I. PORT OF WILMINGTON - INTERMODAL YARD IMPROVEMENT PROJECT

Benefit-Cost Analysis Report

EXECUTIVE SUMMARY

Current Status/ Baseline & Problem to be Addressed	Change to Baseline	Type of Impacts	Affected Population	Economic Benefits	Summary of Results
Port of Wilmington additional Rail Investment for Queen City Express and CCX rail intermodal in lieu of truck.	Improvements on the Port to facilitate more efficient loading, unloading and storage of intermodal container trains.	Social Environmental Competitive.	Throughout North Carolina	Monetized value of reduced highway congestion costs	Projected Investment Cost undiscounted $22.6 M including $4.5M non-federal match.
Creates significant safety and environmental benefits.	Reduces adverse impact of additional projected activity at Port on highway system.	Accident reductions. Fuel consumption savings. Social benefits of reduced air emissions.	Local and regional community affected by air emissions, accidents, and road degradation.	Monetized value of reduced accidents, fuel consumption, and emissions.	$86.5 million benefits NPV at 7% discount rate.
Creates significant maintenance and competitiveness benefits.	Port expects to divert trucks carrying containers to rail at lower cost.	Improved traffic flow and reduce delays and maintenance.	Drivers realizing fewer traffic delays higher safety through area.	Monetized value of competitive benefits, reduced hwy. maintenance, net consumer benefit.	**Benefit/Cost Ratio of 4.8 at 7% NPV**.

PROJECT DESCRIPTION

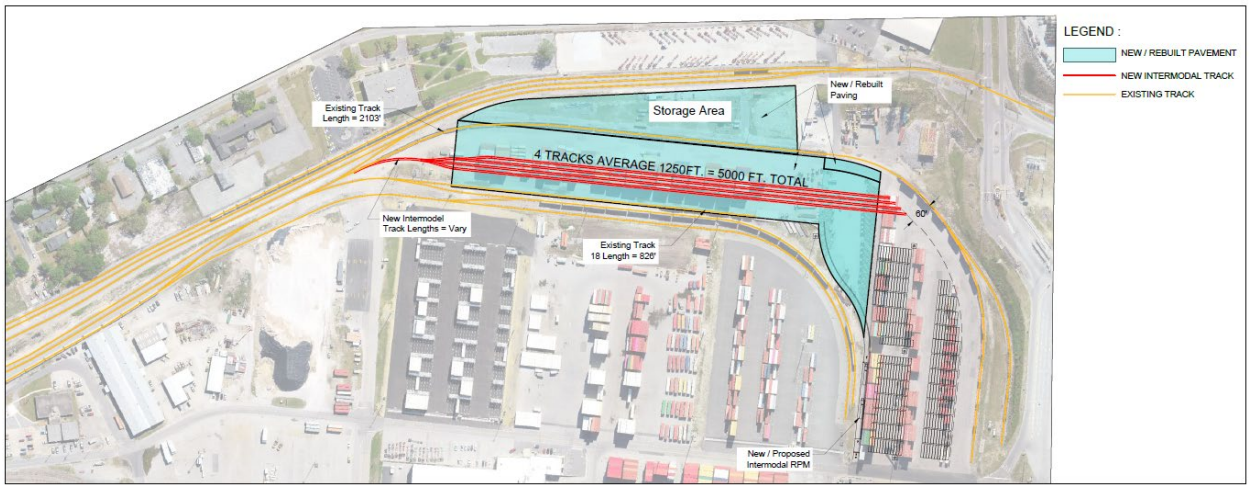
Rail movement of import and export containerized cargo is key to the Port of Wilmington's expanding its container market share participation. The purpose of the Port of Wilmington Rail Yard Improvements Project is to support the operation of the Queen City Express (QCE), an intermodal container train service operating between the Port of Wilmington, NC, and Charlotte, NC where the Port maintains an inland port. Services are being expanded to include connections with the Carolina Connector (CCX)regional rail container hub located in Rocky Mount, NC and the rest of the CSX Transportation rail system.

This is consistent with the competitive requirement to provide rail intermodal services to the hinterland enjoyed by neighboring, competing ports from Norfolk to Savannah. All these ports have constructed or plan to construct on dock or near dock rail intermodal facilities and rail served inland ports.

In Wilmington's case, the Port has been proactive to assume the role of agent and arranger of transportation for the movement of containers between the Port of Wilmington, NC, and Charlotte or CCX at Rocky Mount, NC and beyond on behalf of its customers. QCE's customers are ocean carriers, intermodal marketing companies, and transportation intermediaries. The service is configured as follows:

- CSX Transportation (CSXT), the line haul rail carrier, provides service to Charlotte, 200 miles distant, and to CCX via connection to CSXT's north-south mainline passing through Rocky Mount, NC (see Figure 6 Map);
- Within the Port, switching services are provided by Port-owned Wilmington Terminal Railway (WTRY); and
- Motor carriers provide drayage services for containers and chassis from railhead to customer.

Figure 1 New Intermodal Facility Improvements



Current Situation and Improvements: Referring to Figure 1, today the Port is using parts of the upper and lower pair of (orange) curved tracks formerly used for rail car storage as an "evolving" arrangement to establish proof of concept for the rail service.

While the Port has an excellent reputation for high productivity and low port costs, and the rail service has been enthusiastically received by clients, it is presently only a small fraction of Port throughput. Today, trains using the Port's intermodal rail facilities are constrained by the length of rail tracks available

for loading intermodal flat cars, and by lack of storage for cars awaiting loads, as well as by the incremental difficulty of loading cars on curves.

The proposed project provides an on-terminal intermodal yard with 5,000 feet of working tracks. The construction would include four 1,250-foot sidings with transfer areas that are located on both the east and west side of the intermodal tracks, allowing the Port to safely load and unload containers to and from an intermodal train on the terminal. Rehabilitation projects on connecting tracks are included to meet the overall need for increased capacity and train frequency. Additional paved container storage near the loading area is also planned. Without this investment, the Port's intermodal activity is capped at approximately 14,000 intermodal rail movements annually. With the proposed investment, the capacity increases to approximately 50,000 intermodal rail movements annually.

In 2023, the Port is forecasted to move 343,000 twenty-foot equivalent units (TEU) or 191,000 forty-foot equivalent containers (FEU), with rail accounting for 5.4% of total Port moves. By 2040, the number of rail intermodal moves is projected to grow to 50,000 containers, reflecting North Carolina's historic 5.5% real growth rate of Industrial GDP. Capacity could later be increased with the addition of gantry crane technology. The proposed facility could have a maximum design capacity to handle 100,000 containers per year with that technology.[1] By emphasizing rail intermodal share of throughput, Wilmington is emulating its A 25% level has already been realized by Savannah and 34% by Norfolk[2] and 25% is planned by Charleston[3]. Table 1 below relates current and predicted rail intermodal performance to the overall throughput of the Port per the 2012-2026 Strategic Plan and projections.

Table 1 Current & Projected Traffic

Port of Wilmington 5 Year Strategic Plan 2021-2026 plus Outyear Projections													
Fiscal Year	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	*2030*	*2035*	*2039*	*2040*	*2042*	*2044*
20 foot units (TEU's)	330,000	319,300	330,300	343,113	448,807	467,109	484,640	5.50%	NC Industrial GDP real growth			Max. Cap'y	1,200,000
Containers @1.8	173,000	177,389	183,500	190,618	249,337	259,505	269,244	333,547	435,932	540,043	569,746	634,141	667,000
												Below as Modeled	
QCE Service Cont.	6,000	7,661	6,957	8,446	8,578	8,466	8,608	10,664	13,937	17,266	18,215	*18,215*	*18,215*
CCX Service Cont.			100	1,882	5,760	10,393	15,028	18,617	24,332	30,143	31,801	*31,801*	*31,801*
Total Rail Containers	**6,000**	**7,661**	**7,057**	**10,328**	**14,338**	**18,859**	**23,636**	**29,281**	**38,269**	**47,408**	**50,016**	***50,016***	***50,016***
Rail Share	3%	4%	4%	5%	6%	7%	9%	9%	9%	9%	9%	8%	7%
Note: Some intermediate years are hidden from view.													

Investments required total $22.7 million including $18 million in proposed federal funding for construction of the new intermodal loading facility tracks and loading pads. Matching funding in the amount of $4.5 million will be provided by non-federal match. These matching investments result in an overall non-federal contribution of 20% consisting of funding contributions from the Port.

[1] Section 6 Port Improvement Projects, *Mott MacDonald | Wilmington Rail Improvements 49 Landside Rail Improvements Serving the Port and Moving Trains Safely through the Communit*y, September 2017, page 45 etc.

[2] ttps://www.joc.com/port-news/us-ports/georgia-ports-authority/savannah-intermodal-surges-rail-work-pushes-ahead_20190813.html?destination=node/3614451

[3], *Market assessment and forecast for South Carolina Ports Authority facilities*, August 30, 2019, Mercator Advisors, pg. 63. Comprehensive graphic here: https://www.joc.com/port-news/us-ports/georgia-ports-authority/savannah-intermodal-surges-rail-work-pushes-ahead_20190813.html

Service life rail tracks and crossties assets is expected to exceed the 20 years discounting period provided in the Guidelines[4]. In total, the discounted investment costs are approximately $18.1 million, discounting at 7%.

DEMOGRAPHICALLY QUANTIFIABLE BENEFITS DISCUSSION

The Port of Wilmington is located on the southern periphery of the City of Wilmington, NC along the Cape Fear River. The Port terminal is adjacent to Opportunity Zone (37129011000) in New Hanover County, North Carolina[5]. The Port-owned railroad employed to move container boxes in and out of the Port goes through two Opportunity Zones (37129011000 and 37129011100) as it enters and exits the Port. There are an additional Opportunity Zones in Wilmington and adjacent Pender and Brunswick Counties. Although the Port of Wilmington rail only goes through two Opportunity Zones in the region, the port draws employees from these other zones, and Port activities provide direct benefits to these zones.

