Benefit-Cost Analysis Memorandum

Heartland Flyer Corridor Safety, Efficiency, and Resiliency

Prepared for the Texas Department of Transportation

May 23, 2024

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Executive Summary

A benefit-cost analysis (BCA) for the *Heartland Flyer Corridor Safety, Efficiency, and Resiliency* Project (the "Project" hereafter), located along the BNSF-owned rail corridor between Oklahoma City and Fort Worth, was prepared for the Texas Department of Transportation (TxDOT) to support an application to the Consolidated Rail Infrastructure and Safety Improvements Program (CRISI). The BCA was conducted in accordance with the U.S. Department of Transportation's (USDOT's) *Benefit-Cost Analysis Guidance for Discretionary Grant Programs* (December 2023). This BCA compares expected benefits and costs of undertaking the Project (the "Build" scenario) to the "No Build" (or baseline) scenario, to estimate the Project's net benefits.

For the BCA, all values are in 2022 dollars, discounted at 3.1 percent, except for carbon emissions. The analysis covers a 20-year operating period following the opening of the Project in 2028. The BCA estimates the Total Project's Net Present Value (NPV) to be $22.7 million and the benefit-cost ratio (BCR) to be 1.4.

The BCA compares expected benefits and costs of the Build alternative to the no build (baseline) alternatives to estimate the proposed project's net benefits. Exhibit 1 presents the Impact Matrix, which summarizes the baseline, the Project, and the estimated benefits.

As shown in Exhibit 2, the Project provides $83.7 million in total benefits over the analysis period, using a 3.1 percent discount rate. The benefits include train operating cost savings, travel time savings, emissions reductions, vehicle operating cost avoided, safety savings, avoided operating and maintenance (O&M) costs, external highway user cost, and the Project's residual value.

Exhibit 1 – Impact Matrix

Current Status/Baseline & Problem to be Addressed	Change to Baseline or Alternatives	Types of Impacts	Affected Population	Economic Benefit (Net Present Values, $2022 M) Discounted at 3.1%	Page Reference in BCA
The Project is expected to improve the resiliency of infrastructure on the line and reduce conflict points at two siding relocations: Davis, OK and Valley View, TX. The growing demand for freight and passenger services along the *Heartland Flyer* corridor is increasing pressure on the already constrained network.	The analysis assesses the Project as the summation of three individual elements that have independent utility: Davis, Valley View, and Resiliency. In Davis, the Project improvements consist of closing two at-grade crossing locations and removing the siding track. In Valley View, the Project will relocate a siding to south of Farm to Market (FM) Road 922 to stop road blockages. The Resiliency component of the Project will address issues to eliminate slow orders, improving reliability and operational efficiency and resilience along the corridor.	**Effects on System and Service Performance**			
		Train Operating Cost Savings	BNSF, Amtrak	$5.4	10
		Avoided O&M Cost	BNSF	$0.9	10
		Residual Value	TxDOT, ODOT, BNSF	$13.4	11
		Effects on Safety, Competitiveness, Reliability, Trip Time, and Resilience			
		Travel Time Savings	Road Users, Amtrak	$31.8	11
		Emissions Reductions	Community	$17.3	12
		Auto and Truck Operating Cost Savings	Road Users	$7.7	13
		Safety Savings	Road Users	$5.2	13
		External Highway User Cost	Road Users, Community	$2.0	14
		Ability to Meet Existing or Anticipated Demand			
			Qualitative		

Source: USDOT, TxDOT, ODOT, BNSF, AECOM, TranSystems, Jacobs
Note: M = millions

Exhibit 2 – Costs and Benefits of Project

Heartland Flyer Corridor Safety, Efficiency, and Resiliency *20-year benefits period (2028-2047), 2022 $M, Discounted at 3.1%*				
	Summary	**Resiliency**	**Davis**	**Valley View**
Costs *(2022 $M)*				
Capital Costs	$61.1	$4.7	$27.1	$29.3
Total Costs	**$61.1**	***$4.7***	***$27.1***	***$29.3***
Benefits (2022 $M)				
Effects on System and Service Performance				
Train Operating Cost Savings	$5.4	$4.6	$0.6	$0.2
Avoided O&M Cost	$0.9	$0.9	-	-
Residual Value	$13.4	$1.5	$5.6	$6.3
Sub-total	***$19.7***	***$7.0***	***$6.2***	***$6.5***
Effects on Safety, Competitiveness, Reliability, Trip Time, and Resilience				
Travel Time Savings	$31.8	$0.7	$19.5	$11.5
Emissions Reductions	$17.3	$13.7	$1.7	$1.9
Auto and Truck Operating Cost Savings	$7.7	-	$1.2	$6.4
Safety Savings	$5.2	-	$0.6	$4.6
External Highway User Cost	$2.0	-	$0.2	$1.8
Sub-total	***$64.0***	***$14.4***	***$23.3***	***$26.2***
Ability to Meet Existing or Anticipated Demand				
	Qualitative			
Total Benefits	**$83.7**	**$21.5**	**$29.5**	**$32.7**
Outcome				
Net Present Value (2022 $M)	**$22.7**	**$16.8**	**$2.5**	**$3.4**
Benefit-Cost Ratio	**1.4**	**4.6**	**1.1**	**1.1**

Source: USDOT, TxDOT, ODOT, BNSF, AECOM, TranSystems, Jacobs
Note: M = millions

1. Project Description

The Texas Department of Transportation (TxDOT) and the Oklahoma Department of Transportation (ODOT) request Consolidated Rail Infrastructure and Safety Improvements (CRISI) Grant Program funding for the *Heartland Flyer Corridor Safety, Efficiency, and Resiliency* Project (the Project) to improve safety along the Burlington Northern Sata Fe (BNSF) line from Oklahoma City, OK to Fort Worth, TX. The route is served by BNSF freight trains and two Amtrak *Heartland Flyer* trains every day.

