	$24,411	$8,937	$0	$0	**$77,338**	$52,317	**$52,317**
3	**2017**	$236	$42,987	$0	$0	$6,116	$28,139	$10,320	$0	$0	**$87,797**	$52,871	**$52,871**
4	**2018**	$238	$48,578	$0	$0	$7,008	$32,411	$11,908	$0	$0	**$100,142**	$52,571	**$52,571**
5	**2019**	$240	$55,472	$0	$0	$8,024	$37,307	$13,730	$0	$0	**$114,773**	$16,184	**$16,184**
6	**2020**	$240	$55,472	$0	$0	$8,137	$37,307	$13,730	$0	$0	**$114,886**	$1,884	**$1,884**
7	**2021**	$240	$55,472	$0	$0	$8,249	$37,307	$13,730	$0	$0	**$114,999**	$2,784	**$2,784**
8	**2022**	$240	$55,472	$0	$0	$8,362	$37,307	$13,730	$0	$0	**$115,111**	$1,884	**$1,884**
9	**2023**	$240	$55,472	$0	$0	$8,475	$37,307	$13,730	$0	$0	**$115,224**	$2,784	**$2,784**
10	**2024**	$240	$55,472	$0	$0	$8,587	$37,307	$13,730	$0	$0	**$115,337**	$1,884	**$1,884**
11	**2025**	$240	$55,472	$0	$0	$8,813	$37,307	$13,730	$0	$0	**$115,562**	$3,834	**$3,834**
12	**2026**	$240	$55,472	$0	$0	$8,813	$37,307	$13,730	$0	$0	**$115,562**	$2,984	**$2,984**
13	**2027**	$240	$55,472	$0	$0	$8,925	$37,307	$13,730	$0	$0	**$115,675**	$2,834	**$2,834**
14	**2028**	$240	$55,472	$0	$0	$9,038	$37,307	$13,730	$0	$0	**$115,788**	$1,934	**$1,934**
15	**2029**	$240	$55,472	$0	$0	$9,151	$37,307	$13,730	$0	$0	**$115,900**	$10,434	**$10,434**
16	**2030**	$240	$55,472	$0	$0	$9,263	$37,307	$13,730	$0	$0	**$116,013**	$16,958	**$16,958**
17	**2031**	$240	$55,472	$0	$0	$9,376	$37,307	$13,730	$0	$0	**$116,126**	$24,916	**$24,916**
18	**2032**	$240	$55,472	$0	$0	$9,489	$37,307	$13,730	$0	$0	**$116,238**	$26,585	**$26,585**
19	**2033**	$240	$55,472	$0	$0	$9,601	$37,307	$13,730	$0	$0	**$116,351**	$26,244	**$26,244**
20	**2034**	$240	$55,472	$0	$0	$9,714	$37,307	$13,730	$0	$0	**$116,464**	$7,342	**$7,342**
Residual	**2035**	$0	$0	$0	$0	$0	$0	$0	$0	$151,222	**$151,222**	$0	**$0**
NPV at	3%	$4,474	$836,591	$0	$0	$122,815	$549,477	$201,800	$0	$81,289	**$1,796,446**	$315,437	**$315,437**
NPV at	7%	$3,502	$605,163	$0	$0	$111,799	$393,945	$144,562	$0	$36,522	**$1,295,493**	$260,528	**$260,528**

C. Benefit-Cost Ratio		
B/C at	3%	**5.70**
B/C at	7%	**4.97**

* Emissions benefits shown are annual values used for 3% discount rate calculations.