Table 2 Opportunity Zones in the Tri-county Area

New Hanover County	Pender County	Brunswick County
37129011000	37141920602	37019020104
37129011100	37141920601	37019020101
37129011200		37019020602
37129011903		

According to the Transportation Disadvantaged Census mapping tool, the Port of Wilmington, which is in Census Tract 109, is in a Disadvantaged Community with four or more Transportation Disadvantage indicators (Disadvantaged Community with Resilience Indicator, Environmental Indicator, Economy Indicator, Health Indicator, and Transportation Indicator). Additionally, neighboring tracts 107 and 108 within the Port's ready labor draw area show five or more Transportation Disadvantage Indicators including the APP designation.

a. Demographic Qualifier: Poverty

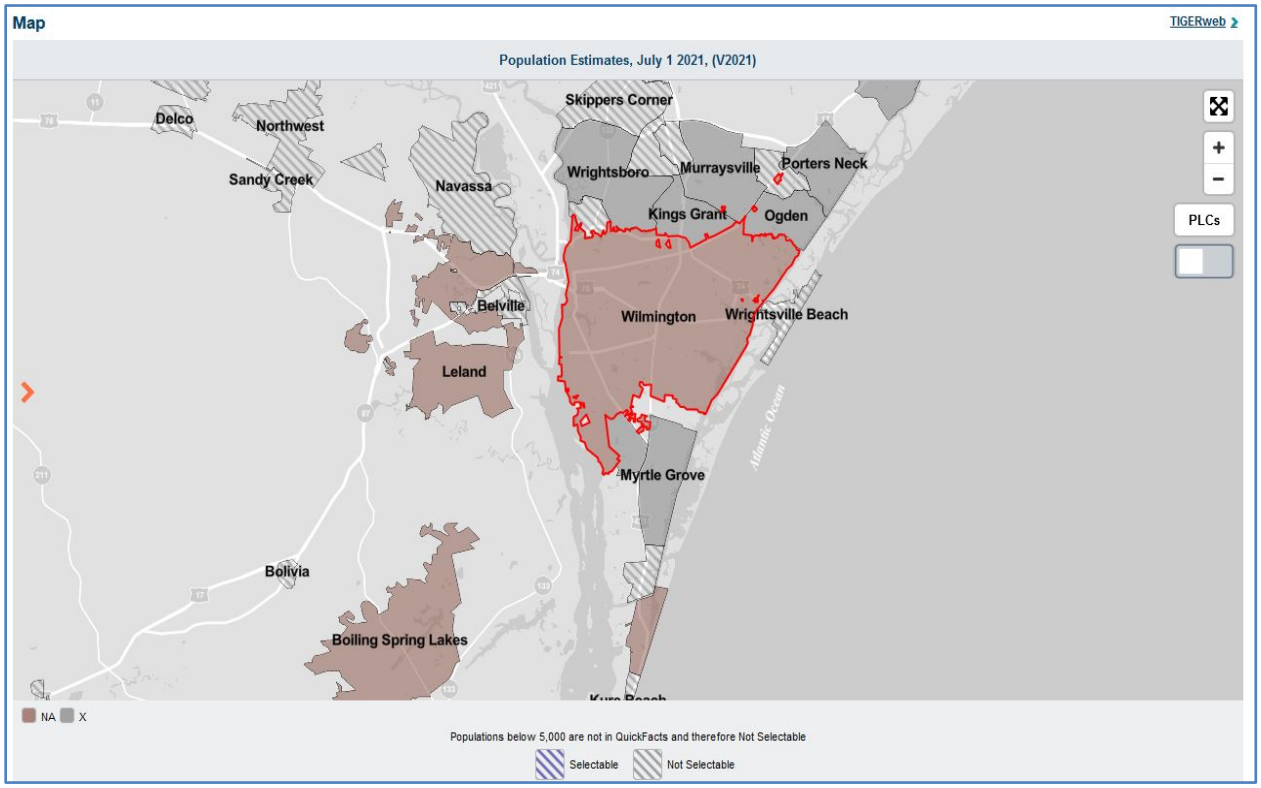
According to the 2019 U.S. Census Bureau American Community Survey (ACS) 22.2% of the population of the City of Wilmington were living below the poverty level. According to the U.S. Census Bureau the median income in Wilmington was $47,580 and the per capita income was $31,846[6].

[4] Guidelines for the Preparation of Discretionary Grants, USDOT, OST Office of Policy, February, 2021.
[5] https://www.cdfifund.gov/Pages/Opportunity-Zones.aspx
[6] Stated in 2019 dollars, averaged for the period 2015-2019, U.S. Census Bureau, American Community Survey.

b. Urban or Rural Designation?

The population of greater Wilmington as defined by the US Census Bureau in April 2020 was 115,451[7], suggesting that projects in the greater Wilmington area would qualify as "rural" according to the Notice of Finding Opportunity definition of area population less than 200,000.

Figure 2 Map of Greater Wilmington

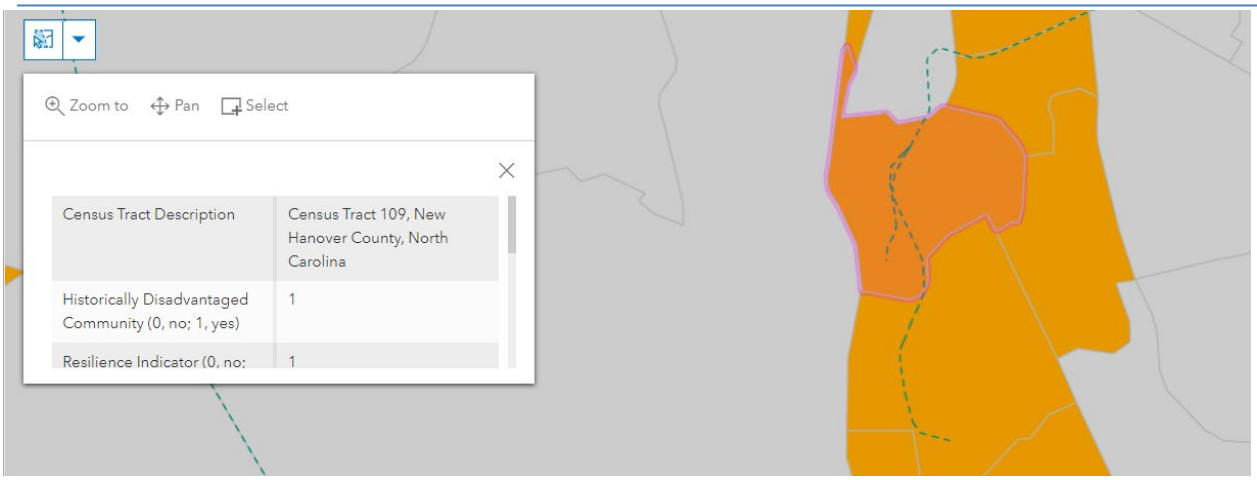


c. Demographic Qualifier: Economic Equity

The Port's labor draw area encompasses numerous Census Tracts that display Areas of Persistent Poverty (APP) and Historically Disadvantaged Community status (HDC) as shown by the Map and Table that follow.

Figure 3 Map from Transportation disadvantaged Census Tracts

[7] In the 2010 Census the Wilmington area had a population of 106,000.



Source: https://usdot.maps.arcgis.com/apps/dashboards/d6f90dfcc8b44525b04c7ce748a3674a

Table 3 APP and HDC Designations Wilmington Port Area

County	Tract #	Locator	County	Tract APP	Tract
New Hanover					
	101	NE WLM	no	yes	yes
	102	SE WLM	no	yes	yes
	103	Castle Hayne	no	yes	yes
	104	Suburban	no	no	no
	105.01	WLM East	no	yes	yes
	107	WLM SE	no	yes	yes
	108	WLM SE	no	yes	yes
	109	WLM S & Port	no	no	yes
	110	WLM East	no	yes	yes
	111	WLM East	no	yes	yes
	112	WLM East	no	yes	yes
	113	WLM Center	no	yes	no
	114	Suburban	no	yes	yes
	119.02	WLM far East	no	yes	yes
	121.01	WLM far S	no	no	yes
Brunswick					
	201.04	Leyland -	no	yes	yes

d. Demographic Qualifier: Ethnicity and Race

Wilmington and the area around the Port are racially diverse. According to the U.S. Census Bureau the area of greater Wilmington has the following racial and ethnic composition.

According to the FOCUS Equitable Growth Profile Summary of the Cape Fear Region and the U.S. Census Bureau, the region is experiencing rapid population growth[8]. But the dynamics of growth differ in in the Wilmington region compared with most growing regions. While in most growing regions, communities of color are driving growth as the aging White population shrinks as a share of the population,

[8] Link here.

this is not the case in the Wilmington region. Non-Hispanic Whites represented 75 percent of Cape Fear's population in 1980 and are expected to represent 77 percent of the population in 2040.

The FOCUS study found that the Wilmington region is experiencing a demographic transformation characterized by a diversifying younger population and a rapidly growing senior population that is predominantly White. As the region's labor force grows increasingly diverse, closing wide and persistent racial gaps in economic opportunity and outcomes will be key to the region's future growth and prosperity. By creating pathways to good jobs, connecting younger generations with older ones, building communities of opportunity throughout the region, and ensuring educational and career pathways for all youth, the region's leaders can put all residents on the path toward reaching their full potential, and secure a bright economic future for all.

Any economic activity induced by an investment in the Port facilities and particularly in operating assets for expanded activities such as container handling and transportation are likely to be spread on a favorable ethnic and racial basis, even without considering the multiplier effects typically considered in a broader based impact analysis.

e. How does the Port's Business Expansion Impact Equity Issues?

A large part of the Port's labor force of 178 persons are drawn from those demographic groups most disadvantaged by today's technology centric and education focused economy. To secure a good paying job as a stevedore or a trucker or a railroad worker typically does not require higher education in the form of a completed college or graduate degree. Thus, the Port's expansion provides an excellent source of employment for those populations frequently facing the lack of sustained employment and falling into poverty

The North Carolina State Ports Authority has for many years maintained a policy of equal opportunity hiring from the local population and, along with that, a policy of training and promoting from within on the basis on merit. Current demographics of the Port of Wilmington labor force demonstrate that commitment.

Table 4 Port of Wilmington Demographics

Project Title	Year	Percent
Asian (Non-Hispanic/Latino)	1	1%
Black or African American	32	18%
Hispanic/Latino	6	3%
Two or More Races (Non-Hispanic/Latino)	1	1%
White (Non-Hispanic/Latino)	138	78%
TOTAL	178	

METHODOLOGY FOR COMPUTING QUANTITATIVE BENEFITS

We are measuring the public and competitive benefits of diverting containers from road to rail.