The Project is expected to improve the resiliency of infrastructure on the line and reduce conflict points at two siding relocations: Davis, OK and Valley View, TX. The growing demand for freight and passenger services along the *Heartland Flyer* corridor is increasing pressure on the already constrained network. The analysis assesses the Project as the summation of three individual elements that have independent utility: Davis, Valley View, and Resiliency.

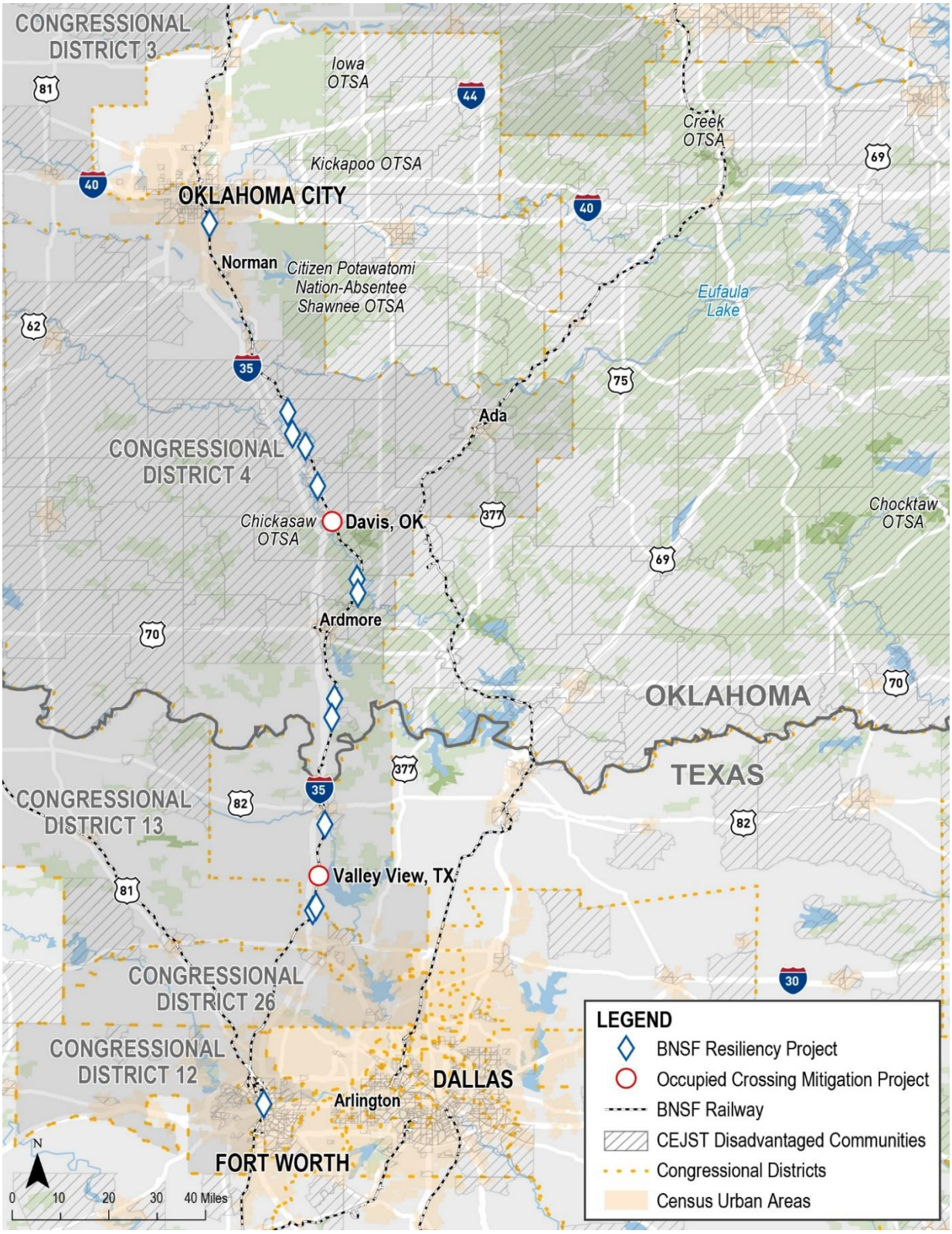
In Davis, the Project improvements consist of closing two at-grade crossing locations at Atlanta Avenue and Hanover Road and removing the siding track between Benton Avenue and Main Street (US-77/SH-7). Approximately two miles of new siding and industry operations will be relocated south of Haliburton Road/CR-3310 to reduce the impact of loading trains that currently occupy multiple crossings in the city.

In Valley View, the Project will relocate a siding to south of Farm to Market (FM) Road 922 to stop road blockages and extend it from 8,204 to 11,900 feet to meet current siding standard distances. The existing FM 922 crossing is directly next to the interchange with Interstate 35; when trains located on the siding track block the at-grade crossing, vehicles are forced to detour of 8.5 miles.

