Appendix E –Benefit Cost Analysis

Upper Midwest Transportation Hub

Iowa Department of Transportation

ONE COMPANY | *Many Solutions*®

IOWA DEPARTMENT OF TRANSPORTATION

UPPER MIDWEST TRANSPORTATION HUB AT MANLY, IOWA

TIGER DISCRETIONARY GRANTS PROGRAM

ECONOMIC ANALYSIS SUPPLEMENTARY DOCUMENTATIONAPRIL 22, 2014

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 3
2. INTRODUCTION 7
3. METHODOLOGICAL FRAMEWORK 7
4. PROJECT OVERVIEW 8
   4.1 Base Case, Build Case and Alternative 10
   4.2 Project Cost and Schedule 10
   4.3 Effects on Long-Term Outcomes 10
5. GENERAL ASSUMPTIONS 13
6. DEMAND PROJECTIONS 14
   6.1 Methodology 14
   6.2 Assumptions 15
   6.3 Demand Projections 15
7. BENEFITS MEASUREMENT, DATA AND ASSUMPTIONS 16
   7.1 State of Good Repair 16
   7.2 Economic Competitiveness 18
   7.3 Quality of Life 26
   7.4 Environmental Sustainability 28
   7.5 Safety 35
8. SUMMARY OF FINDINGS AND BCA OUTCOMES 38
9. BCA SENSITIVITY/ALTERNATIVE ANALYSIS 38
10. SUPPLEMENTARY DATA TABLES 39
   10.1 Annual Estimates of Total Project Benefits and Costs 40
   10.2 Annual Demand Projections 41
   10.3 Benefit Estimates – Undiscounted Values 42
   10.4 Benefit Estimates – Discounted Values (at 7 Percent) 43

LIST OF TABLES

Table 1: Expected Effects on Long-Term Outcomes and Benefit Categories 13
Table 2: Demand Input Assumptions 15
Table 3: Projections of Truck Miles Saved 16
Table 4: Assumptions used in the Estimation of State-of-Good-Repair Benefits 17
Table 5: Estimates of State-of-Good-Repair Benefits, Millions of 2013$ 18
Table 6: Assumptions used in the Estimation of Transportation Cost Savings 20
Table 7: Estimates of Transportation Cost Savings, Millions of 2013$ 22
Table 8: Project Spending and Economic Impacts (Direct, Indirect and Induced) during Project Development Phase 23
Table 9: Project Spending and Job-Year Estimates with IMPLAN and CEA Methodologies 23
Table 10: Project Spending and Short-Term Economic Impacts by Quarter 24
Table 11: Short-Term Impacts in Key Industries Employing Low-Income People 24
Table 12: Economic Impacts of the UMTH Project, Annual for Selected Years 25
Table 13: Economic Impacts of Capital Expenditures Related to Ancillary Operations 26
Table 14: Economic Impacts of Operations and Maintenance Expenditures Related to Ancillary Operations 26
Table 15: Assumptions used in the Estimation of Livability Benefits 27
Table 16: Estimates of Quality of Life Benefits, Millions of 2013$ 28
Table 17: Assumptions used in the Estimation of Environmental Sustainability Benefits 29
Table 18: Estimates of Environmental Sustainability Benefits, Millions of 2013$ 35
Table 19: Assumptions used in the Estimation of Safety Benefits 37
Table 20: Estimates of Safety Benefits, 2013$ 37
Table 21: Overall Results of the Benefit Cost Analysis, Millions of 2013$* 38
Table 22: Benefit Estimates by Long-Term Outcome for the Full Project, Millions of 2013$ 38
Table 23: Quantitative Assessment of Sensitivity, Summary 39

1. Executive Summary

This TIGER Grant application is for infrastructure construction for the Upper Midwest Transportation Hub (UMTH) Project at Manly, Iowa. It consists primarily of the intermodal portion of the UMTH Project that will provide the infrastructure for staging, transloading containers ("container stuffing"), and loading/unloading of domestic and international shipping trailers and containers. The development will serve an approximately 150 mile radius encompassing north central Iowa, southern Minnesota, and a portion of western Wisconsin where little useful intermodal service is currently available.

Manly, Iowa, is currently the home of an approximately 350 acre campus that already serves as a major transportation hub. The long term potential for continued growth of this transportation hub is considerable. The site currently includes a major rail support and classification yard, a grain terminal, a large liquid transload facility with over 5 million gallon storage tanks, and capacity for a multitude of both inbound and outbound products. Expansion of the liquid infrastructure is already underway, and ground has been broken for a large steel distribution facility. A nearly 15,000 foot single track loop is complete on the 160 acre UMTH-North parcel. Two major portions of the UMTH project remain; namely 1) UMTH-North – construction of infrastructure for a full service intermodal facility and; 2)UMTH-South - construction of infrastructure that will provide an interim intermodal facility and rail yard support for transloading highway trailers and shipping containers, The project planned for this TIGER Grant is all contained within the existing transportation campus.

The project will provide significant benefits to the region, state, and nation through:

1) improving freight rail efficiency and capacity,
2) diverting existing freight from truck to rail,
3) reducing truck miles traveled,
4) reducing highway maintenance costs,
5) reducing transportation costs,
6) reducing congestion costs,
7) reducing transportation costs,
8) reducing accident costs (fatalities and injuries), and
9) job creation.

The overall project is designed to provide an independent, high service and lower cost package of rail, truck and intermodal logistics for Iowa and Minnesota manufacturers, producers and consumers, with the particular portion of the project directly providing lower cost access to domestic and international intermodal service to a large and growing number of shippers/receivers that do not currently have such cost-competitive access. This project will result in reducing the time, distance and related costs for shippers and receivers in the region to access the national and international intermodal network. That will allow existing and potential shippers, receivers and consumers in this region a more equal and competitive access to the world marketplace.

A table summarizing the changes expected from the project (and the associated benefits) is provided below.

Table ES-1: Summary of Infrastructure Improvements and Associated Benefits

Current Status or Baseline & Problems to be Addressed	Changes to Baseline / Alternative	Type of Impacts	Population Affected by Impacts	Benefits	Summary of Results ($2013, 7% Discounted, Millions)	Page #
The region served by the UMTH suffers from a serious lack of nearby intermodal infrastructure and service. There also exists a severe container imbalance situation from too little inbound containers, causing high dray costs. Declining truckload capacity and increasing costs has become a concern. Also, no direct, competitive, time sensitive intermodal service to US Eastern Seaboard, Texas-Mexico and California exists in this region.	Improvements to the UMTH include completing the construction of the UMTH-North intermodal facility and container yard within the loop track, and providing a second loop track. Construction in the UMTH-South include converting an existing wind component area into a startup intermodal facility and eventual transload and container loading facility,	Reduced Highway Maintenance Costs from truck diversion to rail.	Federal and State (various) Governments	Monetized Maintenance Costs Savings.	$171.7	15
		Reduced Transportation Costs from truck diversion to rail.	Goods Shippers	Monetized Shipping Costs Savings.	$371.5	18
		Short-Term Economic Impacts from construction/planning expenditure.	Local Citizens and Businesses	Job years, income etc.	*Pg 22*	22
		Reduction in Highway Congestion from truck diversion to rail	On Road Motorists Using Trucking Routes	Monetized Reduced Congestion Costs Savings.	$107.5	26
		Reduced Emissions from truck diversion to rail.	Iowa	Monetized Reduced Pollution.	$125.5	28
		Reduced Accident Costs	On Road Motorists Using Trucking Routes	Monetized Costs of Change in Injuries and Fatalities.	$490.2	35

The period of analysis used in the estimation of benefits and costs is 22 years, including 2 years of construction and 20 years of operation. The total project capital costs are $23.37 M in nominal terms, and are expected to be financed by Federal (TIGER) and private funds from Iowa Northern Railway Company (IANR); Manly Terminal LLC (MT); and Manly Logistics Park LLC (MLP) according to the distribution shown in Table ES-2 below.

Table ES-2: Summary of Project Costs and Anticipated Funding Sources, 2012$

Funding Source	Capital/Construction	Percent of Total Capital Cost Financed by Source
Federal (TIGER)	$14,586,397	62.4%
Private (IANR-MT-MLP)	$8,780,426	37.6%
TOTAL	**$23,366,823**	**100.0%**

A summary of the relevant outcomes and partial calculations leading to project evaluation metrics are shown in Table ES-3 (in 2013 dollars). Based on the Benefit Cost Analysis presented in the rest of this document, the project is expected to generate $1,266.4 million in discounted benefits and $223.6 million in discounted costs, using a 7 percent real discount rate. Therefore, the project is expected to generate a Net Present Value of $1,043.8 million and a Benefit/Cost Ratio of 5.66.

Table ES-3: Summary of Pertinent Data, Quantifiable Benefits and Costs

Calendar Year	Project Year	Total Direct Beneficiaries	Total Benefits ($2013)	Total Costs ($2013)	Undiscounted Net Benefits ($2013)	Discounted Net Benefits at 7%
2014	1	Federal and state/local governments, shippers, vehicle operators, rail operators, other users of roads, and local residents	$0	-$934,673	-$934,673	-$934,673
2015	2		$0	-$22,432,150	-$22,432,150	-$20,964,626
2016 (opening)	3		$8,602,937	-$2,860,000	$5,742,937	$4,840,181
2017	4		$55,615,304	-$9,622,500	$45,992,804	$36,612,427
2018	5		$78,973,397	-$13,767,250	$65,206,147	$48,677,363
2019	6		$83,859,428	-$15,291,147	$68,568,280	$48,012,539
2020	7		$94,112,002	-$17,121,219	$76,990,783	$50,550,155
2021	8		$107,805,305	-$19,295,385	$88,509,919	$54,476,960
2022	9		$121,009,729	-$20,838,410	$100,171,320	$57,841,174
2023	10		$132,830,948	-$22,503,275	$110,327,672	$59,759,493
2024	11		$142,547,149	-$24,339,725	$118,207,424	$60,082,569
2025	12		$159,011,768	-$26,448,890	$132,562,878	$63,240,594
2026	13		$177,535,632	-$27,417,019	$150,118,613	$67,223,807
2027	14		$182,449,349	-$27,813,896	$154,635,452	$65,065,463
2028	15		$187,328,319	-$28,225,163	$159,103,156	$62,873,197
2029	16		$192,357,336	-$28,650,954	$163,706,382	$60,770,419
2030	17		$197,541,592	-$29,091,414	$168,450,177	$58,753,623
2031	18		$202,677,542	-$29,546,697	$173,130,845	$56,694,611
2032	19		$208,326,732	-$30,016,963	$178,309,769	$54,943,465
2033	20		$213,928,009	-$30,502,382	$183,425,627	$53,143,268
2034	21		$219,696,254	-$31,003,133	$188,693,120	$51,416,031
2035	22		$225,624,253	-$31,519,404	$194,104,849	$49,755,769
Total			**$2,991,832,983**	**-$489,241,649**	**$2,502,591,334**	**$1,042,833,810**

A summary of the monetized benefits of the UMTH project are included below in Table ES-4.

Table ES-4: Summary of Monetized Benefits, in Million of 2013$

Long-Term Outcomes	Benefit Categories	7% Discount Rate	3% Discount Rate
State of Good Repair	Avoided Pavement Maintenance Costs	$171.7	$274.7
Economic Competitiveness	Shipper Savings due to Modal Switch from Truck to Rail	$371.5	$592.2
Livability	Reduced Road Congestion due to Modal Switch from Truck to Rail	$107.5	$172.0
Environmental Sustainability	Emission Cost Savings due to Modal Switch from Truck to Rail	$125.5	$128.4
Safety	Accident Cost Savings due to Modal Switch from Truck to Rail	$490.2	$823.5
Total Benefit Estimates		**$1,266.4**	**$1,990.6**

In addition to the monetized benefits presented in Table ES-4, the project would generate benefits that are difficult to quantify. These benefits are discussed in more details in the main part of this application to provide more context and justification for project needs. A brief description of those benefits is provided below. These benefits would be additive to those reported in Table ES-4 and are acknowledged here in qualitative terms.

- *Induced Regional Benefits to Shippers and Receivers*: it is assumed that a proportion of the lifts in the build scenario will represent 'induced' shipments. That is to say that some volume of the lift forecast is made up of lifts that are not currently moving in the base case (in addition to existing demand). The presence of the intermodal hub at Manly will create new business opportunities through providing access to markets that were previously not cost effective. As an example, this new origin-destination hub will bring new regional opportunities to local commodity producers or processors. The induced component of the lift forecast has been excluded from the cost-benefit analysis to be conservative. As such, it can be said that induced demand will further improve the Benefit Cost Analysis evaluation metrics, as the corresponding benefits will be achieved within the same capital and operating costs. The effects of one of such opportunities, construction and operation of a cold storage facility, is evaluated here in terms of its economic impacts, i.e. the number of jobs and economic output that it would contribute to the local and national economy.
- *Container imbalance:* Iowa has an imbalance of inbound versus outbound international shipping containers. According to US Census Bureau Data, in 2011 the ratio of the two categories of containers was 1 to 3. This implies a severe shortage of empty containers available to Iowa producers for loading their shipments. Empty containers must be shipped or "drayed" into Iowa to meet demand. This significantly increases the transportation cost. A new, efficient, independent regional intermodal terminal in north central Iowa can draw inbound and outbound container loads from a widespread region including much of Iowa and the southern half of Minnesota alleviating the shortage.
- *Shortage of truck drivers:* The Iowa DOT's Freight Advisory Council has identified driver shortages as one of the major challenges facing truck freight movement in Iowa. There

are a number of issues that contribute to the problem, including hours of service regulations, relatively low salaries that fail to attract enough of new drivers, and cultural shifts making the life style of a long-distance truck driver less attractive. Any conversion from long haul trucking to shorter drays for regional commodities will provide opportunities to attract new truck drivers to the profession. The ability to be “off road” for longer periods of time will greatly impact the lifestyle of the trucking community, allowing drivers to be home more often and fully participate in home and family life while earning a living in a rural location where attractive jobs can be scarce.