Specifically, among quantitative inputs needed to create benefit estimates for environmental quality of life, sustainability, safety, and competitiveness/consumer benefit are:

- ***Reduced truck haulage versus increased rail haulage expressed as:***
  - ***Miles traveled, tons hauled, ton-miles hauled, etc.***
- ***Environmental and quality of life characteristics including:***
  - ***Gallons of fuel consumed, and contaminants produced, hours driven, congestion and safety effects, etc.***
- ***Competitiveness:***
  - ***Reduced transport cost per mile, transit time, inventory carrying cost, etc.***

How did we derive transport effects for this investment?

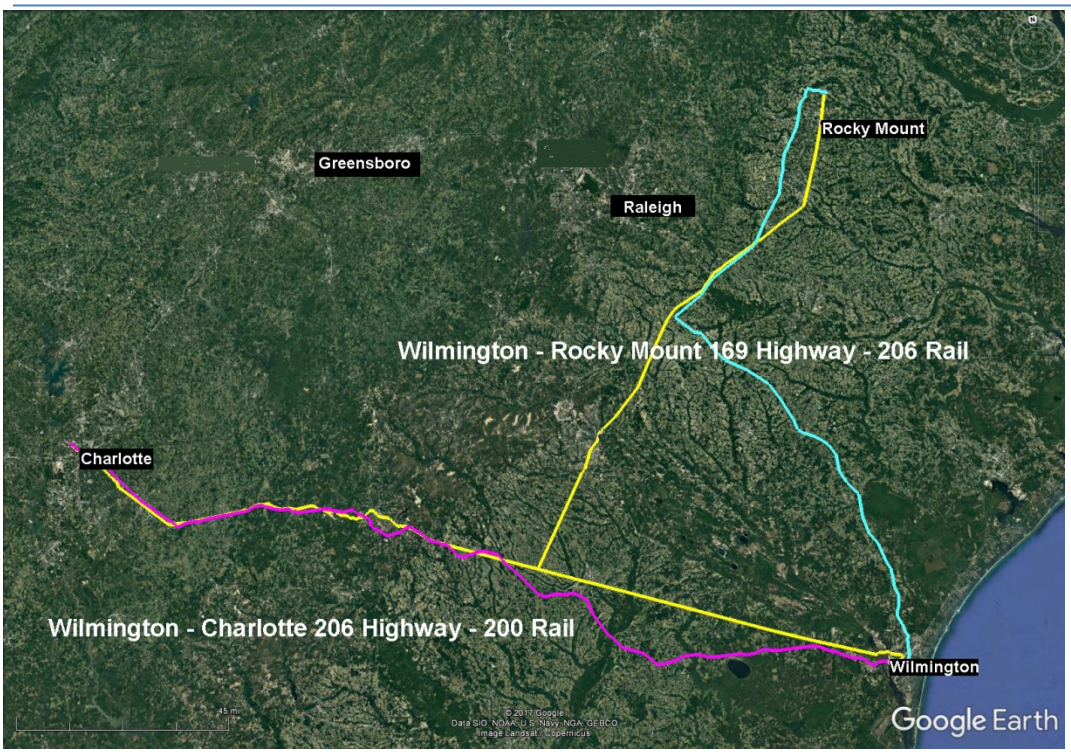
The diversion is defined as a loaded or empty container diverted onto rail, first with the Queen City Express (QCE), and then a broader variety of rail paths via the CSXT rail system. Analysis done for the Port using PIERS[9] data indicates the greater Charlotte intermodal market, comprised of cities and towns in western North Carolina including far western Asheville and central towns like Salisbury, Lexington, and the western Triad region[10] is approximately 300,000 FEUs[11] import and export containers coming through Southeast ports ranging from Norfolk on the north to Savannah on the south.

QCE's available import-export marketplace, excluding some of the eastern Triad, was around 220,000 containers. We judged that 10-15% or 20,000+ containers was readily accessed by QCE trains for substitution for trucks. This figure is reached near the end of the projection period according to the projections and assumed ultimate rail share of movements. (See Table 1).

Referring to Figure 6 Map of Proposed Routes, the remaining growth of Wilmington containers handled by rail was assigned to other paths via CSXT railroad system using the recently completed CCX intermodal terminal located near Rocky Mount, NC. Looking at the dispersion of possible lanes and end points for CCX, prior studies[12] theorized that a 60% component of CCX's throughput would come mainly from eastern and central North Carolina including the Raleigh and Greensboro MSAs[13] and the balance 40% of "pass-through" traffic would arrive from elsewhere and change trains, which is the means proposed here.

Figure 2: Map of Proposed Routes

[9] PIERS is the leading provider of import and export data at the detailed, bill-of-lading level.
[10] The Triad Region of North Carolina refers to the three neighboring cities of Winston Salem, Greensboro and High Point.
[11] Twenty-Foot Equivalent units and Forty-Foot Equivalent Units are standard measures; FEUs being equivalent to one typical 40-foot-long marine container,
[12] E.g. *Evaluation of Proposed Eastern Carolina Intermodal Terminal (CCX)*, WSP Parsons Brinkerhoff, July 2016.
[13] Metropolitan Statistical Areas include surrounding areas. At the time of the referenced study the Raleigh MSA included the entire Research Triangle, Raleigh, Durham, and Chapel Hill.



Since, for our purposes, CCX is a concentration point, the relationship to highway transport can be defined by making the conservative, simplifying assumption that all subsequent movements via CCX are by rail and, therefore, from our perspective, benefits are defined by the truck dray **versus** all rail movements between CCX and the Port. An illustration may be helpful to illustrate this point.

Assume a container arrives by ship at Wilmington destined for Toledo, OH. Assuming there were no CCX, it would be placed on a truck and driven to Toledo. Assuming further there were CCX, but no CCX rail connection to the Port, it would be driven to CCX at Rocky Mount and placed on a train for New Baltimore, OH, detrained there and drayed approximately 40 miles to Toledo.

Addition of an all-rail CSXT service from Wilmington via CCX allows that container to be placed on the train at the Port, thereby eliminating the truck transport from Wilmington to CCX at Rocky Mount. All other aspects of the journey whether by truck or train remain the same. The following diagram illustrates the point.

Truck ---------
Train ++++++
WLM ----------Toledo
WLM ----------RMT/CCX++++++++++++++++++++++++++++NBalto.----------Toledo
WLM+++++++++RMT/CCX++++++++++++++++++++++++++++NBalto.----------Toledo

BENEFIT COST ANALYSIS

A quantitative benefit-cost analysis (BCA) was performed using available information about current truck drayage practices and current and proposed train operations, USDOT guidance, and supported by documentable costs and industry research data.

This BCA is not a comprehensive measure of the project's total potential economic impact as many likely regional benefits related to increased competitiveness of North Carolina firms and products and their employment and multiplier effects are not used in this type of analysis[14].

Identifiable future years' costs and benefits have been projected, in constant dollars, for a period extending 20 years beyond construction. Per federal guidance, the monetized value of these quantified future benefits and costs are discounted to Present Value at a discount rate of 7%.

Table 5 Benefit Cost Summary

Benefit or Cost Category	
Tot. Capital Cost including Match @ 7% NPV	$18,184,207
Quantified Benefits @ 7% NPV:	
Accident Reduction	$6,606,246
Non-Carbon Emissions Reduction	$3,075,711
Fuel Cost Savings	$8,235,014
Social Cost of Carbon @ 3%	5,296,877
Additional Savings:	
Road Wear Savings	$5,589,267
Reduced Highway Congestion	$26,183,412
Consumer Transport Cost Reduction	$40,389,306
Increased Inventory Holding Cost	$(8,834,992)
Total Quantified Benefits	$86,540,843
Benefit Cost Ratio (BCR)	4.8

Figures are presented in constant 2020 dollars.

PROJECT BENEFITS

Quantified project benefits are estimated through 2044, 20 years after the project is fully functioning. Benefits are projected using constant, 2020 dollars discounted at 7%, with the exception of carbon emissions damage, which, per federal guidelines, are discounted at 3%.

Abbreviated summaries of analysis methods and benefits are presented below. The BCA spreadsheet is provided in the Appendix.

a. Accident Reduction

Safety benefits are calculated based on estimated number of accidents that will be eliminated or avoided as a result of the Project. The accident data used for the analysis are based on experienced

[14] Ibid. Footnote 5.

rates for North Carolina highways as found in *North Carolina 2020 Crash Facts* published by the North Carolina Division of Motor Vehicles[15]. First, avoided social costs of diverting trucks from North Carolina highways were calculated, an undiscounted sample of which is shown below.

Table 6 Accident Savings (partial capture)

Year	Operational Year #	Truck 100MVMT Avoided	People Killed	People Injured	PDO	Killed Cost	Injured Cost	PDO Cost	Truck Cost Avoided
			1.21	106.99	166.06	$ 12,837,400	$ 302,600	$ 4,600	
			100MVMT	100MVMT	100MVMT	Per Accident	Per Accident	Per Accident	
						$10 MM/Death	$136,806/Inj.		
2025	1	(0.0076)	(0.01)	(0.82)	(1.27)	$ (108,882)	$ (171,779)	$ (5,836)	$ (286,498)
2026	2	(0.0157)	(0.02)	(1.68)	(2.61)	$ (223,930)	$ (353,286)	$ (12,003)	$ (589,218)
2027	3	(0.0179)	(0.02)	(1.92)	(2.97)	$ (255,238)	$ (402,679)	$ (13,681)	$ (671,599)
2028	4	(0.0283)	(0.03)	(3.02)	(4.69)	$ (402,836)	$ (635,539)	$ (21,593)	$ (1,059,968)
2029	5	(0.0298)	(0.04)	(3.19)	(4.95)	$ (424,992)	$ (670,494)	$ (22,780)	$ (1,118,267)
2030	6	(0.0315)	(0.04)	(3.37)	(5.22)	$ (448,367)	$ (707,371)	$ (24,033)	$ (1,179,771)

Next, the costs of rail accidents were calculated and used to reduce the truck calculated benefits to a net sum. The KABCO-scaled data for 2018 were evaluated and quantified using BCA guidance for valuation of accident costs and are then converted to an annual monetized benefit[16].

Table 7 Rail Accident Costs (partial capture – Net Decrease refers to sum of above table and this one.)