In addition, various subgrade issues have led to recurring slow orders, compromising operational efficiency for both freight and passenger services across Texas and Oklahoma. The Resiliency component of the Project will address issues to eliminate slow orders, improving reliability and operational efficiency, and resilience along the corridor. The work involves the following elements: riprap/ballast install, surfacing, grout injection, and turnout improvement; rail replacement; correct line swing at several bridges; and deck replacement of two bridges in the Fort Worth division. This component of the Project's benefits will be driven by the elimination of slow orders. Both freight and passenger services will achieve higher speeds across parts of the corridor, leading to operational efficiencies.

Exhibit 3 shows the Project location and the main components.

Exhibit 3 – Project Area and Components Description



2. Analysis Framework

The benefit-cost analysis (BCA) of the Project was conducted using the USDOT's *Benefit-Cost Analysis Guidance for Discretionary Grant Programs* document[1] (USDOT BCA Guidance) as a guide for preferred methods and monetized values. The parameters of the benefits analysis follow the protocols set by the Office of Management and Budget (OMB) "Circular A-94," as well as recommended benefit quantification methods from the USDOT. Generally, for the benefits calculations, standard factors and values accepted by Federal agencies were used, except in cases where Project-specific values or prices were available. In such cases, modifications are noted, and references are provided for data sources.

This analysis follows a conservative estimation of the quantifiable benefits of the Project; the actual total benefits of the Project may be greater than depicted in the results. The "Baseline" scenario assumes that the Project will not be built and the purpose of, and need for, the Project would not be met. The Project ("Build" scenario) was compared to the Baseline scenario to identify net benefits in the following categories: "effects on system and service performance;" "effects on safety, competitiveness, reliability, transit time, and resilience;" "efficiencies from improved integration with other modes;" and "ability to meet existing or anticipated demand."[2]

Benefits and costs were estimated over a 20-year period, beginning when construction is scheduled to be completed (2028) and concluding after 20 full years of operation (2047). All dollar values are in 2022 dollars and were discounted to 2022 at 3.1 percent, except for carbon dioxide (CO_2) emissions, which applies a 2 percent discount rate.

[1] US Department of Transportation, USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2023. Available https://www.transportation.gov/sites/dot.gov/files/2023-12/Benefit%20Cost%20Analysis%20Guidance%202024%20Update.pdf

[2] Benefits categories are consistent with the merit criteria found in the FY 2023-2024 CRISI NOFO

3. Analysis Assumptions

A list of assumptions and sources used in the analysis is provided in Exhibit 4.

Exhibit 4 – Benefit-Cost Analysis Inputs

Input	Value	Source
General		
Discount Rate	3.1%	2024 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
Discount Rate	2.0%	
Discount Year	2022	
Period of Analysis (years)	20	
Construction Start Year	2026	
Operations Start Year	2028	
Train Operations & Delays Avoided - Resiliency Component		
Daily Freight Trains	23	BNSF
Daily Passenger Trains	2	
Annualization (days) -Assume Slow Orders 20% per year	73	
Baseline: Average Speed due to Slow Orders (mph)	40	
Build: Freight - Average Speed with Project (mph)	55	
Build: PAX - Average Speed with Project (mph)	70	
Baseline: Average Speed (mph), for Rail Replacement Segment	10	
Build: Freight - Average Speed with Project (mph), No Slow Orders - Rail Replacement	25	
Baseline: Annual Increase in Delays	1%	
Build: Annual Increase in Delays	1%	
Heartland Flyer Services, 2022	63,051	Amtrak
Average Daily Passenger Train Occupancy	40	Calculated
Train Operations & Delays Avoided - Davis Component		
Average Train Length (ft)	5,300	BNSF
% Change in Average Train Speed	10%	
Average Train Speed, No Build (mph)	20	
Average Crossing Time, No Build (mins)	3	
Average Train Speed, Build (mph)	22	
Average Crossing Time, Build (mins)	3	
No. of Railcars	30	
Average Daily Crossings	See “Davis Inputs” Tab	
Train Operations & Delays Avoided - Valley View Component		
Daily Freight Trains	26	BNSF
Daily Passenger Trains	2	
Average Annual Freight Train Growth	1%	
Project Area Net Detour Length (miles)	8.5	
No Build Crossing (Siding) Occupancy Time per Meet (hours)	0.53	
Build Crossing (No Siding) Occupancy Time per Meet (hours)	0.08	
Annual Growth in Occupancy Time per Meet	1%	
Daily Train Meets (occurrences)	3	
Trains Utilizing Siding per Meet	1	
No Build Average Speed for Freight Trains Utilizing Siding (mph)	20	
Build Average Speed for Freight Trains Utilizing Siding (mph)	40	
Distance Impacted by Build Operational Speed (miles)	0.70	
Train Count Base Year	2024	Data provided by BNSF.
Traffic Count Base Year	2022	FRA WBAPS database.
AADT,2022	3,433	TxDOT

