# Benefit-Cost Analysis of EW2 Segment A

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# TABLE OF CONTENTS


**I. INTRODUCTION ..... 1**

I.1 EW2 SEGMENT A PROJECT ..... 1
I.2 PROJECT CONTEXT ..... 2
I.3 BCA MODEL DEVELOPMENT ..... 2
I.4 ORGANIZATION OF BCA MEMORANDUM ..... 2

**II. PROJECT BENEFITS AND COSTS ..... 3**

II.1 BENEFITS OF THE PROJECT ..... 3
II.2 COSTS OF THE PROJECT ..... 4

**III. MODEL INPUTS AND PARAMETERS ..... 4**

III.1 PERIOD OF ANALYSIS ..... 4
III.2 BASE YEAR OF ANALYSIS ..... 4
III.3 RESIDUAL VALUE ..... 5
III.4 RAIL NETWORK PERFORMANCE ..... 5
III.5 GATE DOWN TIME ..... 6
III.6 DIVERSION IMPACTS ..... 8
III.7 CRASH DATA ..... 8
III.8 CRIME DATA ..... 9
III.9 GLOBAL PARAMETERS ..... 10

**IV. BENEFIT–COST ANALYSIS METHODOLOGY ..... 12**

IV.1 BENEFIT 1A: AVOIDED RAIL DELAY UNDER TYPICAL OPERATIONS ..... 12
IV.2 BENEFIT 1B: AVOIDED PASSENGER RAIL COSTS RESULTING FROM TRAIN DELAY ..... 13
IV.3 BENEFIT 2A: AVOIDED FREIGHT DELAY FROM TRACK CLOSURES ..... 14
IV.4 BENEFIT 2B: AVOIDED PASSENGER TRIP DIVERSION FROM TRACK CLOSURES ..... 15
IV.5 BENEFIT 3: AVOIDED FREIGHT DIVERSION TO TRUCKS FROM REDUCED CAPACITY ..... 17
IV.6 BENEFIT 4: AVOIDED RAIL DIVERSIONS FROM REDUCED CAPACITY ..... 18
IV.7 BENEFIT 5: TRAFFIC DELAY SAVINGS ..... 19
IV.8 BENEFIT 6: REDUCED CRASHES ..... 20
IV.9 BENEFIT 7: REDUCED CRIME ..... 21
IV.10 BENEFIT 8: REDUCED MAINTENANCE COSTS ..... 22

**V. BENEFIT–COST ANALYSIS RESULTS ..... 23**

**APPENDIX A ..... I**

**APPENDIX B ..... VI**

## TABLES

TABLE 1: PROJECT MATRIX ..... 3
TABLE 2: PROJECT CONSTRUCTION COSTS ..... 4
TABLE 3: PROJECT SCHEDULE ..... 4
TABLE 4: TRACK CLOSURE RISK FACTORS ..... 5
TABLE 5: RAIL DELAY TIME (HOURS/YEAR) ..... 6
TABLE 6: TRAFFIC VOLUME AND GATE DOWN TIME ..... 6
TABLE 7: RAIL DIVERSION ANALYSIS ..... 8
TABLE 8: IMPROVEMENT AREA CRASH HISTORY (INCIDENTS PER YEAR) ..... 8
TABLE 9: COOK COUNTY CRASHES BY SEVERITY ..... 9
TABLE 10: IMPROVEMENT AREA CRIME HISTORY (INCIDENTS PER YEAR) ..... 9
TABLE 11: FREIGHT COSTS ..... 10
TABLE 12: VALUE OF CRIMES ..... 10
TABLE 13: USDOT BCA PARAMETERS ..... 11
TABLE 14: AVOIDED RAIL DELAY UNDER TYPICAL OPERATIONS ..... 12
TABLE 15: AVOIDED PASSENGER RAIL COSTS RESULTING FROM DELAY ..... 13
TABLE 16: AVOIDED FREIGHT DELAY FROM TRACK CLOSURES ..... 14
TABLE 17: AVOIDED PASSENGER TRIP DIVERSION FROM TRACK CLOSURES ..... 15
TABLE 18: EXTERNAL BENEFITS OF AVOIDED TRUCK DIVERSION ..... 17
TABLE 19: AVOIDED RAIL DIVERSION COST SAVINGS ..... 18
TABLE 20: TRAFFIC DELAY SAVINGS ..... 19
TABLE 21: REDUCED CRASHES ..... 20
TABLE 22: REDUCED CRIME ..... 21
TABLE 23: REDUCED MAINTENANCE COSTS ..... 22
TABLE 24: DISCOUNTED BENEFITS AND COSTS FOR THE PROJECT (IN MILLIONS) ..... 23
TABLE A-1: EW2 SEGMENT A PROJECT BCA SUMMARY- UNDISCOUNTED ..... II
TABLE A-2: EW2 SEGMENT A PROJECT BCA SUMMARY- DISCOUNTED ..... IV

## FIGURES

FIGURE 1: PROJECT OVERVIEW MAP ..... 1

# ACRONYMS

| | |
|---|---|
| AIS | Abbreviated Injury Scale (AIS) |
| AADT | Annual Average Daily Traffic |
| ADA | Americans with Disabilities Act |
| ATRI | American Transportation Research Institute |
| BCA | Benefit-Cost Analysis |
| BRC | Belt Railroad Company |
| CN | Canadian National |
| $CO_2$ | Carbon Dioxide |
| CP | Canadian Pacific |
| CREATE | Chicago Region Environmental and Transportation Efficiency |
| FHWA | Federal Highway Administration |
| GDP | Gross Domestic Product |
| IMR | Interchange Modification Report |
| KABCO | Injury classification scale |
| LOS | Level of Service |
| mph | Miles per Hour |
| $NO_x$ | Nitrogen Oxide |
| NPV | Net Present Value |
| NS | Norfolk Sothern |
| O&M | Operating and Maintenance |
| PDO | Property Damage Only |
| $PM_{2.5}$ | Particulate Matter |
| PV | Present Value |
| RTC | Rail Traffic Controller |
| $SO_2$ | Sulfur Dioxide |
| UP | Union Pacific |
| USDOT | United States Department of Transportation |
| VHT | Vehicle Hours Traveled |
| VMT | Vehicle Miles Traveled |
| VOCs | Volatile Organic Compounds |
| VOT | Value of Time |

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# I. INTRODUCTION

This report documents the Benefit-Cost Analysis (BCA) that evaluates the benefits to society resulting from the Chicago Region Environmental and Transportation Efficiency (CREATE) Program improvements associated with the EW2 Segment A Project. The BCA demonstrates the cost effectiveness of the Project for which the sponsors are seeking federal support, measured in terms of a Benefit-Cost (B/C) ratio and Net Present Value (NPV).

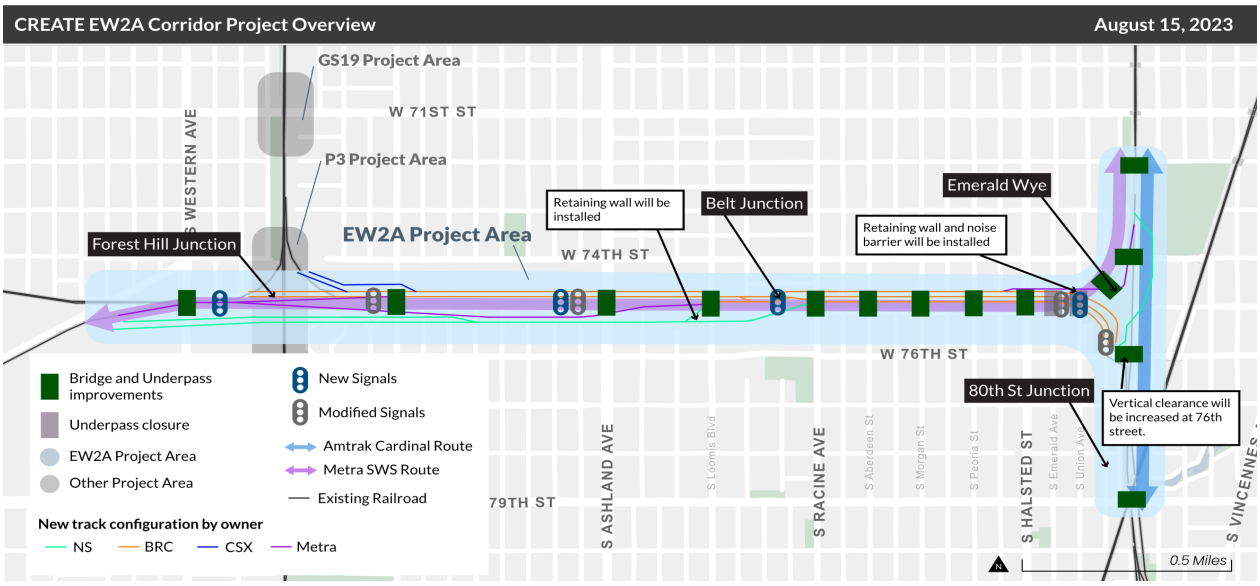
## *I.1 EW2 Segment A Project*

The EW2 Segment A project (the Project) focuses on implementing the next key phase of construction in the 75th Street Corridor Improvement Project (75th St CIP) by delivering a suite of safety, speed, and state of good repair enhancements at Forest Hill, Belt, and 80th Street Junctions. These enhancements will be implemented along a 3-mile elevated rail corridor on Chicago's South Side that serves the Belt Railroad Company (BRC), Canadian National (CN), CSX, Norfolk Southern (NS), and Union Pacific (UP) railroads, in addition to Amtrak and Metra passenger rail. These enhancements include:

- Reconfiguring the east-west tracks at Forest Hill Junction,
- Adding a third track to the Norfolk Southern line,
- Replacing and restoring aging bridge structures, tracks, and viaducts,
- Modernizing signals, and
- Implementing community mobility improvements on streets throughout the corridor.

Project elements are visualized in Figure 1, and the preliminary plan drawings are included as Appendix B.

