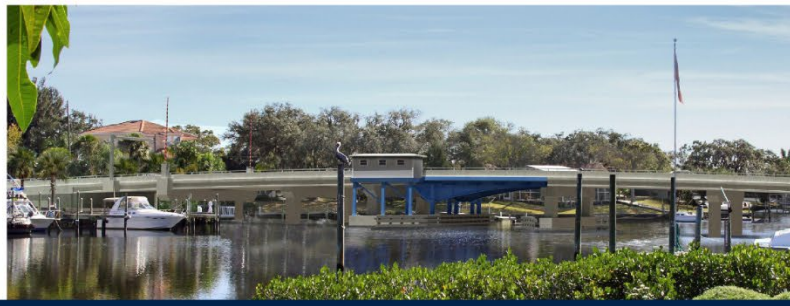
Appendix D:
Benefit-Cost Analysis Narrative



Benefit-Cost Analysis Narrative

Table of Contents

1. Introduction

This document provides technical information on the economic analysis conducted in support of the grant application for the Beckett Bridge Replacement project in Pinellas County, Florida.

Section 2 – Methodological Framework – introduces the conceptual framework used in the Benefit-Cost Analysis (BCA). Section 3 – Project Overview – provides a summary of the project, including a summary of cost estimates and schedule, and a description of the types of effects that the proposed Beckett Bridge Replacement project is expected to generate. Section 4 – General Assumptions – discusses the key assumptions used in the forecasts of project costs and benefits. Specific data elements and assumptions pertaining to the merit selection criteria are presented in Section 5 – Benefits Measurement, Data, and Assumptions – along with the associated benefit projections. The forecast of the project's Net Present Value (NPV), its Benefit-Cost Ratio (B-CR) and other project evaluation metrics are summarized in Section 6.

2. Methodological Framework

The BCA conducted for this project focuses on monetized benefits and costs measured consistent with the pertinent US DOT guidance.[1] Some of the merits of the project could not be quantified. They are outlined qualitatively where applicable.

A BCA provides projections of the benefits that are expected to accrue from a project over a specified period, and compares them to the anticipated costs of the project. Benefits are based on the forecasted effects of the project on both users and non-users of the facility, valued in monetary terms. Costs include both the resources required to develop the project and the costs of maintaining the new or improved asset over time.

The specific methodology used for this application was developed in alignment with the BCA guidance prepared by the US DOT, and is consistent with the Bridge Investment Program (BIP) program guidelines including a deployment of the BIP BCA Tool. In particular, the methodology comprises:

- Establishing existing and future conditions under the Build (with the project) and No-Build (without the project) scenarios;
- Assessing benefits with respect to each of the key merit criteria identified in the Notice of Funding Opportunity (NOFO);
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;

[1] US DOT, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2023.

- Using US DOT guidance for the valuation of travel time savings, vehicle operating costs savings, safety benefits, amenity/health benefits, residual value, and reductions in air emissions, while relying on industry best practice for the valuation of other effects; and
- Discounting future benefits and costs to present value terms with the real discount rate as instructed by US DOT BCA Guidance (3.1 percent)[2]; and
- All monetary values in this Appendix are expressed in 2022 dollars, unless stated otherwise.