AADT Growth	1%	
Passenger Vehicle Percentage	87%	Calculated.
Truck Percentage	13%	FRA WBAPS database.
Project Area Average Vehicle Speed (mph)	30	
Vehicle Operating Cost & Travel Time Savings		
Average hourly operating cost per train, Freight - Hauling (2022$)	$799	2024 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
Average hourly operating cost per train, Freight - Idling (2022$)	$273	
Average hourly operating cost per train, Amtrak State-Supported (2022$)	$810	
Freight Railcar, operating cost per hour	$1.03	
Vehicle Operating Cost, Light Duty Vehicles (per mile) (2022$)	$0.52	
Vehicle Operating Cost, Trucks (per mile) (2022$)	$1.32	
Travel Time Savings, All Purposes (2022$)	$19.60	
Truck Drivers, Hourly Wage (2022$)	$33.50	
Average Occupancy- Passenger Vehicles	1.67	
Light-Duty Vehicle Idling Average Fuel Consumption per Hour (gasoline)	0.30	Argonne National Laboratory, User Guide for AFLEET Tool 2023.
Truck Idling Average Fuel Consumption per Hour (diesel)	0.75	
Cost of Fuel per Gallon (2022$)	$2.92	AAA Gas Prices, by State
Cost of Fuel per Gallon (2022$)	$3.21	
Vehicle Operating Cost- Idling, Light Duty Vehicles (per hour)	$0.87	Calculated.
Vehicle Operating Cost- Idling, Trucks (per hour)	$2.41	Calculated.
Safety		
Value of Reduced Fatalities and Injuries -Fatal Crash (2022$)	$14,022,900	2024 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
Value of Reduced Fatalities and Injuries -Injury Crash (2022$)	$313,000	
Value of PDO, per vehicle (2022$)	$9,100	
Value of Injured - Severity Unknown (2022$)	$217,600	
O&M Cost Savings		
Baseline: Annual O&M Cost related to Failing Bridge Deck (2024$)	$1,170,000	BNSF
Baseline: Annual O&M Cost related to Failing Bridge Deck (2022$)	$1,089,716	
External Highway User Cost		
Congestion Cost per VMT, Light-Duty Vehicles- All Locations (2022$)	$0.116	2024 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
Noise Cost per VMT, Light-Duty Vehicles- All Locations (2022$)	$0.001	
Safety Cost per VMT, Light-Duty Vehicles- All Locations (2022$)	$0.040	
Congestion Cost per VMT, Buses and Trucks - All Locations (2022$)	$0.236	
Noise Cost per VMT, Buses and Trucks, All Locations (2022$)	$0.022	
Safety Cost per VMT, Buses and Trucks, All Locations Rural (2022$)	$0.021	
Emissions Savings		
Freight Train, Non-CO_2 emission cost per hour, Hauling, (2022$)	$2,202	2024 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
Freight Train, CO_2 emission cost per hour, Hauling, (2022$)	$280	
Passenger Train, Non-CO_2 emission cost per hour, Hauling, (2022$)	$727	
Passenger Train, CO_2 emission cost per hour, Hauling, (2022$)	$218	
Freight Train, Non-CO2 emission cost per hour, Idling (2022$)	$749	
Freight Train, CO2 emission cost per hour, Idling (2022$)	$28	
Damage Costs for Emissions per metric ton (2022$)	See Inputs	
Grams per Metric Ton	1,000,000	

3.1. Davis

In the Baseline Scenario for the Davis section, existing rail guideway and at-grade railroad crossing infrastructure is not upgraded or removed and continues to experience the historical level of delays during train crossing events. The key assumptions used to define the Baseline are as follows:

- The freight service trains operating in the service corridor continue to operate at current levels, while baseline vehicle traffic volumes in the City of Davis grows at 1.04%.
- Vehicle traffic at the five identified at-grade railroad crossings in the City of Davis encounters delays during train movements, while a percentage of vehicle users incur additional travel distance and time detouring over the grade-separated crossing on Primrose Lane. Vehicle traffic either idles and choses to take a detour route. (Refer to Exhibit 5).
- Delays related to train movements in and out of the existing siding track continues to cause idling and delays in hauling time of freight trains, resulting in extraneous operating costs and emissions for freight operators. Current average train speed is 20 mph and the average train length is 5,300 feet.
- Inefficiencies in passenger train operations reflect slower train speeds which currently average 20 mph. The length of the project area is 3.1 miles and the average crossing time is estimated at 9.3 minutes.

Exhibit 5 – Baseline and Build Assumptions for the Davis Section

	Benton Ave	E Main St	N 3310 Rd	Hanover Rd	Atlanta Ave
AADT (2022)	575	11,500	72	43	862
Auto	94%	90%	96%	96%	94%
Truck	6%	10%	4%	4%	6%
CAGR	1.04%	1.04%	1.04%	1.04%	1.04%
Annual Extended Delay (hours)	16	29.15	4	4	9.5
Reduction in Extended Delay	100%	100%	100%	100%	100%
% of Traffic Detouring	40%	40%	40%	0%	0%
Average Detour Length (miles)	5.10	5.10	0.30	-	-
Average Detour Time (hours)	0.13	0.13	0.01	-	-
Average Daily Train Crossings	22	22	26		
Daily Train Crossing Time, Baseline (hours)	1.10	1.10	1.30		
Daily Train Crossing Time, Build (hours)	1.00	1.00	1.19		

The main assumptions for the Build Scenario include:

- the removal of the at-grade crossings at Atlanta Avenue and Hanover Road and the moving of the siding track to south of the City of Davis will eliminate the prolonged delays during train movements through the railroad crossings;
- the availability of the siding track allows freight trains stopping in the industrial areas of the City of Davis to avoid idling during train movements, while freight trains moving through the corridor will experience improved travel time due to the reduced on-track conflicts. These reductions in train vehicle-hours of delay reduces operating costs for rail operators and avoids emissions. Average train speed increases to 22 mph.