MM Train-Miles Added	Killed	Injured	Killed Cost	Injured Cost	Total Incremental Rail Cost	Net Decrease
	0.0040	0.0712	$ 12,837,400	$ 302,600		
	Per MM T-M	Per MM T-M				
0.043	0.0002	0.00	$ 1,996	$ 641	$ 2,637	$ (283,861)
6.192	0.0245	0.44	$ 288,591	$ 92,685	$ 381,277	$ (207,942)
6.532	0.0259	0.47	$ 304,464	$ 97,783	$ 402,247	$ (269,352)
6.891	0.0273	0.49	$ 321,209	$ 103,161	$ 424,371	$ (635,598)
7.270	0.0288	0.52	$ 338,876	$ 108,835	$ 447,711	$ (670,556)
7.670	0.0304	0.55	$ 357,514	$ 114,821	$ 472,335	$ (707,436)

b. Fuel Consumption and Emissions Reduction

Fuel consumption drives both fuel saving and emissions effects to the extent that truck traffic is diverted to rail, which is more fuel efficient. Here we have used rail's fuel efficiency as reported by the Association of American Railroads expressed as ton-miles of cargo hauled per gallon of fuel as 470 ton-miles per gallon[17]. This is contrasted with the same calculations for a heavy-duty diesel truck which moves 120 ton-miles per gallon of diesel.

[15] See: https://connect.ncdot.gov/business/DMV/CrashFactsDocuments/2020%20Crash%20Facts.pdf
[16] Assumes Fatal is KABCO "K," Injury is KABCO "U."

[17] https://www.aar.org/wp-content/uploads/2018/07/AAR-Environmental-Benefits-Movig-Freight-by-Rail.pdf

As with other diversion calculations, the savings resulting for decreased truck traffic is offset to the appropriate degree by increased fuel consumption by the railroad. Fuel cost savings are based on prices of $3.73 per gallon[18] for mid-grade diesel for both truck and rail modes operating in in North Carolina. A sample of undiscounted calculations is shown below.

Table 8 Fuel Savings Calculation (partial capture undiscounted)

Year	Reduced Truck Consumption	Value: Reduced Truck Consumption	Increased Rail Consumption	Value: Increased Rail Consumption	Fuel Savings
	Gallons	$ 3.73	Gallons	$ 3.73	
2025	(123,234)	$ (459,662)	70,036	$ 261,233	$ (198,429)
2026	(253,445)	$ (945,352)	144,037	$ 537,259	$ (408,093)
2027	(288,880)	$ (1,077,524)	164,175	$ 612,374	$ (465,150)
2028	(455,933)	$ (1,700,630)	259,114	$ 966,496	$ (734,135)
2029	(481,009)	$ (1,794,165)	273,365	$ 1,019,653	$ (774,512)
2030	(507,465)	$ (1,892,844)	288,401	$ 1,075,734	$ (817,110)

Emissions reductions are estimated for carbon and for non-carbon emissions. For the purposes of calculating fuel consumption and emissions benefits, heavy-duty combination (tractor trailer) trucks are assumed.

- Annual travel time savings for trucks is calculated based on the assumption one container is driven to Charlotte or CCX from Wilmington (or returned) in 4 hours 15 minutes each way and 3 hours to Rocky Mount, respectively. Conservatively, no "dead-head" or empty movements are assumed. Train movements are much longer in time elapsed, although only 7 hours and 45 minutes represent time spent under way on the mainline. Moreover, the train is assumed to be hauling many containers at the same time so that the operating hours attributed to one container are fractional.
- Carbon emissions are estimated based on estimated reduction of fuel consumption using an assumed 1.6 KG of CO_2 per mile for heavy trucks.
- Unit costs for the Social Cost of Carbon (SCC) as presented in the 2021 BCA Resource Guide are applied to calculate carbon-based emissions avoided.[19]
- Non-carbon emission quantities were estimated based on EPA guidance. The appropriate unit price for each type of emission was sourced from recent BTS[20] data or from an earlier study for the Federal Motor Carrier Administration.[21] Offsetting this, increased rail locomotive emissions were based on that study's projection of grams of pollutants per horsepower hour per gallon of fuel.

[18] https://www.dat.com/industry-trends/trendlines/van/national-rates February price of diesel minus $0.36 NC fuel tax.
[19] Social Cost of Carbon has been discounted at the private 7% rate and the public rate of 3%, which has been used here.
[20] https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and
[21] *Final Environmental Assessment for the 2011 Final Hours-of-Service (HOS) of Drivers Rule, Appendix A – Analysis of Air Quality Impacts*. USDOT, Federal Motor Carrier Safety Administration.

- Unit costs of non-carbon emissions were derived from Table A-6 of USDOT's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs."
- Coefficients are shown in the following table for locomotives and trucks. Since the rail fuel consumption is derived from ton-miles and the truck from miles, the co-efficient values are adjusted for rail's approximately 470 to 120 ton-miles per gallon advantage.

Table 9 Table of Authorities for Emissions for Truck & Rail

Factors Applied to Emissions Analysis			
Pollutant	**Mode**	**Units**	**Rate**
CO_2	Rail	grams/gallon	10,084
CO_2	Truck	grams/mile	1,647
NOx	Rail	grams/gallon	99
NOx	Truck	grams/mile	4.58
$PM_{2.5}$	Rail	grams/gallon	2.23
$PM_{2.5}$	Truck	grams/mile	0.139
SO_2	Rail	grams/gallon	0.094
SO_2	Truck	grams/mile	0.0053

Table 10 reflects an estimated annual reduction of fuel use ranging from 123,000 gallons in 2025 to 1,124,000 gallons per year in 2040 when fully implemented. Total forecasted fuel savings and emissions reductions are summarized in the table below.

Table 10 Summary of Fuel Savings and Emissions Reduction

	Fuel consumption (gallons)	Carbon tons	NOx tons	*PM* tons	*SOX tons*
Total savings over 20 years	**16,540,545**	**104,721**	**255.4**	4.0	**.228**
Average annual savings	**827,0275**	**5,236**	**4.3**	0.03	**.011**
Average Annual Value of Fuel Consumption / Emissions Savings	**$1,396,8122**	**$353,390**	**$89,740**	**$276,361**	**$540**

c. Road Wear Savings

Trucks impart significantly more wear on highway pavement and bridges than do autos. When truck traffic is shifted to rail this wear is eliminated and counted as a public benefit. Railroad rights of way are predominantly privately owned and maintained. The *Federal Highway Administration's Addendum to the*

1997 Federal Highway Cost Allocation Study Final Report published in May 2000 and its comprehensive study of highway costs resulted in the following indicia which have been updated to 2023 cost equivalents for use here in calculating Road Wear Savings and Reduced Highway Congestion costs:

> *Costs to public agencies (added use-related rehabilitation and maintenance costs), and external costs such as air pollution and congestion costs imposed on others. Many marginal costs vary by either location of travel or time-of-day. For instance, incremental pavement deterioration associated with an extra mile of travel by particular vehicle classes depends on the design and condition of the pavement upon which they travel, temperature, and other local characteristics. Congestion costs associated with an additional mile of travel on low-volume rural Interstate highways are negligible, but costs on urban Interstate highways may be high, particularly during peak periods when traffic volumes are greatest. The relative costs of pavement damage, congestion, crashes, air pollution, and noise for different vehicle classes operating in rural and urban areas are as important as the individual costs themselves.*[22]

For the journeys from Wilmington to Charlotte and Wilmington to Rocky Mount trips were assumed to be made throughout daylight travel hours using 60-kip, five-axle vehicles operating over 90% rural and 10% urban interstate infrastructure.

Table 11 Costs Authorities Used for North Carolina Road Wear

North Carolina Highway Cost Allocation and Revenue Attribution Study		
https://connect.ncdot.gov/projects/research/RNAProjDocs/RP2019-14%20-%20Full%20Final%20Report.pdf		
From Table 4.14: Unit cost ($/VMT) for five-axle tractor/semitrailer for pavement rehabilitation projects 2014-2017.		
Value =	$	0.189
Inflation to 2020		1.06
2020 Value	$	0.20

[22] Addendum to the 1997 Federal Highway Cost Allocation Study Final Report, FHWA May, 2000. https://www.fhwa.dot.gov/policy/hcas/addendum.cfm

d. Roadway Congestion Savings

Table 12 Congestion Savings Authorities

Congestion Savings=====>		$0.93	Per Guidance, Table A-5/	
Alternative computation:				
Lease/Purchase	$ 0.21			
Driver Pay	$ 0.44			
Driver Benefits	$ 0.13			
Driver Bonus	$ 0.04	Values for 2008.		
Total	$ 0.81			
Inflation to 201	1.17			
2019 Equivalen	$ 0.95			
https://truckingresearch.org/research/results/ATRITRBOpCosts.pdf				

Road congestion costs were calculated in the same way that pavement degradation costs were calculated using the per mile congestion costs from the table above attributed to 60-kip, five-axle combination (tractor trailer) vehicles again assuming 90% rural and 10% urban interstate travel.

e. Competitiveness Benefits (Net Transport Cost Reduction)

It is generally conceded that rail is more economical for the shipper than truck transport if rail can be employed for the same purposes. In this case the Queen City Express and CCX service is expressly designed to provide a truck-competitive service. In order to calculate the beneficial competitive effects for shippers and end users we used the dry van rate of $2.94 per mile charged by Southeastern U.S. truckers[23]. The Journal of Commerce Intermodal Savings Index[24] for Q4 2021 indicates a 36% cost savings for 12 months rail intermodal contract rates versus truck rates. Applying this savings percentage to truck moves converted to rail indicates savings benefits ranging from $1.1 million in 2025 to $10.1 million in 2040 when fully implemented.

Table 13 Consumer Savings Authorities

Dry van rate for SE US:					
Source:	Typical contract rate plus fuel surcharge (Rail)				$1.53
	Truck: DAT Data Services dry van rate for SE US, average per mile, as of mid-Feb., 2022.				$2.98
	Intermodal savings per mile.			Difference	$1.45

f. Offsetting Inventory Carrying Costs

Slower speeds by rail hence added inventory carrying costs partially offset the beneficial shipper effects of rail. To reflect that offset, the carrying cost of inventory in a container was estimated based on work done by the FHWA in 1995 concerning the inventory costs for contents of five-axle combination (tractor trailer) trucks. We assumed the contents of a container today would approximate the contents of a dry freight van trailer. Based on earlier work, and themselves inflating that to 1995 dollars, the FHWA

[23] https://www.dat.com/industry-trends/trendlines/van/national-rates.
[24] Microsoft Word - 1Q2022 JOC ISI Report.docx (sunsettrans.com)

estimated that value at $50,000. Bringing that value forward, and estimating an hourly interest rate to finance inventory, yields an updated carrying cost of 92.6 cents per hour. That financing cost is applied to the estimated differential times between truck and rail for availability in Charlotte or CCX – 67 hours loading to availability for rail versus 4 hours 45 minutes and three hours respectively for truck. While the conceptualized rail trip to Toledo, OH might be similar in time, the truck trip would be multiples longer, so it seems conservative to recognize the carrying cost the same way. The table below summarizes in undiscounted constant dollars the additional benefits discussed above.