3. Project Overview

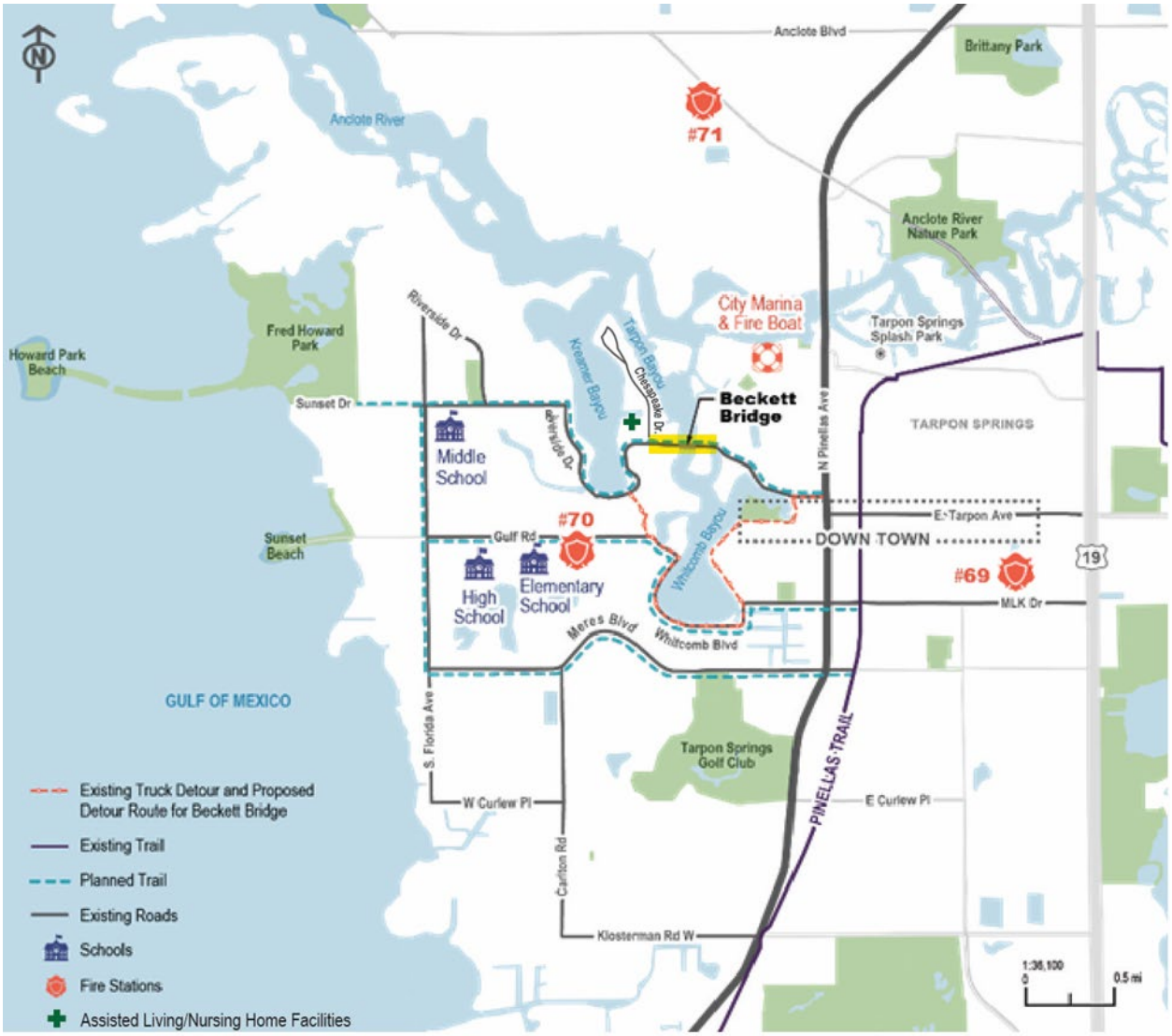
This project will result in a replacement of an existing bascule bridge located in the City of Tarpon Springs, Pinellas County, Florida. The existing bridge, which was originally built in 1924, has been subject to major repairs in 1956, 1979, 1997, and 2012, but requires replacement in order to safely remain open to traffic. The existing bridge is 28.5 feet wide with one-10-feet wide lane in each direction, and 2 feet and 2 inches sidewalks separated by a curb on both sides of the bridge. When closed, the vertical clearance of the bridge is 6 feet with a navigational width of 25 feet. The crossing has an annual average daily traffic (AADT) in 2022 of 6,000 vehicles per day[3], but traffic is restricted to 12-ton single unit trucks and 15-ton combination trucks, limiting emergency response vehicles, school buses, and larger trucks. Please see Figure 1 for the project area map. According to the January 25, 2024 Technical Memorandum (attached with the application – Appendix A) by the Bridge Engineers at Hardesty & Hanover, the existing bridge has a remaining service lifespan of about five to ten years. Thus, past 2034 under the No-Build scenario, it is expected that a permanent closure would have to take place with no crossings available for any vehicular traffic.