TXPF Demand Scenario; Phase IIB Infrastructure Scenario

		I. Long-Term Outcomes											
		A. Benefits										B. Costs	
		1. Shipping Cost Savings		2. Reduced Trips Savings		3. Truck to Rail Mode Shift			4. State of Good Repair			1. Project Development and Construction	
		Ben1a	*Ben1b*	*Ben2a*	*Ben2b*	*Ben3a*	*Ben3b*	*Ben3c*	*Ben4a*	*Ben4b*		*Cost1a*	
Project Year	Calendar Year	No-Build Travel Time Savings	Build Capacity Improvements	Reduced Locomotive Fuel Costs	Reduced Locomotive Emissions*	Reduced Net Emissions*	Improved Net Safety	Reduced Pavement Maintenance Costs	Improved Safety of New Track	Residual Value	**Total Benefits**	Capital Costs	**Total Costs**
-5	**2009**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	**$0**
-4	**2010**	$30	$1,382	$0	$0	$272	$1,115	$400	$0	$0	**$3,197**	$0	**$0**
-3	**2011**	$107	$2,045	$0	$0	$276	$1,119	$401	$0	$0	**$3,948**	$0	**$0**
-2	**2012**	$339	$7,895	$0	$0	$1,189	$5,022	$1,813	$0	$0	**$16,258**	$25,139	**$25,139**
-1	**2013**	$200	$23,935	$0	$0	$2,935	$12,359	$4,466	$0	$0	**$43,895**	$0	**$0**
0	**2014**	$203	$28,379	$0	$0	$3,672	$14,517	$5,216	$0	$0	**$51,986**	$11,877	**$11,877**
1	**2015**	$231	$34,599	$0	$0	$4,637	$21,120	$7,718	$0	$0	**$68,315**	$43,355	**$43,355**
2	**2016**	$233	$38,423	$0	$0	$5,214	$24,366	$8,937	$0	$0	**$77,174**	$53,385	**$53,385**
3	**2017**	$236	$42,987	$0	$0	$6,008	$28,097	$10,320	$0	$0	**$87,648**	$52,871	**$52,871**
4	**2018**	$238	$48,578	$0	$0	$6,911	$32,374	$11,908	$0	$0	**$100,009**	$52,571	**$52,571**
5	**2019**	$240	$55,472	$0	$0	$7,935	$37,273	$13,730	$0	$0	**$114,651**	$16,184	**$16,184**
6	**2020**	$240	$55,472	$0	$0	$8,028	$37,266	$13,730	$0	$0	**$114,737**	$1,884	**$1,884**
7	**2021**	$240	$55,472	$0	$0	$8,138	$37,265	$13,730	$0	$0	**$114,846**	$2,784	**$2,784**
8	**2022**	$240	$55,472	$0	$0	$8,249	$37,265	$13,730	$0	$0	**$114,956**	$1,884	**$1,884**
9	**2023**	$240	$55,472	$0	$0	$8,359	$37,264	$13,730	$0	$0	**$115,065**	$2,784	**$2,784**
10	**2024**	$240	$55,472	$0	$0	$8,470	$37,263	$13,730	$0	$0	**$115,175**	$1,884	**$1,884**
11	**2025**	$240	$55,472	$0	$0	$8,693	$37,263	$13,730	$0	$0	**$115,397**	$3,834	**$3,834**
12	**2026**	$240	$55,472	$0	$0	$8,691	$37,262	$13,730	$0	$0	**$115,395**	$2,984	**$2,984**
13	**2027**	$240	$55,472	$0	$0	$8,801	$37,261	$13,730	$0	$0	**$115,505**	$2,834	**$2,834**
14	**2028**	$240	$55,472	$0	$0	$8,911	$37,261	$13,730	$0	$0	**$115,614**	$1,934	**$1,934**
15	**2029**	$240	$55,472	$0	$0	$9,021	$37,260	$13,730	$0	$0	**$115,723**	$10,434	**$10,434**
16	**2030**	$240	$55,472	$0	$0	$9,131	$37,259	$13,730	$0	$0	**$115,833**	$16,958	**$16,958**
17	**2031**	$240	$55,472	$0	$0	$9,244	$37,259	$13,730	$0	$0	**$115,945**	$24,916	**$24,916**
18	**2032**	$240	$55,472	$0	$0	$9,356	$37,259	$13,730	$0	$0	**$116,057**	$26,585	**$26,585**
19	**2033**	$240	$55,472	$0	$0	$9,468	$37,259	$13,730	$0	$0	**$116,169**	$26,244	**$26,244**
20	**2034**	$240	$55,472	$0	$0	$9,580	$37,259	$13,730	$0	$0	**$116,281**	$7,342	**$7,342**
Residual	**2035**	$0	$0	$0	$0	$0	$0	$0	$0	$151,321	**$151,321**	$0	**$0**
NPV at	3%	$4,474	$836,591	$0	$0	$121,255	$548,869	$201,800	$0	$81,342	**$1,794,331**	$323,936	**$323,936**
NPV at	7%	$3,502	$605,163	$0	$0	$110,622	$393,528	$144,562	$0	$36,546	**$1,293,923**	$268,673	**$268,673**

C. Benefit-Cost Ratio		
B/C at	3%	**5.54**
B/C at	7%	**4.82**

* Emissions benefits shown are annual values used for 3% discount rate calculations.