2. Introduction

This document provides detailed technical information on the economic analyses conducted in support of the Grant Application for Upper Midwest Transportation Hub (UMTH) Project at Manly, Iowa.

Section 3, Methodological Framework, introduces the conceptual framework used in the Benefit-Cost Analysis (BCA). Section 4, Project Overview, provides an overview of the project, including a brief description of existing conditions and proposed alternatives; a summary of cost estimates and schedule; and a description of the types of effects that the UMTH project is expected to generate. Section 5, General Assumptions, discusses the general assumptions used in the estimation of project costs and benefits, while estimates of travel demand and traffic growth can be found in Section 6, Demand Projections. Specific data elements and assumptions pertaining to the long-term outcome selection criteria are presented in Section 7, Benefits Measurement, Data and Assumptions, along with associated benefit estimates. Estimates of the project’s Net Present Value (NPV), its Benefit/Cost ratio (BCR) and other project evaluation metrics are presented in Section 8. Section 9 provides the outcomes of the sensitivity analysis with respect to variation in key input assumptions. Additional data tables are provided in Section 10, Supplementary Data Tables, including annual estimates of benefits and costs, as well as intermediate values to assist DOT in its review of the application.[1]

3. Methodological Framework

Benefit-Cost Analysis (BCA) is a conceptual framework that quantifies in monetary terms as many of the costs and benefits of a project as possible. Benefits are broadly defined. They represent the extent to which people impacted by the project are made better-off, as measured by their own willingness-to-pay. In other words, central to BCA is the idea that people are best able to judge what is “good” for them, what improves their well-being or welfare.

BCA also adopts the view that a net increase in welfare (as measured by the summation of individual welfare changes) is a good thing, even if some groups within society are made worse-

[1] While the models and software themselves do not accompany this appendix, greater detail can be provided, including spreadsheets presenting additional interim calculations and discussions on model mechanics and coding, if requested.

off. A project or proposal would be rated positively if the benefits to some are large enough to compensate the losses of others.

Finally, BCA is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life-cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational concerns.

The specific methodology developed for this application was developed using the above BCA principles and is consistent with the TIGER guidelines. In particular, the methodology involves:

- Establishing existing and future conditions under the build and no-build scenarios;
- Assessing benefits with respect to each of the five long-term outcomes identified in the Notice of Funding Availability (NOFA);
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using DOT guidance for the valuation of travel time savings, safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects;
- Discounting future benefits and costs with the real discount rates recommended by the DOT (7 percent, and 3 percent for sensitivity analysis); and
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.

4. Project Overview

This TIGER Grant application is for infrastructure construction for the Upper Midwest Transportation Hub (UMTH) Project at Manly, Iowa. It consists primarily of the intermodal portion of the UMTH Project that will provide the infrastructure for staging, transloading and loading/unloading domestic and international shipping trailers and containers. The project is being developed by **Manly Terminal LLC (MT)**, **Manly Logistics Park, LLC (MLP)**, and the railroad common carrier, **Iowa Northern Railway Company (IANR).** The project collectively will be referred to throughout this document as the **Upper Midwest Transportation Hub (UMTH)**. The development will serve an approximately 150 mile radius encompassing north central Iowa, southern Minnesota, and a smaller portion of Wisconsin where little useful intermodal service is currently available. The total UMTH covers approximately 350 acres of specialized transportation infrastructure and is divided into three distinct parts:

1. UMTH – North – 160 acres;
2. UMTH-South – 100 acres, and
3. Manly Yard – 90 acres (No TIGER grant funds are requested for the yard.)

1) UMTH-North: Construction includes completing the UMTH-North intermodal facility and container yard within the existing loop track, and providing a second loop track. Currently under development, the 160 acre industrial development will handle distribution of steel products, various transload components and commodities, and a

large scale intermodal facility and a container/trailer staging and storage yard and an eventual cold and freezer storage warehouse and cross dock. Once the UMTH-North intermodal facility is in service, the smaller initial intermodal facility in UMTH-South will continue in service in specialized container loading (called "container stuffing" in the industry) for food products, manufactured goods, export grain, distiller grains, and edible bean products for export. It is contemplated that this will eventually be recognized as a bonded area for US Customs clearance of imported goods to the region.

2) UMTH-South: Construction in the UMTH-South includes conversion of an existing wind component area into a startup intermodal facility and eventual transload and container stuffing facility. The 100 acre facility built in 2007 includes substantial infrastructure for the storage and transfer of liquid commodities, such as chemicals, fuel and fuel components, feed additives and other liquids used in various manufacturing processes throughout the region, and includes 28 acres designed for the handling of heavy dimensional shipments, particularly wind turbine components and an initial intermodal facility.
3) Manly Yard: The IANR's 90 acre railroad yard includes 11 classification and switching tracks with adjacent car repair facility, grain staging tracks, engine house, maintenance of way material yard, food grade transload and support tracks and several other customer transload areas, including a new food grade rail-to-truck transfer station. Manly Yard is the critical support yard for IANR interchange with Union Pacific Railroad and to provide track support for the UMTH North and South. (Note that no TIGER grant funds are requested for the Manly Yard.)

Manly, Iowa is currently the home of an approximately 350 acre campus that already serves as a major transportation hub and the long term potential for continued growth of this transportation hub is considerable. The site currently includes a major rail support and classification yard, a grain terminal, a large liquid transload facility with over 5 million gallon storage tanks, and capacity for a multitude of both inbound and outbound products. Expansion of the liquid infrastructure is already underway, and ground has been broken for a large steel distribution facility. A nearly 15,000 foot single track loop is complete on a 160 acre UMTH-North parcel. Two major portions of the UMTH project remain; 1) UMTH-North – construction of infrastructure for a full service intermodal facility and; 2) UMTH-South - construction of infrastructure that will provide an interim intermodal facility and rail yard support for transloading highway trailers and shipping containers, The project planned for this TIGER Grant is all contained within the existing transportation campus.

The region served by (UMTH) suffers from a serious lack of nearby intermodal infrastructure and service. There also exists a severe container imbalance situation from too little inbound containers, causing high dray costs. Declining truckload capacity and increasing costs has become a concern. Also, no direct, competitive, time sensitive intermodal service to US Eastern Seaboard, Texas-Mexico and California exists to this region.

The project will provide significant benefits to the region, state, and nation through:
1) improving freight rail efficiency and capacity,
2) diverting existing freight from truck to rail,

3) reducing truck miles traveled,
4) reducing highway maintenance costs,
5) reducing transportation costs,
6) reducing congestion costs,
7) reducing transportation costs,
8) reducing accident costs (fatalities and injuries), and
9) job creation.

The overall project is designed to provide an independent, high service and lower cost package of rail, truck and intermodal logistics for Upper Midwest manufacturers, producers and consumers. The project will directly provide lower cost access to domestic and international intermodal service to a large and growing number of shippers/receivers that do not currently have such cost-competitive access. This project will result in reducing the time, distance and related costs for shippers and receivers in the region to access the national and international intermodal network. That will allow existing and potential shippers, receivers and consumers in this region a more equal and competitive access to the world marketplace.

4.1 Base Case, Build Case and Alternative

Base Case (No-Build Case): In the base case, the UMTH project is not undertaken. Shipping is continued via truck and other intermodal facilities farther away.

Build Case: In the build case the UMTH project is undertaken. Trucking traffic and intermodal traffic from less direct routes are diverted to the proposed facility. The benefits of the build case are attributed to the avoidance of truck use as well as use of less direct intermodal routes.

4.2 Project Cost and Schedule

Total costs of the proposed project are estimated at $23,366,823. This figure includes all relevant costs: construction, engineering planning, and equipment. About 4 percent of total costs, or $934,673, is expected to be incurred in 2014. The remainder of the costs, or $22,432,150, would be incurred in 2015.

4.3 Effects on Long-Term Outcomes

Reduction in Highway Maintenance Costs from Displacing Heavy Truck Travel to Rail
An avoidance of heavy trucks on the highway system reduces highway maintenance costs and in particular pavement re-surfacing and maintenance costs. Typically, this benefit is realized in terms of increased cycle times between maintenance work orders. This benefit category captures the reduced highway maintenance cost associated with diverting freight shipments from truck to rail.

Reduced Transportation Costs from Diverting Heavy Truck Travel to Rail
Rail shipping rates tend to be lower than truck shipping rates on a per ton-mile basis. As such, diversion of highway freight to rail can generate cost savings to shippers. The UMTH project allows shippers a greater choice of transportation mode. Furthermore, these improvements increase schedule reliability, one of the key challenges facing a railroad in terms of product delivery. In the absence of such improvements, some shipments would likely be carried by truck

at a greater cost to producers. The UMTH project will also offer some existing intermodal shippers more direct routes and thus also less costly shipping options.

Transportation cost savings are quantified using the calculation of the number of container lifts and shipping costs savings per container. The benefits in this category are counted as public because the difference in transportation prices between rail intermodal and truckload freight accrue directly to the shipper and receiver lowering the final price consumers pay.

Shipping costs savings for existing rail users have the potential of spurring dynamic changes in land-use, manufacturing, and industrial re-organization. Research conducted for USDOT/FHWA indicated that reduced shipping costs could enable shifts in mode choice and investments in productivity in the 'medium term'. In addition, these combined savings could increase further based on industrial re-organization, and the shifting of warehousing or just-in-time manufacturing to realize even lower transportation costs.[2] Economists call the difference between the amount people actually pay for something and the amount they would pay for the next most costly alternative, "consumer surplus." Consumer surplus is a monetary quantity that equates to the economic value (EV) of the reduced costs to mode-shifting shippers in this project and is shown in the figure below. The change in consumer surplus is evaluated using the equation provided below. This equation assumes the "rule-of-half" is being used. The rule of half is a simplification that assumes a linear approximation of the travel demand curve. The rule of half has been used to calculate this benefit category shown diagrammatically in the figure below.

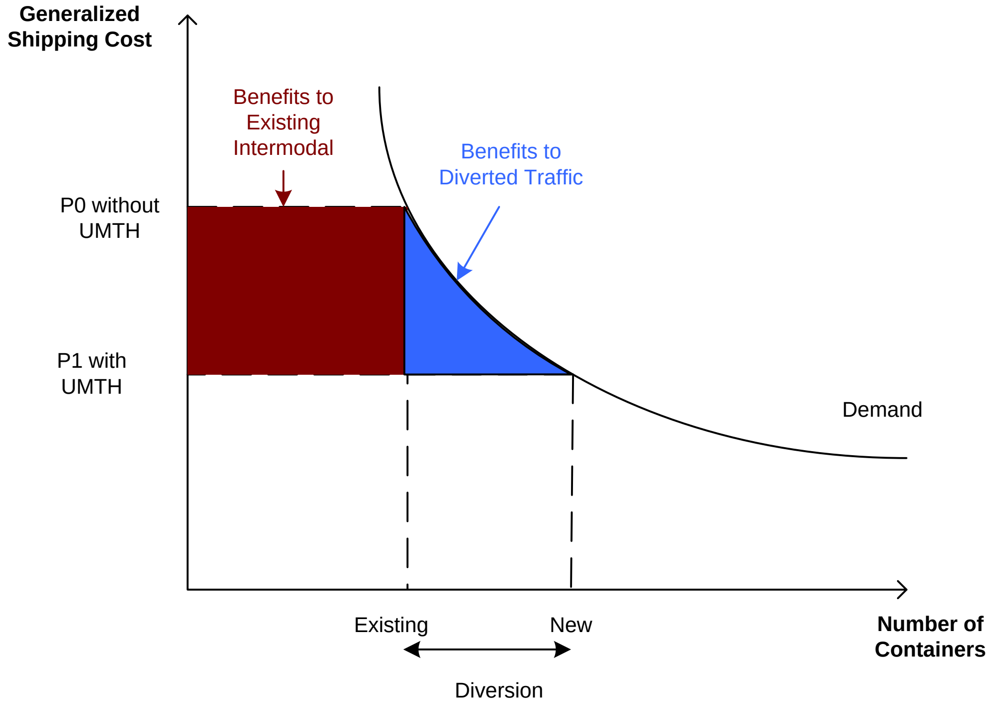
$$\Delta CS = \frac{1}{2}\sum_t (Q_t^0 + Q_t^1)(P_t^0 - P_t^1) \quad [1]$$

Where:

ΔCS = change in consumer surplus due to rail network improvements
t = time period
Q = number of containers during time period t
P = private cost of shipping (shipping rate)
0,1 = index denoting baseline scenario and improvement scenario respectively

[2] (Citation: NCHRP 586. Rail Freight Solutions to Roadway Congestion—Final Report and Guidebook). These additional costs savings would be realized in the long-run through lower prices for consumers.

Figure 1: Sources of Shipping Benefits



Reduction in Highway Congestion Costs from Displacing Heavy Truck Travel to Rail

The proposed UMTH project will divert freight from road to rail resulting in a reduction in the use of public highways by heavy trucks. This reduces highway traffic volume and thus traffic congestion leading to time savings to the remaining on-road motorists.

Emission Savings from Diverting Heavy Truck Travel to Rail

Freight carried over the rail network imposes less environmental impacts for the same amount of cargo than those imposed by trucks on the highway network. This benefit category estimates the value of the reduced environmental emissions associated with transporting goods on rail as opposed to by truck. The reduced amounts of Nitrogen Oxide (NOx), Carbon Dioxide (CO_2), Particulate Matter (PM), and Volatile Organic Compounds (VOCs) are calculated and monetized.

Reduced Accident Costs from Diverting Heavy Truck Travel to Rail

Fatality and injury rates per ton-mile of freight carried by truck are greater than the fatality and injury rates for an equal volume of cargo when shipped by rail. This benefit captures the different accident rates per truck ton-mile and train ton-mile, and the reduced amounts of injuries and fatalities of truck diversion to rail.