- The avoided prolonged wait time for vehicle traffic at the remaining at-grade railroad crossings eliminates the detouring of vehicle traffic around the City of Davis and average crossing time under the Build will fall 3.01 minutes to 2.74 minutes.

3.2. Valley View

In the Baseline scenario, the existing siding track will remain at the railway junction, and vehicular traffic will continue to detour when trains are occupying it. In addition, freight trains that use the existing siding track will operate at restricted speeds (approximately 20 miles per hour) due to the existing smaller No. 14 turnouts/switches over a distance of 0.7 miles.

The key assumptions used to define the No Build are as follows:

- Twenty-two (22) train meets[3] per week (3.14 meets daily) occur at the crossing and grow at 1.0% annually.[4] Each train meet results in the crossing being occupied for 0.53 hours. The average siding occupancy time is also expected to grow by 1.0% annually due to increasing train lengths in the future. Each train meet is assumed to result in traffic detours of 8.52 miles.

- An average of 3,433 vehicles traverse the crossing daily, with approximately 13% truck traffic. Traffic volumes are assumed to grow at 1.0% annually. Vehicular traffic is assumed to travel at an average speed of 30 miles per hour. One freight train per train meet uses the existing siding per meet and will operate at restricted speeds (20 miles per hour) over a distance of 0.70 miles.

In the Build scenario (the alternative whereby the Project is constructed), the existing siding at the railway junction will be relocated, and vehicular traffic will no longer be required to detour when it is occupied by trains. The new infrastructure will involve the same growth assumptions regarding the number of train meets and crossing occupancy time. The Build scenario will also involve the following key assumptions:

- Each train impacted by a train meet in the No Build (2 trains per train meet) will still occupy the main track in the Build scenario. The main track is occupied, on average, for 2.35 minutes (0.08 hours.)

- One freight train per train meet uses the existing siding per meet and will operate at faster speeds (40 miles per hour) over a distance of 0.70 miles. Travel time savings resulting from faster freight train speeds are assumed to be hauling-related.

3.3. Resiliency

For the Resiliency component of the Project, the elimination of slow orders at 13 locations will allow trains to increase their speed across approximately 15 miles of the corridor. The number of trains using this corridor is 25 per day, of which two are passenger trains and 23 are freight. The volume of trains is not expected to increase in the Baseline or Build scenarios. On average, the elimination of slow orders will:

[3] A train meet is defined as a situation in railroading or rail transit operations in which a train traveling in one direction "meets" another traveling in the opposite.
[4] Data provided by BNSF. Growth assumption based on future rail growth in the corridor.

- Increase speeds from 40 miles per hour to 55 miles per hour for freight trains and from 40 miles per hour to 70 miles per hour for passenger trains.
- Replace failing deck bridge which otherwise would require significant rehabilitation cost of $1.1 million in 2026 in order to remain operational.

Exhibit 6 shows how the Project addresses resiliency issues to improve the trains' operational efficiencies.

Exhibit 6 – Propose Resiliency Improvements under the Build

Subdivision	Milepost	Station	Issue	Work Description	Distance Affected (miles)
Red Rock	497.1-497.5	Pauls Valley	Subgrade	Riprap/Ballast install and surfacing	1.0
Red Rock	389.6-391.3	Flynn Siding	Rail	Rail Replacement	2.3
Red Rock	501.2-502.9	Paoli Siding	Subgrade/ Turnout	Riprap/Ballast install and surfacing	2.3
Red Rock	493.6-495.3	Pauls Valley Siding	Subgrade/ Turnout	Riprap/Ballast install and surfacing	2.3
Red Rock	485.4	Wynnewood	Subgrade	Riprap/Ballast install, surfacing and grout injections	0.6
Red Rock	463	CP 4631	Subgrade	Riprap/Ballast install, surfacing and grout injections	0.6
Red Rock	459.4-461.2	Gene Autry Siding	Subgrade	Riprap/Ballast install and surfacing	2.4
Red Rock	435.3	Marietta	Subgrade	Riprap/Ballast install and surfacing	0.6
Red Rock	431.1	Marietta	Subgrade	Riprap/Ballast install, surfacing and grout injections	0.6
Fort Worth	389.6	Metro	Line Swing	Correct line swing at bridge	0.6
Fort Worth	408.3	Gainesville	Line Swing	Correct line swing at bridge	0.6
Fort Worth	346.5	Fort Worth	Bridge Deck	Replace deck to address ballast loss and remove slow orders	0.6
Fort Worth	388.89	Metro	Bridge Deck	Replace deck to address ballast loss and remove slow orders	0.6

4. Benefit Analysis

This Project will result in benefits covering the following categories: "effects on system and service performance;" "safety, competitiveness, reliability, trip time, and resilience;" "efficiencies from improved integration with other modes;" and "ability to meet existing or anticipated demand." The methodologies used to estimate the benefits of the Project are described in the following sections, along with the associated results.