The Build scenario, a replacement of the existing bridge with a new one-lane-per-direction bascule bridge, would maintain the road connection for a 75-year service life. The new bridge would have a width of 48.58 feet, with one 10-foot-wide travel lane per direction, one 6.5-foot-wide bike shoulder per direction, and two 6.5-foot sidewalks. The vertical clearance would improve from 6 feet to 7.8 feet when closed with a navigational width of 25 feet. All roadway restrictions would be lifted, allowing access for trucks, emergency vehicles, and school buses from 2028 onwards. A more detailed description of the project is provided in the main body/narrative of this application.

[2] CO_2 emissions are discounted at the annual rate of 2 percent.

[3] Florida Traffic Online, 2024.

Figure 1: Project Location Map in Tarpon Springs



3.1 Types of Benefits

The proposed Beckett Bridge Replacement is expected to result in a variety of benefits to the regional population. These are broadly summarized in Table 1.

Table 1: Summary of the Transportation Improvements and Associated Key Impacts and Benefits

Current Status or Baseline & Problems to Be Addressed	Changes to Baseline / Alternatives	Type of Impacts	Population Affected by Impacts	Benefits
Growing traffic volumes across the area road network generate accidents on the bridge and its vicinity/detour every year.	Enhanced safety features of the bridge replacement result in safer travel.	Fewer vehicle crashes in the area.	Area residents and businesses, freight carriers, and travelers passing through the area.	Reduced accident costs (saved lives, injuries, and property damage).
Bridge users will not be able to cross the current bridge safety past the next decade, adding to congestion and mileage on other/detour parts of the network, which will be exacerbated by the expected volumes/population growth.	Replacement bridge will provide continued access, eliminating the need for a permanent detour the area.	Congestion relief and changes in vehicle hours traveled and vehicle miles traveled in the area.	Area residents and businesses, freight carriers, and travelers passing through the area.	Travel time savings, vehicle operating cost savings, emission savings, and safety improvemen t.
Due to weight restrictions some emergency response vehicles are unable to cross over the bridge to timely respond to calls.	Replacement bridge will provide access to emergency vehicle, expediting response times to time-sensitive patient needs.	Reduction in mortality in cardiac arrest cases thanks to faster response times.	Area residents/patients.	Health – mortality savings – other benefits.
The current bridge has a remaining service life forecasted at up to ten years, leading to a subsequent closure, and higher annual maintenance costs.	Replacement bridge will have a useful service life of 75 years, and lower annual maintenance cost.	Residual value, and lower O&M costs.	Pinellas County	Residual value, and O&M costs, savings.
Typical construction period for the bridge replacement would be 30 months.	Off-site fabrication and precasting of the pier pile caps.	Accelerated construction period (24 months) resulting in shorter bridge	Area residents and businesses, freight carriers, and travelers passing	Reduced travel time dis-savings – other/innova

		closure and detour period during construction.	through the area.	tion benefits.
Limited sidewalk and cycling access over the current bridge.	Widened sidewalks for pedestrians, and widened shoulders for cyclists to use.	Increased mobility accessibility of active transportation.	Area residents, and travelers passing through the area.	Improved facility amenity/health, safety, mobility, and community quality of life options.

3.2 Project Cost[4] and Schedule

The proposed Bridge Replacement project is forecasted to cost $36.6 million (in 2022 dollars, or around $37.3 million in mixed year-of-expenditure and 2024-dollar terms) in total upfront investment. This amount is scheduled to be expended over a 16-year timeframe from 2012 to 2027, with construction-related expenditures scheduled from 2025 through 2027 totaling $31.8 million (or $33.1 million in 2024 dollars). Table 2 below shows the projected costs and annual schedule related to the project. The discounted value of the capital costs is $32.8 million.

Table 2: Summary of the Project's Forecasted Investment Costs (in millions of 2022$) *

	2012-2023	2024	2025	2026	2027	16-year Total
Annual Cost	$4.1	$0.6	$12.0	$16.7	$3.1	**$36.6**

* Values are rounded.