The main benefit categories associated with the project are mapped into the five long-term outcome criteria set forth by the DOT in the table below.

Table 1: Expected Effects on Long-Term Outcomes and Benefit Categories

Impact #	Long-Term Outcomes	Impact Categories	Description	Monetized	Quantified	Qualitative
1	**State of Good Repair**	Avoided Pavement Maintenance Costs	Modal switch from truck to rail will reduce annual pavement O&M costs per ton-mile	√		
2	**Economic Competitiveness**	Shipper Savings due to Modal Switch from Truck to Rail and Choice of More Direct Intermodal Routes	Modal switch from truck to rail will reduce total shipping costs (due to lower rail shipping rates). In addition, more direct routes from UMTH will offer savings to existing intermodal shippers.	√		
3		Short-term economic impacts*	Number of jobs expected to be created by the project, and related income.		√	
4		Induced Localized Demand	Intermodal terminal will induce additional businesses to ship who would otherwise not.			√
5	**Quality of Life**	Reduced Road Congestion due to Modal Switch from Truck to Rail	Modal switch from truck to rail will reduce highway congestion and generate time savings to other motorists.	√		
6	**Environmental Sustainability**	Emission Cost Savings due to Modal Switch from Truck to Rail	Modal switch from truck to rail will reduce the amounts of emissions.	√		
7	**Safety**	Accident Cost Savings due to Modal Switch from Truck to Rail	Modal switch from truck to rail will reduce the number of accidents and corresponding socio-economic costs.	√		

5. General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of construction (2014) and including 20 years of operations after construction completion in 2015. The benefits start accruing in 2016 after construction is completed.

The monetized benefits and costs are estimated in 2013 dollars with future dollars discounted to 2014 and in compliance with TIGER requirements using a 7 percent real rate, and a rate of 3 percent for sensitivity assessment.

The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are expressed in 2013 dollars;
- The period of analysis begins in 2014 and ends in 2035. It includes project development and construction years (2014 - 2015) and 20 years of operations (2016 - 2035);

- A constant 7 percent real discount rate is assumed throughout the period of analysis. A 3 percent real discount rate is used for sensitivity analysis;
- Annual demand ramps up conservatively to account for shifting demand forecasts; and
- Induced lifts have been estimated and subsequently removed from the annual lift diversions forecasts so as to be conservative in estimation of project benefits.

6. Demand Projections

Accurate demand projections are important to ensure the reasonable BCA output results. The magnitudes of the long-term benefits accruing over the Upper Midwest Transportation Hub study period are a function of the number of existing and projected truck and intermodal trips diverted to rail.

6.1 Methodology

The demand projections are based on the number of truck and intermodal trips in the build scenario. One key assumption is the source of the lifts for the intermodal operations. An assumption has been made that 1) existing intermodal moves will be diverted from more distant facilities, like Chicago and 2) there will be a conversion of current truck moves to intermodal as a consequence of the opening of UMTH. A conservative approach has been taken on the truck-miles saved as a consequence of the opening of UMTH, with 1) existing intermodal moves netting a 250 mile savings and 2) conversion from other truck moves netting 750 mile savings (from Origin/Destination sample with rail versus highway mileage to/from Manly, Iowa).[3]

The demand growth of diverted moves is segmented into lifts attributed to UMTH-South and UMTH-North. Growth estimates are based on engineering estimates and discussions with transportation companies. It should be emphasized that in general the Manly lift forecasts can be considered conservative. Comparing these forecasts (see Table 2 in the next section) with forecasts of truck movements to and from Iowa and Minnesota from FAF 3 database (see Table 2 in the main part of this application), it can be seen that for 2020 the number of lifts assumed for this BCA accounts for less than 1% of total truck movements.

The difference in diversion miles from the base case versus the build case is a function of a weighted average between the distance diverted from existing intermodal moves and the conversion from truck moves. The diverted intermodal moves and conversion from truck to intermodal each have an associated distance and a percentage share of the total lifts. The intermodal lift forecasts at this facility were then adjusted through removal of the estimated proportion of induced traffic in those lift estimates. Both the number of lifts and the estimated proportion of induced traffic vary year to year. The annual lift value is then multiplied by the proportion of lifts that are diverted intermodal moves and the proportion that comes from

[3] Based on an analysis of specific origin destination pairs using FAF 3 data that could reasonably be diverted to rail service.

truck to intermodal by the estimated distance per lift saved from diverted intermodal moves and from truck to intermodal diversions to get the total truck miles diverted to rail.

6.2 Assumptions

Table 2 below lists the key demand inputs used in the benefit-cost assessment of the UMTH project.

Table 2: Demand Input Assumptions

Year	UMTH-South Lifts	UMTH-North Lifts	UMTH Total Lifts	Percentage of Diverted Intermodal Moves	Percentage of Moves Diverted from Truck	Percentage of Induced Moves	UMTH Lifts Used in this BCA
2016	10,000	0	10,000	15%	85%	5%	9,500
2017	15,000	60,000	75,000	25%	75%	15%	63,750
2018	25,000	90,000	115,000	30%	70%	20%	92,000
2019	25,625	108,000	133,625	37%	63%	25%	100,219
2020	26,266	129,600	155,866	39%	61%	28%	113,003
2021	26,922	155,520	182,442	40%	60%	29%	129,534
2022	27,595	174,182	201,778	35%	65%	30%	141,244
2023	28,285	195,084	223,369	30%	70%	33%	150,774
2024	28,992	218,494	247,487	30%	70%	35%	160,866
2025	29,717	244,714	274,431	30%	70%	35%	178,380
2026	30,460	274,079	304,539	30%	70%	35%	197,951
2027	31,222	279,561	310,783	30%	70%	35%	202,009
2028	32,002	285,152	317,154	30%	70%	35%	206,150
2029	32,802	290,855	323,657	30%	70%	35%	210,377
2030	33,622	296,672	330,295	30%	70%	35%	214,691
2031	34,463	302,606	337,069	30%	70%	35%	219,095
2032	35,324	308,658	343,982	30%	70%	35%	223,588
2033	36,207	314,831	351,039	30%	70%	35%	228,175
2034	37,113	321,128	358,240	30%	70%	35%	232,856
2035	38,040	327,550	365,591	30%	70%	35%	237,634

6.3 Demand Projections

The resulting projections for the truck miles diverted (based on the savings of 250 miles for intermodal moves and 750 miles for truck moves) are shown in the table below.

Table 3: Projections of Truck Miles Saved

Year of Operation	Truck Miles Saved Per Year, by Year
2016	6,412,500
2017	39,843,750
2018	55,200,000
2019	56,623,594
2020	62,716,431
2021	71,243,705
2022	81,215,533
2023	90,464,645
2024	96,519,828
2025	107,028,041
2026	118,770,386
2027	121,205,191
2028	123,690,177
2029	126,226,384
2030	128,814,876
2031	131,456,737
2032	134,153,074
2033	136,905,018
2034	139,713,723
2035	142,580,367

7. Benefits Measurement, Data and Assumptions

This section describes the measurement approach used for each benefit or impact category identified in Table 1 (Expected Effects on Long Term Outcomes and Benefit Categories) and provides an overview of the associated methodology, assumptions, and estimates.

7.1 State of Good Repair

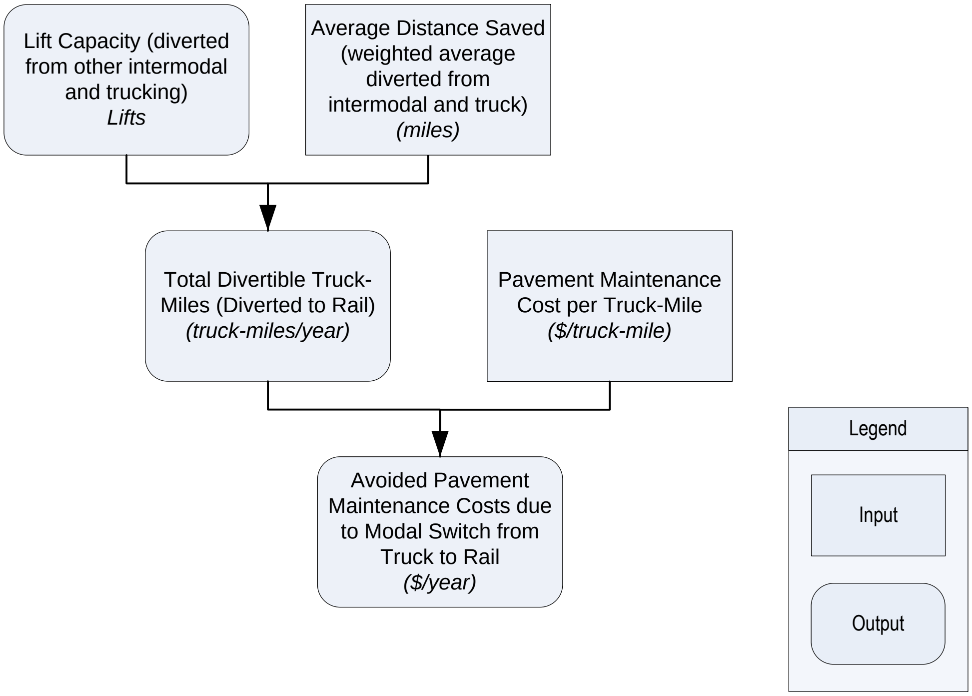
To quantify the benefits associated with maintaining the existing transportation network in a state of good repair, *Reduction in Maintenance Costs from Displacing Heavy Truck Travel to Rail* is monetized.

7.1.1 Methodology

Reduction in Maintenance Costs from Displacing Heavy Truck Travel to Rail

An avoidance of heavy trucks on the highway system reduces highway maintenance costs and in particular pavement re-surfacing and maintenance costs. Typically, this benefit is realized in terms of increased cycle times between maintenance work orders. This benefit category captures the reduced maintenance cost associated with diverting freight shipments from truck to rail. The total diverted truck miles are applied to highway maintenance cost per truck -mile to calculate highway maintenance costs. Figure 2 below provides the structure and logic (S&L) diagram for the calculation.

Figure 2: Reduction in Highway Maintenance S&L



7.1.2 Assumptions

The assumptions used in the estimation of State-of-Good-Repair benefits are summarized in the table below.

Table 4: Assumptions used in the Estimation of State-of-Good-Repair Benefits

Input #	Input Name	Units	Value	Source/Comment
1	Total Divertible Truck -miles - 2016	truck-VMT	6,412,500	Based on detailed market analysis conducted by IANR and Florilli using FAF 3 data assessing specific origin destination pairs amenable to truck and rail diversion.
2	Total Divertible Truck-miles - 2017	truck-VMT	39,843,750	
3	Total Divertible Truck -miles - 2018	truck-VMT	55,200,000	
4	Total Divertible Truck-miles - 2019	truck-VMT	56,623,594	
5	Total Divertible Truck-miles - 2020	truck-VMT	62,716,431	
6	Total Divertible Truck-miles - 2021	truck-VMT	71,243,705	
7	Total Divertible Truck-miles - 2022	truck-VMT	81,215,533	
8	Total Divertible Truck-miles - 2023	truck-VMT	90,464,645	
9	Total Divertible Truck-miles - 2024	truck-VMT	96,519,828	
10	Total Divertible Truck-miles - 2025	truck-VMT	107,028,041	
11	Total Divertible Truck-miles - 2026	truck-VMT	118,770,386	
12	Total Divertible Truck-miles - 2027	truck-VMT	121,205,191	

13	Total Divertible Truck-miles - 2028	truck-VMT	123,690,177	
14	Total Divertible Truck-miles - 2029	truck-VMT	126,226,384	
15	Total Divertible Truck-miles - 2030	truck-VMT	128,814,876	
16	Total Divertible Truck-miles - 2031	truck-VMT	131,456,737	
17	Total Divertible Truck-miles - 2032	truck-VMT	134,153,074	
18	Total Divertible Truck-miles - 2033	truck-VMT	136,905,018	
19	Total Divertible Truck-miles - 2034	truck-VMT	139,713,723	
20	Total Divertible Truck-miles - 2035	truck-VMT	142,580,367	
21	Total Divertible Truck-miles - 2035	truck-VMT	145,506,153	
22	Pavement Maintenance Cost	$/Truck Mile	$0.2061	HDR Calculations based on the Addendum to the 1997 Federal Highway Cost Allocation Study, Final Report, U.S. Department of Transportation and Federal Highway Administration, May 2000; Table 13. Assuming 50/50 split of 60,80 kip and 35/65 urban/rural split.

7.1.3 Benefit Estimates

The benefit estimates to reduced pavement maintenance costs are shown in the table below. This benefit category accounts for roughly 14% of the total benefits of this build case.

Table 5: Estimates of State-of-Good-Repair Benefits, Millions of 2013$

	In Project Opening Year, Discounted at 7 Percent	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Avoided Pavement Maintenance Costs	$1.15	$406.14	$171.72

7.2 Economic Competitiveness

The proposed project would contribute to enhancing the economic competitiveness of the Nation through improvements in the mobility of goods within and across the study area. In this analysis, one measure of mobility is presented: *Transportation Cost Savings*.

Rail shipping rates tend to be lower than truck shipping rates on a per ton-mile basis. This generates a transportation cost savings to shippers/receivers.

Also presented in this section are estimates of the economic impacts of the project. These include short-terms impacts due to construction as well as long-term permanent impacts due to facility operations and additional (external or ancillary) activity attracted to the vicinity of the proposed facility.

