Executive Summary and Project Description

Hanson Professional Services performed a Benefit Cost Analysis (BCA) for the BNSF Chillicothe Subdivision Viaduct Over IL 29 in Chillicothe, IL. The project proposes to replace the existing viaduct with a new rail bridge. Through coordination with BNSF and IDOT, the proposed rail bridge will carry additional tracks spanning a three-lane cross section with modern clear zones over IL 29, replacing the effected pavement. The BCA uses the *Benefit-Cost Analysis Guidance for Discretionary Grant Programs* document issued by the Office of the Secretary of the USDOT on November 18, 2024. **The BNSF Chillicothe Subdivision Viaduct Over IL 29 project has an expected benefit-cost ratio of 0.33.**

Benefit-Cost Analysis

The calculations provide present value (2023) estimates of the project's benefits and costs relative to a no-build baseline. Because the viaduct is narrow and over 100 years old, the project proposes to remove the existing structure and replace it with a new, wider, and safer bridge. The project will also replace existing pavement on IL 29 directly affected by the construction of the new rail bridge. The following assumptions for the no-build scenario, in which the asset has failed, were determined through discussions with IDOT and BNSF:

- The existing viaduct will fail and make the rail and road impassable sometime in 2028.
- Trains will not be able to run on the BNSF Chillicothe Subdivision for two (2) days.
- Vehicle traffic on IL 29 will be diverted for 90 days while the new rail bridge is constructed.
- After the 90 day period, regular rail and vehicular traffic patterns will return.

All the project's benefits and costs were discounted to 2023 dollars by applying a real discount rate of 3.1 percent per year to the project's streams of benefits and costs with the exception of carbon dioxide equivalent emissions, which were discounted at a rate of 2 percent per year.

The City of Chillicothe is located in Peoria County near the northern boundary of the Peoria-Pekin Urbanized Area Transportation Study (PPUATS) region-wide Travel Demand Model (TDM), which is maintained by the Tri-County Regional Planning Commission. Since the project is directly adjacent to the northern boundary of the Tri-County TDM, the project team collaborated with IDOT to use the Illinois Statewide Travel Demand Model (ILSTDM) to determine all adverse travel metrics associated with the 90-day IL 29 closure.

The BCA makes a comparison between the existing statewide socioeconomic condition with and without IL 29 open at the viaduct. This comparison shows the significance of IL 29 to the transportation system in Illinois and the Peoria Region. Table 1 illustrates the daily predicted differences in vehicle hours (VHT) and vehicle miles (VMT) traveled throughout the affected region with and without this section of IL 29 in operation.

Table 1: Existing Daily VHT and VMT Comparison

		(D)	(C)
		Total Vehicle Hours	**Total Vehicle Miles**
(A)	**IL 29 Open**	224,311	9,543,085
(B)	**IL 29 Closed**	**224,501**	9,551,799
€	**Change**	190	8714

€ = (B) – (A)
(D) = Total Regional Vehicle Hours Traveled from ILSTDM
(C) = Total Regional Vehicle Hours Miles from ILSTDM

VMT and VHT values used for the benefit cost analysis were calculated using a combination of the road (link) length from the road network file, the modeled Average Daily Traffic (ADT) volumes, and the modeled congested travel speeds for each link. The values and methodology were provided by IDOT via a memo. The memo can be provided upon request. The impact of the 90-day closure of IL 29, used in the BCA, was calculated by multiplying the daily metrics by 90.

Avoiding additional VHT and VMT is a significant part of the derived benefit of completing a project like the BNSF Viaduct Over IL 29. Economic and population growth projections should be accurate and conservative to ensure that the results of the benefit-cost analysis are not overly sensitive to change. Given the need to be conservative, Illinois' current population outflow, and the unknown nature of the viaduct's potential failure, the benefit-cost analysis produced for the project assumes that the 2028 economic and population conditions will be held constant.

1. Primary Economic Benefits

The primary economic benefits for completing the BNSF Viaduct Over IL 29 project are the monetization of travel efficiency, reduced carbon emissions, and reduced $PM_{2.5}$ emissions. The following sections describe and illustrate each of these calculations.