50,000 Carload Max Demand Scenario; Baseline Infrastructure Scenario

		I. Long-Term Outcomes											
		A. Benefits										B. Costs	
		1. Shipping Cost Savings		2. Reduced Trips Savings		3. Truck to Rail Mode Shift			4. State of Good Repair			1. Project Development and Construction	
		Ben1a	*Ben1b*	*Ben2a*	*Ben2b*	*Ben3a*	*Ben3b*	*Ben3c*	*Ben4a*	*Ben4b*		*Cost1a*	
Project Year	Calendar Year	No-Build Travel Time Savings	Build Capacity Improvements	Reduced Locomotive Fuel Costs	Reduced Locomotive Emissions*	Reduced Net Emissions*	Improved Net Safety	Reduced Pavement Maintenance Costs	Improved Safety of New Track	Residual Value	**Total Benefits**	Capital Costs	**Total Costs**
-5	**2009**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	**$0**
-4	**2010**	$30	$1,382	$0	$0	$272	$1,115	$400	$0	$0	**$3,197**	$0	**$0**
-3	**2011**	$107	$2,045	$0	$0	$276	$1,119	$401	$0	$0	**$3,948**	$0	**$0**
-2	**2012**	$339	$7,895	$0	$0	$1,189	$5,022	$1,813	$0	$0	**$16,258**	$25,139	**$25,139**
-1	**2013**	$200	$23,935	$0	$0	$2,935	$12,359	$4,466	$0	$0	**$43,895**	$0	**$0**
0	**2014**	$203	$28,379	$0	$0	$3,672	$14,517	$5,216	$0	$0	**$51,986**	$11,877	**$11,877**
1	**2015**	$229	$24,108	$0	$0	$3,111	$13,630	$4,962	$0	$0	**$46,050**	$11,400	**$11,400**
2	**2016**	$229	$24,108	$0	$0	$3,153	$13,630	$4,962	$0	$0	**$46,082**	$13,592	**$13,592**
3	**2017**	$229	$24,108	$0	$0	$3,196	$13,630	$4,962	$0	$0	**$46,125**	$15,992	**$15,992**
4	**2018**	$229	$24,108	$0	$0	$3,238	$13,630	$4,962	$0	$0	**$46,167**	$15,692	**$15,692**
5	**2019**	$229	$24,108	$0	$0	$3,280	$13,630	$4,962	$0	$0	**$46,209**	$16,184	**$16,184**
6	**2020**	$229	$24,108	$0	$0	$3,322	$13,630	$4,962	$0	$0	**$46,251**	$1,884	**$1,884**
7	**2021**	$229	$24,108	$0	$0	$3,364	$13,630	$4,962	$0	$0	**$46,293**	$2,784	**$2,784**
8	**2022**	$229	$24,108	$0	$0	$3,407	$13,630	$4,962	$0	$0	**$46,336**	$1,884	**$1,884**
9	**2023**	$229	$24,108	$0	$0	$3,449	$13,630	$4,962	$0	$0	**$46,378**	$2,784	**$2,784**
10	**2024**	$229	$24,108	$0	$0	$3,491	$13,630	$4,962	$0	$0	**$46,420**	$1,884	**$1,884**
11	**2025**	$229	$24,108	$0	$0	$3,575	$13,630	$4,962	$0	$0	**$46,504**	$2,784	**$2,784**
12	**2026**	$229	$24,108	$0	$0	$3,575	$13,630	$4,962	$0	$0	**$46,504**	$1,884	**$1,884**
13	**2027**	$229	$24,108	$0	$0	$3,618	$13,630	$4,962	$0	$0	**$46,547**	$2,784	**$2,784**
14	**2028**	$229	$24,108	$0	$0	$3,660	$13,630	$4,962	$0	$0	**$46,589**	$1,884	**$1,884**
15	**2029**	$229	$24,108	$0	$0	$3,702	$13,630	$4,962	$0	$0	**$46,631**	$10,434	**$10,434**
16	**2030**	$229	$24,108	$0	$0	$3,744	$13,630	$4,962	$0	$0	**$46,673**	$4,134	**$4,134**
17	**2031**	$229	$24,108	$0	$0	$3,786	$13,630	$4,962	$0	$0	**$46,715**	$6,834	**$6,834**
18	**2032**	$229	$24,108	$0	$0	$3,829	$13,630	$4,962	$0	$0	**$46,758**	$8,134	**$8,134**
19	**2033**	$229	$24,108	$0	$0	$3,871	$13,630	$4,962	$0	$0	**$46,800**	$8,434	**$8,434**
20	**2034**	$229	$24,108	$0	$0	$3,913	$13,630	$4,962	$0	$0	**$46,842**	$7,342	**$7,342**
Residual	**2035**	$0	$0	$0	$0	$0	$0	$0	$0	$56,573	**$56,573**	$0	**$0**
NPV at	3%	$4,319	$423,870	$0	$0	$58,064	$237,832	$86,453	$0	$30,411	**$840,948**	$147,363	**$147,363**
NPV at	7%	$3,397	$322,749	$0	$0	$52,876	$180,719	$65,655	$0	$13,663	**$639,060**	$124,334	**$124,334**