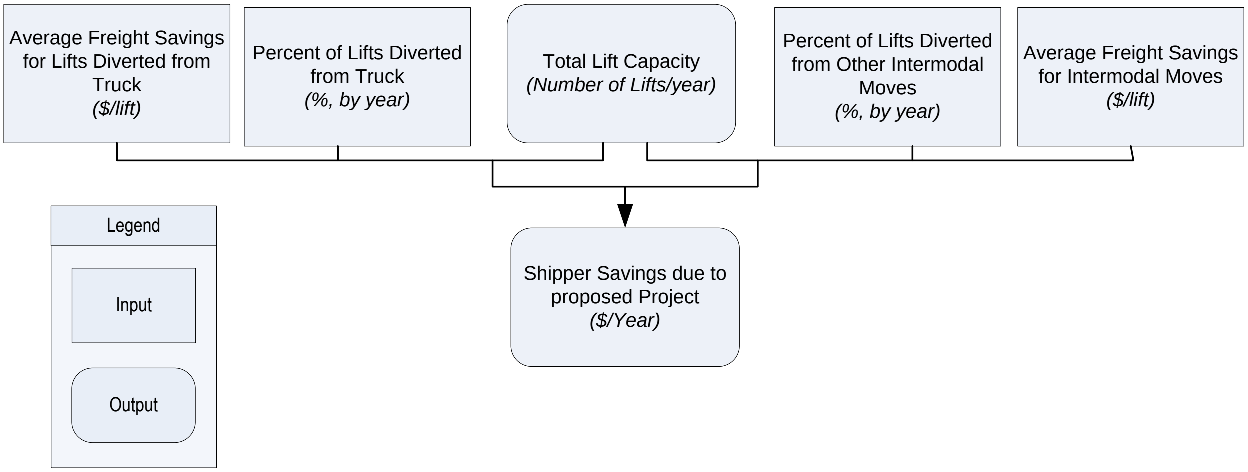
7.2.1 Methodology

Reduced Transportation Costs from Diverting Heavy Truck Travel to Rail and Reduced Transportation Costs from Diverting Existing Intermodal Shipments to More Direct Routes out of UMTH

Rail shipping rates tend to be lower than truck shipping rates on a per ton-mile basis. As such, diversion of highway freight to rail can generate cost savings to shippers. In addition, the proposed project would offer for some existing intermodal shipments more direct – and thus less costly – shipping routes. In other words, the UMTH facility would reduce shipping costs on a 'per lift' basis, with cost reductions attributed to diverting both existing intermodal and truck-only freight. The category of cost savings relating to the diversion of truck-only freight to rail is attributed to 'new users' of the rail system. As such, it is appropriate to apply the '50% rule' when accounting for this consumer surplus change. Consumer surplus is a monetary quantity that equates to the economic value (EV) of the additional transportation options to users (here shippers of freight) through the new project.

Transportation cost savings are quantified using the calculation of the volume of truck ton-miles avoided and relative shipping rates. Rates were converted into a 'per lift' basis by Iowa Northern Railway Company (IANR). Florilli Logistics, an Iowa based trucking company that handles large volumes of both refrigerated and dry freight within the region and the entire country, compared the assumptions with confidential traffic flow data in-house and confirmed that the assumptions by IANR were reasonable. The benefits in this category are counted as public because the difference in transportation costs between rail intermodal and truckload freight accrue directly to the shipper and receiver lowering the final price consumers pay. The figure below outlines the methodology for quantifying this benefit.

Figure 3: Reduced Transportation Costs S&L



7.2.2 Assumptions

The assumptions used in the estimation of shipping cost reductions are summarized in the table below. Note that input called "Total Lifts (by year)" represents total lifts in UMTH reduced by the percentage of lifts which are expected to represent induced traffic.

Table 6: Assumptions used in the Estimation of Transportation Cost Savings

Input #	Input Name	Units	Value	Source/Comment
3	Total Lifts - 2016	#/year	9,500	Based on detailed market analysis conducted by IANR and Florilli using FAF 3 data assessing specific origin destination pairs amenable to truck and rail diversion.
4	Total Lifts - 2017	#/year	63,750	
5	Total Lifts - 2018	#/year	92,000	
6	Total Lifts - 2019	#/year	100,219	
7	Total Lifts - 2020	#/year	113,003	
8	Total Lifts - 2021	#/year	129,534	
9	Total Lifts - 2022	#/year	141,244	
10	Total Lifts - 2023	#/year	150,774	
11	Total Lifts - 2024	#/year	160,866	
12	Total Lifts - 2025	#/year	178,380	
13	Total Lifts - 2026	#/year	197,951	
14	Total Lifts - 2027	#/year	202,009	
15	Total Lifts - 2028	#/year	206,150	
16	Total Lifts - 2029	#/year	210,377	
17	Total Lifts - 2030	#/year	214,691	
18	Total Lifts - 2031	#/year	219,095	
19	Total Lifts - 2032	#/year	223,588	
20	Total Lifts - 2033	#/year	228,175	
21	Total Lifts - 2034	#/year	232,856	
22	Total Lifts - 2035	#/year	237,634	
23	Percentage Diverted of Intermodal Moves - 2016	%	15%	
24	Percentage Diverted of Intermodal Moves - 2017	%	25%	
25	Percentage Diverted of Intermodal Moves - 2018	%	30%	
26	Percentage Diverted of Intermodal Moves - 2019	%	37%	
27	Percentage Diverted of Intermodal Moves - 2020	%	39%	
28	Percentage Diverted of Intermodal Moves - 2021	%	40%	
29	Percentage Diverted of Intermodal Moves - 2022	%	35%	
30	Percentage Diverted of Intermodal Moves - 2023	%	30%	
31	Percentage Diverted of Intermodal Moves - 2024	%	30%	
32	Percentage Diverted of Intermodal Moves - 2025	%	30%	
33	Percentage Diverted of Intermodal Moves - 2026	%	30%	
34	Percentage Diverted of Intermodal Moves - 2027	%	30%	
35	Percentage Diverted of Intermodal Moves - 2028	%	30%	
36	Percentage Diverted of Intermodal Moves - 2029	%	30%	
37	Percentage Diverted of Intermodal Moves - 2030	%	30%	

38	Percentage Diverted of Intermodal Moves - 2031	%	30%	
39	Percentage Diverted of Intermodal Moves - 2032	%	30%	
40	Percentage Diverted of Intermodal Moves - 2033	%	30%	
41	Percentage Diverted of Intermodal Moves - 2034	%	30%	
42	Percentage Diverted of Intermodal Moves - 2035	%	30%	
43	Freight Savings Per Lift: Diverted Intermodal - 2016	$/Lift	$350	
44	Freight Savings Per Lift: Diverted Intermodal - 2017	$/Lift	$350	
45	Freight Savings Per Lift: Diverted Intermodal - 2018	$/Lift	$350	
46	Freight Savings Per Lift: Diverted Intermodal - 2019	$/Lift	$350	
47	Freight Savings Per Lift: Diverted Intermodal - 2020	$/Lift	$350	
48	Freight Savings Per Lift: Diverted Intermodal - 2021	$/Lift	$350	
49	Freight Savings Per Lift: Diverted Intermodal - 2022	$/Lift	$350	
50	Freight Savings Per Lift: Diverted Intermodal - 2023	$/Lift	$350	
51	Freight Savings Per Lift: Diverted Intermodal - 2024	$/Lift	$350	
52	Freight Savings Per Lift: Diverted Intermodal - 2025	$/Lift	$350	
53	Freight Savings Per Lift: Diverted Intermodal - 2026	$/Lift	$350	
54	Freight Savings Per Lift: Diverted Intermodal - 2027	$/Lift	$350	
55	Freight Savings Per Lift: Diverted Intermodal - 2028	$/Lift	$350	
56	Freight Savings Per Lift: Diverted Intermodal - 2029	$/Lift	$350	
57	Freight Savings Per Lift: Diverted Intermodal - 2030	$/Lift	$350	
58	Freight Savings Per Lift: Diverted Intermodal - 2031	$/Lift	$350	
59	Freight Savings Per Lift: Diverted Intermodal - 2032	$/Lift	$350	
60	Freight Savings Per Lift: Diverted Intermodal - 2033	$/Lift	$350	
61	Freight Savings Per Lift: Diverted Intermodal - 2034	$/Lift	$350	
62	Freight Savings Per Lift: Diverted Intermodal - 2035	$/Lift	$350	
63	Percentage Diverted From Truck to Intermodal - 2016	%	85%	
64	Percentage Diverted From Truck to Intermodal - 2017	%	75%	
65	Percentage Diverted From Truck to Intermodal - 2018	%	70%	
66	Percentage Diverted From Truck to Intermodal - 2019	%	63%	
67	Percentage Diverted From Truck to Intermodal - 2020	%	61%	
68	Percentage Diverted From Truck to Intermodal - 2021	%	60%	
69	Percentage Diverted From Truck to Intermodal - 2022	%	65%	
70	Percentage Diverted From Truck to Intermodal - 2023	%	70%	
71	Percentage Diverted From Truck to Intermodal - 2024	%	70%	
72	Percentage Diverted From Truck to Intermodal - 2025	%	70%	
73	Percentage Diverted From Truck to Intermodal - 2026	%	70%	
74	Percentage Diverted From Truck to Intermodal - 2027	%	70%	
75	Percentage Diverted From Truck to Intermodal - 2028	%	70%	
76	Percentage Diverted From Truck to Intermodal - 2029	%	70%	
77	Percentage Diverted From Truck to Intermodal - 2030	%	70%	
78	Percentage Diverted From Truck to Intermodal - 2031	%	70%	
79	Percentage Diverted From Truck to Intermodal - 2032	%	70%	

80	Percentage Diverted From Truck to Intermodal - 2033	%	70%	
81	Percentage Diverted From Truck to Intermodal - 2034	%	70%	
82	Percentage Diverted From Truck to Intermodal - 2035	%	70%	
83	Freight Savings Per Lift: Diverted From Truck - 2016	$/Lift	$450	
84	Freight Savings Per Lift: Diverted From Truck - 2017	$/Lift	$450	
85	Freight Savings Per Lift: Diverted From Truck - 2018	$/Lift	$450	
86	Freight Savings Per Lift: Diverted From Truck - 2019	$/Lift	$450	
87	Freight Savings Per Lift: Diverted From Truck - 2020	$/Lift	$450	
89	Freight Savings Per Lift: Diverted From Truck - 2021	$/Lift	$450	
90	Freight Savings Per Lift: Diverted From Truck - 2022	$/Lift	$450	
91	Freight Savings Per Lift: Diverted From Truck - 2023	$/Lift	$450	
92	Freight Savings Per Lift: Diverted From Truck - 2024	$/Lift	$450	
93	Freight Savings Per Lift: Diverted From Truck - 2025	$/Lift	$450	
94	Freight Savings Per Lift: Diverted From Truck - 2026	$/Lift	$450	
95	Freight Savings Per Lift: Diverted From Truck - 2027	$/Lift	$450	
96	Freight Savings Per Lift: Diverted From Truck - 2028	$/Lift	$450	
97	Freight Savings Per Lift: Diverted From Truck - 2029	$/Lift	$450	
98	Freight Savings Per Lift: Diverted From Truck - 2030	$/Lift	$450	
99	Freight Savings Per Lift: Diverted From Truck - 2031	$/Lift	$450	
100	Freight Savings Per Lift: Diverted From Truck - 2032	$/Lift	$450	
101	Freight Savings Per Lift: Diverted From Truck - 2033	$/Lift	$450	
102	Freight Savings Per Lift: Diverted From Truck - 2034	$/Lift	$450	
103	Freight Savings Per Lift: Diverted From Truck - 2035	$/Lift	$450	

7.2.3 Benefit Estimates

The table below shows the benefit estimates of transportation cost savings due to the UMTH project. Shipper cost savings from modal switch and shorter intermodal routes accounts for about 29% of the total benefits generated with this project.

Table 7: Estimates of Transportation Cost Savings, Millions of 2013$

	In Project Opening Year, Discounted at 7%	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Shipper Savings due to Modal Switch from Truck to Rail and Choice of More Direct Intermodal Routes	$2.02	$873.42	$371.46

7.2.4 Estimation of Short-Term Economic Impacts

The Minnesota IMPLAN Group's input-output model has been used to estimate the short-term direct, indirect and induced effects of the UMTH project, in terms of employment, labor income and value added.

Employment effects represent full-time and part-time jobs created for a full year (unless noted otherwise). Labor income consists of total employee compensation (wage and salary payments, as well as health and life insurance benefits, retirement payments and any other non-cash compensation) and proprietary income (payments received by self-employed individuals as income). Value added represents total business sales (output) minus the cost of purchasing intermediate products and is roughly equivalent to gross regional/domestic product.

Estimated spending on project engineering, construction, procurement and IT integration (capital expenditures) between 2014 and 2015 is used to compute short-term economic impacts.

The project is expected to generate 394.7 job-years during the project development phase. It is also expected to create $31.57 million in value added, including $22.14 million in labor income. A breakdown of short-term impacts by type of effect (direct, indirect and induced) is provided in the table below.

Table 8: Project Spending and Economic Impacts (Direct, Indirect and Induced) during Project Development Phase

Category of Impact	Spending (Millions of 2013 Dollars)	Economic Impacts			
		Direct	Indirect	Induced	Total
Employment*	$23.37	165.2	90.1	139.4	394.7
Labor Income**		$9.60	$5.76	$6.78	$22.14
Value Added**		$10.40	$9.14	$12.03	$31.57

*Note: * Employment impacts from IMPLAN reflect total employment (full time plus part time). On average, the ratio of FTE to total employment is estimated at 90 percent. **Millions of 2013 Dollars.*

Another method to estimate job-years from additional spending uses the Council of Economic Advisors' (CEA) methodology as presented in a 2011 analysis[4]. This method assumes that for every $76,923 of government spending, one job-year is created. The following table shows the difference in job-year estimates using the IMPLAN and CEA methodologies.

Note that the estimated employment impacts are lower when using CEA's approach. Specifically, the simplified computation produces a more conservative estimate of 303.8 job-years (including 194.4 direct and indirect job-years and 109.4 induced jobs-years).