Starting from the first full year of the replaced bridge operations in 2028, there will also be a decrease in the operating and maintenance (O&M) costs of the bridge relative to the No-Build scenario. The change in O&M costs was computed by Pinellas County Public Works, and accounts for additional maintenance costs of painting and spall repairs under the No-Build scenario relative to the Build case. This incremental O&M cost is projected to be a saving of $72 thousand per year (in 2022-dollar terms), for a 30-year discounted total of almost $1.2 million in maintenance savings.

3.3 Disruptions Due to Construction

The proposed replacement is not expected to cause any significant disruption to existing traffic over the first year of the two-year construction period. During the first year, maintenance of traffic (MOT) standard plans will be followed, and most of the construction is envisioned to take place in the lightly-traveled hours, and will be combined with various mitigating measures (such as

[4] All cost estimates in this section are in expressed in 2022 constant dollar terms, unless otherwise noted.

appropriate safety signage), with minimal impact on traffic flow is expected. However, the bridge will be closed to traffic during the second year of the construction period, and a detour will be necessary. Using the vehicular volumes, based on NBI data, and bike/ped volumes, based on the Replica data, combined with applicable incremental detour times, the resulting 12-month (6 months in 2026 and 6 months in 2027) construction-related bridge closure disruptions amount to about $1.2 million in discounted disbenefits, which are included in the BCA.

3.4 Effects on Key Selection Criteria

The main benefit categories associated with the project are mapped into the key selection criteria set forth by US DOT in Table 3.

Table 3: Benefit Categories and Expected Effects on US DOT Merit Criteria

Merit Criteria	Benefit or Impact Categories	Description	Monetized	Quantified	Qualitative
State of Good Repair	Maintenance costs, and residual value of investment in a new bridge.	Residual value of the project at the end of the analysis period, and reduction in annual O&M costs.	Yes	Yes	No
Safety and Mobility	Safety benefits.	Reduction in the number of accidents, resulting in fatality, injury, and property damage savings.	Yes	Yes	No
	Travel time savings.	Lower travel time in the area stemming from reduced or eliminated detours.	Yes	Yes	No
	Vehicle operating cost savings.	Change in vehicle operating cost due to changes in vehicle miles traveled with detour avoidance in the area.	Yes	Yes	No
Economic Competitiveness and Opportunity	Job creation.	Construction and other jobs.	No	No	Yes
	Improved supply chain	Improved access for heavy vehicles to the Regional Freight Activity Center.	No	No	Yes
	Improved access to more productive land use.	Improved access to various residential, recreational, and commercial properties/land uses around the replaced bridge.	No	No	Yes
Climate Change, Sustainability, Resiliency, and the Environment	Change in emissions.	Change in emission volumes due to changes in vehicle miles traveled in the area.	Yes	Yes	No
Quality of Life	Reduced vehicle dependence, and lower morbidity.	Improved active/nonvehicular transportation, and access to daily destinations in locations around the area. Lower morbidity due to faster emergency vehicle response times.	Yes	Yes	No
Innovation	Innovative techniques yielding in reduced travel time dis-savings.	Accelerated construction period resulting in shorter bridge closure and detour period during construction.	Yes	Yes	No

4. General Assumptions

The BCA measures, on a discounted basis, benefits against costs throughout the 46-year period of analysis beginning at the start of the investment in year 2012, and including 30 full years of operations from 2028 through 2057.

The monetized benefits and costs are shown in constant dollars of 2022 with future dollars discounted in compliance with the BIP requirements using a 3.1 percent real rate, consistent with the US DOT BCA Guidance. The methodology makes several important assumptions, and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are expressed in 2022 dollars;
- The period of analysis begins in 2012 and ends in 2057. It includes project development and construction years (2012 - 2027), and 30 full years of operations (2028 - 2057);
- A constant 3.1 percent real discount rate is assumed throughout the period of analysis;[5] and
- Opening year demand is an input to the BCA, and is assumed to be fully realized in Year 1 (no ramp-up).
- The existing bridge permanent closure year is projected to be by 2034 as it has a remaining service lifespan of about five to ten years bridge, per the Bridge Engineer Technical Memorandum (attached with the application – Appendix A). Hence, the replacement would avoid forcing all the bridge traffic to an alternative route from 2034 onwards.