C. Benefit-Cost Ratio		
B/C at	3%	**5.71**
B/C at	7%	**5.14**

* Emissions benefits shown are annual values used for 3% discount rate calculations.

50,000 Carload Max Demand Scenario; Phase I Infrastructure Scenario

		I. Long-Term Outcomes											
		A. Benefits										B. Costs	
		1. Shipping Cost Savings		2. Reduced Trips Savings		3. Truck to Rail Mode Shift			4. State of Good Repair			1. Project Development and Construction	
		Ben1a	*Ben1b*	*Ben2a*	*Ben2b*	*Ben3a*	*Ben3b*	*Ben3c*	*Ben4a*	*Ben4b*		*Cost1a*	
Project Year	Calendar Year	No-Build Travel Time Savings	Build Capacity Improvements	Reduced Locomotive Fuel Costs	Reduced Locomotive Emissions*	Reduced Net Emissions*	Improved Net Safety	Reduced Pavement Maintenance Costs	Improved Safety of New Track	Residual Value	**Total Benefits**	Capital Costs	**Total Costs**
-5	**2009**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	**$0**
-4	**2010**	$30	$1,382	$0	$0	$272	$1,115	$400	$0	$0	**$3,197**	$0	**$0**
-3	**2011**	$107	$2,045	$0	$0	$276	$1,119	$401	$0	$0	**$3,948**	$0	**$0**
-2	**2012**	$339	$7,895	$0	$0	$1,189	$5,022	$1,813	$0	$0	**$16,258**	$25,139	**$25,139**
-1	**2013**	$200	$23,935	$0	$0	$2,935	$12,359	$4,466	$0	$0	**$43,895**	$0	**$0**
0	**2014**	$203	$28,379	$0	$0	$3,672	$14,517	$5,216	$0	$0	**$51,986**	$11,877	**$11,877**
1	**2015**	$229	$25,387	$0	$0	$3,286	$14,397	$5,242	$0	$0	**$48,551**	$13,125	**$13,125**
2	**2016**	$229	$26,940	$0	$0	$3,546	$15,329	$5,581	$0	$0	**$51,625**	$33,770	**$33,770**
3	**2017**	$229	$28,587	$0	$0	$3,826	$16,317	$5,941	$0	$0	**$54,898**	$36,170	**$36,170**
4	**2018**	$229	$30,332	$0	$0	$4,125	$17,364	$6,322	$0	$0	**$58,371**	$35,870	**$35,870**
5	**2019**	$229	$32,181	$0	$0	$4,446	$18,474	$6,726	$0	$0	**$62,056**	$16,184	**$16,184**
6	**2020**	$229	$34,142	$0	$0	$4,790	$19,651	$7,154	$0	$0	**$65,966**	$1,884	**$1,884**
7	**2021**	$229	$36,220	$0	$0	$5,158	$20,898	$7,608	$0	$0	**$70,114**	$2,784	**$2,784**
8	**2022**	$229	$38,424	$0	$0	$5,553	$22,220	$8,090	$0	$0	**$74,516**	$1,884	**$1,884**
9	**2023**	$229	$40,759	$0	$0	$5,977	$23,622	$8,600	$0	$0	**$79,186**	$2,784	**$2,784**
10	**2024**	$229	$43,234	$0	$0	$6,430	$25,107	$9,141	$0	$0	**$84,141**	$1,884	**$1,884**
11	**2025**	$229	$45,858	$0	$0	$6,999	$26,682	$9,714	$0	$0	**$89,481**	$2,784	**$2,784**
12	**2026**	$229	$46,822	$0	$0	$7,151	$27,260	$9,924	$0	$0	**$91,385**	$1,934	**$1,934**
13	**2027**	$229	$46,822	$0	$0	$7,235	$27,260	$9,924	$0	$0	**$91,470**	$2,834	**$2,834**
14	**2028**	$229	$46,822	$0	$0	$7,319	$27,260	$9,924	$0	$0	**$91,554**	$1,934	**$1,934**
15	**2029**	$229	$46,822	$0	$0	$7,404	$27,260	$9,924	$0	$0	**$91,638**	$10,434	**$10,434**
16	**2030**	$229	$46,822	$0	$0	$7,488	$27,260	$9,924	$0	$0	**$91,723**	$5,461	**$5,461**
17	**2031**	$229	$46,822	$0	$0	$7,573	$27,260	$9,924	$0	$0	**$91,807**	$17,383	**$17,383**
18	**2032**	$229	$46,822	$0	$0	$7,657	$27,260	$9,924	$0	$0	**$91,892**	$19,324	**$19,324**
19	**2033**	$229	$46,822	$0	$0	$7,741	$27,260	$9,924	$0	$0	**$91,976**	$18,983	**$18,983**
20	**2034**	$229	$46,822	$0	$0	$7,826	$27,260	$9,924	$0	$0	**$92,060**	$7,342	**$7,342**
Residual	**2035**	$0	$0	$0	$0	$0	$0	$0	$0	$101,807	**$101,807**	$0	**$0**
NPV at	3%	$4,319	$644,387	$0	$0	$90,803	$370,162	$134,629	$0	$54,726	**$1,299,026**	$224,353	**$224,353**
NPV at	7%	$3,397	$462,555	$0	$0	$81,253	$264,615	$96,199	$0	$24,588	**$932,605**	$185,515	**$185,515**