Table 9: Project Spending and Job-Year Estimates with IMPLAN and CEA Methodologies

	Spending (Millions of 2013 Dollars)	Employment Impacts (Job-Years)			
		Direct	Indirect	Induced	Total
IMPLAN *	$23.37	165.2	90.1	139.4	394.7
CEA		194.4		109.4	303.8

*Note: * Employment impacts from IMPLAN should not be interpreted as full-time equivalent (FTE) as they reflect the mix of full and part time jobs that is typical for each sector.*

[4] Executive Office of the President, Council of Economic Advisers, "Estimates of Job Creation from the American Recovery and Reinvestment Act of 2009," Washington, D.C., May 11, 2009; and September 2011 Update.

A breakdown of short-term economic impacts (using IMPLAN estimates) in terms of employment (job-hours), labor income and value added is provided by quarter in the table below.

Table 10: Project Spending and Short-Term Economic Impacts by Quarter

Period	Spending (Millions of 2013 Dollars)*	Economic Impacts			
		Total Job-Hours**	Direct Job-Hours**	Total Labor Income (Millions of 2013 Dollars)	Total Value Added (Millions of 2013 Dollars)
2014 - Q3	$0.38	12,830.7	5,862.8	$0.40	$0.56
2014 - Q4	$0.38	12,830.7	5,862.8	$0.40	$0.56
2015 - Q1	$5.65	170,607.6	71,160.8	$5.34	$7.61
2015 - Q2	$5.65	170,607.6	71,160.8	$5.34	$7.61
2015 - Q3	$5.65	170,607.6	71,160.8	$5.34	$7.61
2015 - Q4	$5.65	170,607.6	71,160.8	$5.34	$7.61
Total	**$23.37**	**708,091.8**	**296,368.8**	**$22.14**	**$31.57**

*Notes: * based on project spending on construction ($24.61 million); ** assuming average weekly hours of 34.5 (Bureau of Labor Statistics estimate).*

The table below presents the short-term increase in employment and labor income resulting from capital expenditures in key industries employing low-income people. 64.8 cumulative job-years (or 16.4 percent of total job-years) are expected to be created in those industries by the end of 2015, bringing in an additional $1.96 million in labor income.

Table 11: Short-Term Impacts in Key Industries Employing Low-Income People

Sectors	Employment (Job-Years)	Labor Income (Millions of 2012 Dollars)
Retail Industries	27.1	$0.90
Services to buildings and dwellings	4.6	$0.12
Other business services	4	$0.14
Food services and drinking places	15.1	$0.35
Hotel/accommodation services	2	$0.08
Personal care and other personal Services	12	$0.38
Total	**64.8**	**$1.96**

Note: Low-income sectors are identified in BLS, A Profile of the Working Poor, March 2009; BLS, Characteristics of Minimum Wage Workers, March 2009; and Carsey Institute, Issue Brief No. 2, Summer 2008.

7.2.5 Estimation of Long-Term Economic Impacts

The UMTH project will also create long-term job opportunities stemming from the expenditures on operations and maintenance. Unlike construction effects, these are long-term annual effects which contribute to the region's and national economic footprint on a long-term (permanent) basis. Since expenditures on operations and maintenance vary by year and increase over time as the scale of operations increases, the impacts are estimated – as an illustration – for three selected years: 2016 (the first year of operations), 2021, and 2026.

As for short-term impacts, the Minnesota IMPLAN Group's input-output model has been used to estimate the impacts in terms of direct, indirect and induced effects. The results are shown in Table 12. The table shows that in the opening year, the UMTH is expected to generate 26.5 job years and a total of 59.6 job-years. These are expected to increase as the scale of operations increases. By 2026, the UMTH is expected to generate nearly 254 direct job years and a total of 571.4 job-years.

Table 12: Economic Impacts of the UMTH Project, Annual for Selected Years

	O&M Spending (Millions of 2013 Dollars)*	Direct	Indirect	Induced	Total
Calendar Year 2016					
Employment*	$2.86	26.5	12.1	21	59.6
Labor Income**		$1.63	$1.66	$2.86	$6.16
Value Added**		$0.63	$0.94	$1.67	$3.24
Calendar Year 2021					
Employment*	$19.30	178.7	81.5	141.9	402.1
Labor Income**		$11.03	$11.20	$19.30	$41.53
Value Added**		$4.28	$6.32	$11.28	$21.88
Calendar Year 2026					
Employment*	$27.42	253.9	115.8	201.7	571.4
Labor Income**		$15.67	$15.92	$27.42	$59.00
Value Added**		$6.08	$8.98	$16.03	$31.10

*Note: * Employment impacts from IMPLAN reflect total employment (full time plus part time). On average, the ratio of FTE to total employment is estimated at 90 percent. **Millions of 2013 Dollars.*

7.2.6 Estimation of External Long-Term Impacts

As indicated earlier, the UMTH is expected to attract economic activity that would likely not take place in the absence of the hub. The impact of one of such ancillary activities, cold storage warehousing, is quantified in this section. The related investment and operational activities will also generate jobs and economic opportunities in the same way as the construction and operational activities at the hub itself. Specifically, it is estimated that the attracted investment would amount to about $20 million and the annual operation and maintenance expenditures related to the resulting activities would amount to $1.77 annually. Table 13 and Table 14 present the impacts of capital expenditures and operating expenditures, respectively, related to the investment and operating activities in question.

Table 13: Economic Impacts of Capital Expenditures Related to Ancillary Operations

	Spending (Millions of 2013 Dollars)*	Direct	Indirect	Induced	Total
Employment*	$20.00	164.7	84.4	131.8	380.9
Labor Income**		$9.83	$10.78	$20.00	$40.61
Value Added**		$4.55	$7.38	$15.45	$27.39

*Note: * Employment impacts from IMPLAN reflect total employment (full time plus part time). On average, the ratio of FTE to total employment is estimated at 90 percent. **Millions of 2013 Dollars.*

Table 14: Economic Impacts of Operations and Maintenance Expenditures Related to Ancillary Operations

	Spending (Millions of 2013 Dollars)*	Direct	Indirect	Induced	Total
Employment*	$1.77	19.3	5.7	10.8	35.8
Labor Income**		$0.89	$1.17	$1.77	$3.83
Value Added**		$0.28	$0.49	$0.83	$1.60

*Note: * Employment impacts from IMPLAN reflect total employment (full time plus part time). On average, the ratio of FTE to total employment is estimated at 90 percent. **Millions of 2013 Dollars.*

7.3 Quality of Life

The proposed project would contribute to enhancing livability and quality of life in the study area through the reduction in highway congestion from displacing heavy truck travel to rail. This represents the travel time savings of the remaining on-road motorists.

7.3.1 Methodology

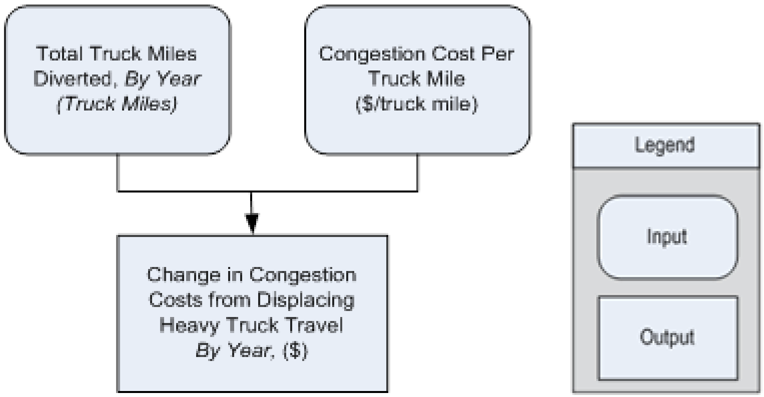
Reduction in Highway Congestion Costs from Displacing Heavy Truck Travel to Rail

The proposed UMTH project will divert freight from road to rail resulting in a reduction in the use of public highways by heavy trucks. This benefit category estimates the avoided highway congestion costs by applying the total diverted truck miles to a rate of congestion cost per mile.

It should also be noted that increased goods shipment by rail increase traffic on the rail network. Congestion delays do occur on railroads, but costs of delays to trains are internal because one carrier is responsible for all the freight on the rail system. Therefore the cost of congestion is included in the rail rate cost and the external social cost is assumed equal to zero.[5] The figure below outlines the structure and logic model of the benefit calculation.

[5] Transportation Research Board. Paying Our Way: Estimating Marginal Social Costs of Freight Transportation. 1996.

Figure 4: Reduction in Highway Congestion Costs



7.3.2 Assumptions

The assumptions used in the estimation of livability benefits are summarized in the table below.

Table 15: Assumptions used in the Estimation of Livability Benefits

Input #	Input Name	Units	Value	Source/Comment
1	Truck Congestion Cost	$/mile	$0.1290	HDR Calculations based on the Addendum to the 1997 Federal Highway Cost Allocation Study, Final Report, U.S. Department of Transportation and Federal Highway Administration, May 2000; Table 13. Assuming 50/50 split of 60,80 kip and 35/65 urban/rural split.
2	Rail Congestion Cost	$/mile	$0.00	Congestion delays occur on railroads, but costs of delays to trains are internal because one carrier is responsible for all the freight on the rail system. Therefore the cost of congestion is included in the rail rate cost. Transportation Research Board. Paying Our Way: Estimating Marginal Social Costs of Freight Transportation. 1996.
3	Truck Miles Diverted to Rail - 2016	miles/year	6,412,500	Based on detailed market analysis conducted by IANR and Florilli using FAF 3 data assessing specific origin destination pairs amenable to truck and rail diversion.
4	Truck Miles Diverted to Rail - 2017	miles/year	39,843,750	
5	Truck Miles Diverted to Rail - 2018	miles/year	55,200,000	
6	Truck Miles Diverted to Rail - 2019	miles/year	56,623,594	
7	Truck Miles Diverted to Rail - 2020	miles/year	62,716,431	
8	Truck Miles Diverted to Rail - 2021	miles/year	71,243,705	
9	Truck Miles Diverted to Rail - 2022	miles/year	81,215,533	
10	Truck Miles Diverted to Rail - 2023	miles/year	90,464,645	
11	Truck Miles Diverted to Rail - 2024	miles/year	96,519,828	

12	Truck Miles Diverted to Rail - 2025	miles/year	107,028,041	
13	Truck Miles Diverted to Rail - 2026	miles/year	118,770,386	
14	Truck Miles Diverted to Rail - 2027	miles/year	121,205,191	
15	Truck Miles Diverted to Rail - 2028	miles/year	123,690,177	
16	Truck Miles Diverted to Rail - 2029	miles/year	126,226,384	
17	Truck Miles Diverted to Rail - 2030	miles/year	128,814,876	
18	Truck Miles Diverted to Rail - 2031	miles/year	131,456,737	
19	Truck Miles Diverted to Rail - 2032	miles/year	134,153,074	
20	Truck Miles Diverted to Rail - 2033	miles/year	136,905,018	
21	Truck Miles Diverted to Rail - 2034	miles/year	139,713,723	
22	Truck Miles Diverted to Rail - 2035	miles/year	142,580,367	

7.3.3 Benefit Estimates

The table below shows the benefit estimates of road congestion savings due to the UMTH project. Congestion savings from modal switch and shorter intermodal routes accounts for roughly 9% of the total benefits generated with this project.

Table 16: Estimates of Quality of Life Benefits, Millions of 2013$

	In Project Opening Year, Discounted at 7%	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Reduced Road Congestion due to Modal Switch from Truck to Rail	$0.72	$254.27	$107.50

7.4 Environmental Sustainability

The proposed project would contribute to environmental sustainability through emission savings from diverting heavy truck travel to rail.

7.4.1 Methodology

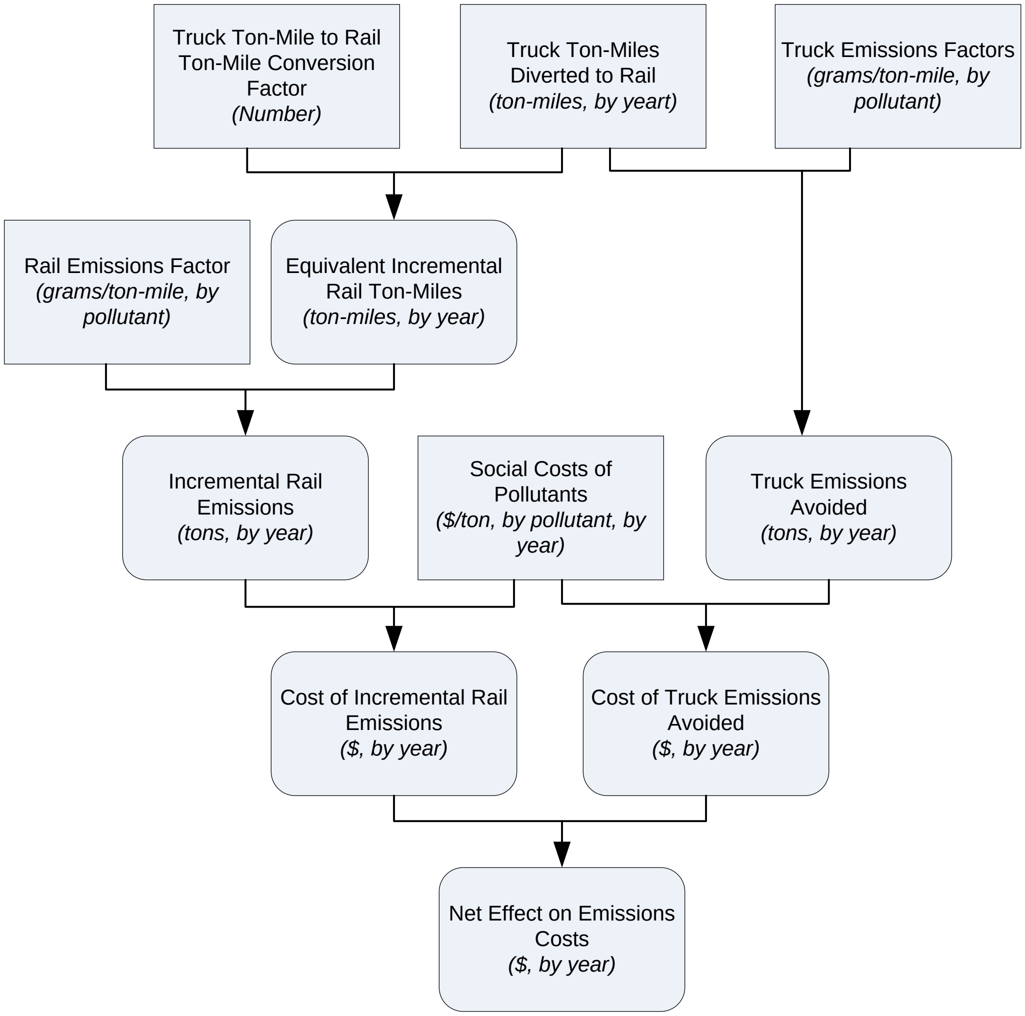
Emission Savings from Diverting Heavy Truck Travel to Rail

Freight carried over the rail network imposes less environmental impacts for the same amount of cargo than those imposed by trucks on the highway network. This benefit category estimates the value of the reduced environmental emissions associated with transporting goods on rail as opposed to by truck. The amount of greenhouse gas (GHG) and critical air contaminants (CAC) are calculated on the basis of pollutants generated per ton-mile travelled by truck and train.