5. Benefits Measurement, Data, and Assumptions

The proposed Bridge Replacement project will yield various benefits for the traveling public and the larger economy. The following subsections describe the measurement approach used for each benefit or impact category identified in Table 3 above, and provide an overview of the related methodology, assumptions, and projections.

5.1 State of Good Repair

The 100-year-old Beckett Bridge is presently classified as structurally deficient, functionally obsolete, and with NBI Substructure Rating of 4 or Poor Condition. Moreover, the Bridge has been load-rated with weight restrictions with signs posted for 12-ton limits for single-unit trucks and 15-ton limits for combination trucks since 1987. The continued settlement and movement require frequent monitoring, surveying, inspections, and maintenance.

[5] Two percent real discount rate is applied to CO_2 emission changes.

To quantify the benefits associated with maintaining the Bridge in a state of good repair, both the maintenance savings, and the residual value of the project's initial investment in the replacement bridge were projected.

5.1.1 Maintenance Cost Savings

Under the No-Build scenario, the annual O&M of the Bridge is estimated to amount to $408 thousand (or $425 thousand in 2024-dollar terms), accounting for additional maintenance costs of painting and spall repairs, according to the Pinellas County Public Works. The projected annual O&M cost of the Replacement Bridge is $336 thousand (or $350 thousand in 2024 dollars), per the Pinellas County Public Works. The annual difference of about $72 thousand amounts to the total 30-year discounted maintenance savings of almost $1.2 million.

5.1.2 Residual Value

The proposed Bridge Replacement is expected to retain some value beyond the 2057-time horizon for which the various benefits described in this document are computed.

The residual value of the proposed project was estimated based on the useful life of the bridge construction assets of 75 years. Such construction assets amount to about $31.8 million in upfront investment, and their residual value is $6.7 million in discounted present value terms.

Benefits Subtotal

As summarized in Table 3, the total state of good repair benefits, based on the combined maintenance cost savings and residual value, are projected to amount to $7.9 million in discounted terms.

Table 3: Projected State of Good Repair Benefits (in millions of 2022$) *

Benefits Category	Total Discounted State of Good Repair Benefits
Maintenance	$1.2
Residual Value	$6.7
Total	**$7.9**

* Values are discounted at an annual rate of 3.1%, and are rounded.

5.2 Safety and Mobility

The condition, as summarized in the previous subsection and in the main narrative, of the current bridge leads to a number of safety and mobility issues, which the Replacement Bridge project will alleviate. The related benefits are summarized below.

5.2.1 Safety

One of the primary benefits of focus in this analysis pertains to enhanced safety associated with reductions in future accidents stemming from the proposed bridge replacement.

The monetized safety benefits of the project were derived based on a projection of future crash savings, and unit values of crashes by type. A crash savings analysis of the proposed Beckett Bridge Replacement was conducted through the application of known Crash Modification Factors (CMFs) to the most recent five years of crash data in the bridge area.

Historically, the crash data over the most recent five-year period (2018 – 2022) for the bridge project area, as extracted for this analysis from the University of Florida's Signal Four Analytics database, show a total of four crashes, of which three were of property damage only (PDO) type, and one was a (non-incapacitating) injury type.

Multiple improvements were proposed along the bridge area, but only the benefits for the following improvements/countermeasures were quantifiable with appropriate CMFs.

New Shoulders

New shoulders will allow emergency vehicles to pass during emergency situations. This proposed improvement relates to CMF 5285 from the CMF Clearinghouse, which is for widening paved shoulder for all crash types, severity, and roadway types.

Lighting

New bridge lighting installed will provide illumination for the roadway, bike shoulders, and sidewalks, improving safety and security for all travel along the bridge and approaches.

This proposed improvement relates to two CMFs for illumination/lighting from the CMF Clearinghouse: 1) CMF 579 – applicable to PDO crashes; and 2) CMF 578 – applicable to injury crashes, both on urban roadways of all types.

Products of the two CMFs for each countermeasure and crash type were used in the BCA Tool to derive avoided crash costs from these improvements for the applicable crash types.