Figure 1: Project Overview Map



## I.2 Project Context

The BCA discussed in this report covers only the costs and benefits for the EW2A phase of the greater 75th St CIP. The EW2A phase will build upon the Forest Hill Flyover (P3) and 71st Street Grade Separation (GS19) projects that are currently under construction. EW2A also serves as foundational for delivering the future phases of the Belt Junction and 80th Street Junction Replacement project (EW2B-D), focused on additional track realignment, reconstruction, and replacement work, and the Metra Rock Island Connection project (P2), which will eliminate passenger and freight rail conflict points and will build a new flyover structure to connect the Metra's SouthWest Service (SWS) to its Rock Island Line. Once fully implemented, the 75th Street CIP will serve to cut rail traffic delay and emissions and increase safety at the most complex and congested rail junction in the Chicago Terminal 1 (Terminal), yielding substantial benefit towards the Chicago region's freight economy, passenger rail service, infrastructure resilience, and the national distribution of commodities and goods.

## I.3 BCA Model Development

The Benefit-Cost Analysis is based on freight rail, passenger rail, and traffic data in the Project area.

A spreadsheet-based BCA model was constructed for the purposes of this analysis. The model uses Rail Traffic Controller (RTC) modeling outputs for different scenarios, City of Chicago data, and global parameters. Many of the global parameters were provided by the United States Department of Transportation (USDOT) specifically for the purposes of completing BCAs in support of grant applications. The RTC model outputs are detailed in 'Exhibit 3A. RTC Modeling of CREATE EW2 and P2 Projects.'

Using both Project-specific inputs and global parameters, the BCA model calculates life-cycle costs, life-cycle benefits, annual benefits, the NPV of quantifiable costs and benefits, and the resulting B/C ratio, utilizing a methodology that aligns with the most recent USDOT guidance.

## I.4 Organization of BCA Memorandum

Section II describes the mechanisms that generate the benefits of the Project and the classes of benefits evaluated.

Section III describes the inputs and parameters to the BCA model.

Section IV describes the detailed methodology for computing Project benefits, including an illustration of the benefits calculated for an example year for the Project.

Section V summarizes the BCA results and the resulting B/C ratio.

Appendix A provides detailed tabulations of annual benefits and costs for the overall Project.

Appendix B provides a construction staging schematic of the preliminary plan for the Project.

# II. PROJECT BENEFITS AND COSTS

## *II.1 Benefits of the Project*

The Project is expected to generate benefits through two main mechanisms: typical operations and avoided track closures.

Benefits generated under typical operations and improvements include:

- Avoided rail delay under typical operations
- Avoided additional passenger rail costs resulting from train delay under typical operations
- Reduced crashes resulting from improved viaduct lighting
- Reduced crime resulting from improved viaduct lighting
- Reduced maintenance costs
- Traffic delay savings resulting from reduced gate down time

Benefits generated by avoiding track closures in the Build scenario include:

- Avoided freight delay resulting from track closures
- Avoided passenger rail diversion resulting from track closures
- External benefits of avoided freight diversion to trucks from reduced capacity
- Avoided rail diversion from reduced capacity
- Traffic delay savings resulting from reduced gate down time

The methodology for evaluating each of these benefits is discussed in Section IV.

Table 1: Project Matrix

| | |
|---|---|
| Current Status / Baseline & Problem to be Addressed | The project reduces conflicts and congestion between freight trains, passenger rail, and roadway users in Chicago's South Side. |
| Change to Baseline / Alternatives | Build Scenario includes reconfiguring the east-west tracks at Forest Hill Junction; adding a third track to the Norfolk Southern line; replacing and restoring aging bridge structures, tracks, and viaducts; modernizing signals; and implementing community mobility improvements on surface streets throughout the corridor. |
| Type of Impacts | Reduced freight delay, reduced idling, travel time savings, reduced vehicle operating costs, reduced crashes, reduced emissions damage, reduced crime, improved freight movement and economic vitality, and improved operational efficiency. |
| Affected Population | Daily local users and commercial through-traffic. |
| Economic Benefit | The BCA indicates that the Project will result in travel time savings,traffic delay savings, crash cost reductions, trip diversion benefits, and maintenance cost savings. |
| Summary of Results | Benefit/Cost ratio greater than 1.0 indicates that the Project generates benefits to society that exceed its costs. |

In addition to the benefit classes quantified in this analysis, the Project is expected to generate other benefits including:

- Avoided passenger rail ridership impacts
- Avoided track usage and pilot fees associated with rerouted freight movement
- Reduced community externalities resulting from a more efficient freight network

## *II.2 Costs of the Project*

Construction costs are estimated to be $485,298,416 (2030$) spent between 2027 and 2033. These values are show in Table 2.

Table 2: Project Construction Costs

| Year | Project Total | Units |
|---|---|---|
| Cost Estimate | $485,298,416 | *2030$* |
| Base Dollar Value | $396,879,657 | *2022$* |
| Discounted Value | $311,239,996 | *2022$* |

The project will also significantly reduce the maintenance costs of the existing infrastructure. Throughout the duration of this analysis, the Project will likely only incur inspection costs. Projected maintenance cost estimates are described in Benefit 8 on page 22, where incremental cost savings are quantified.

# III. MODEL INPUTS AND PARAMETERS

## *III.1 Period of Analysis*

Benefits were evaluated for a period of 20 years beginning with the opening of the Project in 2033 and ending in 2052.

Table 3: Project Schedule

| Factor | Year |
|---|---|
| Construction Start | 2027 |
| Opening Year | 2033 |

## *III.2 Base Year of Analysis*

Per USDOT BCA guidance, this analysis was conducted in constant 2022 dollars. All benefits and costs are discounted to 2022 at a 3.1% discount rate, except for carbon-related benefits which are discounted at 2%.

## *III.3 Residual Value*

This analysis estimates the residual value of the Project based on a useful life of 75 years and a project opening year of 2033. The undiscounted residual value in year 2052 is $296,336,811 (2022$).

## *III.4 Rail Network Performance*

RTC modeling was performed by HDR, Inc. on the Project area to understand the impact of the Project to the overall network. All model outputs are provided for years 2022, 2027, 2032, 2037, 2042, 2047 and 2052. This analysis interpolates values for all interim years to assess project benefits on an annual basis.

RTC modeling was used to develop railroad forecasts for five scenarios. Each of the scenarios, as described below, account for the projected growth in rail volumes and their impact on the network

- The **Base (No-Build)** scenario describes the network under typical operations if the Project is not completed.
- The **Build** scenario models the network after the Project is completed.
- The **Out (1N)** and **Out (1S)** scenarios are **No-Build** scenarios that describe the network if one north or one south track along the alignment must be closed as a result of a critical inspection finding resulting from the deteriorating state of good repair. These scenarios account for any rerouting or slow zones resulting from the track closure. Depending on the type of impact, either a single north track or a single south track is expected to be closed.

This assessment is conservative because it does not consider the risk of multiple tracks being closed concurrently or a full closure of any track segments.

Based on the current conditional of the railroad assets, the risk factors summarized in Table 4 were used in the analysis to estimate the likelihood that one of the two track closure scenarios would occur. While this risk is expected to increase over time, this analysis conservatively assumes a flat 10% risk throughout the analysis period. This analysis also assumes that after year 2047, the rail infrastructure would reach a level of deterioration that would no longer support single-track closures and would require either a full segment closure or diverting local freight traffic to trucks.

Table 4: Track Closure Risk Factors

| Factor | 2022 | 2027 | 2032 | 2037 | 2042 | 2047 | 2052 | Units |
|---|---|---|---|---|---|---|---|---|
| OUT (1N) | | | | | | | | |
| Probability of Impact | 0% | 0% | 10% | 10% | 10% | 10% | 10% | *%* |
| Duration of Impact | 365 | 365 | 365 | 365 | 365 | 365 | 365 | *days/year* |
| OUT (1S) | | | | | | | | |
| Probability of Impact | 0% | 0% | 10% | 10% | 10% | 10% | 10% | *%* |
| Duration of Impact | 365 | 365 | 365 | 365 | 365 | 365 | 365 | *days/year* |

Table 5 summarizes the projected rail delays by scenario. While the model shows the expected passenger rail delay under the track closure scenarios, this analysis assumes that under that scenario, passenger rail operations would be halted.

Table 5: Rail Delay Time (hours/year)

| Factor | 2022 | 2027 | 2032 | 2037 | 2042 | 2047 | 2052 |
|---|---|---|---|---|---|---|---|
| BASE | | | | | | | |
| Passenger | 1,009 | 866 | 1,091 | 1,660 | 1,865 | 1,149 | 1,480 |
| Freight | 11,268 | 12,561 | 18,233 | 20,767 | 27,844 | 32,687 | 45,822 |
| BUILD | | | | | | | |
| Passenger | 906 | 842 | 986 | 1,807 | 1,131 | 1,211 | 1,352 |
| Freight | 9,600 | 10,186 | 15,232 | 19,326 | 22,872 | 30,367 | 38,808 |
| OUT (1N) | | | | | | | |
| Passenger | 920 | 800 | 735 | 1,409 | 1,530 | 1,530* | 1,530* |
| Freight | 13,935 | 20,788 | 25,986 | 33,437 | 47,600 | 47,600* | 47,600* |
| OUT (1S) | | | | | | | |
| Passenger | 1,504 | 1,398 | 1,239 | 2,140 | 2,461 | 1,947 | 1,947* |
| Freight | 13,247 | 14,838 | 21,198 | 28,071 | 33,406 | 41,571 | 41,571* |

* Denotes model network saturation.

## *III.5 Gate Down Time*

The projected gate down time and traffic volumes at impacted railroad crossings in the Project area were considered to estimate the impact of the Project on local traffic. Table 6 shows the traffic volume and gate down time for each railroad crossing location in the base year. Traffic volume data is collected through Illinois Department of Transportation (IDOT) traffic counts and gate down times and instances are outputs from RTC modeling. This analysis assumes a 0.6% annual growth rate for roadway traffic derived from CMAP traffic forecasts for the project area. The growth for the gate down time is proportional to the projected rail volume growth and resulting network delay under each scenario. In addition to the gate down time durations summarized below, the analysis adds an additional 20 seconds per gate down occurrence as a warning and clearance buffer.