Truck ton-miles diverted to rail are estimated by multiplying truck miles diverted (as shown in previous tables, e.g. Table 15) by the average truck load. The estimated truck ton-miles diverted from truck to rail are then multiplied by truck emissions factors (grams of pollutants per truck-ton mile) to calculate the amounts of pollutant emissions avoided.

Truck ton-miles diverted to rail are also multiplied by a truck-mile to rail-mile conversion factor to obtain the equivalent train ton-miles. These are then multiplied by rail emissions factors (grams of pollutants per train ton-mile) to obtain the incremental rail emissions due to diversion of truck shipments. The difference between the two sets of emissions multiplied by the social costs of emissions gives the net impact on emissions. The structure and logic model outlining this calculation is provided in the figure below.

Figure 5: Emission Savings S&L



7.4.2 Assumptions

The key assumptions used in the estimation of sustainability benefits are summarized in the table below.

Table 17: Assumptions used in the Estimation of Environmental Sustainability Benefits

Input #	Input Name	Units	Value	Source/Comment
1	Grams of NOx per truck ton-mile - 2014	grams/TM	0.42	United States Environmental Protection Agency, Motor
2	Grams of NOx per truck ton-mile - 2015	grams/TM	0.38	

3	Grams of NOx per truck ton-mile - 2016	grams/TM	0.35	Vehicle Emission Simulator, 2010.
4	Grams of NOx per truck ton-mile - 2017	grams/TM	0.32	
5	Grams of NOx per truck ton-mile - 2018	grams/TM	0.29	
6	Grams of NOx per truck ton-mile - 2019	grams/TM	0.27	
7	Grams of NOx per truck ton-mile - 2020	grams/TM	0.25	
8	Grams of NOx per truck ton-mile - 2021	grams/TM	0.23	
9	Grams of NOx per truck ton-mile - 2022	grams/TM	0.22	
10	Grams of NOx per truck ton-mile - 2023	grams/TM	0.21	
11	Grams of NOx per truck ton-mile - 2024	grams/TM	0.20	
12	Grams of NOx per truck ton-mile - 2025	grams/TM	0.19	
13	Grams of NOx per truck ton-mile - 2026	grams/TM	0.18	
14	Grams of NOx per truck ton-mile - 2027	grams/TM	0.18	
15	Grams of NOx per truck ton-mile - 2028	grams/TM	0.17	
16	Grams of NOx per truck ton-mile - 2029	grams/TM	0.17	
17	Grams of NOx per truck ton-mile - 2030	grams/TM	0.17	
18	Grams of NOx per truck ton-mile - 2031	grams/TM	0.16	
19	Grams of NOx per truck ton-mile - 2032	grams/TM	0.16	
20	Grams of NOx per truck ton-mile - 2033	grams/TM	0.16	
21	Grams of NOx per truck ton-mile - 2034	grams/TM	0.16	
22	Grams of NOx per truck ton-mile - 2035	grams/TM	0.16	
23	Grams of NOx per truck ton-mile - 2036	grams/TM	0.16	
24	Grams of NOx per train ton-mile - 2014	grams/TM	0.28	United States Environmental Protection Agency, Office of Transportation and Air Quality, "Emission Factors for Locomotives", EPA-420-F-09-025, April 2009.
25	Grams of NOx per train ton-mile - 2015	grams/TM	0.27	
26	Grams of NOx per train ton-mile - 2016	grams/TM	0.25	
27	Grams of NOx per train ton-mile - 2017	grams/TM	0.24	
28	Grams of NOx per train ton-mile - 2018	grams/TM	0.23	
29	Grams of NOx per train ton-mile - 2019	grams/TM	0.21	
30	Grams of NOx per train ton-mile - 2020	grams/TM	0.21	
31	Grams of NOx per train ton-mile - 2021	grams/TM	0.20	
32	Grams of NOx per train ton-mile - 2022	grams/TM	0.19	
33	Grams of NOx per train ton-mile - 2023	grams/TM	0.18	
34	Grams of NOx per train ton-mile - 2024	grams/TM	0.16	
35	Grams of NOx per train ton-mile - 2025	grams/TM	0.15	
36	Grams of NOx per train ton-mile - 2026	grams/TM	0.14	
37	Grams of NOx per train ton-mile - 2027	grams/TM	0.14	
38	Grams of NOx per train ton-mile - 2028	grams/TM	0.13	
39	Grams of NOx per train ton-mile - 2029	grams/TM	0.12	
40	Grams of NOx per train ton-mile - 2030	grams/TM	0.11	
41	Grams of NOx per train ton-mile - 2031	grams/TM	0.10	
42	Grams of NOx per train ton-mile - 2032	grams/TM	0.10	
43	Grams of NOx per train ton-mile - 2033	grams/TM	0.09	
44	Grams of NOx per train ton-mile - 2034	grams/TM	0.08	

45	Grams of NOx per train ton-mile - 2035	grams/TM	0.08	
46	Grams of NOx per train ton-mile - 2036	grams/TM	0.07	
47	Grams of CO2 per truck ton-mile - 2014	grams/TM	102.92	United States Environmental Protection Agency, Motor Vehicle Emission Simulator, 2010.
48	Grams of CO2 per truck ton-mile - 2015	grams/TM	102.93	
49	Grams of CO2 per truck ton-mile - 2016	grams/TM	102.94	
50	Grams of CO2 per truck ton-mile - 2017	grams/TM	102.95	
51	Grams of CO2 per truck ton-mile - 2018	grams/TM	102.95	
52	Grams of CO2 per truck ton-mile - 2019	grams/TM	102.95	
53	Grams of CO2 per truck ton-mile - 2020	grams/TM	102.96	
54	Grams of CO2 per truck ton-mile - 2021	grams/TM	102.96	
55	Grams of CO2 per truck ton-mile - 2022	grams/TM	102.96	
56	Grams of CO2 per truck ton-mile - 2023	grams/TM	102.96	
57	Grams of CO2 per truck ton-mile - 2024	grams/TM	102.96	
58	Grams of CO2 per truck ton-mile - 2025	grams/TM	102.96	
59	Grams of CO2 per truck ton-mile - 2026	grams/TM	102.96	
60	Grams of CO2 per truck ton-mile - 2027	grams/TM	102.95	
61	Grams of CO2 per truck ton-mile - 2028	grams/TM	102.95	
62	Grams of CO2 per truck ton-mile - 2029	grams/TM	102.95	
63	Grams of CO2 per truck ton-mile - 2030	grams/TM	102.95	
64	Grams of CO2 per truck ton-mile - 2031	grams/TM	102.94	
65	Grams of CO2 per truck ton-mile - 2032	grams/TM	102.94	
66	Grams of CO2 per truck ton-mile - 2033	grams/TM	102.94	
67	Grams of CO2 per truck ton-mile - 2034	grams/TM	102.94	
68	Grams of CO2 per truck ton-mile - 2035	grams/TM	102.94	
69	Grams of CO2 per truck ton-mile - 2036	grams/TM	102.94	
70	Grams of CO2 per train ton-mile - 2014	grams/TM	21.27	United States Environmental Protection Agency, Office of Transportation and Air Quality, "Emission Factors for Locomotives", EPA-420-F-09-025, April 2009.
71	Grams of CO2 per train ton-mile - 2015	grams/TM	21.27	
72	Grams of CO2 per train ton-mile - 2016	grams/TM	21.27	
73	Grams of CO2 per train ton-mile - 2017	grams/TM	21.27	
74	Grams of CO2 per train ton-mile - 2018	grams/TM	21.27	
75	Grams of CO2 per train ton-mile - 2019	grams/TM	21.27	
76	Grams of CO2 per train ton-mile - 2020	grams/TM	21.27	
77	Grams of CO2 per train ton-mile - 2021	grams/TM	21.27	
78	Grams of CO2 per train ton-mile - 2022	grams/TM	21.27	
79	Grams of CO2 per train ton-mile - 2023	grams/TM	21.27	
80	Grams of CO2 per train ton-mile - 2024	grams/TM	21.27	
81	Grams of CO2 per train ton-mile - 2025	grams/TM	21.27	
82	Grams of CO2 per train ton-mile - 2026	grams/TM	21.27	
83	Grams of CO2 per train ton-mile - 2027	grams/TM	21.27	
84	Grams of CO2 per train ton-mile - 2028	grams/TM	21.27	
85	Grams of CO2 per train ton-mile - 2029	grams/TM	21.27	
86	Grams of CO2 per train ton-mile - 2030	grams/TM	21.27	

87	Grams of CO2 per train ton-mile - 2031	grams/TM	21.27	
88	Grams of CO2 per train ton-mile - 2032	grams/TM	21.27	
89	Grams of CO2 per train ton-mile - 2033	grams/TM	21.27	
90	Grams of CO2 per train ton-mile - 2034	grams/TM	21.27	
91	Grams of CO2 per train ton-mile - 2035	grams/TM	21.27	
92	Grams of CO2 per train ton-mile - 2036	grams/TM	21.27	
93	Grams of PM per truck ton-mile - 2014	grams/TM	0.016	United States Environmental Protection Agency, Motor Vehicle Emission Simulator, 2010.
94	Grams of PM per truck ton-mile - 2015	grams/TM	0.013	
95	Grams of PM per truck ton-mile - 2016	grams/TM	0.012	
96	Grams of PM per truck ton-mile - 2017	grams/TM	0.010	
97	Grams of PM per truck ton-mile - 2018	grams/TM	0.008	
98	Grams of PM per truck ton-mile - 2019	grams/TM	0.007	
99	Grams of PM per truck ton-mile - 2020	grams/TM	0.006	
100	Grams of PM per truck ton-mile - 2021	grams/TM	0.005	
101	Grams of PM per truck ton-mile - 2022	grams/TM	0.005	
102	Grams of PM per truck ton-mile - 2023	grams/TM	0.004	
103	Grams of PM per truck ton-mile - 2024	grams/TM	0.004	
104	Grams of PM per truck ton-mile - 2025	grams/TM	0.003	
105	Grams of PM per truck ton-mile - 2026	grams/TM	0.003	
106	Grams of PM per truck ton-mile - 2027	grams/TM	0.003	
107	Grams of PM per truck ton-mile - 2028	grams/TM	0.002	
108	Grams of PM per truck ton-mile - 2029	grams/TM	0.002	
109	Grams of PM per truck ton-mile - 2030	grams/TM	0.002	
110	Grams of PM per truck ton-mile - 2031	grams/TM	0.002	
111	Grams of PM per truck ton-mile - 2032	grams/TM	0.002	
112	Grams of PM per truck ton-mile - 2033	grams/TM	0.002	
113	Grams of PM per truck ton-mile - 2034	grams/TM	0.002	
114	Grams of PM per truck ton-mile - 2035	grams/TM	0.002	
115	Grams of PM per truck ton-mile - 2036	grams/TM	0.002	
116	Grams of PM per train ton-mile - 2014	grams/TM	0.008	United States Environmental Protection Agency, Office of Transportation and Air Quality, "Emission Factors for Locomotives", EPA-420-F-09-025, April 2009.
117	Grams of PM per train ton-mile - 2015	grams/TM	0.007	
118	Grams of PM per train ton-mile - 2016	grams/TM	0.006	
119	Grams of PM per train ton-mile - 2017	grams/TM	0.006	
120	Grams of PM per train ton-mile - 2018	grams/TM	0.006	
121	Grams of PM per train ton-mile - 2019	grams/TM	0.005	
122	Grams of PM per train ton-mile - 2020	grams/TM	0.005	
123	Grams of PM per train ton-mile - 2021	grams/TM	0.005	
124	Grams of PM per train ton-mile - 2022	grams/TM	0.004	
125	Grams of PM per train ton-mile - 2023	grams/TM	0.004	
126	Grams of PM per train ton-mile - 2024	grams/TM	0.004	
127	Grams of PM per train ton-mile - 2025	grams/TM	0.003	
128	Grams of PM per train ton-mile - 2026	grams/TM	0.003	