Detour-related

Additionally, safety benefits due to avoided detour (with the bridge replacement) were also computed. These reductions in crashes on the alternative route (S. Spring Blvd./Whitcomb Blvd., as shown in Figure 1) that would take place due to the elimination of bridge closure (Build Scenario) were also accounted for by applying savings in projected VMT to the crash rate (by fatality and injury) per 100 million VMT. The crash rate on the detour route was based on the recent five-year (2018-2022) historical annual average of crash occurrences by severity, as per the University of Florida's Signal Four Analytics database, combined with the annual VMT based on the interpolated AADT values from the Tampa Bay Regional Planning Model (TBRPM, v.9.3) and the net detour length from the NBI/Tool.

For both the countermeasures and the detour-related components of the analysis, the unit costs of injuries PDO crashes were based on the dollar values from the latest USDOT BCA Guidance for Discretionary Grants, matching the BIP Tool.

Overall, the findings from the safety analysis show projected future benefits through 2057 from the Bridge Replacement project to total about $6.3 million in discounted terms.

5.2.2 Mobility

The mobility benefits are captured here through both travel time savings and vehicle operating cost savings. Replacement of the Beckett Bridge will improve the movement of people and goods by eliminating the need for a detour for some vehicles in the area if the bridge were to continue in its weight-restricted condition (commercial trucks, and school buses) or had to be completely closed (all vehicles).

5.2.2.1 Travel Time Savings

Travel time savings are a function of vehicle hours traveled (VHT), and the value of travel time (VOTT). The reduction of VHT due to the detour elimination with the Bridge Replacement was based on the detour average travel time (as calculated in the Tool using the net detour length and travel speed), and the annual future AADT by vehicle category (matching the pertinent volumes in the NBI database).

The hours saved in the Build scenario were monetized with the motorists' VOTT, recognizing that the economic VOTT varies by vehicle class. For each of the vehicle classes, the travel time benefits were derived by multiplying VHT savings by the applicable vehicle occupancy rates, and the appropriate VOTT (using the latest BCA Guidance for Discretionary Grants, matching the Tool values).

The resulting travel time savings are expected to amount to $70.3 million through 2057 in discounted terms.

5.2.2.2 Vehicle Operating Cost Savings

The vehicle operating cost savings related to this project were derived based on the changes in VMT, and the average operating costs per mile for passenger and commercial vehicles, as per the latest US DOT BCA Guidance. The change in VMT was based on the net detour length, and the projected annual AADT, as in the NBI/Tool.

The resulting total vehicle operating cost savings with the detour avoidance through 2057 are projected to total $18.4 million in discounted terms.

Benefits Subtotal

As summarized in Table 4, the total safety and mobility benefits, based on the combined crash savings, travel time savings, and vehicle operating cost savings are forecasted to amount to about $95.0 million in discounted terms.

Table 4: Projected Safety and Mobility Benefits (in millions of 2022$) *

Benefits Category	Total Discounted Safety and Mobility Benefits
Safety	$6.3
Travel Time	$70.3
Vehicle Operating Cost	$18.4
Total	**$95.0**

* Values are discounted at an annual rate of 3.1%, and are rounded.

5.3 Economic Competitiveness and Opportunity

The proposed project will contribute to enhancing the economic competitiveness of the area and potentially beyond through improvements in the mobility of people and goods within and across the region. This section summarizes the effects of the project on the job creation and regional impact, as well as supply chain, and land use.

5.3.1 Job Creation and Regional Impact

Injection of capital infrastructure spending, such as that related to the proposed Bridge Replacement project, into the area economy will lead to direct construction and related professional services jobs, as well as indirect jobs supporting the suppliers of materials and equipment, and the induced jobs and earnings impacts to the larger economy in the region and beyond.

Additionally, the project improvements can be expected to aid further business attraction and retention (with the related jobs) that would not otherwise occur. However, these impacts were not quantified as part of this application.

5.3.2 Supply Chain

The proposed Bridge Replacement project is expected to improve the supply chain in the area by providing a structurally sound connection to existing freight routes.