1.1. Travel Efficiency

1.1.1. Savings in Travel Time Costs

The BCA uses the recommended monetized value from Table A-2: *Value of Travel Time Savings* for In-Vehicle Travel – All Purposes Category[1], which is an hourly rate of $21.10 in 2023 dollars. Using the TDM, referenced above, the total VHT for the IL 29 open and closed conditions were calculated. TDM calculations show a travel time efficiency benefit of 190 vehicle hours per day for a 90-day closure. This amounts to a 2028 project benefit of $360,810 in 2023 dollars.

Table A-2: Value of Travel Time Savings

Recommended Monetized Value(s)	
Recommended Hourly Values of Travel Time Savings (2023 $ per person-hour)	
Category	**Hourly Value**
General Travel Time	
Personal[1]	$19.40
Business[2]	$33.50
All Purposes[3]	$21.10
Walking, Cycling, Waiting, Standing, and Transfer Time[4]	$38.80
Commercial Vehicle Operators[5]	
Truck Drivers	$35.70
Bus Drivers	$42.60
Transit Rail Operators	$59.60
Locomotive Engineers	$52.90

1.1.2. Savings in Vehicle Operating Costs

Based on Table-A-4: *Vehicle Operating Costs,* the recommended monetized values for the Light Duty Vehicles category is $0.56 per mile in 2023 dollars. Using the Total Vehicle Miles data calculated by the ILSTDM with IL 29 open and closed, it was found that the project decreases VMT by 8,714 miles-per-day for 90 days. Hence, the BCA found that the 2028 benefit is $439,186 in 2023 dollars.

[1] Office of the Secretary of the United States Department of Transportation. November 2024. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs." https://www.transportation.gov/sites/dot.gov/files/2024-11/Benefit%20Cost%20Analysis%20Guidance%202025%20Update%20%28Final%29.pdf

Table A-4: Vehicle Operating Costs

Recommended Monetized Value(s)

Vehicle Type	Recommended Value per Mile (2023 $)
Light Duty Vehicles[1]	$0.56
Commercial Trucks[2]	$1.27

1.2. Reduced Emissions

1.2.1. Reduced Damage from Carbon Dioxide Equivalent (CO_2E) Emissions

The BCA calculated reduced damage from Carbon Dioxide Equivalent emissions based on the reduction in regional VMT created by keeping IL 29 open in the TDM (Table 1). According to the United States Environmental Protection Agency, 8.8873.9x10-3 metric tons of CO_2E per mile traveled are emitted by the average passenger vehicle per mile[2]. Again, using the information from the ILSTDM (Table 1), the 2028 assumed project completion date, and the recommended monetized value from Table A-6, the BCA shows a project benefit in 2028 of $25,733 ($2021) assuming 1.8% trucks and 270 travel days per year.

*Table A-6: Damage Costs for Emissions per Metric Ton**

Recommended Monetized Value(s)

Emission Type	NO_X	SO_X	$PM_{2.5}$**	CO_2
2024	$20,800	$55,800	$998,300	$241
2025	$21,100	$56,800	$1,011,100	$246
2026	$21,400	$58,100	$1,029,700	$250
2027	$21,800	$59,500	$1,048,800	$254
2028	$22,100	$60,800	$1,068,200	$259

1.2.2. Reduced Damage from Particulate Matter Emissions

The BCA uses the 2027 projected average Particulate Matter gram per mile from the Bureau of Transportation Statistics[5] (BTS) of approximately 0.012 grams of emissions per mile traveled by light duty gasoline powered vehicles. Multiplying this factor by the reduction in VMT, resulting from keeping IL 29 open, and the recommended monetized values from Table A-6 produces an annual project benefit of $100,604 ($2023) in 2028.

[2]United States Environmental Protection Agency. 2018. "Greenhouse Gas Emissions from a Typical Passenger Vehicle." https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle.

1.3. Crash Reductions

To calculate the economic efficiency savings from reductions in crashes, historical crash data (2016-2023) was analyzed. The crash data used included Property Damage Only (PDO) crashes and Injury/Fatality crashes within the project limits.