Table 6: Traffic Volume and Gate Down Time

| Location | Traffic Volume [A] *(vehicles/day)* | Gate Down Duration (*minutes/day*) [B] | | | | Gate Down Occurrences (*times/day*) [B] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Base | Build | Out 1N | Out 1S | Base | Build | Out 1N | Out 1S |
| Broadway St | 4,300 | 48.7 | 46.9 | 77.3 | 123.3 | 13.5 | 13.0 | 19.8 | 32.0 |
| Chatham St | 750 | 68.4 | 66.3 | 100.6 | 132.6 | 15.5 | 15.0 | 26.0 | 36.3 |
| Clark Rd | 1 | 119.5 | 121.2 | 128.0 | 129.4 | 43.0 | 44.3 | 45.0 | 44.3 |
| E 137th St | 825 | 135.9 | 113.9 | 208.0 | 244.8 | 23.3 | 17.3 | 32.5 | 41.3 |

Table 6 (cont.): Traffic Volume and Gate Down Time

| Location | Traffic Volume [A] *(vehicles/day)* | Gate Down Duration (*minutes/day*) [B] | | | | Gate Down Occurrences (*times/day*) [B] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Base | Build | Out 1N | Out 1S | Base | Build | Out 1N | Out 1S |
| E 138th St | 9,550 | 125.6 | 119.3 | 178.0 | 225.4 | 36.0 | 42.5 | 38.8 | 48.3 |
| Kennedy Ave | 1 | 55.9 | 56.6 | 64.5 | 85.1 | 25.5 | 25.8 | 31.0 | 40.8 |
| S Perry Ave | 575 | 147.7 | 129.6 | 220.5 | 253.5 | 23.3 | 17.3 | 32.3 | 40.8 |
| Union St | 950 | 50.6 | 38.6 | 56.8 | 57.8 | 14.5 | 12.5 | 16.3 | 16.5 |
| Western Ave | 5,750 | 51.6 | 54.5 | 89.4 | 119.0 | 15.5 | 15.3 | 26.3 | 36.0 |
| W 103rd St | 18,400 | 36.7 | 30.6 | 41.8 | 42.0 | 27.3 | 33.0 | 22.0 | 22.3 |
| W 104th St | 525 | 36.6 | 30.6 | 41.7 | 41.8 | 14.0 | 12.0 | 16.0 | 16.3 |
| W 105th St | 1,200 | 36.6 | 30.6 | 41.7 | 41.8 | 14.0 | 12.0 | 16.3 | 16.5 |
| W 107th St | 1,800 | 36.5 | 30.7 | 41.7 | 41.8 | 27.3 | 33.0 | 22.5 | 22.5 |
| W 109th St | 1,250 | 36.4 | 30.7 | 41.7 | 41.8 | 27.5 | 33.3 | 22.8 | 22.8 |
| W 111th St | 13,100 | 36.7 | 31.0 | 42.0 | 42.0 | 27.5 | 33.0 | 22.8 | 22.5 |
| W 113th St | 725 | 36.8 | 31.2 | 42.2 | 42.1 | 14.3 | 12.3 | 16.8 | 16.5 |
| W 115th St | 9,600 | 37.3 | 31.7 | 42.9 | 42.4 | 27.5 | 33.3 | 22.8 | 22.5 |
| W 119th St | 11,800 | 39.8 | 33.4 | 45.8 | 45.6 | 14.5 | 12.5 | 16.5 | 16.5 |
| W 123rd St | 5,250 | 43.3 | 35.2 | 49.1 | 49.7 | 14.5 | 12.5 | 16.5 | 16.8 |
| W 127th St | 21,400 | 48.5 | 37.6 | 54.4 | 55.4 | 14.5 | 12.5 | 16.3 | 16.5 |
| W 71st St | 9,600 | 300.1 | 255.3 | 314.3 | 349.7 | 20.5 | 20.8 | 17.8 | 24.5 |
| W 87th St | 25,600 | 54.2 | 47.6 | 64.8 | 69.0 | 14.3 | 12.3 | 16.3 | 16.0 |
| W 91st St | 3,850 | 46.1 | 38.2 | 52.7 | 53.9 | 14.3 | 12.3 | 16.5 | 16.3 |
| W 99th St | 10,200 | 38.1 | 31.4 | 43.4 | 43.7 | 14.0 | 12.0 | 16.0 | 16.3 |
| E 130th St | 16,700 | 49.3 | 78.0 | 13.5 | 13.5 | 12.8 | 20.5 | 6.0 | 6.0 |
| E 138th St | 1,800 | 47.3 | 83.0 | 16.1 | 16.1 | 36.0 | 42.5 | 38.8 | 48.3 |
| Lincoln Ave | 3,350 | 48.2 | 83.3 | 16.0 | 16.0 | 13.0 | 20.8 | 6.0 | 6.0 |
| S State St | 2,900 | 32.0 | 47.0 | 9.0 | 9.0 | 13.3 | 21.0 | 6.0 | 6.0 |
| S Wentworth Ave | 2,450 | 30.1 | 45.1 | 8.8 | 8.8 | 13.3 | 21.0 | 6.0 | 6.0 |
| W 101st St | 2,150 | 31.7 | 44.2 | 11.5 | 11.5 | 13.3 | 20.8 | 6.0 | 6.0 |
| W 103rd St | 10,400 | 28.9 | 44.1 | 8.8 | 8.8 | 27.3 | 33.0 | 22.0 | 22.3 |
| W 107th St | 4,650 | 28.8 | 43.8 | 8.7 | 8.7 | 27.3 | 33.0 | 22.5 | 22.5 |
| W 109th St | 825 | 28.9 | 44.1 | 8.7 | 8.7 | 27.5 | 33.3 | 22.8 | 22.8 |
| W 111th St | 8,650 | 29.2 | 44.5 | 8.7 | 8.7 | 27.5 | 33.0 | 22.8 | 22.5 |
| W 115th St | 8,200 | 30.4 | 45.5 | 8.9 | 8.9 | 27.5 | 33.3 | 22.8 | 22.5 |
| W 95th St | 19,700 | 82.8 | 73.5 | 45.0 | 63.5 | 27.5 | 33.0 | 22.3 | 22.5 |
| W 97th St | 725 | 36.1 | 45.3 | 15.1 | 15.1 | 13.3 | 20.8 | 6.0 | 6.0 |

Source: A: IDOT 2022 AADT, from https://www.gettingaroundillinois.com/Traffic%20Counts/index.html

Source: B: RTC modeling output

## III.6 Diversion Impacts

Based on the RTC model results, the infrastructure is at risk for degraded performance and reduced capacity in the No-Build, resulting in the diversion of local freight to trucks and other regional freight diversions. To be conservative, this analysis assessed a five-year diversion beginning in year 2047 which represents when a capacity reduction may be in place and when an alternative long-term solution could be implemented. Without a long-term solution like the proposed Project, the estimated diversion impacts would likely continue in perpetuity, resulting in wide-spread regional impacts to all modes. Table 7 summarizes the avoided truck VMT and tons of avoided non-intermodal freight movements diverted to other regions based on a Cambridge Systematics freight forecast analysis.

Table 7: Rail Diversion Analysis

| Year | Truck Diversion VMT (VMT/year) | Non-Intermodal Movement Diversion (tons/year) [A] |
|---|---|---|
| 2047 | 15,647,000 | 94,551,654 |
| 2048 | 31,763,047 | 95,308,068 |
| 2049 | 48,362,306 | 96,070,532 |
| 2050 | 65,459,382 | 96,839,096 |
| 2051 | 83,069,325 | 97,613,809 |

Source: Cambridge Systematics Rail Diversion & Truck Diversion Analysis, 2023

Source: A: Based on 2019 outputs and a CAGR of 0.80% derived from Cambridge Systematics Rail and Freight Forecast Analysis for CREATE 75th St. CIP Modeling Calculations, 2023

## III.7 Crash Data

To estimate the benefits associated lighting improvements under viaducts, crash history was collected at the locations to be improved, as summarized in Table 8. The analysis applies a crash modification factor of 0.7, based on the CMF Clearinghouse value for lighting improvement.

Table 8: Improvement Area Crash History (incidents per year)

| Factor | Crashes | Injuries | Fatalities |
|---|---|---|---|
| S Ashland and Belt Railroad | 27.56 | 5.11 | 0.00 |
| S Morgan and Belt Railroad | 2.44 | 0.22 | 0.00 |
| Peoria and Belt Railroad | 3.33 | 0.00 | 0.00 |
| W 72nd and NS/Metra Railroad | 3.33 | 0.44 | 0.22 |
| W 73rd and NS/Metra Railroad | 0.22 | 0.00 | 0.00 |
| W 76th and NS Railroad | 13.56 | 2.22 | 0.00 |
| W 78th and NS Railroad | 0.67 | 0.00 | 0.00 |

Source: City of Chicago Data Portal. Traffic Crashes, from https://data.cityofchicago.org/Transportation/Traffic-Crashes-Crashes/85ca-t3if/

Cook County traffic and crash data was also used to estimate the incremental crash risk by severity when traffic volumes increase. The crash rates per 100 million vehicle miles traveled are summarized in Table 9: Cook County Crashes by Severity on page 9.

Table 9: Cook County Crashes by Severity

| Factor | Value | Units |
|---|---|---|
| VMT | 102,220 | *MVMT/year* |
| CRASH STATISTICS | | |
| Crashes | 295,604 | *crashes/year* |
| Injuries | 85,398 | *injuries/year* |
| Fatalities | 1,341 | *fatalities/year* |
| CRASH RATES | | |
| Crashes | 289.184 | *crashes/100MVMT* |
| Injuries | 83.543 | *injuries/100MVMT* |
| Fatalities | 1.312 | *fatalities/100MVMT* |

Source: IDOT 2021 Crash Facts. https://idot.illinois.gov/content/dam/soi/en/web/idot/documents/transportation-system/resources/safety/crash-reports/crash-facts/2021-crash-facts.pdf

## *III.8 Crime Data*

To estimate the benefits associated lighting improvements under viaducts, crime history was collected at the locations to be improved, as summarized in Table 10. The analysis assumes a 4% crime reduction based on a UChicago study of crime reduction through street lighting in New York City.