Table 14 Summary of Additional Benefits

	Road Wear Savings $'s	Congestion Savings $'s	Consumer Transport Benefits $'s	Inventory Carrying Costs $'s	Net Consumer Col 3-4 Benefits
Total savings over 20 years	**17,950,913**	**84,092,626**	**129,717,348**	**-28,884,005**	**100,833,343**
Average annual savings	**897,546**	**4,204,631**	**6,485,867**	**-1,444,200**	**5,041,667**

PROJECT INVESTMENT COSTS

Project costs are arrayed in Table 9 below to show the major project elements, sequence, and costs.

The project is included in NC State Ports Authority plans, demonstrating strong collaboration among a broad range of stakeholders, and is the product of a robust, inclusive planning process.[25].

The BCA assumes the project will be executed during 2022 to 2024, while maintaining present rail operational continuity, and will be complete and full benefits will accrue beginning in 2025.

Operations & Maintenance Costs:

The project is not expected to generate any material incremental operations and maintenance costs per se that are not already associated with present operations. In yard service, as contemplated here, rail tracks have very long service lives, more than 20 years, and require only incidental maintenance. Similarly, operational costs for periodic pavement repairs and those associated with stacking and lifting the containers onto railcars will not differ materially from truck-oriented costs, nor do the clerical and administrative costs differ.

[25] The project is not included in the STIP (the port rail is operated by a short line which are not eligible to participate in the STIP), but references to the need for improved Port intermodal capabilities are included in NCDOT statewide plans including the recent North Carolina Statewide Multimodal Freight Plan https://connect.ncdot.gov/projects/planning/Statewide-Freight-Plan/Documents/NCDOT_SWFrtPln_FinalReport_180209.pdf, and the North Carolina Department of Transportation 2040Plan https://www.ncdot.gov/initiatives-policies/Transportation/plan/Documents/NCDOT_2040TransportationPlan.pdf.

Table 15 Summary of Proposed Investments (undiscounted)

Table 4. Costs

Activity		Cost Per Unit	Quanity	TOTAL	Federal Share	Federal %	Port Share	Port %
Removal of Existing Rail Tracks, Container Track 1 (tail only)	lin.ft.	1,000	50	$50,000	$40,000	80%	$10,000.00	20%
Container Stacking Yard Lighting (masts, luminaries, conduit, foundations)	Ea	150,000	5	$750,000	$600,000	80%	$150,000.00	20%
Line/corner Marking and Signage	Ea	50,000	1	$50,000	$40,000	80%	$10,000.00	20%
Roadway jersey barriers	Ea	1,500	120	$180,000	$144,000	80%	$36,000.00	20%
5,000 feet of working track on 4 sidings (1250 each), transfer areas both the east and west side of the intermodal yard	lin.ft.	6,000	500	$3,000,000	$2,400,000	80%	$600,000.00	20%
Paving Intermodal area	acre	1,100,000	9.7	$10,670,000	$8,536,000	80%	$2,134,000.00	20%
Technology system enhancement (OCR, RFID, connectivity, etc.)	Ea	1,000,000	1.0	$1,000,000	$800,000	80%	$200,000.00	20%
Improved paving for future RMG	lin.ft.	750	500	$375,000	$300,000	80%	$75,000.00	20%
Secondary inspection area	Ea	350,000	1	$350,000	$280,000	80%	$70,000.00	20%
SUBTOTAL				*$16,425,000*	*$13,140,000*	80%	*$3,285,000*	20%
Reach stackers	Ea	1,500,000	3	$4,500,000	$3,600,000	80%	$900,000.00	20%
Contingency				$1,642,500	$1,314,000	80%	$328,500.00	20%
TOTAL				***$22,567,500***	***$18,054,000***	***80%***	***$4,513,500***	***20%***

1. BCA SPREADSHEET

Summary of Benefits & Costs

Summary Discounted										
13	14	15	16	17	18	19	20	21	22	23
	7% discounted Value of User Benefits in Base Year (2020) Dollars									
7% Discount Factor to 2020	Road Wear Savings	Consumer Cost Savings	Congestion Savings	Inventory Carrying Cost	Fuel Cost Savings	Social Cost of Carbon Savings	Non-Carbon Emission Savings	Accident Savings	3% Discount Factor to 2020	Social Cost of Carbon Savings @3%
0.86									0.94	$ -
0.80									0.91	$ -
0.75									0.89	$ -
0.70	$ 106,658	$ 770,733	$ 499,648	$ (184,763)	$ 138,044	$ 41,982	$ 47,626	$ 197,479	0.86	$ 51,821
0.65	$ 204,000	$ 1,474,151	$ 955,656	$ (353,979)	$ 264,032	$ 81,730	$ 91,904	$ 134,536	0.83	$ 105,224
0.60	$ 216,245	$ 1,562,638	$ 1,013,021	$ (375,227)	$ 279,881	$ 88,156	$ 100,110	$ 162,069	0.81	$ 118,379
0.56	$ 317,404	$ 2,293,635	$ 1,486,909	$ (394,120)	$ 410,808	$ 131,626	$ 150,929	$ 355,669	0.78	$ 184,354
0.52	$ 311,421	$ 2,250,400	$ 1,458,880	$ (410,840)	$ 403,065	$ 131,334	$ 152,023	$ 348,965	0.76	$ 191,856
0.48	$ 305,551	$ 2,207,980	$ 1,431,380	$ (425,553)	$ 395,467	$ 131,006	$ 153,746	$ 342,387	0.74	$ 199,608
0.45	$ 299,791	$ 2,166,360	$ 1,404,399	$ (438,418)	$ 388,012	$ 130,644	$ 150,848	$ 335,933	0.72	$ 207,618
0.42	$ 294,140	$ 2,125,524	$ 1,377,926	$ (449,577)	$ 380,698	$ 130,248	$ 148,004	$ 329,600	0.69	$ 215,893
0.39	$ 288,596	$ 2,085,458	$ 1,351,952	$ (459,167)	$ 373,522	$ 129,822	$ 145,214	$ 323,387	0.67	$ 224,441
0.36	$ 283,156	$ 2,046,147	$ 1,326,468	$ (467,312)	$ 366,481	$ 131,355	$ 142,477	$ 317,291	0.65	$ 236,859
0.34	$ 277,818	$ 2,007,577	$ 1,301,464	$ (474,126)	$ 359,573	$ 130,832	$ 139,791	$ 311,311	0.63	$ 246,062
0.31	$ 282,048	$ 2,038,145	$ 1,321,280	$ (479,719)	$ 381,179	$ 135,565	$ 146,769	$ 323,134	0.61	$ 265,930
0.29	$ 295,717	$ 2,136,918	$ 1,385,312	$ (484,190)	$ 430,915	$ 145,716	$ 163,280	$ 352,520	0.60	$ 298,138
0.27	$ 307,799	$ 2,224,225	$ 1,441,911	$ (487,630)	$ 475,730	$ 155,185	$ 178,131	$ 378,870	0.58	$ 331,167
0.25	$ 318,417	$ 2,300,955	$ 1,491,653	$ (490,125)	$ 515,993	$ 164,002	$ 191,446	$ 402,413	0.56	$ 365,037
0.23	$ 327,532	$ 2,366,818	$ 1,534,351	$ (491,756)	$ 551,797	$ 172,120	$ 203,249	$ 423,167	0.54	$ 399,583
0.22	$ 310,797	$ 2,245,888	$ 1,455,955	$ (492,595)	$ 543,003	$ 166,573	$ 198,696	$ 410,064	0.53	$ 403,339
0.20	$ 295,117	$ 2,132,581	$ 1,382,500	$ (492,710)	$ 534,263	$ 163,470	$ 194,280	$ 397,567	0.51	$ 412,850
0.19	$ 280,420	$ 2,026,377	$ 1,313,651	$ (492,165)	$ 525,582	$ 158,342	$ 190,711	$ 385,639	0.50	$ 417,099
0.18	$ 266,639	$ 1,926,795	$ 1,249,095	$ (491,019)	$ 516,968	$ 153,459	$ 186,475	$ 374,246	0.48	$ 421,621
	$ 5,589,267	$ 40,389,306	$ 26,183,412	$ (8,834,992)	$ 8,235,014	$ 2,673,167	$ 3,075,711	$ 6,606,246		$ 5,296,877
			Total Discounted Benefits @7% (Except for Carbon@3%)							$ 86,540,843
			Benefit-Cost Ratio							4.8