Under the Build scenario, Project improvements will improve operational efficiencies for both freight and passenger trains, the avoidance of vehicle miles traveled related to a reduction in detours yield several benefits related to avoided crashes, travel time savings, operating cost savings, avoided external highway use costs, and avoided emissions, improve safety, reduce congestion, and increase connectivity along the corridor. Total values are shown in the text and benefits by components are provided in the summary tables.

4.1. Effects on System and Service Performance

Project improvements along the *Heartland Flyer* corridor will improve train operational efficiencies by reducing the number of slow orders issued along the corridor and reducing conflict points for siding locations at Davis and Valley View. Additional benefits will be realized as the replacement of the bridge deck at MP #346.5 and MP#388.89 will avoid significant O&M cost required to keep the facility operational.

Train Operating Cost Savings

Train operating cost savings will be realized under the Build due to increased speeds along the corridor. Exhibit 7 summarizes the change in speed for each project component and the project impacts.

Exhibit 7 – Impact of Project on Train Operating Cost Savings

Project Component	Average Speed (Baseline)	Average Speed (Build)	Distance Covered	Impact on Speed
Resiliency	40mph	55mph (Freight) 70mph (Passenger)	15.1 miles	Remove Slow Orders
Davis	20mph	22mph (Freight)	1.0 miles	Reduce On-track Conflict
Valley View	20mph	40mph (Freight)	0.7 miles	Reduce On-track Conflict

Source: BNSF

Under the baseline for the Resiliency component, slow orders are issued for 13 locations identified by the Project. These slow orders are issued on average for 20 percent of the year and require trains to reduce their speeds ranging from 40 mph to as low as 10 mph. By addressing the current subgrade issues, correcting alignment, and replacing the failing bridge deck, speeds are expected to increase from an average of 40 mph to 55 mph. Based on discussions with BNSF, benefits will accrue within a 0.3-mile distance before and after the Project location. This component of the Project will decrease travel time for freight trains by 400 hours per year, and 44 hours per year for passenger trains.

For the siding relocation projects located in Davis and Valley View, higher average train speeds will result from the relocation of the sidings that reduces on-track conflicts. Current baseline speeds are estimated at 20 mph and is expected to improve to 22 mph for Davis and 40 mph for Valley View. On average, travel time for freight trains will fall by 30 hours per year, and 10 hours per year for passenger trains.

The total value of train operating cost savings under the Build scenario amounts to $5.4 million in 2022 dollars over the 20-year period, discounted at 3.1 percent.

Avoided O&M Cost

Without the Project, two bridge decks will require significant rehabilitation to continue to be operational over the next five years. BNSF estimates a total O&M cost of $1.2 million will be required in 2025 in order for the bridge to remain in service for the following five years.

Avoided O&M cost for the Build scenario will total $0.9 million in 2022 dollars, discounted at 3.1 percent for the 20-year period of analysis.

Residual Value

The Project would result in benefits beyond the 20-year period of analysis because the useful life of the Project exceeds this time span. The useful life of the Project (38 years for replacement track for railroads, 54 years for other rail infrastructure, 60 years for other government non-residential structures[5]) is used to depreciate the asset to the end of the analysis period using straight-line depreciation. The remaining value of this cost is discounted from the final year of the 20-year analysis period (2047). Exhibit 8 summarizes the residual value for each Project component.

Exhibit 8 – Residual Value

Project Component	Remaining Value (2022$)				Discounted, 3.1%
	Rail Road Replacement	Other Railroad Structure	Utilities	Right-of-Way	
Resiliency	$285,000	$2,862,000	$0	$0	$1,467,000
Valley View	$0	$13,129,000	$0	$303,000	$6,261,000
Davis	$0	$10,374,000	$1,690,000	$0	$5,624,000
Total					**$13,352,000**

The value of the remaining useful life for the Project amounts to $13.4 million in 2022 dollars, discounted at 3.1 percent.

4.2. Safety, Competitiveness, Reliability, Trip Time, and Resilience

Reductions in detour-related vehicle miles travelled (VMT) and vehicle hours travelled (VHT) underpin several Project benefits including safety savings, travel time savings, vehicle operating cost savings, and emissions reductions.

Travel Time Savings

For Davis and Valley View where sidings are relocated, on-street traffic will benefit from a reduction in idle time and detour time. For the Resiliency component, passenger travel time savings will accrue from the improved travel speeds for Amtrak trains along the corridor.

At the Davis and Valley View locations, vehicular traffic at the existing at-grade crossing experience delays from the frequent and lengthy periods where the crossing is blocked as the existing siding track is occupied while waiting for Amtrak and freight trains to pass. During this time, vehicular traffic is forced to take a detour or may wait until the tracks are cleared. In the Build scenario, the existing siding at the railway junction will be relocated, and vehicular traffic will no longer be required to detour nor will remain idle (refer to Section 3. Analysis Assumptions). On average, 37,000 hours will be saved per year by those in autos and 2,600 for those in trucks with the implementation of the relocation of siding at these two locations. In addition, improved train speeds will reduce annual travel time for Amtrak passengers at the Davis location by about 2,277 hours in 2028 and is expected to grow in line with passenger volume growth.