C. Benefit-Cost Ratio		
B/C at	3%	**5.79**
B/C at	7%	**5.03**

* Emissions benefits shown are annual values used for 3% discount rate calculations.

50,000 Carload Max Demand Scenario; Phase IIA Infrastructure Scenario

		I. Long-Term Outcomes											
		A. Benefits										B. Costs	
		1. Shipping Cost Savings		2. Reduced Trips Savings		3. Truck to Rail Mode Shift			4. State of Good Repair			1. Project Development and Construction	
		Ben1a	*Ben1b*	*Ben2a*	*Ben2b*	*Ben3a*	*Ben3b*	*Ben3c*	*Ben4a*	*Ben4b*		*Cost1a*	
Project Year	Calendar Year	No-Build Travel Time Savings	Build Capacity Improvements	Reduced Locomotive Fuel Costs	Reduced Locomotive Emissions*	Reduced Net Emissions*	Improved Net Safety	Reduced Pavement Maintenance Costs	Improved Safety of New Track	Residual Value	**Total Benefits**	Capital Costs	**Total Costs**
-5	**2009**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	**$0**
-4	**2010**	$30	$1,382	$0	$0	$272	$1,115	$400	$0	$0	**$3,197**	$0	**$0**
-3	**2011**	$107	$2,045	$0	$0	$276	$1,119	$401	$0	$0	**$3,948**	$0	**$0**
-2	**2012**	$339	$7,895	$0	$0	$1,189	$5,022	$1,813	$0	$0	**$16,258**	$25,139	**$25,139**
-1	**2013**	$200	$23,935	$0	$0	$2,935	$12,359	$4,466	$0	$0	**$43,895**	$0	**$0**
0	**2014**	$203	$28,379	$0	$0	$3,672	$14,517	$5,216	$0	$0	**$51,986**	$11,877	**$11,877**
1	**2015**	$231	$24,303	$0	$0	$3,220	$14,372	$5,242	$0	$0	**$47,377**	$35,638	**$35,638**
2	**2016**	$233	$24,892	$0	$0	$3,404	$15,275	$5,581	$0	$0	**$49,385**	$52,317	**$52,317**
3	**2017**	$236	$25,727	$0	$0	$3,599	$16,230	$5,941	$0	$0	**$51,733**	$52,871	**$52,871**
4	**2018**	$238	$26,852	$0	$0	$3,803	$17,242	$6,322	$0	$0	**$54,457**	$52,571	**$52,571**
5	**2019**	$240	$28,316	$0	$0	$4,018	$18,312	$6,726	$0	$0	**$57,612**	$16,184	**$16,184**