Summary of Benefits & Costs continued

Summary/BCA Matrix

1	2	3	4	5	6	7	8	9	10	11	12
		Undiscounted Project Costs	Discounted Project Costs	Undiscounted Value of User Benefits in Base Year Dollars							
Project Year	Calendar Year	Site Work/Track Work	To 2019, @7%	Road Wear Savings	Consumer Cost Savings	Congestion Savings	Inventory Carrying Cost	Fuel Cost Savings	Social Cost of Carbon Savings	Non-Carbon Emission Savings	Accident Savings
0	2022	7,522,500	6,506,210								
1	2023	7,522,500	6,050,776								
2	2024	7,522,500	5,627,221								
3	2025			$ 153,313	$ 1,107,871	$ 718,206	$ (265,583)	$ 198,429	$ 60,345	$ 68,458	$ 283,861
4	2026			$ 315,306	$ 2,278,475	$ 1,477,080	$ (547,117)	$ 408,093	$ 126,324	$ 142,049	$ 207,942
5	2027			$ 359,390	$ 2,597,035	$ 1,683,595	$ (623,611)	$ 465,150	$ 146,512	$ 166,378	$ 269,352
6	2028			$ 567,217	$ 4,098,839	$ 2,657,178	$ (704,312)	$ 734,135	$ 235,222	$ 269,718	$ 635,598
7	2029			$ 598,414	$ 4,324,275	$ 2,803,323	$ (789,452)	$ 774,512	$ 252,366	$ 292,122	$ 670,556
8	2030			$ 631,327	$ 4,562,110	$ 2,957,506	$ (879,274)	$ 817,110	$ 270,683	$ 317,668	$ 707,436
9	2031			$ 666,050	$ 4,813,026	$ 3,120,168	$ (974,037)	$ 862,051	$ 290,252	$ 335,140	$ 746,345
10	2032			$ 702,682	$ 5,077,742	$ 3,291,778	$ (1,074,012)	$ 909,464	$ 311,155	$ 353,573	$ 787,394
11	2033			$ 741,330	$ 5,357,018	$ 3,472,826	$ (1,179,485)	$ 959,485	$ 333,479	$ 373,019	$ 830,701
12	2034			$ 782,103	$ 5,651,654	$ 3,663,831	$ (1,290,759)	$ 1,012,256	$ 362,815	$ 393,535	$ 876,389
13	2035			$ 825,119	$ 5,962,495	$ 3,865,342	$ (1,408,154)	$ 1,067,930	$ 388,570	$ 415,180	$ 924,591
14	2036			$ 900,734	$ 6,508,906	$ 4,219,567	$ (1,532,005)	$ 1,217,312	$ 432,932	$ 468,714	$ 1,031,941
15	2037			$ 1,015,468	$ 7,337,999	$ 4,757,048	$ (1,662,667)	$ 1,479,728	$ 500,377	$ 560,691	$ 1,210,526
16	2038			$ 1,136,512	$ 8,212,693	$ 5,324,091	$ (1,800,517)	$ 1,756,577	$ 573,001	$ 657,727	$ 1,398,934
17	2039			$ 1,264,214	$ 9,135,495	$ 5,922,321	$ (1,945,948)	$ 2,048,652	$ 651,140	$ 760,100	$ 1,597,703
18	2040			$ 1,398,280	$ 10,104,290	$ 6,550,367	$ (2,099,377)	$ 2,355,701	$ 734,805	$ 867,701	$ 1,806,563
19	2041			$ 1,426,707	$ 10,309,705	$ 6,683,533	$ (2,261,246)	$ 2,492,644	$ 764,651	$ 912,112	$ 1,882,391
20	2042			$ 1,456,696	$ 10,526,417	$ 6,824,022	$ (2,432,017)	$ 2,637,120	$ 806,889	$ 958,966	$ 1,962,390
21	2043			$ 1,488,336	$ 10,755,049	$ 6,972,238	$ (2,612,180)	$ 2,789,541	$ 840,406	$ 1,012,205	$ 2,046,788
22	2044			$ 1,521,715	$ 10,996,255	$ 7,128,607	$ (2,802,253)	$ 2,950,346	$ 875,791	$ 1,064,216	$ 2,135,829
Total		22,567,500	18,184,207	$ 17,950,913	$ 129,717,348	$ 84,092,626	$ (28,884,005)	$ 27,936,235	$ 8,957,716	$ 10,389,273	$ 22,013,229
				Total Undiscounted Benefits							$ 272,173,334

Input Values

Based on increment between "No Build" and "Build" scenarios.

	Truck-Miles Diverted	Reduced Truck Hours	Containers Diverted to Rail		Increased Rail RTM (MM)	Truck-Miles Avoided	Train-Miles Added (MM)	Truck Fuel Avoided (Gallons)	Rail Fuel Added (Gallons)
			Charlotte	CCX					
2025	(764,049)	(13,563)	2,030	2,491	85.6	(764,049)	0.043	(123,234)	70,036
2026	(1,571,362)	(27,894)	3,386	5,912	123.8	(1,571,362)	0.062	(253,445)	144,037
2027	(1,791,059)	(31,794)	3,860	6,738	130.6	(1,791,059)	0.065	(288,880)	164,175
2028	(2,826,785)	(50,180)	4,359	7,610	137.8	(2,826,785)	0.069	(455,933)	259,114
2029	(2,982,258)	(52,939)	4,886	8,530	145.4	(2,982,258)	0.073	(481,009)	273,365
2030	(3,146,283)	(55,851)	5,442	9,501	153.4	(3,146,283)	0.077	(507,465)	288,401
2031	(3,319,328)	(58,923)	6,029	10,525	161.8	(3,319,328)	0.081	(535,376)	304,263
2032	(3,501,891)	(62,164)	6,647	11,605	170.7	(3,501,891)	0.085	(564,821)	320,997
2033	(3,694,495)	(65,583)	7,300	12,745	180.1	(3,694,495)	0.090	(595,886)	338,652
2034	(3,897,692)	(69,190)	7,989	13,947	190.0	(3,897,692)	0.095	(628,660)	357,278
2035	(4,112,066)	(72,995)	8,715	15,216	200.5	(4,112,066)	0.100	(663,236)	376,928
2036	(4,488,901)	(78,564)	9,482	16,554	211.5	(4,488,901)	0.106	(724,016)	397,659
2037	(5,060,689)	(86,237)	10,291	17,966	223.2	(5,060,689)	0.112	(816,240)	419,530
2038	(5,663,926)	(94,331)	11,144	19,455	235.4	(5,663,926)	0.118	(913,536)	442,604
2039	(6,300,341)	(102,871)	12,044	21,027	248.4	(6,300,341)	0.124	(1,016,184)	466,948
2040	(6,968,476)	(111,813)	12,994	22,684	261.9	(6,968,476)	0.131	(1,123,948)	492,392
2041	(7,110,141)	(109,626)	13,995	24,433	254.5	(7,110,141)	0.127	(1,146,797)	478,528
2042	(7,259,598)	(107,320)	15,052	26,279	246.8	(7,259,598)	0.123	(1,170,903)	463,900
2043	(7,417,275)	(104,886)	16,167	28,225	238.5	(7,417,275)	0.119	(1,196,335)	448,468
2044	(7,583,624)	(102,319)	17,344	30,279	229.9	(7,583,624)	0.115	(1,223,165)	432,188
Total		(1,459,044)	179,156	311,722	3,830	(89,460,240)	2	(14,429,071)	6,939,464
Avg. Annual		(72,952)	8,958	15,586	192	(4,473,012)	0	(721,454)	346,973

Input Values Continued …

			Road Wear (8)	Economic Competitiveness (9)	Congestion (10)	Inventory Carrying Cost			
Year	Operational Year #	Truck-Miles Diverted	Road Wear Savings	Customer Cost Savings	Congestion Savings	Containers Diverted to Rail		Cost	Net Savings
			.20/truck-mile 1/	1.45/truck-mile saved 2/	.94/truck-mile saved 3/	Charlotte	CCX	.926/hour	
2025	1	(764,049)	$ (153,313)	$ (1,107,871)	$ (718,206)	2,030	2,491	$ (265,583)	
2026	2	(1,571,362)	$ (315,306)	$ (2,278,475)	$ (1,477,080)	3,386	5,912	$ (547,117)	
2027	3	(1,791,059)	$ (359,390)	$ (2,597,035)	$ (1,683,595)	3,860	6,738	$ (623,611)	
2028	4	(2,826,785)	$ (567,217)	$ (4,098,839)	$ (2,657,178)	4,359	7,610	$ (704,312)	
2029	5	(2,982,258)	$ (598,414)	$ (4,324,275)	$ (2,803,323)	4,886	8,530	$ (789,452)	
2030	6	(3,146,283)	$ (631,327)	$ (4,562,110)	$ (2,957,506)	5,442	9,501	$ (879,274)	
2031	7	(3,319,328)	$ (666,050)	$ (4,813,026)	$ (3,120,168)	6,029	10,525	$ (974,037)	
2032	8	(3,501,891)	$ (702,682)	$ (5,077,742)	$ (3,291,778)	6,647	11,605	$ (1,074,012)	
2033	9	(3,694,495)	$ (741,330)	$ (5,357,018)	$ (3,472,826)	7,300	12,745	$ (1,179,485)	
2034	10	(3,897,692)	$ (782,103)	$ (5,651,654)	$ (3,663,831)	7,989	13,947	$ (1,290,759)	
2035	11	(4,112,066)	$ (825,119)	$ (5,962,495)	$ (3,865,342)	8,715	15,216	$ (1,408,154)	
2036	12	(4,488,901)	$ (900,734)	$ (6,508,906)	$ (4,219,567)	9,482	16,554	$ (1,532,005)	
2037	13	(5,060,689)	$ (1,015,468)	$ (7,337,999)	$ (4,757,048)	10,291	17,966	$ (1,662,667)	
2038	14	(5,663,926)	$ (1,136,512)	$ (8,212,693)	$ (5,324,091)	11,144	19,455	$ (1,800,517)	
2039	15	(6,300,341)	$ (1,264,214)	$ (9,135,495)	$ (5,922,321)	12,044	21,027	$ (1,945,948)	
2040	16	(6,968,476)	$ (1,398,280)	$ (10,104,290)	$ (6,550,367)	12,994	22,684	$ (2,099,377)	
2041	17	(7,110,141)	$ (1,426,707)	$ (10,309,705)	$ (6,683,533)	13,995	24,433	$ (2,261,246)	
2042	18	(7,259,598)	$ (1,456,696)	$ (10,526,417)	$ (6,824,022)	15,052	26,279	$ (2,432,017)	
2043	19	(7,417,275)	$ (1,488,336)	$ (10,755,049)	$ (6,972,238)	16,167	28,225	$ (2,612,180)	
2044	20	(7,583,624)	$ (1,521,715)	$ (10,996,255)	$ (7,128,607)	17,344	30,279	$ (2,802,253)	
		Total	$ (17,950,913)	$ (129,717,348)	$ (84,092,626)			$ (28,884,005)	$ (100,833,343)
		Avg. Annual	$ (897,546)	$ (6,485,867)	$ (4,204,631)			$ (1,444,200)	$ (5,041,667)