A Highway Safety Manual (HSM)-level crash analysis was completed using crash data provided by the Illinois Department of Transportation and Crash Modification Factors (CMF) from the HSM Clearing House. The safety improvements associated with the BNSF Viaduct Over IL 29 project are moving fixed objects outside the clear zone and increasing lane widths. The CMFs for these improvements were applied to the existing crash rates to determine expected crash reductions caused by the project. The CMFs for moving fixed objects outside the clear zone and increasing the lane width from 11 feet to 12 feet are 38% and 15%, respectively. The annual crash reduction is monetized using Table A-1: *Value of Reduced Fatalities, Injuries, and Crashes*. A summary of the annual crash reduction benefits are shown in Table 2.

Table A-1: Value of Reduced Fatalities, Injuries, and Crashes

Recommended Monetized Value(s)	Refere

KABCO Level	Monetized Value (2023 $)
O – No Injury	$5,300
C – Possible Injury	$118,000
B – Non-incapacitating	$246,900
A – Incapacitating	$1,254,700
K – Killed	$13,200,000
U – Injured (Severity Unknown)	$229,800

Crash Type	Monetized Value (2023 $)
PDO Crash[1]	$9,500
Injury Crash[1]	$329,500
Fatal Crash[1]	$14,806,000

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Table 2: Annual Crash Reductions and Monetized Benefits

	(A) Existing	(B) Proposed	(C) Project Benefit	(D) (E) Unit Value (Year $)	(H) Benefit/ Time	(I) Times/ Year	(J) Annual Project Benefit (2023$)
IL 29 @ Viaduct							**$124,162.50**
Safety Benefits							
PDO Crashes *(Crashes/Year)*	2.86	1.51	1.35	$9,500.00 (2023)	$12,838.57	1	$12,838.57
Injury/Fatality Crashes *(Crashes/Year)*	0.71	0.38	0.34	$329,500.0 (2023)	$111,323.93	1	$111,323.93

(A) = Existing Values, calculations shown elsewhere
(B) = Proposed Values, calculations shown elsewhere
(C) = (A) - (B)
(D) = Unit Values, sources in this document
(E) = Year of Unit Values, sources in this document
(F) = Change in GDP Deflator; Source is RAISE BCA Guidance
(G) = (D) x (F)
(H) = (C) x (G)
(I) = How Many Times the Benefit Can Be Claimed Annually
(J) = (H) x (I)

1.4. Freight Train Delay

Interviews with BNSF representatives indicated that, in the event of a failure of the Chillicothe Subdivision Viaduct over IL 29, freight train traffic on the Chillicothe Subdivision would cease for approximately two (2) days. There is an operational cost to delaying the freight train traffic and adding delays to the locomotive engineers. Current freight train traffic, per the Illinois Commerce Commission website, was assumed to be 52 trains per day. Using these factors and the operating cost from Table A-5: *Train Operating and Social Costs*, the total benefit of avoiding these delays was calculated to be $3,524,352.

Table A-5: Train Operating and Social Costs

Recommended Monetized Value(s)

	Recommended Value per Hour (2023 $)		
Train and Movement Type	**Operating Costs[1]**	**Non-CO_2 Emission Costs[2]**	**CO_2 Costs[2]**
Idling			
Freight Train	$262	$776	$29
Commuter Train	$282	$106	$27
Amtrak Long-Distance	$718	$106	$27
Amtrak State-Supported	$323	$106	$27
Hauling			
Freight Train	$706	$2,284	$290
Commuter Train	$687	$755	$226
Amtrak Long-Distance	$1,123	$755	$226
Amtrak State-Supported	$728	$755	$226
All Movements			
Freight Railcar	$1.07	*	*

1) Includes fuel cost, depreciation, and labor cost.

1. Project Costs

The BNSF Viaduct Over IL 29 project costs consist of engineering fees for the design of the new bridge and initial project construction. Based on BNSF maintenance practices, no future maintenance costs were added to the project. The following sections describe and illustrate each of those calculations.