Table 10: Improvement Area Crime History (incidents per year)

| Factor | Burglary | Auto Theft | Larceny | Robbery | Murder | Rape | Assault |
|---|---|---|---|---|---|---|---|
| S Ashland and Belt Railroad | 9.20 | 1.20 | 38.20 | 3.20 | 0.00 | 0.00 | 15.00 |
| S Morgan and Belt Railroad | 3.00 | 1.00 | 0.80 | 0.60 | 0.00 | 0.20 | 3.80 |
| Peoria and Belt Railroad | 3.60 | 2.40 | 2.60 | 1.00 | 0.00 | 0.00 | 7.80 |
| W 72nd and NS/Metra Railroad | 12.00 | 3.20 | 7.80 | 1.80 | 0.20 | 0.00 | 30.60 |
| W 73rd and NS/Metra Railroad | 7.80 | 1.60 | 5.20 | 1.40 | 0.00 | 0.00 | 16.00 |
| W 76th and NS Railroad | 12.80 | 4.00 | 5.40 | 1.00 | 0.00 | 0.40 | 15.20 |
| W 78th and NS Railroad | 9.00 | 1.40 | 5.80 | 2.20 | 0.00 | 0.20 | 14.00 |

Source: City of Chicago Data Portal. Crimes, from https://data.cityofchicago.org/Public-Safety/Crimes-2001-to-Present-Map/ahwe-kpsy/

## III.9 Global Parameters

In addition to the project-specific data described in this section, the analysis also considers the following global parameters including those provided in the USDOT guidance for completing BCAs.

### III.10.i Freight Costs

To estimate the impact of rail diversions, an average shipping rate by ton-mile provided by the Congressional Budget Office (CBO) was used, as summarized in Table 11: Freight Costs on page 10.

Table 11: Freight Costs

| Factor | Value | Units |
|---|---|---|
| Shipper Cost | $0.0622 | *2022$/ton-mile* |

**Source:** Congressional Budget Office 2015 Pricing Freight Transport to Account for External Costs, Table A-4. https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/workingpaper/50049-Freight_Transport_Working_Paper-2.pdf

### III.10.ii Crime Costs

To convert benefits for reduced crime, the unit values provided by the Federal Emergency Management Agency (FEMA) were inflated to 2022 dollars, as summarized in Table 12.

Table 12: Value of Crimes

| Vehicle Type | Value | Units |
|---|---|---|
| Burglary | $5,921 | *2022$/incident* |
| Auto Theft | $12,409 | *2022$/incident* |
| Larceny | $2,003 | *2022$/incident* |
| Robbery | $69,261 | *2022$/incident* |
| Murder | $12,654,428 | *2022$/incident* |
| Rape | $298,055 | *2022$/incident* |
| Assault | $166,583 | *2022$/incident* |

**Source:** FEMA Benefit-Cost Analysis Re-engineering (BCAR). 2011. Accessed at https://files.hudexchange.info/course-content/ndrc-nofa-benefit-cost-analysis-data-resources-and-expert-tips-webinar/FEMA-BCAR-Resource.pdf

### III.10.iii Emissions Rates

All emissions benefit calculations use the USDOT-recommended emissions costs in Table 13.

While not quantified for the BCR, the volume of emissions in metric tons are estimated in the BCA by emission type, vehicle type, and travel speed as derived by Caltrans and summarized in the California Life-Cycle Benefit/Cost Analysis Model's emissions calculator. For the emissions volume analysis, an assumed travel speed is used to estimate the emissions rate.

### *III.10.iv USDOT Parameters*

Table 13 summarizes the USDOT-provided values for BCAs used in this analysis

Table 13: USDOT BCA Parameters

| Factor | Value | Units |
|---|---|---|
| VALUE OF TIME | | |
| In-Vehicle Travel, All Purposes | $19.60 | *2022$/person-hour* |
| Truck Drivers | $33.50 | *2022$/person-hour* |
| VEHICLE OCCUPANCY | | |
| Passenger Vehicles | 1.67 | *persons/auto* |
| Trucks | 1.00 | *persons/truck* |
| OPERATING COSTS | | |
| Light Duty Vehicles | $0.52 | *2022$/vehicle-mile* |
| Commercial Trucks | $1.01 | *2022$/vehiicle-mile* |
| Commuter Train (including fuel and labor) | $299 | *2022$/train-hour* |
| Amtrak Long-Distance (including fuel and labor) | $747 | *2022$/train-hour* |
| VALUE OF EMISSIONS (Automobile) | | |
| CO2 | $0.107 | *2022$/VMT* |
| Non-CO2 | $0.012 | *2022$/VMT* |
| VALUE OF EMISSIONS (Buses & Trucks) | | |
| CO2 | $0.303 | *2022$/VMT* |
| Non-CO2 | $0.035 | *2022$/VMT* |
| VALUE OF EMISSIONS (Commuter Train & Amtrak) | | |
| CO2 | $26 | *2022$/train-hour* |
| Non-CO2 | $102 | *2022$/train-hour* |
| FREIGHT BENEFITS | | |
| O&M | $273 | *2022$/train-hour* |
| CO2 Emissions | $28 | *2022$/train-hour* |
| Non-CO2 Emissions | $749 | *2022$/train-hour* |
| EXTERNAL BENEFITS | | |
| Congestion | $0.345 | *$2022/VMT* |
| Noise | $0.044 | *$2022/VMT* |
| Safety | $0.016 | *$2022/VMT* |
| CRASH COSTS | | |
| Killed | **$12,500,000** | *2022$/person* |
| Injured (Unknown Severity) | **$217,600** | *2022$/person* |
| Property Damage | **$9,100** | *2022$/vehicle* |

Source: U.S. Department of Transportation. Benefit Cost Analysis Guidance for Discretionary Grant Programs, December 2023. Accessed at https://www.transportation.gov/sites/dot.gov/files/2023-12/Benefit%20Cost%20Analysis%20Guidance%202024%20Update.pdf

# IV. BENEFIT–COST ANALYSIS METHODOLOGY

## *IV.1 Benefit 1a: Avoided Rail Delay Under Typical Operations*

This benefit is a function of the reduced delay time for freight trains when comparing the Base and Build conditions. This analysis assumes a passenger load of 224 persons per train based on the most recent Metra commuter rail ridership data. Amtrak trains typically carry more passengers per train than Metra, but the same occupancy is assumed for this analysis to be conservative.

Table 14 summaries the estimation of the undiscounted benefit for the year 2033, the first year of benefits, as an example. Over the analysis period (2033-2052), there are 3,258 hours of avoided delay for passenger trains and 69,969 hours of avoided delay for freight trains in the Terminal.

Table 14: Avoided Rail Delay under Typical Operations

| | Input | | 2033 Value | Units |
|---|---|---|---|---|
| | DELAY [A] | | | |
| | No Build Delay | | | |
| a | Passenger | | 1,181 | *hours/year* |
| b | Freight | | 18,714 | *hours/year* |
| | Build Delay | | | |
| c | Passenger | | 1,110 | *hours/year* |
| d | Freight | | 15,975 | *hours/year* |
| | Avoided Delay | | | |
| e | Passenger | a- c | 71 | *hours/year* |
| f | Freight | b- d | 2,739 | *hours/year* |
| | MONETIZATION | | | |
| g | Passenger Train Occupancy | | 224 | *persons/train* |
| | Passenger | | | |
| h | Value of Time [B] | | $19.60 | *2022$/person-hour* |
| | Freight [C] | | | |
| i | O&M | | $273.00 | *2022$/train-hour* |
| j | Non-CO2 | | $749.00 | *2022$/train-hour* |
| k | CO2 | | $28.00 | *2022$/train-hour* |
| | VALUE OF BENEFIT | | | |
| l | Passenger | e * g * h | $310,664 | *2022$/year* |
| m | Freight | f * (i + j + k) | $2,876,267 | *2022$/year* |
| | **Total** | l + m | **$3,186,931** | *2022$/year* |

Source: A See Section III.4 Rail Network Performance on page 5

Source: B See Section III.10.iv USDOT Parameters on page 11

Source: C See Section III.10.i Freight Costs on page 10

## *IV.2 Benefit 1b: Avoided Passenger Rail Costs Resulting from Train Delay*

This benefit estimates the additional cost savings to passenger rail providers resulting from the reduction in idling time. The analysis considers the costs associated with fuel, emissions, and crew costs, as summarized in Table 15 for the year 2033. In 2033, avoided passenger rail delay results in 2.5 metric tons of emissions reduced and 248 gallons of fuel saved.

Table 15: Avoided Passenger Rail Costs Resulting from Delay

| | Input | | 2033 Value | Units |
|---|---|---|---|---|
| a | Avoided Metra Delay | | 31 | *train-hours/year* |
| b | Avoided Amtrak Delay | | 40 | *train-hours/year* |
| | EMISSIONS REDUCTION | | | |
| | Rail Vehicle Emissions Damage Costs | | | |
| c | Non-CO2 Emissions Costs | | $102 | *2022$/train-hour* |
| d | CO2 Emissions Costs | | $26 | *2022$/train-hour* |
| e | Total Avoided Emissions Cost | (a + b )* (c + d) | $9,057 | *2022$/year* |
| | OPERATING COST (FUEL AND LABOR) | | | |
| f | Commuter Train | | $299 | *2022$/train-hour* |
| g | Amtrak Long-Distance | | $747 | *2022$/train-hour* |
| h | Total Avoided Fuel Cost | b * (f + g) | $38,984 | *2022$/year* |
| | **Total** | e + h | **$48,041** | *2022$/year* |

Source: See Section III.10.iv USDOT Parameters on page 11

## *IV.3 Benefit 2a: Avoided Freight Delay from Track Closures*

This benefit estimates the impact of track closures on the rail network using RTC outputs and their respective risks of closures. As described in Section III.4 on page 5, this analysis considers both the reduction in delay under typical network operations as estimated in Benefit 1a and avoided delays resulting from the increasing risk of track closures which are prevented in the Build scenario.