Input Values Continued …

DECREASED EMISSIONS FROM TRUCKS						
Year	Operational Year #	Reduced Truck Hours	Fuel Use Savings (Trucks)	Carbon Emission Truck	Unit Cost for SCC by Year	Social Cost of Carbon
		hours	activity inputs	metric tons	per metric ton	
2025	1	(13,563)	(123,234)	(1,258)	$ 56	$ (70,460)
2026	2	(27,894)	(253,445)	(2,588)	$ 57	$ (147,498)
2027	3	(31,794)	(288,880)	(2,949)	$ 58	$ (171,069)
2028	4	(50,180)	(455,933)	(4,655)	$ 59	$ (274,650)
2029	5	(52,939)	(481,009)	(4,911)	$ 60	$ (294,666)
2030	6	(55,851)	(507,465)	(5,181)	$ 61	$ (316,054)
2031	7	(58,923)	(535,376)	(5,466)	$ 62	$ (338,903)
2032	8	(62,164)	(564,821)	(5,767)	$ 63	$ (363,310)
2033	9	(65,583)	(595,886)	(6,084)	$ 64	$ (389,376)
2034	10	(69,190)	(628,660)	(6,419)	$ 66	$ (423,629)
2035	11	(72,995)	(663,236)	(6,772)	$ 67	$ (453,700)
2036	12	(78,564)	(724,016)	(7,392)	$ 68	$ (502,670)
2037	13	(86,237)	(816,240)	(8,334)	$ 69	$ (575,033)
2038	14	(94,331)	(913,536)	(9,327)	$ 70	$ (652,905)
2039	15	(102,871)	(1,016,184)	(10,375)	$ 71	$ (736,642)
2040	16	(111,813)	(1,123,948)	(11,476)	$ 72	$ (826,236)
2041	17	(109,626)	(1,146,797)	(11,709)	$ 73	$ (854,742)
2042	18	(107,320)	(1,170,903)	(11,955)	$ 75	$ (896,619)
2043	19	(104,886)	(1,196,335)	(12,215)	$ 76	$ (928,308)
2044	20	(102,319)	(1,223,165)	(12,489)	$ 77	$ (961,616)
Total		(1,251,838)	(12,009,571)	(122,618)		$ (8,288,163)

DECREASED EMISSIONS FROM TRUCKS

NOx Reductions	Unit Cost of NOx by Year	Value of Nox Reductions	PM Reductions	Unit Cost of PM by Year	Value of PM Reductions	Sox Reductions	Unit Cost of Sox by Year	Value of Sox Reductions	Total Value: Non-Carbon Emissions Reductions
metric tons	per metric ton		metric tons	per metric ton		metric tons	per metric ton		
(3.5)	$ 16,500	$ (57,739)	(0.106)	$ 801,700	$ (85,143)	(0.004)	$ 44,900	$ (182)	$ (143,064)
(7.2)	$ 16,800	$ (120,907)	(0.218)	$ 814,500	$ (177,903)	(0.008)	$ 45,500	$ (379)	$ (299,188)
(8.2)	$ 17,100	$ (140,272)	(0.249)	$ 827,400	$ (205,987)	(0.009)	$ 46,200	$ (439)	$ (346,698)
(12.9)	$ 17,400	$ (225,272)	(0.393)	$ 840,600	$ (330,291)	(0.015)	$ 46,900	$ (703)	$ (556,266)
(13.7)	$ 17,700	$ (241,760)	(0.415)	$ 854,000	$ (354,012)	(0.016)	$ 47,600	$ (752)	$ (596,524)
(14.4)	$ 18,100	$ (260,821)	(0.437)	$ 867,600	$ (379,430)	(0.017)	$ 48,200	$ (804)	$ (641,055)
(15.2)	$ 18,100	$ (275,166)	(0.461)	$ 867,600	$ (400,299)	(0.018)	$ 48,200	$ (848)	$ (676,313)
(16.0)	$ 18,100	$ (290,300)	(0.487)	$ 867,600	$ (422,315)	(0.019)	$ 48,200	$ (895)	$ (713,510)
(16.9)	$ 18,100	$ (306,266)	(0.514)	$ 867,600	$ (445,543)	(0.020)	$ 48,200	$ (944)	$ (752,753)
(17.9)	$ 18,100	$ (323,111)	(0.542)	$ 867,600	$ (470,048)	(0.021)	$ 48,200	$ (996)	$ (794,154)
(18.8)	$ 18,100	$ (340,882)	(0.572)	$ 867,600	$ (495,900)	(0.022)	$ 48,200	$ (1,050)	$ (837,833)
(20.6)	$ 18,100	$ (372,121)	(0.624)	$ 867,600	$ (541,345)	(0.024)	$ 48,200	$ (1,147)	$ (914,613)
(23.2)	$ 18,100	$ (419,521)	(0.703)	$ 867,600	$ (610,301)	(0.027)	$ 48,200	$ (1,293)	$ (1,031,115)
(25.9)	$ 18,100	$ (469,528)	(0.787)	$ 867,600	$ (683,049)	(0.030)	$ 48,200	$ (1,447)	$ (1,154,024)
(28.9)	$ 18,100	$ (522,286)	(0.876)	$ 867,600	$ (759,798)	(0.033)	$ 48,200	$ (1,609)	$ (1,283,694)
(31.9)	$ 18,100	$ (577,673)	(0.969)	$ 867,600	$ (840,373)	(0.037)	$ 48,200	$ (1,780)	$ (1,419,826)
(32.6)	$ 18,100	$ (589,416)	(0.988)	$ 867,600	$ (857,457)	(0.038)	$ 48,200	$ (1,816)	$ (1,448,690)
(33.2)	$ 18,100	$ (601,806)	(1.009)	$ 867,600	$ (875,481)	(0.038)	$ 48,200	$ (1,855)	$ (1,479,142)
(34.0)	$ 18,100	$ (614,877)	(1.031)	$ 867,600	$ (894,497)	(0.039)	$ 48,200	$ (1,895)	$ (1,511,269)
(34.7)	$ 18,100	$ (628,667)	(1.054)	$ 867,600	$ (914,558)	(0.040)	$ 48,200	$ (1,937)	$ (1,545,162)
(341)		$ (6,134,846)	(10.3)		$ (8,934,677)	(0.395)		$ (18,938)	$ (15,088,461)

INCREASED EMISSIONS FROM RAIL						
Year	perational Year	Increased Rail RTM (MM)	Increased Rail Fuel Consumed	Carbon Emissions Rail	Unit Cost for SCC by Year	Social Cost of Carbon
			activity inputs	metric tons	per metric ton	
2025	1	85.6	70,036	181	$ 56	$ 10,115
2026	2	123.8	144,037	371	$ 57	$ 21,174
2027	3	130.6	164,175	423	$ 58	$ 24,558
2028	4	137.8	259,114	668	$ 59	$ 39,427
2029	5	145.4	273,365	705	$ 60	$ 42,301
2030	6	153.4	288,401	744	$ 61	$ 45,371
2031	7	161.8	304,263	785	$ 62	$ 48,651
2032	8	170.7	320,997	828	$ 63	$ 52,155
2033	9	180.1	338,652	873	$ 64	$ 55,897
2034	10	190.0	357,278	921	$ 66	$ 60,814
2035	11	200.5	376,928	972	$ 67	$ 65,131
2036	12	211.5	397,659	1,026	$ 68	$ 69,738
2037	13	223.2	419,530	1,082	$ 69	$ 74,656
2038	14	235.4	442,604	1,141	$ 70	$ 79,903
2039	15	248.4	466,948	1,204	$ 71	$ 85,502
2040	16	261.9	492,392	1,270	$ 72	$ 91,431
2041	17	254.5	478,528	1,234	$ 73	$ 90,091
2042	18	246.8	463,900	1,196	$ 75	$ 89,730
2043	19	238.5	448,468	1,157	$ 76	$ 87,902
2044	20	229.9	432,188	1,115	$ 77	$ 85,825
Total			6,939,464	17,897		$ 1,220,370
Net Rail Savings (Cost)			5,070,107	104,721		$ 7,067,792
Average Savings			253,505	5,236		$ 353,390

INCREASED EMISSIONS FROM RAIL									
NOx Incease	Unit Cost of NOx by Year	Value of Nox Increase	PM Increase	Unit Cost of PM by Year	Value of PM Increase	Sox Increase	Unit Cost of Sox by Year	Value of Sox Increase	Total Value: Non-Carbon Emissions
metric tons	per metric ton		metric tons	per metric ton		metric tons	per metric ton		
2.6	$ 16,500	$ 42,526	0.040	$ 801,700	$ 32,004	0.002	$ 44,900	$ 75	$ 74,605
5.3	$ 17,000	$ 90,110	0.082	$ 814,500	$ 66,871	0.003	$ 45,700	$ 158	$ 157,139
6.0	$ 17,000	$ 102,708	0.094	$ 827,400	$ 77,428	0.004	$ 46,500	$ 183	$ 180,319
9.5	$ 17,000	$ 162,102	0.148	$ 840,600	$ 124,152	0.006	$ 47,300	$ 294	$ 286,548
10.1	$ 17,000	$ 171,017	0.156	$ 854,000	$ 133,069	0.007	$ 48,200	$ 316	$ 304,402
10.6	$ 17,000	$ 180,423	0.164	$ 867,600	$ 142,623	0.007	$ 49,100	$ 340	$ 323,387
11.2	$ 17,000	$ 190,347	0.173	$ 867,600	$ 150,468	0.007	$ 49,100	$ 359	$ 341,173
11.8	$ 17,000	$ 200,816	0.183	$ 867,600	$ 158,743	0.008	$ 49,100	$ 378	$ 359,937
12.5	$ 17,000	$ 211,861	0.193	$ 867,600	$ 167,474	0.008	$ 49,100	$ 399	$ 379,734
13.1	$ 17,000	$ 223,513	0.204	$ 867,600	$ 176,685	0.009	$ 49,100	$ 421	$ 400,619
13.9	$ 17,000	$ 235,806	0.215	$ 867,600	$ 186,403	0.009	$ 49,100	$ 444	$ 422,653
14.6	$ 17,000	$ 248,775	0.227	$ 867,600	$ 196,655	0.010	$ 49,100	$ 469	$ 445,899
15.4	$ 17,000	$ 262,458	0.239	$ 867,600	$ 207,471	0.010	$ 49,100	$ 494	$ 470,424
16.3	$ 17,000	$ 276,893	0.252	$ 867,600	$ 218,882	0.011	$ 49,100	$ 522	$ 496,297
17.2	$ 17,000	$ 292,122	0.266	$ 867,600	$ 230,921	0.011	$ 49,100	$ 550	$ 523,593
18.1	$ 17,000	$ 308,041	0.281	$ 867,600	$ 243,504	0.012	$ 49,100	$ 580	$ 552,125
17.6	$ 17,000	$ 299,367	0.273	$ 867,600	$ 236,647	0.011	$ 49,100	$ 564	$ 536,578
17.1	$ 17,000	$ 290,216	0.264	$ 867,600	$ 229,414	0.011	$ 49,100	$ 547	$ 520,176
16.5	$ 17,000	$ 280,562	0.256	$ 852,700	$ 217,973	0.011	$ 49,100	$ 528	$ 499,063
15.9	$ 17,000	$ 270,377	0.246	$ 852,700	$ 210,060	0.010	$ 49,100	$ 509	$ 480,946
255.4		$ 4,340,040	4.0		$ 3,407,448	0.167		$ 8,131	$ 7,755,620
85.7		$ 1,794,807	6.4		$ 5,527,229	0.228		$ 10,806	$ 7,332,841
4.3		$ 89,740	0.3		$ 276,361	0.011		$ 540	$ 366,642