Freight access is currently limited due to the posted legal load on the bridge (12-ton Single-Unit Trucks and 15-ton Combination Trucks), forcing heavy trucks to take alternative routes. With the Bridge Replacement, such detours will not be necessary, increasing the routing options, and lowering the freight movement costs along the supply chain.

The Northwest Tarpon Springs Industrial Area is a potential Regional Freight Activity Center located north of the Spring Boulevard/Riverside Drive and west of Alternate US 19 at Anclote Boulevard and Anclote Road, as illustrated in Figure 2.

Freight Activity Centers are major generators of truck trips, which include long-haul trips extending beyond the region. While the current detour around Beckett Bridge necessitates adding over 1.5 miles to truck routes, the connecting routes, e.g., Tarpon Ave., and Alternate US 19 (SR 595), and Tarpon Avenue are all unrestricted truck routes. Replacing the Beckett Bridge will allow freight to use the bridge again, which will improve the movement of goods/supply chain in the area.

Figure 2: Map of the Proposed Freight Activity Center

5.3.3 Land Use

The Bridge Replacement will also improve access to the nearby land uses. The Beckett Bridge and nearby roadways connect to various residential, recreational, and commercial establishments. For example, replacement of Beckett Bridge will have a positive effect on access to community resources, including two fire stations, one police station, one hospital, five religious institutions,

and five schools within 1.5 miles of the bridge, as well as the health center operated by the Pinellas County Health Department located approximately 1.2 miles from the Beckett Bridge. These will become more accessible with the enhanced vehicular as well as pedestrian and cycling circulation connecting to the area network, and may be better positioned to realize their full potential. This land use productivity benefit was not quantified, and hence, is not incorporated in the BCA results.

5.4 Climate Change, Sustainability, Resiliency, and the Environment

The project will reduce air pollution and greenhouse gas emissions by eliminating the need for the 1.9-mile detour, providing a more direct route, and reducing the number of vehicle miles traveled. The environmental effects were monetized as the product of changes in tons of emissions by pollutant and their unit value per ton. The unit values for CO_2 and the Non-CO_2 emissions (i.e., NOx, $PM_{2.5}$, SO_X) reflect the US DOT recommendations from the latest BCA Guidance. Changes in tons of emissions by pollutant are a function of emissions rates and changes in VMT by vehicle type. The emission rates were based on the EPA's MOVES (Motor Vehicles Emission Simulator) model, as included in the BIP BCA Tool, while changes in total VMT by vehicle category were based on the net detour length and the projected annual AADT, as in the NBI/Tool.

The resulting environmental/emission cost changes are summarized in Table 5. They include changes related to carbon dioxide, the other three pollutants, and environmental cost savings. These benefits are projected to amount to about $4.9 million in present value terms (discounted at 3.1 percent, except for CO_2 – discounted at 2 percent).

Table 5: Projected Total Environmental Savings (in millions of 2022$) *

Benefits Category	Total Discounted Environmental Benefits
CO_2 Emissions	$4.3
Non-CO_2 Emissions	$0.5
Other Environmental	$0.1
Total	**$4.9**

* Values are discounted at an annual rate of 3.1%, except for CO_2 emission savings that are discounted at the annual rate of 2%. The values are rounded.

5.5 Equity and Quality of Life

The project would contribute to enhancing the quality of life and equity in the study area through improved access to daily destinations such as job and recreational opportunities via active/nonvehicular transportation, as well as health and lower mortality through faster emergency response times for area residents.

5.5.1 Nonvehicular Transportation

The lack of adequate pedestrian and bicycle facilities limits multimodal access and creates safety concerns. The community has expressed concerns about safety as cyclists have been observed using narrow travel lanes and sidewalks, interweaving with vehicles and pedestrians. Also, the area is vehicular-dependent and access to recreational areas such as the beaches and Pinellas Trail area is limited as safe, multimodal options are not currently provided on the bridge. The enhanced pedestrian and bicycle facilities on the new bridge will provide an important connection between the regional Pinellas Trail and Howard Park located west of the bridge on the Gulf of Mexico. The 155-acre Howard Park welcomes approximately 2 million visitors each year. The proposed Howard Park Trail from Howard Park on the Gulf of Mexico to the Pinellas Trail along Riverside Drive/North Spring Boulevard, crossing the Beckett Bridge, is included in Forward Pinellas' (Pinellas County MPO) current Long Range Transportation Plan.[6]

The improved access to nonvehicular transportation on the bridge under the Build scenario was captured in terms of the improved facility amenities/health for pedestrians.