2.1 Engineering Fees for Environmental Documentation and Design Services

Engineering fees include environmental documentation, which consists of obtaining NEPA approval, and preliminary design. Design services include final design, land acquisition services, production of construction plans, specifications, and estimates. Because IDOT had already completed the NEPA documentation and preliminary design more than 10 years ago, it was assumed that a cost of 10% of construction would need to be designated to updating the NEPA documentation and design documents. This project would reduce the originally proposed bridge span length by reducing and/or eliminating the widening of IL 29 through the project area. Land acquisition was already completed by IDOT for the wider road and bridge design. Therefore, land acquisition costs are expected to be $0 for this project. Table 3 states the years and amounts of those fees paid by Peoria County.

Table 3: Engineering Fees

Category	Cost
Environmental Documentation	**$200,000**
2027	*$200,000*
Design Services	**$1,500,000**
2027	*$1,500,000*
Land Acquisition	**$0**
	$0
Construction Observation	**$0**
2028	*$250,000*
Total	**$1,950,000**

2.2 Initial Project Construction

Given the age, condition and narrowness of the existing viaduct, the project proposes removing the existing viaduct and replacing it with a new bridge. The bridge will be designed to span a new three lane cross section on IL 29, but IL 29 will only be reconstructed in the area directly impacted by the failure of the existing viaduct and the construction of the new bridge. IL 29 will not be widened as a part of this project. Table 4 splits the costs for the project into Roadway Reconstruction and Rail Bridge Reconstruction.

Table 4: Initial Construction Costs

Category	Cost
Roadway	$250,000
Rail Bridge	$17,000,000
Total	**$17,250,000**

Benefit-Cost Analysis Summary

Table 5 presents the benefit-cost analysis and the timeframe for capturing these benefits and costs. To summarize the text above, the following assumptions were used to complete the benefit-cost analysis:

- The existing viaduct will fail and make the rail and road impassable some time in 2028.
- Vehicle traffic on IL 29 will be diverted for 90 days while the new rail bridge is constructed.
- After the 90-day period, regular rail and vehicular traffic patterns will return.
- To determine the travel efficiency benefits of vehicle hours and miles saved by constructing a new rail bridge on the Chillicothe Subdivision Over IL 29, the ILSTDM was used.
- The ILSTDM transportation network was edited and run under two conditions – with the existing viaduct open and with it closed. The difference in the scenarios illustrates the additional vehicle hours and miles traveled if the viaduct fails before the new bridge is constructed.
- Economic and population growth were held to an average annual rate of 0% to ensure that travel time efficiencies were not overestimated in the benefit calculations.
- Based on conversations with BNSF, the BCA assumes that freight train traffic on the Chillicothe subdivision would be delayed for two days.
- Engineering costs input into the analysis were $1,950,000 and take place in 2027 and 2028.
- Land acquisition was not considered as IDOT has already purchased property for a planned widening of IL 29.
- Construction of the new rail bridge over IL 29 and pavement replacement were estimated to occur in 2028. Because the construction of new roadway is expected to be limited, the maintenance of the pavement and its subsequent life cycle were not included in the BCA.
- Maintenance of the new bridge was not included in the BCA due to the current maintenance practices of BNSF.
- A discount rate of 3.1% was used for all benefits and costs other than CO_2E which used a 2% discount rate.
- The benefit-cost analysis used a period of 20 years after initial reconstruction.