Table 16 summarizes the methodology used to calculate the undiscounted benefit for the year of 2033. During the analysis period (2033-2052), there are 36,096 hours of avoided delay resulting in $21.2 million in savings.

Table 16: Avoided Freight Delay from Track Closures

| Factor | | | 2033 Value | Units |
|---|---|---|---|---|
| AVOIDED DELAY [A] | | | | |
| Base | | | | |
| a | Freight Delay | | 18,714 | *train-hours/year* |
| Out (1N) | | | | |
| b | Probability of Impact | | 10 | *%* |
| c | Impact Duration | | 365 | *days/year* |
| d | Freight Delay | | 27,330 | *hours/year* |
| e | Avoided Extra Delay | (d- a) * b * c / 365 | 862 | *hours/year* |
| Out (1S) | | | | |
| f | Probability of Impact | | 10 | *%* |
| g | Impact Duration | | 365 | *days/year* |
| h | Freight Delay | | 22,423 | *hours/year* |
| i | Avoided Extra Delay | (h- a) * f * g / 365 | 371 | *hours/year* |
| Total Avoided Delay | | | | |
| j | All Avoided Delay | e + i | 1,232 | *hours/year* |
| FREIGHT MONETIZATION [B] | | | | |
| k | O&M | | **$273.00** | *2022$/train-hour* |
| l | Non-CO2 Emissions | | $749.00 | *2022$/train-hour* |
| m | CO2 Emissions | | $28.00 | *2022$/train-hour* |
| | Value of Benefit | j * (k + l + m) | **$1,294,107** | *2022$/year* |

**Source:** A: See Section III.4 Rail Network Performance on page 5

**Source:** B: See Section III.10.iv USDOT Parameters on page 11

## *IV.4 Benefit 2b: Avoided Passenger Trip Diversion from Track Closures*

While the RTC output includes delays for passenger rail, it is more likely that Metra service in the project area would be stopped in the event of a track closure, thus resulting in some existing Metra users completing their trips by automobile. This benefit estimates the avoided operating, crash, and emissions impacts resulting from mode shift from passenger rail to automobile in the event of a track closure. This analysis assumes that only 20% of users of the Metra SouthWest Service corridor would drive to their destination if passenger rail service was not available, and this assumption is consistent with what Metra has used for previous grant proposals.

Table 17 summarizes the methodology used to calculate the undiscounted benefit for the year of 2033. During the analysis period (2033-2052), 50.6 million vehicle miles of diversion and combined 9,085 metric tons of emissions are avoided. While not quantified as part of the benefit, an estimated $1.1 million in vehicle operating costs will be saved for automobile users.

Table 17: Avoided Passenger Trip Diversion from Track Closures

| Factor | | | 2033 Value | Units |
|---|---|---|---|---|
| METRA STATISTICS [A] | | | | |
| a | Ridership | | 224 | *persons/train* |
| b | Average Trip Distance | | 19 | *miles/trip* |
| c | Train Count | | 30 | *train-trips/day* |
| CONVERSION FACTORS | | | | |
| d | Share of Passengers Diverting to Auto | | 20% | *percent of persons* |
| e | Annualization Factor | | 260 | *days/year* |
| f | Vehicle Occupancy [B] | | 1.67 | *persons/vehicle* |
| Out (1N) [C] | | | | |
| g | Probability of Impact | | 10 | *%* |
| h | Impact Duration | | 365 | *days/year* |
| i | Avoided Diversion | a * b * c * d * e * f * g * h / 365 | 1,108,773 | *vehicle-miles/year* |
| Out (1S) [C] | | | | |
| j | Probability of Impact | | 10 | *%* |
| k | Impact Duration | | 365 | *days/year* |
| l | Avoided Diversion | a * b * c * d * e * f * j * k / 365 | 1,108,773 | *vehicle-miles/year* |
| m | Total Avoided Diversion | i + l | 2,217,546 | *vehicle-miles/year* |
| CRASH COST | | | | |
| | Crash Rates [D] | | | |
| n | Crashes | | 289.184 | *crashes/100MVMT* |
| o | Injuries | | 83.543 | *injuries/100MVMT* |
| p | Fatalities | | 1.312 | *fatalities/100MVMT* |
| q | Average Vehicles per Crash | | 1.798 | *vehicles/crash* |

Table 17 (cont.): Avoided Passenger Trip Diversion from Avoided Track Closures

| Factor | | | 2033 Value | Units |
|---|---|---|---|---|
| | Monetization [B] | | | |
| r | PDO | | $9,100 | *2022$/vehicle* |
| s | Injuries | | $217,600 | *2022$/person* |
| t | Fatalities | | $12,500,000 | *2022$/person* |
| | Value of Benefit | | | |
| u | PDO | m / 100,000,000 * p * s * t | $104,905 | *2022$/year* |
| v | Injuries | m / 100,000,000 * q * u | $403,128 | *2022$/year* |
| w | Fatalities | m / 100,000,000 * r * v | $363,643 | *2022$/year* |
| x | All Crashes | w + x + y | $871,677 | *2022$/year* |
| EMISSIONS COST | | | | |
| | Emissions Monetization [B] | | | |
| y | CO2 | | $0.107 | *2022$/VMT* |
| z | Non-CO2 | | $0.012 | *2022$/VMT* |
| aa | Total Avoided Emissions Cost | m * (y + z) | $263,888 | *2022$/year* |
| TOTAL BENEFIT | | x + aa | $1,135,565 | *2022$/year* |

**Source:** A: Metra SouthWest Service Statistics

**Source:** B: See Section III.10.iv USDOT Parameters on page 11

**Source:** C: See Table 4: Track Closure Risk Factors on page 5

**Source:** D: See Table 9: Cook County Crashes by Severity on page 9

**Source:** E: See Section III.10.iii Emissions Rates on page 10

## *IV.5 Benefit 3: Avoided Freight Diversion to Trucks from Reduced Capacity*

This benefit quantifies the value of avoided external impacts associated with truck diversions resulting from degraded performance and reduced capacity on the network. To be conservative, this analysis considers 5 years of freight diversion risk between 2047 and the end of the analysis period, representing the minimum impact duration before a long-term alternative solution could be implemented.

To estimate the avoided truck VMT, the analysis considers the volume of local freight movement that would be most likely diverted when capacity is constrained. The analysis estimates a 10% risk of diversion between 2047 and 2051 and applies a weighted average trip distance of 255 miles which accounts for rail traffic to or from Chicago from Midwest markets that are less than 500 roadway miles away. Between 2047 and 2051, over 37 million vehicle miles traveled and combined 25,624 metric tons of emissions are avoided. Table 18 summarizes the benefit in year 2047.

Table 18: External Benefits of Avoided Truck Diversion

| | Factor | | 2047 Value | Units |
|---|---|---|---|---|
| AVOIDED TRUCK DIVERSIONS [A] | | | | |
| a | Vehicle Miles | | 1,564,700 | *persons/train* |
| EMISSIONS COST | | | | |
| | Emissions Rate [E] | | | |
| b | CO2 | | $0.303 | *2022$/VMT* |
| c | Non-CO2 | | $0.035 | *2022$/VMT* |
| d | Total Avoided Emissions Cost | a * (b + c) | $528,869 | *2022$/year* |
| EXTERNAL BENEFITS | | | | |
| | Unit Value [B] | | | |
| e | Congestion | | $0.345 | *2022$/VMT* |
| f | Noise | | $0.044 | *2022$/VMT* |
| g | Safety | | $0.016 | *2022$/VMT* |
| | Unit Value | | | |
| h | Congestion | a * e | $539,822 | *2022$/year* |
| i | Noise | a * f | $68,377 | *2022$/year* |
| j | Safety | a * g | $25,035 | *2022$/year* |
| k | All External Benefits | h + i + j | $633,234 | *2022$/year* |
| TOTAL BENEFITS | | d + k | $1,162,103 | *2022$/year* |

Source: A: See Section III.6 Diversion Impacts on page 8

Source: B: See Section III.10.iv USDOT Parameters on page 11

## *IV.6 Benefit 4: Avoided Rail Diversions from Reduced Capacity*

This benefit quantifies the value of avoided rail-to-rail rerouting impacts associated with diversions in non-intermodal freight movements in other regions. An analysis was completed using the public use waybill sample, looking at US traffic originating and destined west of the Mississippi (Freight Territories 3, 4, and 5). Traffic was assumed to switch in Chicago from UP or BNSF to NS or CSX (and vice versa) for freight traveling east and west in these territories, being rerouted the distances shown in Table 19. To be conservative, this analysis only considers 5 years of freight diversions beginning in 2047. As additional measures of conservativeness, only 5% of the traffic is assumed to be diverted and no empty equipment movements were considered.

To estimate the avoided non-intermodal tonnage, the analysis considers the volume of freight moving through Chicago and a 0.80% cumulative annual growth rate for through traffic. The distance used to represent the minimum diversion distance based on the average non-intermodal movement distances through Chicago. Table 19 summarizes the benefit in year 2047. Between 2047 and 2051, over 13 billion ton-miles of freight rail shipments would be diverted, saving an average of $170 million annually.

