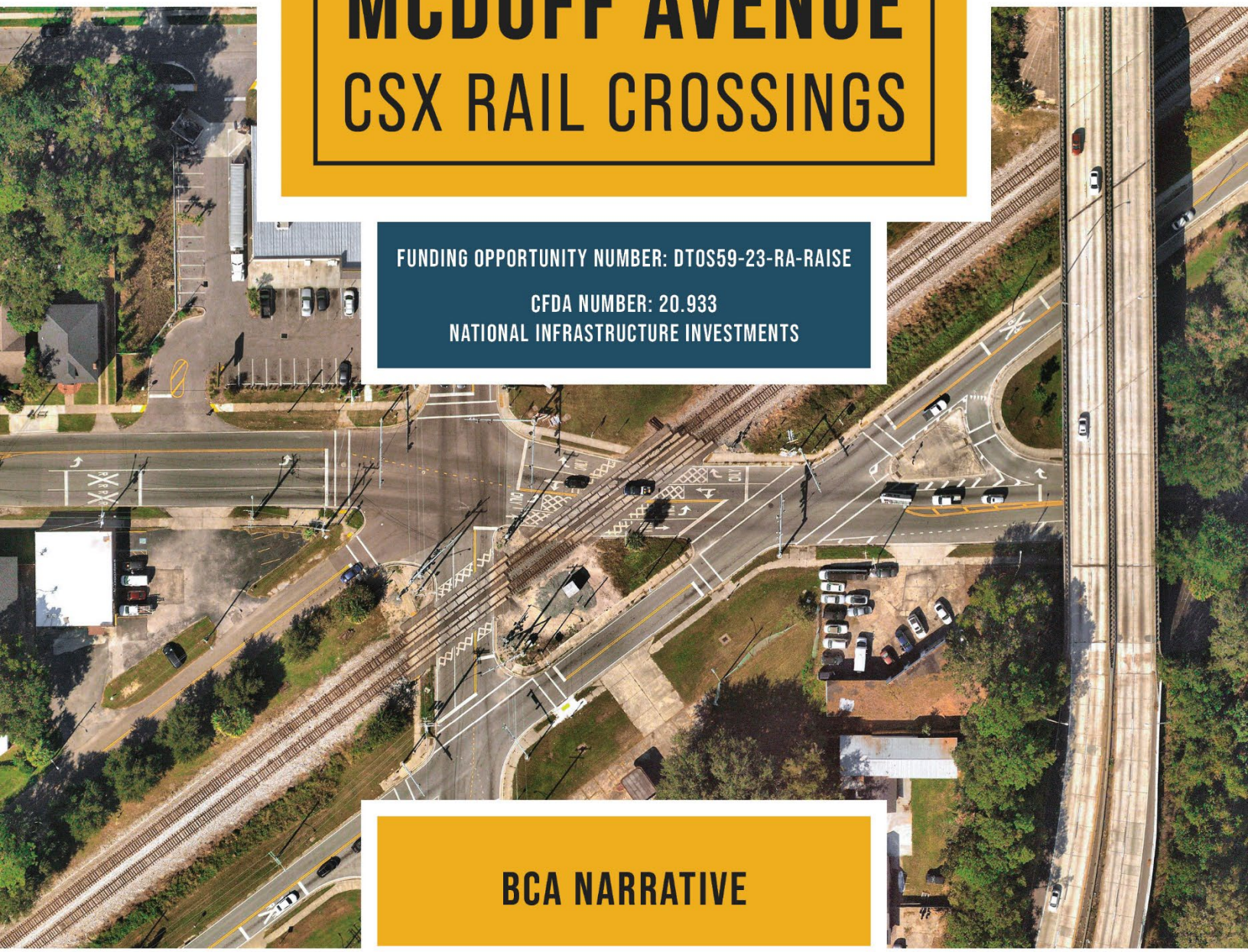
POST ST.
&
MCDUFF AVENUE
CSX RAIL CROSSINGS



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NATIONAL INFRASTRUCTURE INVESTMENTS

BCA NARRATIVE

FEBRUARY 27, 2023

FDOT

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U.S. Department of Transportation
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Benefit Cost Analysis Narrative

Benefit-Cost Analysis Technical Memorandum
Post Street & McDuff Avenue Rail Crossings

Project Overview

The Florida Department of Transportation (FDOT) (Grantee) is pursuing a grant with the U.S. Department of Transportation's (USDOT) Fiscal Year 2023 Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program to implement the Post Street Innovative Crossing project to provide rail crossing and safety improvements at the Post Street and McDuff Avenue intersection over the CSX railroad corridor.