Table 5: Benefit Cost Analysis

(A)	(B)								(C)				(D)	(E)	(F)	(G)	(H)
Year	Calendar Year	Travel Time	Vehicle Operations	CO_2E Emission Reduction	$PM_{2.5}$ Emission Reduction	Property Damage Only Crashes	Injury Crashes	Freight Train Delay	Benefits ($2022)	Engineering Costs	Land Acquisition Costs	Construction Costs	Total Costs	2% Discounted CO_2E Benefit	3.1% Discounted Benefits	Total Benefits (NPV)	3.1% Discounted Total Costs (NPV)
	2014								$ -				$ -			$ -	$ -
	2015								$ -				$ -			$ -	$ -
	2016								$ -				$ -			$ -	$ -
	2017								$ -				$ -			$ -	$ -
	2018								$ -				$ -			$ -	$ -
	2019								$ -				$ -			$ -	$ -
	2020								$ -				$ -			$ -	$ -
	2021								$ -				$ -			$ -	$ -
	2022								$ -				$ -			$ -	$ -
1	2023								$ -				$ -	$ -	$ -	$ -	$ -
2	2024								$ -				$ -	$ -	$ -	$ -	$ -
3	2025								$ -				$ -	$ -	$ -	$ -	$ -
4	2026								$ -				$ -	$ -	$ -	$ -	$ -
5	2027								$ -	$1,700,000			$ 1,700,000	$ -	$ -	$ -	$ 1,504,576
6	2028	$360,810	$439,186	$80,713	$100,604	$12,839	$111,324	$3,524,352	$ 4,629,827	250,000		$17,250,000	$ 17,500,000	$ 73,105	$ 3,905,112	$ 3,978,216	$ 15,022,587
7	2029					$12,839	$111,324		$ 124,163				$ -	$ -	$ 103,380	$ 103,380	$ -
8	2030					$12,839	$111,324		$ 124,163				$ -	$ -	$ 100,272	$ 100,272	$ -
9	2031					$12,839	$111,324		$ 124,163				$ -	$ -	$ 97,257	$ 97,257	$ -
10	2032					$12,839	$111,324		$ 124,163				$ -	$ -	$ 94,333	$ 94,333	$ -
11	2033					$12,839	$111,324		$ 124,163				$ -	$ -	$ 91,496	$ 91,496	$ -
12	2034					$12,839	$111,324		$ 124,163				$ -	$ -	$ 88,745	$ 88,745	$ -
13	2035					$12,839	$111,324		$ 124,163				$ -	$ -	$ 86,077	$ 86,077	$ -
14	2036					$12,839	$111,324		$ 124,163				$ -	$ -	$ 83,489	$ 83,489	$ -
15	2037					$12,839	$111,324		$ 124,163				$ -	$ -	$ 80,978	$ 80,978	$ -
16	2038					$12,839	$111,324		$ 124,163				$ -	$ -	$ 78,544	$ 78,544	$ -
17	2039					$12,839	$111,324		$ 124,163				$ -	$ -	$ 76,182	$ 76,182	$ -
18	2040					$12,839	$111,324		$ 124,163				$ -	$ -	$ 73,891	$ 73,891	$ -
19	2041					$12,839	$111,324		$ 124,163				$ -	$ -	$ 71,670	$ 71,670	$ -
20	2042					$12,839	$111,324		$ 124,163				$ -	$ -	$ 69,515	$ 69,515	$ -
21	2043					$12,839	$111,324		$ 124,163				$ -	$ -	$ 67,424	$ 67,424	$ -
22	2044					$12,839	$111,324		$ 124,163				$ -	$ -	$ 65,397	$ 65,397	$ -
23	2045					$12,839	$111,324		$ 124,163				$ -	$ -	$ 63,431	$ 63,431	$ -
24	2046					$12,839	$111,324		$ 124,163				$ -	$ -	$ 61,524	$ 61,524	$ -
25	2047					$12,839	$111,324		$ 124,163				$ -	$ -	$ 59,674	$ 59,674	$ -
Residual Life									$ -						$ -	$ -	
Total									**$ 6,988,915**					**$ 73,105**	**$ 5,418,390**	**$ 5,491,494**	**$ 16,527,163**
Benefit Cost Ratio																**0.33**	

(C) = Total Benefit ($2020)
(D) = Total Costs Annual Costs (Year Expended)
(E) = $(CO_2E)/(1.03^{(A-1)})$
(F) = (Benefits $2020 (C) - CO_2E)$/(1.07^{(A-1)})$
(G) = (E) + (F)
(H) = (F)*(1.07(A-1)) or (H) = $(F)/(1.07^{(A-1)})$
Benefit Cost Ratio = Total (G)/Total (H)
Useful Service Life = 40 years for initial Construction
Useful Service Life = 12 years for maintenance