[5] BEA Rates of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wykoff Categories. Available: https://apps.bea.gov/scb/account_articles/national/0797fr/table3.htm

For the Resiliency component, Amtrak passengers will benefit from faster train speeds which is expected to increase from an average of 40 mph to 70 mph along the corridor. According to BNSF, two passenger trains will take this route daily and slow orders affect 20 percent of the year (equivalent to 73 days). Total daily VHT along the corridor will fall from an average of 1.07 hours to 0.53 hours. A 1% growth rate was applied to both the baseline and build conditions. Over the 20-year period of analysis, passengers' travel time will fall by an average of 1,800 hours per year. A value of $19.60 per hour, based on the USDOT BCA Guidance, was applied to travel times for all passengers.

The total value of travel time savings due to the Project amounts to $31.8 million in 2022 dollars over the 20-year period, discounted at 3.1 percent.

Emissions Reductions

Under the Build, emissions reductions will be realized for passenger and freight trains, as well as for autos and trucks. Exhibit 9 summarizes how the Project impacts emissions reductions for each mode. To estimate the value of emissions reductions for trains, the number of operating hours were multiplied by the emission cost per hour provided in the USDOT BCA Guidance. For autos and trucks, emissions rates (g/mile) are estimated based on the California Air Resources Board (CARB) "On Road Emissions Rates[6]" model and USDOT's value for CO_2 and Non-CO_2 emissions were applied.

Exhibit 9 – Impact of Project on Emissions

Project Component	Impact on Trains	Impact on On-Street Traffic
Resiliency	Reduces VHT for freight (hauling) and passenger trains	Not applicable
Davis	Improves maneuverability and improves overall average speed of freight trains	Reduces auto and truck detours and idling times
Valley View	Improves maneuverability and improves overall average speed of freight trains	Reduces auto and truck detours

For the Resiliency component, emissions were related to time savings for freight and passenger trains. Net time savings under the build was estimated at 378 hours and 40 hours in 2028, respectively. Annual growth of 1% was assumed for both Baseline and Build conditions.

For the siding relocations at Davis and Valley View, emissions reductions are related to (i) the reduction in auto and truck VMT generated from detours; (ii) the reduction in delays from trains maneuvering on the existing siding track which lowers idling time of freight trains; and (iii) improved speeds for freight and passenger trains. In 2028, total VMT related to detours is estimated at 88,000 for autos and 5,700 for trucks for the Davis location. Under the Build for the Davis component, freight hauling and idling time will be reduced by 37 and 29 hours per year, respectively, while passenger hauling time will be reduced by 10 hours per year.

For the Valley View location, in 2028, total VMT related to detours is estimated at 618,000 for autos and 80,000 for trucks. Reduction in freight (hauling) VHT will amount to 21 hours in 2028 and will increase based on 1% growth assumption in train meet times.

[6] California Air Resources Board, Emissions Inventory, https://arb.ca.gov/emfac/emissions-inventory/747eda1236e185f07668f8c5fabd093d532c0f50

Exhibit 10 summarizes the value of emissions savings from the Project.

Exhibit 10 –Summary of Value of Emissions Reductions, by Mode

Project Component	Mode	Non-CO2 Emissions, Discounted 3.1%	CO2 Emissions, Discounted 2%
Resiliency	Freight Train	$11,487,000	$1,716,000
Resiliency	Passenger Train	$403,000	$142,000
Davis	Auto	$94,000	$2,000
Davis	Truck	$26,000	$6,000
Davis	Freight Train	$1,297,000	$164,000
Davis	Passenger	$95,000	$43,000
Valley View	Auto	$650,000	$12,000
Valley View	Truck	$392,000	$91,000
Valley View	Freight Train	$635,000	$95,000

The value of emissions cost avoided under the Build scenario amounts to $17.3 million in 2022 dollars, when discounted at 3.1 percent for non-carbon emissions and 2 percent for carbon emissions.

Auto and Truck Operating Cost Savings

For both Davis and Valley View, auto and truck operating costs will be incurred under the Build due to the reduction in detours and idling time, as described in Section 3. Analysis Assumptions. To value the operating cost savings from the Project, the vehicle operating cost per mile in 2022 dollars was applied for each mode: $0.52 for passenger vehicles and $1.32 for buses based on the USDOT BCA Guidance (Exhibit 4) to the annual VMT savings.

Auto and truck operating cost savings will amount to $7.7 million in 2022 dollars, discounted at 3.1 percent over the 20-year analysis period.

Safety Cost Savings

Safety savings realized from the Project are largely attributed to the VMT reductions due to detours avoided when sidings are relocated at Davis and Valley View locations. In addition, the removal of the crossing at Atlanta Avenue and Handover Road will reduce annual crash reductions by 0.024, based on FRA's Rail Predictive Modelling.[7]

To estimate the number of crashes prevented by reducing detour-related VMT, crash rates were sourced from the Bureau of Transportation Statistics[8] and National Highway Traffic Safety Administration[9] data. These crash rates were multiplied by the VMT avoided to obtain the number of crashes saved per year. Crashes related to detour reductions and crossing removal were then

[7] Federal Rail Administration, New Model for Highway-Rail Grade Crossing Accident Prediction and Severity, https://railroads.dot.gov/elibrary/new-model-highway-rail-grade-crossing-accident-prediction-and-severity
[8]Bureau of Transportation Statistics, "Motor Vehicle Safety Data," https://www.bts.gov/content/motor-vehicle-safety-data.
[9] National Highway Traffic Safety Administration data, March 2022. Available: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813266

valued based on USDOT BCA guidance (see Exhibit 4). Exhibit 11 summarizes safety benefits under the Build.