129	Grams of PM per train ton-mile - 2027	grams/TM	0.003	
130	Grams of PM per train ton-mile - 2028	grams/TM	0.003	
131	Grams of PM per train ton-mile - 2029	grams/TM	0.002	
132	Grams of PM per train ton-mile - 2030	grams/TM	0.002	
133	Grams of PM per train ton-mile - 2031	grams/TM	0.002	
134	Grams of PM per train ton-mile - 2032	grams/TM	0.002	
135	Grams of PM per train ton-mile - 2033	grams/TM	0.002	
136	Grams of PM per train ton-mile - 2034	grams/TM	0.001	
137	Grams of PM per train ton-mile - 2035	grams/TM	0.001	
138	Grams of PM per train ton-mile - 2036	grams/TM	0.001	
139	Grams of VOC per truck ton-mile - 2014	grams/TM	0.041	United States Environmental Protection Agency, Motor Vehicle Emission Simulator, 2010.
140	Grams of VOC per truck ton-mile - 2015	grams/TM	0.041	
141	Grams of VOC per truck ton-mile - 2016	grams/TM	0.039	
142	Grams of VOC per truck ton-mile - 2017	grams/TM	0.038	
143	Grams of VOC per truck ton-mile - 2018	grams/TM	0.036	
144	Grams of VOC per truck ton-mile - 2019	grams/TM	0.035	
145	Grams of VOC per truck ton-mile - 2020	grams/TM	0.034	
146	Grams of VOC per truck ton-mile - 2021	grams/TM	0.033	
147	Grams of VOC per truck ton-mile - 2022	grams/TM	0.033	
148	Grams of VOC per truck ton-mile - 2023	grams/TM	0.032	
149	Grams of VOC per truck ton-mile - 2024	grams/TM	0.031	
150	Grams of VOC per truck ton-mile - 2025	grams/TM	0.031	
151	Grams of VOC per truck ton-mile - 2026	grams/TM	0.031	
152	Grams of VOC per truck ton-mile - 2027	grams/TM	0.030	
153	Grams of VOC per truck ton-mile - 2028	grams/TM	0.030	
154	Grams of VOC per truck ton-mile - 2029	grams/TM	0.030	
155	Grams of VOC per truck ton-mile - 2030	grams/TM	0.030	
156	Grams of VOC per truck ton-mile - 2031	grams/TM	0.029	
157	Grams of VOC per truck ton-mile - 2032	grams/TM	0.029	
158	Grams of VOC per truck ton-mile - 2033	grams/TM	0.029	
159	Grams of VOC per truck ton-mile - 2034	grams/TM	0.029	
160	Grams of VOC per truck ton-mile - 2035	grams/TM	0.029	
161	Grams of VOC per truck ton-mile - 2036	grams/TM	0.029	
162	Grams of VOC per train ton-mile - 2014	grams/TM	0.013	United States Environmental Protection Agency, Office of Transportation and Air Quality, "Emission Factors for Locomotives", EPA-420-F-09-025, April 2009.
163	Grams of VOC per train ton-mile - 2015	grams/TM	0.013	
164	Grams of VOC per train ton-mile - 2016	grams/TM	0.011	
165	Grams of VOC per train ton-mile - 2017	grams/TM	0.010	
166	Grams of VOC per train ton-mile - 2018	grams/TM	0.009	
167	Grams of VOC per train ton-mile - 2019	grams/TM	0.009	
168	Grams of VOC per train ton-mile - 2020	grams/TM	0.008	
169	Grams of VOC per train ton-mile - 2021	grams/TM	0.007	
170	Grams of VOC per train ton-mile - 2022	grams/TM	0.007	

171	Grams of VOC per train ton-mile - 2023	grams/TM	0.007	
172	Grams of VOC per train ton-mile - 2024	grams/TM	0.006	
173	Grams of VOC per train ton-mile - 2025	grams/TM	0.006	
174	Grams of VOC per train ton-mile - 2026	grams/TM	0.005	
175	Grams of VOC per train ton-mile - 2027	grams/TM	0.005	
176	Grams of VOC per train ton-mile - 2028	grams/TM	0.005	
177	Grams of VOC per train ton-mile - 2029	grams/TM	0.004	
178	Grams of VOC per train ton-mile - 2030	grams/TM	0.004	
179	Grams of VOC per train ton-mile - 2031	grams/TM	0.004	
180	Grams of VOC per train ton-mile - 2032	grams/TM	0.004	
181	Grams of VOC per train ton-mile - 2033	grams/TM	0.003	
182	Grams of VOC per train ton-mile - 2034	grams/TM	0.003	
183	Grams of VOC per train ton-mile - 2035	grams/TM	0.003	
184	Grams of VOC per train ton-mile - 2036	grams/TM	0.003	
185	NOx cost per ton	2013$/short ton	$7,147	TIGER Benefit-Cost Analysis Resource Guide, April 4, 2014. Values per metric ton converted to $/short ton.
186	CO2 cost per ton - 2014	2013$/short ton	$39.92	TIGER Benefit-Cost Analysis Resource Guide, April 4, 2014. Values per metric ton converted to $/short ton.
187	CO2 cost per ton - 2014	2013$/short ton	$40.82	
188	CO2 cost per ton - 2015	2013$/short ton	$41.73	
189	CO2 cost per ton - 2016	2013$/short ton	$42.64	
190	CO2 cost per ton - 2017	2013$/short ton	$44.45	
191	CO2 cost per ton - 2018	2013$/short ton	$46.27	
192	CO2 cost per ton - 2019	2013$/short ton	$47.17	
193	CO2 cost per ton - 2020	2013$/short ton	$47.17	
194	CO2 cost per ton - 2021	2013$/short ton	$48.99	
195	CO2 cost per ton - 2022	2013$/short ton	$49.90	
196	CO2 cost per ton - 2023	2013$/short ton	$50.80	
197	CO2 cost per ton - 2024	2013$/short ton	$51.71	
198	CO2 cost per ton - 2025	2013$/short ton	$52.62	
199	CO2 cost per ton - 2026	2013$/short ton	$54.43	
200	CO2 cost per ton - 2027	2013$/short ton	$55.34	
201	CO2 cost per ton - 2028	2013$/short ton	$56.25	
202	CO2 cost per ton - 2029	2013$/short ton	$57.15	
203	CO2 cost per ton - 2030	2013$/short ton	$57.15	
204	CO2 cost per ton - 2031	2013$/short ton	$58.97	
205	CO2 cost per ton - 2032	2013$/short ton	$59.87	
206	CO2 cost per ton - 2033	2013$/short ton	$60.78	
207	CO2 cost per ton - 2034	2013$/short ton	$61.69	
208	CO2 cost per ton - 2035	2013$/short ton	$62.60	

209	PM cost per ton	2013$/short ton	$326,935	TIGER Benefit-Cost Analysis Resource Guide, April 4, 2014. Values per metric ton converted to $/short ton.
210	VOC cost per ton	2013$/short ton	$1,813	TIGER Benefit-Cost Analysis Resource Guide, April 4, 2014. Values per metric ton converted to $/short ton.
211	Truck to Rail Distance Factor	Truck mile/Rail mile	$7,147	National Cooperative Highway Research Program (NCHRP) Report 388, "A Guidebook for Forecasting Freight Transportation Demand", 1997. We assume this figure includes dray distances.
212	Average tons per truck	Tons	20	HDR reasoned assumption based on previous project experience.

7.4.3 Benefit Estimates

The table below shows the benefit estimates of emissions savings due to the UMTH project. The greenhouse gas and criteria air contaminant savings account for about 10% of the total benefits generated with this project.

Table 18: Estimates of Environmental Sustainability Benefits, Millions of 2013$

	In Project Opening Year, Discounted at 7%	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Emission Cost Savings due to Modal Switch from Truck to Rail	$0.47	$193.38	$125.53

7.5 Safety

The proposed project would contribute to promoting DOT’s safety long-term outcome through a reduction in accident costs (through reduced fatalities and injuries) from diverting heavy truck travel to rail.

7.5.1 Methodology

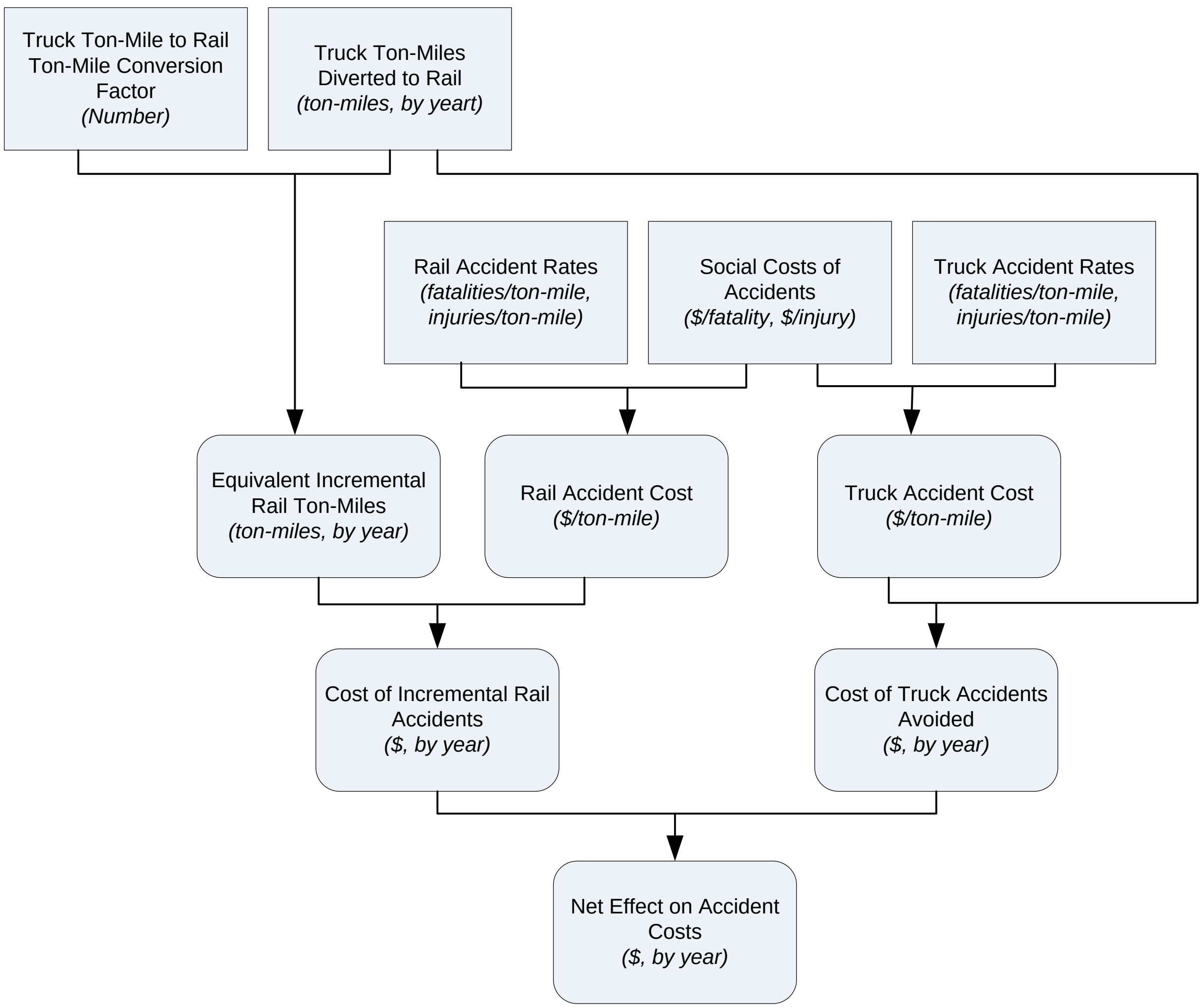
Reduced Accident Costs from Diverting Heavy Truck Travel to Rail

Fatality and injury rates per ton-mile of freight carried by truck are greater than the fatality and injury rates for an equal volume of cargo when shipped by rail. This benefit captures the different accident rates per truck ton-mile and train ton-mile. The accident cost values used here are based on TIGER Benefit-Cost Analysis Guide for accident values and the rates are based on published accident rate analysis for the two modes.[6] Due to the way accident rates

[6] The specific rates used are sourced from a 2011 GAO report: United States Government Accountability Office, “Surface Freight Transportation. A Comparison of the Costs of Road, Rail, and Waterways Freight Shipments That Are Not Passed on to Consumers“, Report to the Subcommittee on Select Revenue Measures, Committee on Ways and Means, House of Representatives, January 2011, Table 4, page 27.

are published, the accident cost values are based on the valuation of a fatal accident and an injury accident in which the severity of injury is unknown. Both accident costs are being increased annually by a rate of 1.07% (before discounting) to reflect the forecasts of growth in real incomes and thus growth in social costs of accidents.[7] Truck accident costs avoided are estimated by multiplying truck ton-miles diverted to rail by total accident cost per truck ton-mile. The incremental train ton-miles are estimated by multiplying truck ton-miles diverted by a truck ton-mile to train ton-mile conversion factor. This is then multiplied by the rail accident cost per train ton-mile to obtain the incremental rail accident costs that is partially offsetting truck accident costs avoided. The logic model outlining this calculation is provided in the figure below.

Figure 6: Reduced Accident Costs S&L



[7] See" Guidance on Treatment of the Economic Value of a Statistical Life (VSL) in U.S. Department of Transportation Analysis, Memo dated February28, 2013, page 1.

7.5.2 Assumptions

The assumptions used in the estimation of safety benefits are summarized in the table below. Truck ton-miles diverted to rail were estimated in the same way as for other benefit categories.