Table 19: Avoided Rail Diversion Cost Savings

| Factor | | | 2047 Value | Units |
|---|---|---|---|---|
| AVOIDED DELAY [A] | | | | |
| | Avoided Tons | | | |
| a | BNSF/CSX | | 28,630,200 | *tons/year* |
| b | BNSF/NS | | 25,984,584 | *tons/year* |
| c | UP/CSX | | 20,935,734 | *tons/year* |
| d | UP/NS | | 19,001,136 | *tons/year* |
| | Distance Rerouted | | | |
| e | BNSF/CSX | | 325 | *miles* |
| f | BNSF/NS | | 274 | *miles* |
| g | UP/CSX | | 1,019 | *miles* |
| h | UP/NS | | 844 | *miles* |
| MONETIZATION | | | | |
| i | Percent Rerouted | | 5 | *percent* |
| j | Shipper Cost [B] | | $0.0622 | *2022$/ton-mile* |
| | Value of Benefit | (a*e + b*f + c*g + d*h) * i * j | **$167,356,440** | *2022$/year* |

Source: A: See Section III.6 Diversion Impacts on page 8

Source: B: See Section III.10.i Freight Costs on page 10

## *IV.7 Benefit 5: Traffic Delay Savings*

This benefit assesses the Project's impact on local roadway traffic by reducing the amount of gate down time at railroad crossings. The analysis considers both delays associated with typical rail operations and when track closures are required in the 1N Out and 1S Out scenarios. The analysis also assumes a 9% truck percentage and that the average impacted user experiences half the total gate down time, which includes a 20-second warning buffer. Table 20 summarizes the benefit in year 2033.

Table 20: Traffic Delay Savings

| Input | 2033 Value | Units |
|---|---|---|
| TYPICAL OPERATIONS | | |
| Avoided Gate Down Time by Vehicle Type | | |
| Auto | 47,829 | *vehicle-hours/year* |
| Truck | 4,908 | *vehicle-hours/year* |
| CRITICAL IMPACTS | | |
| Total Delay | | |
| 1N Out | 87.3 | *vehicle-hours/day* |
| 1S Out | 58.0 | *vehicle-hours/day* |
| Avoided Gate Down Time by Vehicle Type | | |
| Auto | 38,654 | *vehicle-hours/year* |
| Truck | 3,966 | *vehicle-hours/year* |
| VALUE OF BENEFIT | | |
| Auto | $2,830,744 | *2022$/year* |
| Truck | $290,476 | *2022$/year* |
| **Total** | **$3,121,220** | *2022$/year* |

Source: See Section III.4 on page 5

## *IV.8 Benefit 6: Reduced Crashes*

This benefit estimates the reduction in crashes in the project area resulting from the improved lighting under viaducts. A crash modification factor of 0.7 was applied to existing crash rates by severity, as summarized in Table 21 for year 2033.

Table 21: Reduced Crashes

| | Input | | 2033 Value | Units |
|---|---|---|---|---|
| | EXISTING CRASH RATES [A] | | | |
| a | Fatalities | | 0.22 | *persons/year* |
| b | Injuries | | 8.0 | *persons/year* |
| c | Property Damage | | 51.11 | *crashes/year* |
| | CRASH REDUCTION | | | |
| d | Crash Modification Factor | | 0.70 | |
| e | Average Vehicles per Crash [B] | | 1.80 | *vehicles/crash* |
| | Avoided Crashes | | | |
| f | Fatalities | a * d | 0.07 | *persons/year* |
| g | Injuries | b * d | 2.40 | persons/year |
| h | Property Damage | c * d * e | 27.56 | *vehicles/year* |
| | CRASH UNIT VALUE [C] | | | |
| i | Fatalities | | $12,500,000 | *2022$/person* |
| j | Injuries | | $217,600 | 2022$/person |
| k | Property Damage | | $9,100 | *2022$/vehicle* |
| | VALUE OF BENEFIT | | | |
| l | Fatalities | f * i | $833,333 | *2022$/year* |
| m | Injuries | g * m | $522,240 | 2022$/year |
| n | Property Damage | h * k | $250,834 | *2022$/year* |
| | **Total** | l + m + n | **$1,606,407** | *2022$/year* |

Source: A. See Section III.7 Crash Data on page 8

Source: B: Estimated from crash data from the National Highway Traffic Safety Administration.

Source: C: See Section III.10.iv USDOT Parameters on page 11

## *IV.9 Benefit 7: Reduced Crime*

This benefit estimates the reduction in crime in the project area resulting from the improve lighting under viaducts. The analysis assumes a 4% reduction in crime, as summarized in Table 22 for year 2033.

Table 22: Reduced Crime

| Input | 2033 Value | Units |
|---|---|---|
| EXISTING CRIME RATES [A] | | |
| Burglary | 57.4 | *incidents/year* |
| Auto Theft | 14.8 | *incidents/year* |
| Larceny | 65.8 | *incidents/year* |
| Robbery | 11.2 | *incidents/year* |
| Murder | 0.2 | *incidents/year* |
| Rape | 0.8 | *incidents/year* |
| Assault | 102.4 | *incidents/year* |
| CRIME REDUCTION | | |
| Crime Reduction | 4.0% | |
| AVOIDED CRIME | | |
| Burglary | 2.30 | *incidents/year* |
| Auto Theft | 0.59 | incidents/year |
| Larceny | 2.63 | incidents/year |
| Robbery | 0.45 | incidents/year |
| Murder | 0.01 | incidents/year |
| Rape | 0.03 | incidents/year |
| Assault | 4.10 | *incidents/year* |
| VALUE OF BENEFIT | | |
| Burglary | $13,595 | *2022$/year* |
| Auto Theft | $7,346 | *2022$/year* |
| Larceny | $5,271 | *2022$/year* |
| Robbery | $31,029 | *2022$/year* |
| Murder | $101,235 | *2022$/year* |
| Rape | $9,538 | *2022$/year* |
| Assault | $682,326 | *2022$/year* |
| **Total** | **$850,340** | *2022$/year* |

Source: A. See Section III.8 Crime Data on page 9

## *IV.10 Benefit 8: Reduced Maintenance Costs*

This benefit measures the maintenance cost savings expected as a result of the Project. These savings are based on 27 years of Belt Railway's capital and maintenance investments in their bridges. By determining the annual cost per structure (converted to 2022$) and applying this cost to the number of structures in EW2A, future costs were estimated for the No-Build and Build scenarios. The Build scenario is expected to result in a 90% reduction in maintenance costs, as monthly repairs and inspections would become unnecessary.

The annual maintenance savings benefit is shown in Table 23.

Table 23: Reduced Maintenance Costs

| Factor | | | 2047 Value | Units |
|---|---|---|---|---|
| HISTORIC MAINTENANCE COSTS FOR BELT RAILWAY | | | | |
| a | Total Maintenance Cost (1996-2023) | | $97,152,822 | *2022$* |
| b | Years of Total Maintenance Cost | 2023- 1996 | 27 | *years* |
| c | Number of Structures in Maintenance Cost Total | | 108 | *structures* |
| d | Maintenance Cost per Structure | | $33,317 | *2022$/year/structure* |
| | EW2A Maintenance Costs | | | |
| e | Number of Structures in EW2A | | 86 | *structures* |
| f | No Build Maintenance Cost | d * e | $2,865,275 | *2022$* |
| g | Expected Reduction | | 90% | *percent* |
| h | Build Maintenance Cost | f * (1-g) | $286,528 | *2022$* |
| | Value of Benefit | f - h | **$2,578,748** | *2022$/year* |

# V. BENEFIT–COST ANALYSIS RESULTS

The BCA indicates that the Project will result in avoided delay for rail and traffic, avoided rail idling, reduced crashes, and reduced crime. All values are discounted at 3.1% with the exception of carbon-related benefits which are discounted at 2%.

The Project produces a Benefit/Cost ratio of 2.22, shown in Table 24, indicating that the benefits to society exceed the Project's costs.

Appendix A provides detailed tabulations of annual benefits and costs for the Project.

Table 24: Discounted Benefits and Costs for the Project (in millions)

| | Total |
|---|---|
| PROJECT BENEFITS | |
| Avoided Delay under Typical Operations * | $42.6 |
| Avoided Passenger Rail Cost from Train Delay * | $0.7 |
| Avoided Freight Delay from Track Closure * | $21.2 |
| Avoided Passenger Trip Diversion from Track Closure * | $12.5 |
| Avoided Truck Diversion from Reduced Capacity * | $13.6 |
| Avoided Rail Diversion from Reduced Capacity * | $373.1 |
| Traffic Delay Savings from Reduced Gate Down Time | $56.6 |
| Reduced Crashes from Improved Viaduct Lighting | $16.8 |
| Reduced Crime from Improved Viaduct Lighting | $8.9 |
| Reduced Maintenance Costs | $27.0 |
| plus Residual Value | $118.6 |
| **Net Benefits** | **$691.6** |
| TOTAL COSTS | **$311.2** |
| B/C RATIO | **2.22** |
| NET PRESENT VALUE | **$380.3** |