FUEL COST SAVINGS

Year	Reduced Truck Consumption	Value: Reduced Truck Consumption	Increased Rail Consumption	Value: Increased Rail Consumption	Fuel Savings
	Gallons	$ 3.73	Gallons	$ 3.73	
2025	(123,234)	$ (459,662)	70,036	$ 261,233	$ (198,429)
2026	(253,445)	$ (945,352)	144,037	$ 537,259	$ (408,093)
2027	(288,880)	$ (1,077,524)	164,175	$ 612,374	$ (465,150)
2028	(455,933)	$ (1,700,630)	259,114	$ 966,496	$ (734,135)
2029	(481,009)	$ (1,794,165)	273,365	$ 1,019,653	$ (774,512)
2030	(507,465)	$ (1,892,844)	288,401	$ 1,075,734	$ (817,110)
2031	(535,376)	$ (1,996,951)	304,263	$ 1,134,899	$ (862,051)
2032	(564,821)	$ (2,106,783)	320,997	$ 1,197,319	$ (909,464)
2033	(595,886)	$ (2,222,656)	338,652	$ 1,263,171	$ (959,485)
2034	(628,660)	$ (2,344,902)	357,278	$ 1,332,646	$ (1,012,256)
2035	(663,236)	$ (2,473,872)	376,928	$ 1,405,941	$ (1,067,930)
2036	(724,016)	$ (2,700,581)	397,659	$ 1,483,268	$ (1,217,312)
2037	(816,240)	$ (3,044,576)	419,530	$ 1,564,848	$ (1,479,728)
2038	(913,536)	$ (3,407,491)	442,604	$ 1,650,915	$ (1,756,577)
2039	(1,016,184)	$ (3,790,367)	466,948	$ 1,741,715	$ (2,048,652)
2040	(1,123,948)	$ (4,192,325)	492,392	$ 1,836,624	$ (2,355,701)
2041	(1,146,797)	$ (4,277,553)	478,528	$ 1,784,908	$ (2,492,644)
2042	(1,170,903)	$ (4,367,468)	463,900	$ 1,730,348	$ (2,637,120)
2043	(1,196,335)	$ (4,462,328)	448,468	$ 1,672,787	$ (2,789,541)
2044	(1,223,165)	$ (4,562,406)	432,188	$ 1,612,060	$ (2,950,346)
Total	(12,009,571)	$ (44,795,700)	6,058,808	22,599,352	$ (22,196,348)
					$ (1,396,812)
Source:	dat.com	For		(For mid-grade and diesel)	

ACCIDENT SAVINGS				Monetized values per accident assume 1.09 fatalities per fatal crash and 1.44 injuries per injury crash.							NC number reflect deaths or injuries; not crashes.					
Year	Operational Year #	Truck 100MVMT Avoided	People Killed	People Injured	PDO	Killed Cost	Injured Cost	PDO Cost	Truck Cost Avoided	MM Train-Miles Added	Killed	Injured	Killed Cost	Injured Cost	Total Incremental Rail Cost	Net Decrease
			1.21	106.99	166.06	$ 12,837,400	$ 302,600	$ 4,600			0.0040	0.0712	$ 12,837,400	$ 302,600		
			100MVMT	100MVMT	100MVMT	Per Accident	Per Accident	Per Accident			Per MM T-M	Per MM T-M				
						$10 MM/Death	$136,806/Inj.									
2025	1	(0.0076)	(0.01)	(0.82)	(1.27)	$ (108,882)	$ (171,779)	$ (5,836)	$ (286,498)	0.043	0.0002	0.00	$ 1,996	$ 641	$ 2,637	$ (283,861)
2026	2	(0.0157)	(0.02)	(1.68)	(2.61)	$ (223,930)	$ (353,286)	$ (12,003)	$ (589,218)	6.192	0.0245	0.44	$ 288,591	$ 92,685	$ 381,277	$ (207,942)
2027	3	(0.0179)	(0.02)	(1.92)	(2.97)	$ (255,238)	$ (402,679)	$ (13,681)	$ (671,599)	6.532	0.0259	0.47	$ 304,464	$ 97,783	$ 402,247	$ (269,352)
2028	4	(0.0283)	(0.03)	(3.02)	(4.69)	$ (402,836)	$ (635,539)	$ (21,593)	$ (1,059,968)	6.891	0.0273	0.49	$ 321,209	$ 103,161	$ 424,371	$ (635,598)
2029	5	(0.0298)	(0.04)	(3.19)	(4.95)	$ (424,992)	$ (670,494)	$ (22,780)	$ (1,118,267)	7.270	0.0288	0.52	$ 338,876	$ 108,835	$ 447,711	$ (670,556)
2030	6	(0.0315)	(0.04)	(3.37)	(5.22)	$ (448,367)	$ (707,371)	$ (24,033)	$ (1,179,771)	7.670	0.0304	0.55	$ 357,514	$ 114,821	$ 472,335	$ (707,436)
2031	7	(0.0332)	(0.04)	(3.55)	(5.51)	$ (473,027)	$ (746,277)	$ (25,355)	$ (1,244,659)	8.092	0.0320	0.58	$ 377,177	$ 121,136	$ 498,314	$ (746,345)
2032	8	(0.0350)	(0.04)	(3.75)	(5.82)	$ (499,044)	$ (787,322)	$ (26,749)	$ (1,313,115)	8.537	0.0338	0.61	$ 397,922	$ 127,799	$ 525,721	$ (787,394)
2033	9	(0.0369)	(0.04)	(3.95)	(6.13)	$ (526,491)	$ (830,624)	$ (28,221)	$ (1,385,336)	9.007	0.0356	0.64	$ 419,808	$ 134,828	$ 554,635	$ (830,701)
2034	10	(0.0390)	(0.05)	(4.17)	(6.47)	$ (555,448)	$ (876,309)	$ (29,773)	$ (1,461,530)	9.502	0.0376	0.68	$ 442,897	$ 142,243	$ 585,140	$ (876,389)
2035	11	(0.0411)	(0.05)	(4.40)	(6.83)	$ (585,998)	$ (924,506)	$ (31,410)	$ (1,541,914)	10.025	0.0397	0.71	$ 467,257	$ 150,067	$ 617,323	$ (924,591)
2036	12	(0.0449)	(0.05)	(4.80)	(7.45)	$ (639,699)	$ (1,009,229)	$ (34,289)	$ (1,683,217)	10.576	0.0419	0.75	$ 492,956	$ 158,320	$ 651,276	$ (1,031,941)
2037	13	(0.0506)	(0.06)	(5.41)	(8.40)	$ (721,183)	$ (1,137,783)	$ (38,656)	$ (1,897,622)	11.158	0.0442	0.79	$ 520,068	$ 167,028	$ 687,096	$ (1,210,526)
2038	14	(0.0566)	(0.07)	(6.06)	(9.41)	$ (807,149)	$ (1,273,407)	$ (43,264)	$ (2,123,820)	11.771	0.0466	0.84	$ 548,672	$ 176,214	$ 724,886	$ (1,398,934)
2039	15	(0.0630)	(0.08)	(6.74)	(10.46)	$ (897,842)	$ (1,416,491)	$ (48,126)	$ (2,362,458)	12.419	0.0491	0.88	$ 578,849	$ 185,906	$ 764,755	$ (1,597,703)
2040	16	(0.0697)	(0.08)	(7.46)	(11.57)	$ (993,056)	$ (1,566,706)	$ (53,229)	$ (2,612,991)	13.096	0.0518	0.93	$ 610,391	$ 196,036	$ 806,428	$ (1,806,563)
2041	17	(0.0711)	(0.09)	(7.61)	(11.81)	$ (1,013,244)	$ (1,598,556)	$ (54,311)	$ (2,666,111)	12.727	0.0504	0.91	$ 593,204	$ 190,516	$ 783,720	$ (1,882,391)
2042	18	(0.0726)	(0.09)	(7.77)	(12.05)	$ (1,034,543)	$ (1,632,158)	$ (55,453)	$ (2,722,154)	12.338	0.0488	0.88	$ 575,071	$ 184,693	$ 759,764	$ (1,962,390)
2043	19	(0.0742)	(0.09)	(7.94)	(12.32)	$ (1,057,013)	$ (1,667,608)	$ (56,657)	$ (2,781,278)	11.927	0.0472	0.85	$ 555,941	$ 178,549	$ 734,490	$ (2,046,788)
2044	20	(0.0758)	(0.09)	(8.11)	(12.59)	$ (1,080,719)	$ (1,705,008)	$ (57,928)	$ (2,843,655)	11.494	0.0455	0.82	$ 535,759	$ 172,067	$ 707,826	$ (2,135,829)

North Carolina accident rate data source: https://connect.ncdot.gov/business/DMV/CrashFactsDocuments/2020%20Crash%20Facts.pdf
"North Carolina: 2020 Traffic Crash Facts."
Fatality and injury rates reflect 2015-2019 averages. PDO rates reflect 2019 results.

Discount Table

DISCOUNT TABLES		At 7%	At 3%
Discount Factors to 2020		@7%	@3%
2020	0	1.00	1.00
2021	1	0.93	0.97
2022	2	0.86	0.94
2023	3	0.80	0.91
2024	4	0.75	0.89
2025	5	0.70	0.86
2026	6	0.65	0.83
2027	7	0.60	0.81
2028	8	0.56	0.78
2029	9	0.52	0.76
2030	10	0.48	0.74
2031	11	0.45	0.72
2032	12	0.42	0.69
2033	13	0.39	0.67
2034	14	0.36	0.65
2035	15	0.34	0.63
2036	16	0.31	0.61
2037	17	0.29	0.60
2038	18	0.27	0.58
2039	19	0.25	0.56
2040	20	0.23	0.54
2041	21	0.22	0.53
2042	22	0.20	0.51
2043	23	0.19	0.50
2044	24	0.18	0.48
2045	25	0.16	0.47

All tables and data provided in included Excel File