The Post Street and McDuff Avenue CSX Rail Crossings improvement project will reduce travel lane conflict points and improve roadway geometry to improve driver/pedestrian expectancy and sight distance. The proposed improvements provide a free flow single intersection that eliminates three signals and provides for better channelization and wayfinding signage for vehicles, cyclists, and pedestrians traveling through the intersection and crossing the CSX rail corridor.

The proposed design reduces the number of lanes crossing the railroad tracks from seven lanes to two, provides dynamic envelopes for added visibility for motorists, bicyclists, and pedestrians crossing the rail train tracks, and reduces severity of head on and "T-bone" crashes by reducing both vehicle speed and impact angle of collision.

Improving the efficiency of this location will increase all users' abilities to enter and exit the community quicker and safer while becoming less dependent on Edgewood Avenue. These improvements will enhance community value, improve emergency response, reduce travel time, increase resiliency while reducing emissions, and potentially save lives.

This memorandum summarizes the assumptions, methodologies, and results of the benefit-cost analysis (BCA) completed for the FY 2023 RAISE Program. The BCA provides a means to measure a project's overall benefit by developing a uniform measurement of the impact the project has on society. This is accomplished by assigning a monetary value to benefits that can be compared to the construction costs and other related costs. In the BCA, the capital costs of constructing and maintaining the project are compared to the net benefit the project provides to the region. The costs and benefits are discounted to compare all costs and benefits with a common measure such as using 2020 dollars.

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Project Costs

Per the funding application, the cost of the project in year of expenditure (or nominal) dollars is $11,041,019. This reflects the actual costs expected to be incurred in the future in 2023 and 2024. Per USDOT Guidance, all costs (and benefits) used in the BCA should be stated in real or constant dollars using a common base year of 2020. Using actual construction inflation between 2020 and 2022, and further assuming 6 percent annual construction inflation over the next two years, the $11,041,019 in nominal YOE dollars can be converted to $8,043,460 in constant 2020 dollars. Lastly, per USDOT Guidance, all costs (and benefits) used in the BCA should be further discounted at 7 percent to reflect the principle that benefits and costs that occur sooner in time are more highly valued than those that occur in the more distant future, and that there is thus a cost associated with diverting the resources needed for an investment from other productive uses in the future. Using the recommended 7 percent discount rate, the $8,043,460 in real $2020 dollars can be converted to $6,010,171 in discounted 2020 dollars, where the base year for discounting is 2021. The capital expenditures of the project in its three distinct forms are shown in Table 1.

TABLE 1: CAPITAL EXPENDITURES

Nominal YOE Dollars	Real 2020 Dollars	Discounted 2020 Dollars
$11,041,019	**$8,043,460**	**$6,010,171**

Analysis Results

This project will contribute quantifiable benefits in several areas, the greatest of which are related to the reduction in crashes due to unsafe intersection design, reduction in the cost of human life lost due to reduced emergency response times, and the reduction in travel time through the intersection. Among others, these areas of quantifiable benefit are the subject of this BCA. The substantial positive impacts of the project are in 2020 dollars and assume a 7-percent discount rate monetized at $39.7M in benefits, compared to a discounted project cost of $6.0M. As a result, the project has a benefit-cost ratio (BCR) of 6.45 (at a 7-percent discount), which represents a favorable investment of federal funds and a significant benefit to the community. The results in Table 2 are shown both without any discount applied and with a 7-percent discount. As can be seen in the table, there are substantial benefits associated with the Post Street & McDuff Avenue CSX Rail Crossings project.

TABLE 2: BCR SUMMARY

	Undiscounted	7% discount
Benefits	**$125,715,056**	**$39,704,020**
Costs	**-$8,043,460**	**-$6,010,171**
BCR	**15.63**	**6.61**
NPV	**$117,671,596**	**$33,693,849**

BCA Detailed Summary

A detailed summary of all benefits quantified in this BCA both without any discount applied and with a 7-percent discount are shown in 3.