* includes carbon-related benefits discounted at 2%

# APPENDIX A
# Detailed Benefit–Cost Analysis Results

# TABLE A-1: EW2 SEGMENT A PROJECT BCA SUMMARY- UNDISCOUNTED

| | | Undiscounted Benefits | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Calendar Year | Initial Construction Costs | Residual Value | Avoided Delay | Avoided Passenger Rail Cost | Avoided Freight Delay: Avoided Critical Impact | Avoided Passenger Rail Diversion: Avoided Critical Impact |
| 0 | 2022 | $0 | $0 | $0 | $0 | $0 | $0 |
| 1 | 2023 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2 | 2024 | $0 | $0 | $0 | $0 | $0 | $0 |
| 3 | 2025 | $0 | $0 | $0 | $0 | $0 | $0 |
| 4 | 2026 | $0 | $0 | $0 | $0 | $0 | $0 |
| 5 | 2027 | $19,843,983 | $0 | $0 | $0 | $0 | $0 |
| 6 | 2028 | $59,531,949 | $0 | $0 | $0 | $0 | $0 |
| 7 | 2029 | $79,375,931 | $0 | $0 | $0 | $0 | $0 |
| 8 | 2030 | $79,375,931 | $0 | $0 | $0 | $0 | $0 |
| 9 | 2031 | $79,375,931 | $0 | $0 | $0 | $0 | $0 |
| 10 | 2032 | $59,531,949 | $0 | $0 | $0 | $0 | $0 |
| 11 | 2033 | $19,843,983 | $0 | $3,186,931 | $48,041 | $1,294,107 | $1,135,565 |
| 12 | 2034 | $0 | $0 | $2,707,004 | $26,705 | $1,474,938 | $1,135,565 |
| 13 | 2035 | $0 | $0 | $2,166,198 | $2,206 | $1,668,572 | $1,135,565 |
| 14 | 2036 | $0 | $0 | $1,555,944 | -$26,149 | $1,875,787 | $1,135,565 |
| 15 | 2037 | $0 | $0 | $866,456 | -$59,158 | $2,097,407 | $1,135,565 |
| 16 | 2038 | $0 | $0 | $2,388,558 | $28,013 | $2,195,285 | $1,135,565 |
| 17 | 2039 | $0 | $0 | $3,895,807 | $108,290 | $2,299,751 | $1,135,565 |
| 18 | 2040 | $0 | $0 | $5,399,621 | $182,392 | $2,411,350 | $1,135,565 |
| 19 | 2041 | $0 | $0 | $6,910,954 | $250,971 | $2,530,675 | $1,135,565 |
| 20 | 2042 | $0 | $0 | $8,440,382 | $314,613 | $2,658,372 | $1,135,565 |
| 21 | 2043 | $0 | $0 | $7,152,472 | $230,820 | $2,624,624 | $1,135,565 |
| 22 | 2044 | $0 | $0 | $5,892,431 | $154,503 | $2,591,676 | $1,135,565 |
| 23 | 2045 | $0 | $0 | $4,648,163 | $84,842 | $2,559,640 | $1,135,565 |
| 24 | 2046 | $0 | $0 | $3,408,166 | $21,096 | $2,528,633 | $1,135,565 |
| 25 | 2047 | $0 | $0 | $2,161,432 | -$37,402 | $2,498,783 | $1,135,565 |
| 26 | 2048 | $0 | $0 | $3,100,899 | -$22,050 | $2,019,037 | $1,135,565 |
| 27 | 2049 | $0 | $0 | $4,138,485 | -$5,546 | $1,505,762 | $1,135,565 |
| 28 | 2050 | $0 | $0 | $5,282,520 | $12,178 | $956,614 | $1,135,565 |
| 29 | 2051 | $0 | $0 | $6,541,988 | $31,193 | $369,086 | $1,135,565 |
| 30 | 2052 | $0 | $296,336,811 | $0 | $0 | $0 | $0 |
| **Total** | | **$396,879,657** | **$296,336,811** | **$79,844,409** | **$1,345,559** | **$38,160,097** | **$21,575,730** |

## TABLE A-1: CONTINUED

| | | Undiscounted Benefits | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | Calendar Year | Avoided Truck Diversion: Network Saturation | Avoided Rail Diversion: Network Saturation | Traffic Delay Savings | Reduced Crashes | Reduced Crime | Maintenance Cost Savings | Total Benefits |
| 0 | 2022 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 1 | 2023 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2 | 2024 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 3 | 2025 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 4 | 2026 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 5 | 2027 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 6 | 2028 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 7 | 2029 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 8 | 2030 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 9 | 2031 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 10 | 2032 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 11 | 2033 | $0 | $0 | $3,121,220 | $1,606,407 | $850,340 | $2,578,748 | $13,821,359 |
| 12 | 2034 | $0 | $0 | $3,061,221 | $1,606,407 | $850,340 | $2,578,748 | $13,440,927 |
| 13 | 2035 | $0 | $0 | $3,007,242 | $1,606,407 | $850,340 | $2,578,748 | $13,015,277 |
| 14 | 2036 | $0 | $0 | $2,960,989 | $1,606,407 | $850,340 | $2,578,748 | $12,537,631 |
| 15 | 2037 | $0 | $0 | $2,924,503 | $1,606,407 | $850,340 | $2,578,748 | $12,000,267 |
| 16 | 2038 | $0 | $0 | $3,468,398 | $1,606,407 | $850,340 | $2,578,748 | $14,251,314 |
| 17 | 2039 | $0 | $0 | $4,097,654 | $1,606,407 | $850,340 | $2,578,748 | $16,572,561 |
| 18 | 2040 | $0 | $0 | $4,825,315 | $1,606,407 | $850,340 | $2,578,748 | $18,989,737 |
| 19 | 2041 | $0 | $0 | $5,666,388 | $1,606,407 | $850,340 | $2,578,748 | $21,530,048 |
| 20 | 2042 | $0 | $0 | $6,638,140 | $1,606,407 | $850,340 | $2,578,748 | $24,222,566 |
| 21 | 2043 | $0 | $0 | $6,850,060 | $1,606,407 | $850,340 | $2,578,748 | $23,029,035 |
| 22 | 2044 | $0 | $0 | $7,075,476 | $1,606,407 | $850,340 | $2,578,748 | $21,885,145 |
| 23 | 2045 | $0 | $0 | $7,315,205 | $1,606,407 | $850,340 | $2,578,748 | $20,778,909 |
| 24 | 2046 | $0 | $0 | $7,570,144 | $1,606,407 | $850,340 | $2,578,748 | $19,699,099 |
| 25 | 2047 | $1,162,103 | $167,356,440 | $7,841,274 | $1,606,407 | $850,340 | $2,578,748 | $187,153,689 |
| 26 | 2048 | $2,830,850 | $168,695,291 | $7,994,852 | $1,606,407 | $850,340 | $2,578,748 | $190,789,939 |
| 27 | 2049 | $5,028,616 | $170,044,854 | $8,142,210 | $1,606,407 | $850,340 | $2,578,748 | $195,025,440 |
| 28 | 2050 | $7,778,669 | $171,405,213 | $8,282,243 | $1,606,407 | $850,340 | $2,578,748 | $199,888,497 |
| 29 | 2051 | $11,105,206 | $172,776,454 | $8,413,710 | $1,606,407 | $850,340 | $2,578,748 | $205,408,696 |
| 30 | 2052 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Total** | | **$27,905,443** | **$850,278,252** | **$109,256,243** | **$30,521,733** | **$16,156,462** | **$48,996,207** | **$1,224,040,136** |

# TABLE A-2: EW2 SEGMENT A PROJECT BCA SUMMARY- DISCOUNTED

| | | Discounted Benefits | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Calendar Year | Initial Construction Costs | Residual Value | Avoided Delay * | Avoided Passenger Rail Cost * | Avoided Freight Delay: Avoided Critical Impact * | Avoided Passenger Rail Diversion: Avoided Critical Impact * |
| 0 | 2022 | $0 | $0 | $0 | $0 | $0 | $0 |
| 1 | 2023 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2 | 2024 | $0 | $0 | $0 | $0 | $0 | $0 |
| 3 | 2025 | $0 | $0 | $0 | $0 | $0 | $0 |
| 4 | 2026 | $0 | $0 | $0 | $0 | $0 | $0 |
| 5 | 2027 | $17,034,740 | $0 | $0 | $0 | $0 | $0 |
| 6 | 2028 | $49,567,624 | $0 | $0 | $0 | $0 | $0 |
| 7 | 2029 | $64,102,974 | $0 | $0 | $0 | $0 | $0 |
| 8 | 2030 | $62,175,532 | $0 | $0 | $0 | $0 | $0 |
| 9 | 2031 | $60,306,045 | $0 | $0 | $0 | $0 | $0 |
| 10 | 2032 | $43,869,577 | $0 | $0 | $0 | $0 | $0 |
| 11 | 2033 | $14,183,504 | $0 | $2,284,727 | $34,502 | $928,053 | $832,885 |
| 12 | 2034 | $0 | $0 | $1,883,200 | $18,587 | $1,026,261 | $809,838 |
| 13 | 2035 | $0 | $0 | $1,462,621 | $1,433 | $1,126,450 | $787,445 |
| 14 | 2036 | $0 | $0 | $1,020,125 | -$17,267 | $1,228,668 | $765,687 |
| 15 | 2037 | $0 | $0 | $552,563 | -$37,845 | $1,332,968 | $744,545 |
| 16 | 2038 | $0 | $0 | $1,472,078 | $17,361 | $1,353,678 | $724,002 |
| 17 | 2039 | $0 | $0 | $2,327,390 | $65,209 | $1,375,923 | $704,041 |
| 18 | 2040 | $0 | $0 | $3,128,425 | $106,628 | $1,399,793 | $684,645 |
| 19 | 2041 | $0 | $0 | $3,883,904 | $142,429 | $1,425,384 | $665,797 |
| 20 | 2042 | $0 | $0 | $4,601,502 | $173,322 | $1,452,796 | $647,481 |
| 21 | 2043 | $0 | $0 | $3,784,185 | $123,449 | $1,391,718 | $629,683 |
| 22 | 2044 | $0 | $0 | $3,025,757 | $80,234 | $1,333,404 | $612,387 |
| 23 | 2045 | $0 | $0 | $2,316,960 | $42,801 | $1,277,786 | $595,579 |
| 24 | 2046 | $0 | $0 | $1,649,698 | $10,388 | $1,224,800 | $579,246 |
| 25 | 2047 | $0 | $0 | $1,016,881 | -$17,668 | $1,174,382 | $563,372 |
| 26 | 2048 | $0 | $0 | $1,414,578 | -$10,082 | $920,722 | $547,945 |
| 27 | 2049 | $0 | $0 | $1,831,081 | -$2,411 | $666,263 | $532,953 |
| 28 | 2050 | $0 | $0 | $2,267,209 | $5,349 | $410,707 | $518,382 |
| 29 | 2051 | $0 | $0 | $2,723,811 | $13,199 | $153,756 | $504,221 |
| 30 | 2052 | $0 | $118,583,877 | $0 | $0 | $0 | $0 |
| **Total** | | **$311,239,996** | **$118,583,877** | **$42,646,696** | **$749,619** | **$21,203,509** | **$12,450,135** |