6	**2020**	$240	$30,045	$0	$0	$4,334	$19,479	$7,154	$0	$0	**$61,253**	$1,884	**$1,884**
7	**2021**	$240	$31,877	$0	$0	$4,674	$20,716	$7,608	$0	$0	**$65,116**	$2,784	**$2,784**
8	**2022**	$240	$33,820	$0	$0	$5,038	$22,027	$8,090	$0	$0	**$69,215**	$1,884	**$1,884**
9	**2023**	$240	$35,879	$0	$0	$5,428	$23,416	$8,600	$0	$0	**$73,564**	$2,784	**$2,784**
10	**2024**	$240	$38,062	$0	$0	$5,847	$24,890	$9,141	$0	$0	**$78,179**	$1,884	**$1,884**
11	**2025**	$240	$40,375	$0	$0	$6,376	$26,451	$9,714	$0	$0	**$83,156**	$3,834	**$3,834**
12	**2026**	$240	$41,225	$0	$0	$6,514	$27,025	$9,924	$0	$0	**$84,929**	$2,984	**$2,984**
13	**2027**	$240	$41,225	$0	$0	$6,596	$27,025	$9,924	$0	$0	**$85,011**	$2,834	**$2,834**
14	**2028**	$240	$41,225	$0	$0	$6,678	$27,025	$9,924	$0	$0	**$85,093**	$1,934	**$1,934**
15	**2029**	$240	$41,225	$0	$0	$6,760	$27,025	$9,924	$0	$0	**$85,175**	$10,434	**$10,434**
16	**2030**	$240	$41,225	$0	$0	$6,842	$27,025	$9,924	$0	$0	**$85,257**	$16,958	**$16,958**
17	**2031**	$240	$41,225	$0	$0	$6,924	$27,025	$9,924	$0	$0	**$85,339**	$24,916	**$24,916**
18	**2032**	$240	$41,225	$0	$0	$7,006	$27,025	$9,924	$0	$0	**$85,421**	$26,585	**$26,585**
19	**2033**	$240	$41,225	$0	$0	$7,088	$27,025	$9,924	$0	$0	**$85,503**	$26,244	**$26,244**
20	**2034**	$240	$41,225	$0	$0	$7,170	$27,025	$9,924	$0	$0	**$85,585**	$7,342	**$7,342**
Residual	**2035**	$0	$0	$0	$0	$0	$0	$0	$0	$151,222	**$151,222**	$0	**$0**
NPV at	3%	$4,474	$578,733	$0	$0	$83,988	$367,501	$134,629	$0	$81,289	**$1,250,615**	$315,437	**$315,437**
NPV at	7%	$3,502	$418,681	$0	$0	$76,247	$262,861	$96,199	$0	$36,522	**$894,012**	$260,528	**$260,528**

C. Benefit-Cost Ratio		
B/C at	3%	**3.96**
B/C at	7%	**3.43**

* Emissions benefits shown are annual values used for 3% discount rate calculations.