TABLE 3: BCA SUMMARY

Possible Societal Benefits for Consideration	Key Benefits Quantified	Total Benefits	Present Value (7% Discount Rate)
Economic Competitiveness			
Peak Hour Travel Time Savings/-Costs	Reduction in travel time due to improved roadway alignment and an increase in speed limit along the corridor	$33,007,097	$10,378,954
Operating Cost Savings	Reduction in vehicle operating costs due to improved corridor alignment	$28,455,648	$4,473,884
Safety			
Crash Savings	Reduction in fatal, injury and PDO crashes for both motorized and non-motorized crashes	$74,274,313	$23,692,403
Environmental Sustainability			
Peak Hour Vehicle Emissions Savings/-Costs	Decrease in CO, CO_2, VOC, NO_X, $PM_{2.5}$, SO_2 emissions due to reduced vehicle mileage	$2,378,569	$399,993
Other			
Residual Value	Residual value of assets at the end of the analysis period	$894,537	$109,852
Maintenance Costs & State of Good Repair Savings	Change in cost of regular maintenance and inspection of assets, including savings due to state of good repair benefits	$2,122,000	$648,961
Total Benefits		**$141,132,165**	**$39,704,020**
Total Costs		**-$8,043,460**	**-$6,010,171**
Benefit / Cost Ratio		**17.55**	**6.61**
		133,088,704	**33,693,849**

BCA Methodology

The BCA was developed using the updated 2022 guidance provided by the USDOT. Analysis was completed as necessary to develop the benefits and costs of the No-Build and Build alternatives. Major components of the analysis include:

- Establishing existing and future conditions under the Base Case (No-Build) and Alternative (Build) Scenarios
- Assessing benefits with respect to the merit criteria identified in the Notice of Funding Opportunity (NOFO),
- Quantifying Initial capital costs and residual capital value of structures at the end of the BCA period
- Quantifying maintenance and state of good repair impacts as traffic patterns are altered (maintenance and state of good repair is a disbenefit in the analysis due to the addition of new infrastructure)
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a
- common unit of measurement:
    - Safety benefits associated with new traffic patterns, decreased vehicle-hours traveled (VHT)
    - Reduction in human life lost during emergency transportation
    - Reduced travel times, operating costs, and emissions due to decreased VHT
- Discounting future benefits and costs to year 2021 with the real discount rate recommended by US DOT (7%); and
- Deriving and analyzing the BCA summary metrics

In addition to these main benefits, unquantified benefits were also identified. These benefits were not developed into monetized results but describe the value of constructing the project beyond the quantified results of the BCA. These broader benefits are generally discussed in the project narrative and the Factors Not Quantified section.

The BCA spreadsheet included in this application begins with an Inputs tab (Tab A) containing key information about the project. This tab also includes many of the inputs and assumptions discussed below and provides source information as appropriate. The next tab (Tab B) is the Output Table which is shown above in Table 2. The Summary tab (Tab C) includes all the costs and benefits (annualized) and calculates the BCA results. The remaining tabs calculate the costs and benefits for each subject area. These tabs are listed below along with a brief description of key parameters and assumptions.

Analysis Period

The BCA analysis was completed for a 30-year period starting in 2024 and covering the 2-year engineering and construction period of the project as well as a 26-year operating period of benefits following completion of the project. This analysis period was used to capture the benefits of the project while staying within USDOT guidance. The present value of all benefits

and costs was calculated using 2020 dollars. All values discussed in subsequent sections also refer to 2020 dollars. Thirty years is an appropriate analysis period because this project involves the "full reconstruction" of a rail crossing intersection per USDOT BCA guidance.

The analysis uses the current project schedule and construction duration assumptions. This assumes preliminary engineering will occur throughout 2023 and construction will begin in 2024. Construction is scheduled to be completed in 2026, meaning that full project use and benefits will begin in 2026. Any temporary net benefits or indirect costs caused by the construction of the project, including jobs created by the construction or travel time delays due to construction, are assumed to be minimal and were excluded from the analysis.

Construction Costs and Residual Capital Value – Tabs D and E

The project costs were developed based on individual construction line items, with contingencies, incidental costs, and indirect costs assumed as a percentage of the total raw constriction cost. As previously discussed, project costs were developed using year of expenditure dollars (generally 2024) and then discounted back to 2020 dollars and further discounted by 7% per USDOT BCA guidelines.

The total 2020 project cost was $8.0M undiscounted, or $6.0M at a 7-percent discount.