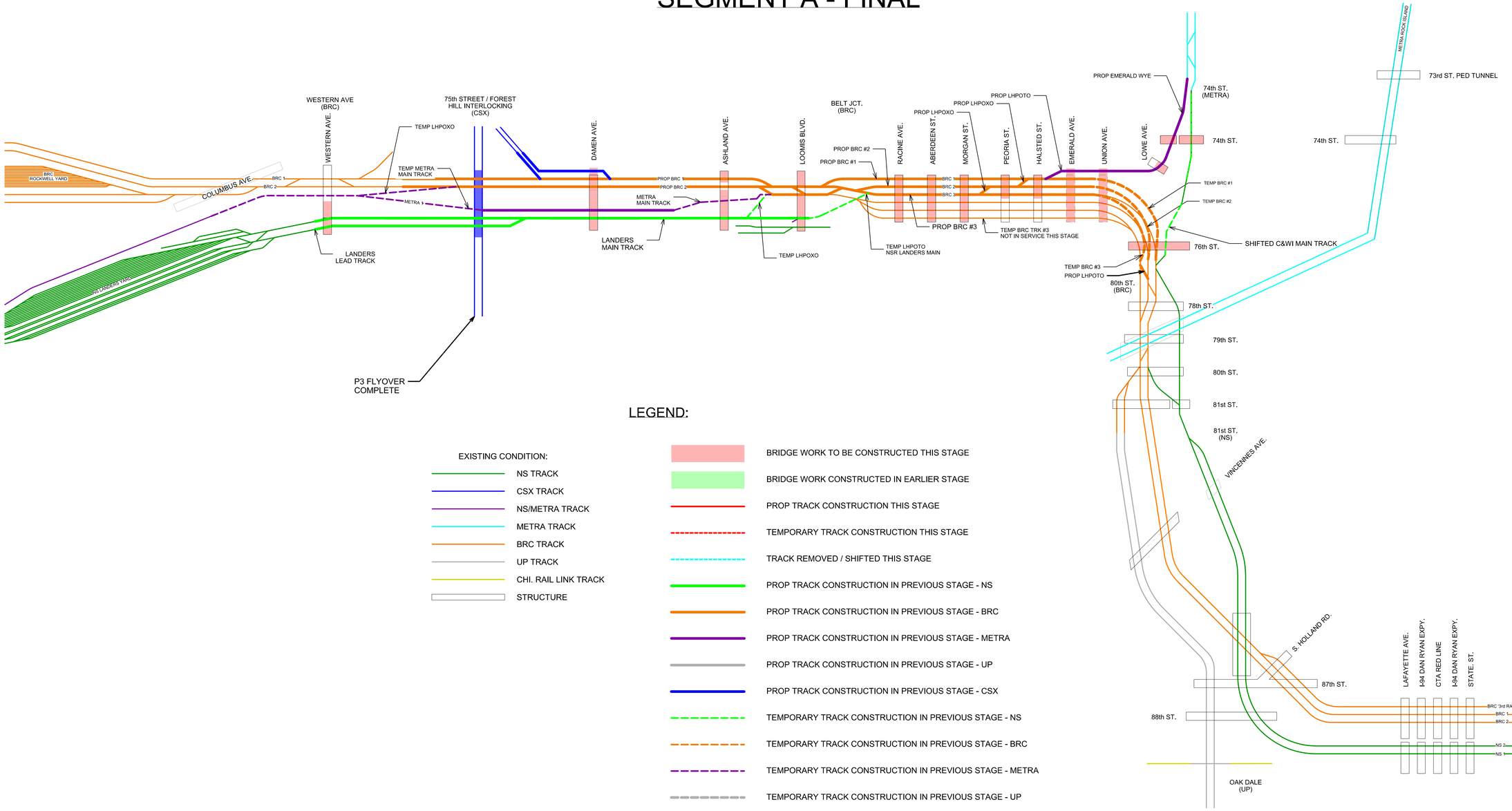
## TABLE A-2: CONTINUED

| | | Discounted Benefits | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | Calendar Year | Avoided Truck Diversion: Network Saturation * | Avoided Rail Diversion: Network Saturation | Traffic Delay Savings | Reduced Crashes | Reduced Crime | Maintenance Cost Savings | Total Benefits |
| 0 | 2022 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 1 | 2023 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 2 | 2024 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 3 | 2025 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 4 | 2026 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 5 | 2027 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 6 | 2028 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 7 | 2029 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 8 | 2030 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 9 | 2031 | $0 | $0 | $0 | $0 | $0 | $0 | $7,950,080 |
| 10 | 2032 | $0 | $0 | $0 | $0 | $0 | $0 | $8,565,720 |
| 11 | 2033 | $0 | $0 | $2,230,895 | $1,148,181 | $607,781 | $1,843,162 | $8,067,024 |
| 12 | 2034 | $0 | $0 | $2,122,221 | $1,113,657 | $589,507 | $1,787,742 | $7,563,271 |
| 13 | 2035 | $0 | $0 | $2,022,115 | $1,080,172 | $571,781 | $1,733,988 | $7,052,017 |
| 14 | 2036 | $0 | $0 | $1,931,148 | $1,047,694 | $554,589 | $1,681,851 | $6,530,644 |
| 15 | 2037 | $0 | $0 | $1,850,002 | $1,016,192 | $537,914 | $1,631,281 | $5,996,338 |
| 16 | 2038 | $0 | $0 | $2,128,091 | $985,637 | $521,740 | $1,582,232 | $7,202,587 |
| 17 | 2039 | $0 | $0 | $2,438,585 | $956,001 | $506,052 | $1,534,658 | $8,373,201 |
| 18 | 2040 | $0 | $0 | $2,785,285 | $927,256 | $490,836 | $1,488,514 | $9,522,868 |
| 19 | 2041 | $0 | $0 | $3,172,427 | $899,375 | $476,078 | $1,443,757 | $10,665,395 |
| 20 | 2042 | $0 | $0 | $3,604,733 | $872,333 | $461,763 | $1,400,347 | $11,813,931 |
| 21 | 2043 | $0 | $0 | $3,607,966 | $846,104 | $447,879 | $1,358,241 | $10,830,983 |
| 22 | 2044 | $0 | $0 | $3,614,640 | $820,663 | $434,412 | $1,317,402 | $9,921,496 |
| 23 | 2045 | $0 | $0 | $3,624,743 | $795,988 | $421,350 | $1,277,790 | $9,075,207 |
| 24 | 2046 | $0 | $0 | $3,638,280 | $772,054 | $408,681 | $1,239,370 | $8,283,147 |
| 25 | 2047 | $609,697 | $78,014,584 | $3,655,274 | $748,840 | $396,393 | $1,202,105 | $86,161,755 |
| 26 | 2048 | $1,447,912 | $76,274,200 | $3,614,807 | $726,324 | $384,474 | $1,165,960 | $85,320,881 |
| 27 | 2049 | $2,507,505 | $74,572,642 | $3,570,741 | $704,485 | $372,914 | $1,130,902 | $84,756,173 |
| 28 | 2050 | $3,781,631 | $72,909,043 | $3,522,941 | $683,302 | $361,701 | $1,096,898 | $84,460,265 |
| 29 | 2051 | $5,263,729 | $71,282,556 | $3,471,253 | $662,757 | $350,826 | $1,063,917 | $84,426,107 |
| 30 | 2052 | $0 | $0 | $0 | $0 | $0 | $0 | $8,007,090 |
| **Total** | | **$13,610,474** | **$373,053,025** | **$56,606,147** | **$16,807,014** | **$8,896,673** | **$26,980,117** | **$573,003,409** |

* includes carbon-related benefits discounted at 2%

# APPENDIX B
# EW2A Segmentation Schematics
# Segment A - Final

# SEGMENT A - FINAL




## LEGEND:

EXISTING CONDITION:

- NS TRACK
- CSX TRACK
- NS/METRA TRACK
- METRA TRACK
- BRC TRACK
- UP TRACK
- CHI. RAIL LINK TRACK
- STRUCTURE

- BRIDGE WORK TO BE CONSTRUCTED THIS STAGE
- BRIDGE WORK CONSTRUCTED IN EARLIER STAGE
- PROP TRACK CONSTRUCTION THIS STAGE
- TEMPORARY TRACK CONSTRUCTION THIS STAGE
- TRACK REMOVED / SHIFTED THIS STAGE
- PROP TRACK CONSTRUCTION IN PREVIOUS STAGE - NS
- PROP TRACK CONSTRUCTION IN PREVIOUS STAGE - BRC
- PROP TRACK CONSTRUCTION IN PREVIOUS STAGE - METRA
- PROP TRACK CONSTRUCTION IN PREVIOUS STAGE - UP
- PROP TRACK CONSTRUCTION IN PREVIOUS STAGE - CSX
- TEMPORARY TRACK CONSTRUCTION IN PREVIOUS STAGE - NS
- TEMPORARY TRACK CONSTRUCTION IN PREVIOUS STAGE - BRC
- TEMPORARY TRACK CONSTRUCTION IN PREVIOUS STAGE - METRA
- TEMPORARY TRACK CONSTRUCTION IN PREVIOUS STAGE - UP
- TEMPORARY TRACK CONSTRUCTION IN PREVIOUS STAGE - CSX

**Preliminary Plan**
*Not Approved for Operations*


benesch
Alfred Benesch & Company
1230 East Diehl Road, Suite 109
Naperville, Illinois 60563
630-577-9100 Job No. 210200.07

TranSystems


| R | By | Date | Revision Description |
|---|---|---|---|
| | | | |

NORFOLK SOUTHERN
Owning Company: NORFOLK SOUTHERN RAILWAY
NORFOLK SOUTHERN ENGINEERING DESIGN & CONSTRUCTION

| | | | |
|---|---|---|---|
| Drawing Date: 04/02/2024 | Operating Division: GREAT LAKES | PID Number: D1049 | City / State: Chicago, IL |
| Designed By: RDC | Milepost: | File Number: TRK0123500 | Project: CREATE 75TH ST. CIP EW2 / P2 CONSTRUCTION STAGING SCHEMATIC |
| Drawn By: LEE / Checked By: RDC | County: COOK | VRN: 1052507 | Drawing Number: SEGMENT A - FINAL |

CADD File: c:\pwwordir\benesch projects\projects\d0164750\EW2 Segments A-D Final.dgn
Printed: $TIME$ $DATE$


CREATE
KEEPING THE GO IN CHICAGO