Exhibit 11 – Summary of Safety Benefits

Project Component	Crashes related to VMT-Reductions			Crashes related to Rail Crossing Elimination	Total Discounted Safety Savings (2022$)
	No. of Fatal Crashes	No. of Injury Crashes	No. of PDO Crashes	No. of Injuries (Severity Unknown)	
Davis	0.03	1.6	3.8	0.5	$0.6 million
Valley View	0.2	12.7	31.0	-	$4.6 million

Over the 20-year analysis period, safety savings will amount to $5.2 million in 2022 dollars, discounted at 3.1 percent.

External Highway User Cost

The reduction in VMT related to detours will also impact non-detoured passengers through congestion, noise, and safety on the detour route. These costs were monetized based on the external highway user costs for autos and trucks, provided in the USDOT BCA Guidance and were applied to the additional VMT to calculate external highway user costs (refer to Exhibit 4).

External highway user cost savings will amount to $2.0 million in 2022 dollars, discounted at 3.1 percent, over the 20-year analysis period.

4.3. Ability to meet Existing or Anticipated Demand

Improvements in train operating efficiencies across the *Heartland Flyer* rail corridor will improve network performance and increase the system's capacity to meet current and future demands of freight and passenger travel.

5. Cost Analysis

Capital costs for the Project are expected to be incurred between 2025 and 2027. Capital costs include the cost of new sidings and extensions of existing passing sidings; track replacement, track and signal system improvements; ballast replacement, surfacing and grout injections, and redesign of curved elements of existing track to facilitate higher speeds.

5.1. Capital Cost

Project engineering activities, utility relocation, and acquisition of right-of-way are scheduled to occur in 2025, while construction will occur in 2026 and 2027. The costs for the Project were provided in real dollars and adjusted to 2022 dollars using the Gross Domestic Product deflator.[10]

[10] Office of Management and Budget Historical Tables, Table 10.1 Gross Domestic Product and Deflators Used in the Historical Tables: 1940 – 2029 available at https://www.whitehouse.gov/omb/budget/historical-tables/

Exhibit 12 provides a break-down of capital cost by construction, design, right-of-way, and utilities costs.

The total capital costs for the Project amount to $61.1 million in 2022 dollars, discounted at 3.1 percent.

Exhibit 12 – Capital Cost

	Construction Cost (2022$)	Design Costs (2022$)	ROW/ Utilities (2022$)	Total Cost (2022$)	Discounted Capital (3.1%)
2025	$0	$23,518,000	$2,838,000	$26,355,000	$24,049,000
2026	$21,237,000	$0	$0	$21,237,000	$18,796,000
2027	$21,237,000	$0	$0	$21,237,000	$18,231,000
Total	**$42,474,000**	**$23,518,000**	**$2,838,000**	**$68,830,000**	**$61,075,000**

Note: Sums may not total due to rounding

6. BCA Results

Taken in total, the Project will deliver $83.7 million in total benefits over the 20-year benefits period, using a 3.1 percent discount rate. Compared to a similarly discounted cost estimate, the net present value (NPV) is $22.7 million, and the benefit-cost ratio (BCR) is 1.4. The results also demonstrate the cost-effectiveness of each section. The resiliency, Davis, and Valley View sections all achieve a positive NPV and a BCR over 1.

The private and public benefits of the Project align closely with the sought after benefits specified in the Notice of Funding Opportunity.

Exhibit 13 provides a summary of the BCA results for the Project.

Exhibit 13 – Benefit-Cost Analysis Results

Heartland Flyer Corridor Safety, Efficiency, and Resiliency *20-year benefits period (2028-2047), 2022 $M, Discounted at 3.1%*				
	Summary	**Resiliency**	**Davis**	**Valley View**
Costs *(2022 $M)*				
Capital Costs	$61.1	$4.7	$27.1	$29.3
Total Costs	**$61.1**	***$4.7***	***$27.1***	***$29.3***
Benefits (2022 $M)				
Effects on System and Service Performance				
Train Operating Cost Savings	$5.4	$4.6	$0.6	$0.2
Avoided O&M Cost	$0.9	$0.9	-	-
Residual Value	$13.4	$1.5	$5.6	$6.3
Sub-total	***$19.7***	***$7.0***	***$6.2***	***$6.5***
Effects on Safety, Competitiveness, Reliability, Trip Time, and Resilience				
Travel Time Savings	$31.8	$0.7	$19.5	$11.5
Emissions Reductions	$17.3	$13.7	$1.7	$1.9
Auto and Truck Operating Cost Savings	$7.7	-	$1.2	$6.4
Safety Savings	$5.2	-	$0.6	$4.6
External Highway User Cost	$2.0	-	$0.2	$1.8
Sub-total	***$64.0***	***$14.4***	***$23.3***	***$26.2***
Ability to Meet Existing or Anticipated Demand				
	Qualitative			
Total Benefits	**$83.7**	**$21.5**	**$29.5**	**$32.7**
Outcome				
Net Present Value (2022 $M)	**$22.7**	**$16.8**	**$2.5**	**$3.4**
Benefit-Cost Ratio	**1.4**	**4.6**	**1.1**	**1.1**

Source: USDOT, TxDOT, ODOT, BNSF, AECOM, TranSystems, Jacobs
Note: M = millions