Many of the components of the project have service lives beyond the analysis period, so a residual capital value can be calculated for the Build Alternative. This residual value is applied as a benefit in the BCA assuming a service life of 30-years applied to the construction value of the project as assigned in Tab D and demonstrated in as a benefit at the end of the analysis period in Tab E.

The residual value benefit of the project was $0.9M undiscounted, or $110K at a 7-percent discount.

Maintenance and State of Good Repair – Tab F

Separate from the initial capital costs of the project previously described are the continual costs of operating and maintaining the roadway and rail crossing facilities throughout the analysis period. Rail crossings should be replaced every 15 years with an average cost of $750/ft for asphalt replacement and $1,750/ft for concrete replacement. The width of this rail crossing is 350 feet. Additionally, traffic signals have a typical annual maintenance cost of $17,400 and an estimated reconstruction cost of $500,000 per signal every 20 years.

The proposed project removes the traffic signals at the intersection (removing the annual and long-term reconstruction costs) and creates a salvage value of $250k as the signal infrastructure will be repurposed by a nearby jurisdiction.

For the Build alternative, a modest $5,000 per year in maintenance of the new intersection complex is assumed.

The total maintenance and state of good repair benefit of the project was $2.1M undiscounted, or $649K at a 7-percent discount.

Crash Savings – Tab G

The Build alternative will provide a net decrease in the monetary impact of crashes in the study area by improving the intersection design to reduce the potentials for queueing across the rail crossing and congestion associated with the train.

A 5-year (2015-2019) crash analysis was provided by FDOT for the Post Street and McDuff Avenue intersection, which included rail accident reported crashes. Where appropriate, crash modification factors (CMFs) from the CMF Clearinghouse were applied to the build scenario to reflect the proposed intersection changes. Two CMFs were identified:

1. Conversion of stop- and signal-controlled intersections into roundabouts, and
2. Install an intersection conflict warning system (ICWS) with post mounted signs (various messages) and flashers at the intersection on minor; loop on major (as a proxy for combined benefits of the ITS improvements)

These CMFs were combined using a multiplicative method recommended by the FHWA for two safety enhancements applied to a common location.[1] The combined CMFs were applied to the anticipated number of annual crashes to result in build condition crashes. (See CMF analysis below)

Crash Modification Factors (CMFs)		
CMF	**Value**	**Description**
1	0.488	Conversion of stop- and signal-controlled intersections into roundabouts
2	0.704	Install an intersection conflict warning system (ICWS) with post mounted signs (various messages) and flashers at the intersection on minor; loop on major
Combined	0.344	

Crashes were categorized as fatal crashes, suspected serious injury crashes, suspected injury crashes, possible injury crashes, or PDO crashes and monetized on a per-crash basis according to values recommended by USDOT for benefit-cost analysis in FY 2022. Based on the Build and No-Build predicted crash values, the annual monetized value of crashes was calculated for each

[1] USDOT, FHWA, Local and Rural Briefing Papers: Crash Modification Factors (CMFs)

https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/cmf.pdf

year of project use. The change in the monetized value of crashes was then calculated during the analysis period.

The total crash cost savings benefit of the project was $74.2M undiscounted, or $23.7M at a 7-percent discount.

Travel Time – Tab I

An VISSIM operational analysis was conducted by FDOT consultants to evaluate the impacts of converting the existing signalized intersection at Post Street and McDuff Avenue to a roundabout configuration. This analysis provided current (2021) and future (2045) peak hour traffic volumes and vehicle delay for the build and no-build scenarios at the study intersection. The annual peak hour traffic volumes for weekdays were used to calculate the annual daily traffic volumes. The annual peak hour volumes were divided by an assumed k-factor of 0.09 to provide an estimate of the annual average daily traffic (AADT) for weekdays.

The peak hour vehicle delay was multiplied by the annual peak hour traffic volumes and divided by seconds in an hour to result in annual hors of peak hour delay. An assumption was made that the study area had 3-hour peak periods and that the delay in the two non-peak hours of the peak period were half the day experienced during the peak hour. Accordingly, the annual peak hour delay savings were multiplied by 2 to result in annual peak period delay savings (annual peak period vehicle-hours traveled (VHT)). It is noted that no other delay savings were assumed for other hours of the delay; this results in a conservative estimate of travel time delay savings.