Table 19: Assumptions used in the Estimation of Safety Benefits

Input #	Input Name	Units	Value	Source/Comment
1	Truck to Rail Distance Factor	Truck mile/Rail mile	0.83	National Cooperative Highway Research Program (NCHRP) Report 388, "A Guidebook for Forecasting Freight Transportation Demand", 1997. We assume this figure includes dray distances. This factor is applied to account for relatively longer rail routes for the same origin-destination (O-D) pair.
2	Fatalities per Billion Ton-Miles, Truck	fatalities/Btm	2.54	Surface Freight Transportation. A Comparison of the Costs of Road, Rail, and Waterways Freight Shipments That Are Not Passed on to Consumers, GAO, January 2011, Table 4.
3	Fatalities per Billion Ton-Miles, Rail	fatalities/Btm	0.39	
4	Injuries per Billion Ton-Miles Truck	injuries/Btm	55.98	
5	Injuries per Billion Ton-Miles Rail	injuries/Btm	3.32	
6	Value of a Statistical Life	2013$	$9,200,000	US DOT, Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses. 2013.
7	Average Cost per Accident Injury	2013$	$166,778	US DOT, Based on MAIS Injury Severity Scale and KACBO-AIS Conversion if Injury Unknown. Department of Transportation Analyses. 2013.
8	Accident Cost - Truck	2013$/per Million truck ton-miles	$32,704.25	Calculated from inputs above.
9	Accident Cost - Train	2013$/per Million truck ton-miles	$4,141.70	Calculated from inputs above.
10	Annual Growth in Real Accident Costs	% Annually	1.07%	US DOT, Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses. 2013.

7.5.3 Benefit Estimates

The table below shows the benefit estimates of improved safety due to the UMTH project. The reductions in accidents due to less truck miles account for about 39% of the total benefits generated with this project.

Table 20: Estimates of Safety Benefits, 2013$

	In Project Opening Year, Discounted at 7%	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Accident Cost Savings due to Modal Switch from Truck to Rail	$1.15	$1,264.62	$490.21

8. Summary of Findings and BCA Outcomes

The tables below summarize the BCA findings. Annual costs and benefits are computed over the lifecycle of the project (2014-2035). As stated earlier, construction is expected to be completed by the end of 2015. Benefits accrue during the full operation of the project and begin in 2016.

Table 21: Overall Results of the Benefit Cost Analysis, Millions of 2013$*

Project Evaluation Metric	7% Discount Rate	3% Discount Rate
Total Discounted Costs	$223.6	$340.9
Total Discounted Benefits	$1,266.4	$1,990.6
Net Present Value	$1,042.8	$1,649.7
Benefit / Cost Ratio	5.66	5.84
Payback Period (years)	4	

** Unless Specified Otherwise*

Considering all monetized benefits and costs, with a 7 percent real discount rate, the $23.4 million of initial capital investment would result in $1,266.4 million in total benefits, net present value of $1,042.8 million, and a Benefit/Cost Ratio of 5.66.

With a 3 percent real discount rate, the Net Present Value of the project would increase to $1,649.7 million, for a Benefit/Cost ratio of 5.84.

Table 22: Benefit Estimates by Long-Term Outcome for the Full Project, Millions of 2013$

Long-Term Outcomes	Benefit Categories	7% Discount Rate	3% Discount Rate
State of Good Repair	Avoided Pavement Maintenance Costs	$171.7	$274.7
Economic Competitiveness	Shipper Savings due to Modal Switch from Truck to Rail	$371.5	$592.2
Quality of Life	Reduced Road Congestion due to Modal Switch from Truck to Rail	$107.5	$172.0
Environmental Sustainability	Emission Cost Savings due to Modal Switch from Truck to Rail	$125.5	$128.4
Safety	Accident Cost Savings due to Modal Switch from Truck to Rail	$490.2	$823.5
Total Benefit Estimates		**$1,266.4**	**$1,990.6**

9. BCA Sensitivity/Alternative Analysis

The BCA outcomes presented in the previous sections rely on a large number of assumptions and long-term projections; both of which are subject to considerable uncertainty.

The primary purpose of the sensitivity analysis is to help identify the variables and model parameters whose variations have the greatest impact on the BCA outcomes: the “critical variables.”

The sensitivity analysis can also be used to:

- Evaluate the impact of changes in individual critical variables – how much the final results would vary with reasonable departures from the "preferred" or most likely value for the variable; and
- Assess the robustness of the BCA and evaluate, in particular, whether the conclusions reached under the "preferred" set of input values are significantly altered by reasonable departures from those values.

The outcomes of the quantitative analysis for the UMTH at Manly, Iowa, using a 7 percent discount rate are summarized in the table below. The table provides the percentage changes in project NPV associated with variations in variables or parameters (listed in row), as indicated in the column headers.

For example, a 25 percent increase in the capital costs of the project leads to a 0.5 percent reduction in the project NPV. A 25 percent decrease raises the project NPV by 0.5 percent.

The main driver in this particular analysis is the volume of truck to rail diversion. In order to illustrate a substantially wide range of possible outcomes, the annual truck miles diverted was adjusted by 25%. The impact of these values carries through to every impact of the study which is evident by the significant changes in NPV with a 7 percent discount rate (-21.5% and +21.5% respectively). Nonetheless, the B/C ratio remains exceptionally favorable (4.66 and 5.66 respectively). **In summary, this sensitivity analysis provides compelling evidence that that this project will generate significant net benefits and a high return on investment.**

Table 23: Quantitative Assessment of Sensitivity, Summary

Parameters	Change in Parameter Value	New NPV (7% discounted)	Change in NPV	New B/C Ratio (7% discounted)
Truck Miles Saved	25% Increase	$1,266.57	21.5%	6.66
	25% Decrease	$819.09	-21.5%	4.66
Capital Cost Estimate	25% Increase	$1,037.36	-0.5%	5.53
	25% Decrease	$1,048.31	0.5%	5.81

10. Supplementary Data Tables

This section breaks down all benefits associated with the five long-term outcome criteria (State of Good Repair, Economic Competiveness, Quality of Life, Sustainability, and Safety) in annual form for the UMTH project in Manly, Iowa.

10.1 Annual Estimates of Total Project Benefits and Costs

Calendar Year	Project Year	Total Undiscounted Benefits ($2013)	Total Undiscounted Costs ($2013)	Undiscounted Net Benefits ($2013)	Discounted Net Benefits at 7%	Discounted Net Benefits at 3%
2014	1	$0	-$934,673	-$934,673	-$934,673	-$934,673
2015	2	$0	-$22,432,150	-$22,432,150	-$20,964,626	-$21,778,786
2016	3	$8,602,937	-$2,860,000	$5,742,937	$4,840,181	$5,313,588
2017	4	$55,615,304	-$9,622,500	$45,992,804	$36,612,427	$41,482,171
2018	5	$78,973,397	-$13,767,250	$65,206,147	$48,677,363	$57,108,595
2019	6	$83,859,428	-$15,291,147	$68,568,280	$48,012,539	$58,315,953
2020	7	$94,112,002	-$17,121,219	$76,990,783	$50,550,155	$63,574,693
2021	8	$107,805,305	-$19,295,385	$88,509,919	$54,476,960	$70,959,132
2022	9	$121,009,729	-$20,838,410	$100,171,320	$57,841,174	$77,949,132
2023	10	$132,830,948	-$22,503,275	$110,327,672	$59,759,493	$83,325,114
2024	11	$142,547,149	-$24,339,725	$118,207,424	$60,082,569	$86,667,738
2025	12	$159,011,768	-$26,448,890	$132,562,878	$63,240,594	$94,362,945
2026	13	$177,535,632	-$27,417,019	$150,118,613	$67,223,807	$103,762,096
2027	14	$182,449,349	-$27,813,896	$154,635,452	$65,065,463	$103,769,034
2028	15	$187,328,319	-$28,225,163	$159,103,156	$62,873,197	$103,653,633
2029	16	$192,357,336	-$28,650,954	$163,706,382	$60,770,419	$103,542,482
2030	17	$197,541,592	-$29,091,414	$168,450,177	$58,753,623	$103,436,042
2031	18	$202,677,542	-$29,546,697	$173,130,845	$56,694,611	$103,208,338
2032	19	$208,326,732	-$30,016,963	$178,309,769	$54,943,465	$103,197,389
2033	20	$213,928,009	-$30,502,382	$183,425,627	$53,143,268	$103,062,120
2034	21	$219,696,254	-$31,003,133	$188,693,120	$51,416,031	$102,929,704
2035	22	$225,624,253	-$31,519,404	$194,104,849	$49,755,769	$102,793,663
Total		**$2,991,832,983**	**-$489,241,649**	**$2,502,591,334**	**$1,042,833,810**	**$1,649,700,104**

10.2 Annual Demand Projections

Calendar Year	Project Year	Truck Miles Saved Per Year
2014	1	0
2015	2	0
2016 (opening)	3	6,412,500
2017	4	39,843,750
2018	5	55,200,000
2019	6	56,623,594
2020	7	62,716,431
2021	8	71,243,705
2022	9	81,215,533
2023	10	90,464,645
2024	11	96,519,828
2025	12	107,028,041
2026	13	118,770,386
2027	14	121,205,191
2028	15	123,690,177
2029	16	126,226,384
2030	17	128,814,876
2031	18	131,456,737
2032	19	134,153,074
2033	20	136,905,018
2034	21	139,713,723
2035	22	142,580,367

10.3 Benefit Estimates – Undiscounted Values

Calendar Year	Project Year	Avoided Pavement Maintenance Costs	Shipper Savings due to Modal Switch from Truck to Rail	Emission Cost Savings due to Modal Switch from Truck to Rail	Accident Cost Savings due to Modal Switch from Truck to Rail	Reduced Road Congestion due to Modal Switch from Truck to Rail
2014	1	$0	$0	$0	$0	$0
2015	2	$0	$0	$0	$0	$0
2016 (opening)	3	$1,321,502	$2,315,625	$507,648	$3,630,822	$827,340
2017	4	$8,211,086	$16,335,938	$3,126,318	$22,801,324	$5,140,637
2018	5	$11,375,736	$24,150,000	$4,398,534	$31,927,228	$7,121,899
2019	6	$11,669,113	$27,184,336	$4,599,353	$33,101,054	$7,305,571
2020	7	$12,924,738	$30,934,456	$5,106,038	$37,055,101	$8,091,669
2021	8	$14,682,057	$35,621,852	$5,765,822	$42,543,716	$9,191,857
2022	9	$16,737,073	$37,959,434	$6,817,398	$49,017,402	$10,478,421
2023	10	$18,643,150	$39,578,282	$7,753,880	$55,183,894	$11,671,741
2024	11	$19,891,016	$42,227,425	$8,468,152	$59,507,576	$12,452,980
2025	12	$22,056,571	$46,824,768	$9,629,400	$66,692,280	$13,808,749
2026	13	$24,476,459	$51,962,044	$10,972,209	$74,801,176	$15,323,745
2027	14	$24,978,229	$53,027,271	$11,654,578	$77,151,388	$15,637,884
2028	15	$25,490,340	$54,114,452	$12,189,416	$79,575,614	$15,958,496
2029	16	$26,013,007	$55,224,043	$12,758,376	$82,076,191	$16,285,718
2030	17	$26,546,449	$56,356,508	$13,363,418	$84,655,531	$16,619,685
2031	18	$27,090,890	$57,512,322	$13,797,672	$87,316,121	$16,960,537
2032	19	$27,646,557	$58,691,970	$14,619,261	$90,060,526	$17,308,419
2033	20	$28,213,683	$59,895,945	$15,263,511	$92,891,395	$17,663,474
2034	21	$28,792,507	$61,124,754	$15,941,682	$95,811,458	$18,025,853
2035	22	$29,383,271	$62,378,911	$16,642,831	$98,823,533	$18,395,707
Total		**$406,143,435**	**$873,420,336**	**$193,375,497**	**$1,264,623,330**	**$254,270,385**

10.4 Benefit Estimates – Discounted Values (at 7 Percent)

Calendar Year	Project Year	Avoided Pavement Maintenance Costs	Shipper Savings due to Modal Switch from Truck to Rail	Emission Cost Savings due to Modal Switch from Truck to Rail	Accident Cost Savings due to Modal Switch from Truck to Rail	Reduced Road Congestion due to Modal Switch from Truck to Rail
2014	1	$0	$0	$0	$0	$0
2015	2	$0	$0	$0	$0	$0
2016 (opening)	3	$1,154,251	$2,022,557	$474,945	$2,963,832	$722,631
2017	4	$6,702,692	$13,334,991	$2,838,258	$17,395,021	$4,196,291
2018	5	$8,678,494	$18,423,919	$3,880,984	$22,763,672	$5,433,263
2019	6	$8,319,916	$19,382,056	$3,947,542	$22,056,630	$5,208,771
2020	7	$8,612,299	$20,612,934	$4,265,638	$23,076,054	$5,391,821
2021	8	$9,143,247	$22,183,499	$4,681,353	$24,760,830	$5,724,227
2022	9	$9,741,129	$22,092,736	$5,374,697	$26,662,219	$6,098,537
2023	10	$10,140,639	$21,527,963	$5,929,835	$28,052,693	$6,348,654
2024	11	$10,111,584	$21,466,281	$6,275,702	$28,271,621	$6,330,464
2025	12	$10,478,918	$22,246,110	$6,908,636	$29,612,170	$6,560,437
2026	13	$10,867,840	$23,071,769	$7,613,927	$31,039,829	$6,803,926
2027	14	$10,365,077	$22,004,432	$7,827,928	$29,920,638	$6,489,166
2028	15	$9,885,593	$20,986,518	$7,916,447	$28,841,864	$6,188,980
2029	16	$9,428,311	$20,015,735	$8,006,059	$27,802,046	$5,902,694
2030	17	$8,992,201	$19,089,899	$8,096,356	$26,799,773	$5,629,662
2031	18	$8,576,282	$18,206,928	$8,062,167	$25,833,689	$5,369,272
2032	19	$8,179,619	$17,364,836	$8,256,524	$24,902,486	$5,120,937
2033	20	$7,801,319	$16,561,728	$8,325,384	$24,004,902	$4,884,098
2034	21	$7,440,531	$15,795,798	$8,393,557	$23,139,721	$4,658,223
2035	22	$7,096,445	$15,065,323	$8,457,773	$22,305,772	$4,442,804
Total			**$371,456,013**	**$125,533,710**	**$490,205,464**	**$107,504,856**