50,000 Carload Max Demand Scenario; Phase IIB Infrastructure Scenario

		I. Long-Term Outcomes											
		A. Benefits										B. Costs	
		1. Shipping Cost Savings		2. Reduced Trips Savings		3. Truck to Rail Mode Shift			4. State of Good Repair			1. Project Development and Construction	
		Ben1a	*Ben1b*	*Ben2a*	*Ben2b*	*Ben3a*	*Ben3b*	*Ben3c*	*Ben4a*	*Ben4b*		*Cost1a*	
Project Year	Calendar Year	No-Build Travel Time Savings	Build Capacity Improvements	Reduced Locomotive Fuel Costs	Reduced Locomotive Emissions*	Reduced Net Emissions*	Improved Net Safety	Reduced Pavement Maintenance Costs	Improved Safety of New Track	Residual Value	**Total Benefits**	Capital Costs	**Total Costs**
-5	**2009**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	**$0**
-4	**2010**	$30	$1,382	$0	$0	$272	$1,115	$400	$0	$0	**$3,197**	$0	**$0**
-3	**2011**	$107	$2,045	$0	$0	$276	$1,119	$401	$0	$0	**$3,948**	$0	**$0**
-2	**2012**	$339	$7,895	$0	$0	$1,189	$5,022	$1,813	$0	$0	**$16,258**	$25,139	**$25,139**
-1	**2013**	$200	$23,935	$0	$0	$2,935	$12,359	$4,466	$0	$0	**$43,895**	$0	**$0**
0	**2014**	$203	$28,379	$0	$0	$3,672	$14,517	$5,216	$0	$0	**$51,986**	$11,877	**$11,877**
1	**2015**	$231	$24,303	$0	$0	$3,220	$14,372	$5,242	$0	$0	**$47,377**	$43,355	**$43,355**
2	**2016**	$233	$20,750	$0	$0	$2,689	$12,552	$4,603	$0	$0	**$40,827**	$53,385	**$53,385**
3	**2017**	$236	$21,922	$0	$0	$2,932	$13,670	$5,018	$0	$0	**$43,777**	$52,871	**$52,871**
4	**2018**	$238	$23,353	$0	$0	$3,187	$14,854	$5,460	$0	$0	**$47,092**	$52,571	**$52,571**
5	**2019**	$240	$24,970	$0	$0	$3,432	$16,020	$5,897	$0	$0	**$50,560**	$16,184	**$16,184**
6	**2020**	$240	$25,534	$0	$0	$3,546	$16,393	$6,036	$0	$0	**$51,750**	$1,884	**$1,884**
7	**2021**	$240	$26,966	$0	$0	$3,812	$17,359	$6,391	$0	$0	**$54,769**	$2,784	**$2,784**
8	**2022**	$240	$28,517	$0	$0	$4,104	$18,405	$6,776	$0	$0	**$58,041**	$1,884	**$1,884**
9	**2023**	$240	$30,139	$0	$0	$4,412	$19,500	$7,178	$0	$0	**$61,470**	$2,784	**$2,784**
10	**2024**	$240	$31,873	$0	$0	$4,746	$20,670	$7,607	$0	$0	**$65,136**	$1,884	**$1,884**
11	**2025**	$240	$33,689	$0	$0	$5,165	$21,894	$8,057	$0	$0	**$69,045**	$3,834	**$3,834**
12	**2026**	$240	$34,269	$0	$0	$5,258	$22,285	$8,201	$0	$0	**$70,253**	$2,984	**$2,984**
13	**2027**	$240	$34,131	$0	$0	$5,301	$22,192	$8,167	$0	$0	**$70,031**	$2,834	**$2,834**
14	**2028**	$240	$33,988	$0	$0	$5,342	$22,094	$8,131	$0	$0	**$69,795**	$1,934	**$1,934**
15	**2029**	$240	$33,818	$0	$0	$5,377	$21,979	$8,089	$0	$0	**$69,504**	$10,434	**$10,434**
16	**2030**	$240	$33,658	$0	$0	$5,414	$21,869	$8,049	$0	$0	**$69,231**	$16,958	**$16,958**
17	**2031**	$240	$33,658	$0	$0	$5,480	$21,869	$8,049	$0	$0	**$69,297**	$24,916	**$24,916**
18	**2032**	$240	$33,658	$0	$0	$5,546	$21,869	$8,049	$0	$0	**$69,363**	$26,585	**$26,585**
19	**2033**	$240	$33,658	$0	$0	$5,612	$21,869	$8,049	$0	$0	**$69,429**	$26,244	**$26,244**
20	**2034**	$240	$33,658	$0	$0	$5,678	$21,869	$8,049	$0	$0	**$69,495**	$7,342	**$7,342**
Residual	**2035**	$0	$0	$0	$0	$0	$0	$0	$0	$151,321	**$151,321**	$0	**$0**
NPV at	3%	$4,474	$498,066	$0	$0	$70,081	$312,620	$114,711	$0	$81,342	**$1,081,295**	$323,936	**$323,936**
NPV at	7%	$3,502	$365,536	$0	$0	$64,104	$226,731	$83,094	$0	$36,546	**$779,513**	$268,673	**$268,673**

C. Benefit-Cost Ratio		
B/C at	3%	**3.34**
B/C at	7%	**2.90**

* Emissions benefits shown are annual values used for 3% discount rate calculations.