The annual peak hour VHT was calculated for the No-Build and Build alternatives and split into truck and non-truck VHT assuming trucks account for 2% of traffic. Using occupancy rates and assumed monetary values for in-vehicle travel time provided by USDOT, travel time impacts were monetized for the Build and No-Build alternatives for each analysis year. The difference between the monetary value of travel time between the two alternatives represents the travel time benefit of the project

The total travel time benefit of the project was $33.0M undiscounted, $10.4M at a 7-percent discount.

Operating Costs – Tab J

As previously discussed, annual peak period VHT was calculated for the Build and No-Build alternatives and split into truck and non-truck VHT assuming trucks account for 2% of traffic. An assumed travel speed of 30 mph was applied to VHT to calculate the approximate annual weekday vehicle miles traveled (VMT) for the Build and No-Build alternatives for truck and non-truck trips. Multiplying the calculated VMT savings and the monetized operating cost of passenger vehicles and trucks as provided by USDOT yielded the annual operating cost savings claimed as a benefit of the project. (Note: In fact, the project does not result in significant VMT reductions, but rather reductions in VHT. Because emission rates were on a VMT basis, an adjustment was required to reflect the lower emissions rates of vehicles idling versus vehicles in motion. A downward adjustment factor of 50 percent was assumed.)

The total operating cost savings benefit of the project was $28.5M undiscounted, or $8.9M at a 7-percent discount.

Environmental Impacts – Tab L

An overall reduction in vehicle hours traveled in the Build alternative will result in mobile-source emissions reductions. The projected emissions were based on imputed vehicle miles traveled in the Build alternative based on time savings and compared against the projected emissions of the No-Build alternative. (Note: In fact, the project does not result in significant VMT reductions, but rather reductions in VHT. Because emission rates were on a VMT basis, an adjustment was required to reflect the lower emissions rates of vehicles idling versus vehicles in motion. A downward adjustment factor of 50 percent was assumed.) The difference in the emissions between the Build and No-Build alternatives and the associated cost to society represents the environmental benefit of the project.

To calculate the projected emissions of each alternative, average in-use emission rates for both passenger cars and heavy-duty trucks from the California Life-Cycle Benefit/Cost Analysis (Cal-B/C) Model (updated 2022) were used for carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NOx), sulfur oxides (SOx), and volatile organic compounds (VOCs). Damage costs for these pollutant emissions from the Cal-B/C model were used to calculate the relative environmental costs of the Build and No-Build alternatives. Note that CO_2 emissions were discounted at a 3-percent discount rate per USDOT guidance, while the remainder of pollutants were discounted at a 7-percent rate.

The total environmental benefit of the project was $2.4M or $800K at the total combined discount.

Economic Output

Construction of the project and an injection of new federal money in the region is anticipated to create short-term spending, earning, and employment gains. **Although these benefits are not included in the overall BCR, this quantification is still represented in the Economic Output tab to demonstrate the short-term economic benefits of this project.** These benefits are quantified using the Bureau of Economic Analysis's Regional Input-Output Modeling System (RIMS II) to determine the regional economic output, household earnings, and employment multipliers for the state of Florida. These multipliers provide an estimate of the total economic gains in all industries in the region per dollar of expenditure for specific industries.

Factors Not Quantified

Several factors were not quantified as part of the analysis but provide additional benefits beyond those quantified above. Some unquantified factors are:

- **Reduced Transit Delays** – The project will return transit service to the area. Currently public transportation has ceased operations in the project area due to safety concerns as buses and vehicles have been caught on the rails and are unable to move when a train is coming. Reduces travel time through the intersection by 50 percent improving transit reliability and on-time performance for the McDuff route.
- **Access for Emergency Responders –** Reduces the friction through the intersection allowing first responders to address community emergencies with reduced delays.
- **Pedestrian and Bicyclist Connectivity Improvements** – The project enhances pedestrian facilities by filling-in missing gaps in the sidewalk network and adds additional bicycle designation/signage throughout the intersection, connecting to downstream bike lanes.

- **Nearby economic (commercial) activity –** Reducing the friction and challenge in navigating the intersection will improve access and economic viability of nearby commercial properties.
- **Freight Reliability —** The project will improve the reliability of the rail line by minimizing rail down time due to accident response and remediation
- **Incident Management –** Improvements associated with this project include utilizing technology to help manage and operate the roadway, creating real-time safety benefits by allowing operators to confirm and respond to conditions and events.
- **Off-Peak Hour delay savings**