Enhanced pedestrian comfort, convenience, and safety is a function of sidewalk/path width. The Bridge Replacement project includes widening and extension of the existing 2-foot-2-inch-wide sidewalks to 6.5-foot-wide sidewalks over 0.38 miles on both sides of the bridge.

The pedestrian amenity benefits for the project corridor were derived by combining the incremental sidewalk width (8 feet and 8 inches in total) with annualized volumes of pedestrians, length of the sidewalk, and the unit value per foot of added sidewalk width.

The annual volumes and average trip length were based on 2023 average daily pedestrian trips data for the bridge area from Replica, annualized (based on a 364.25 days/year factor), and grown over time based on the County's population growth rate between 2023 and 2045 from the Florida Bureau of Economic and Business Research (BEBR).[7] The unit value of the expanded sidewalk, per foot of added width, was based on the US DOT BCA Guidance, as in the BIP Tool.

The findings from the pedestrian health and amenity analysis show projected future benefits from the bridge improvements to total about $1.9 million after discounting.

It should also be noted that cyclists would also be expected to experience improved riding conditions from being able to traverse the bridge on the undesignated widened shoulder, but this benefit was not monetized in this analysis.

5.5.2 Emergency Response Improvement

The area of Tarpon Springs around Beckett Bridge is currently served by three fire rescue stations, with emergency vehicles dispatched from two of which (# 69 and #71) presently require taking a

[6] Forward Pinellas: https://forwardpinellas.org/wp-content/uploads/2020/01/Active-Transportation-Plan-r.pdf

[7] Sources: Replica, November 2023; and BEBR, April 2023.

detour route (due to weight load restrictions) to respond to patients on the west side of the Bridge, including those at the assisted living/nursing home facilities located in close proximity to the Bridge (see Figure 1).

Emergency response improvement for the project was monetized based on the value of avoided out-of-hospital cardiac arrest (OHCA) deaths only. Among many emergency calls placed to the two fire rescue stations in 2023, seven pertained to urgent need to assist patients with cardiac related problems, and requiring to take the detour. Based on to the predictive analysis conducted by the Pinellas County Safety and Emergency Services (see the documentation attached with Appendix A) combined with the 2023 cardiac-related responses from the two stations, the emergency response time differential between the No-Build (bridge barrier/detour at 6 min and 42 sec) vs. Build (no bridge barrier at 5 min and 32 sec) scenarios is a weighted average of 1 min and 10 sec.

The FEMA BCAR methodology[8] provides guidance on estimating numbers of OHCA-related fatalities saved due to removal of bridge closures. This included formulas for deriving cardiac arrest-related survival rates given specific response times. Applying the survival rates to the annual number of relevant cardiac related responses yielded the annual fatalities for the No-Build and Build scenarios. The difference between those two is equal to 0.28 fatalities per annum, resulting in annual saving of $3.4 million, applying the value per fatality as per the USDOT BCA Guidance and in the BIP Tool. That saving is grown over time based on the County's population average future growth rate, as per BEBR[9], resulting in the total saving through 2057 of almost $59.3 million, in discounted terms.

It should be noted that a conservative approach of only quantifying health benefits associated with cardiac arrest was undertaken in this analysis. Numerous other emergency calls, including those related to fires, strokes, and car crash injuries, also require critical emergency response, but are not quantified nor incorporated in the BCA results.

The emergency response improvements are captured under Other Benefits in the BIP Tool and BCA summary tables.

Benefits Subtotal

As summarized in Table 6, the total quality of life and equity benefits, based on the combined nonvehicular health and amenity benefits and the improved emergency response times for OHCA, are projected to amount to $61.2 million in discounted terms.

[8] Federal Emergency Management Agency. 2011. Benefit-Cost Analysis Re-engineering (BCAR) – attached with Appendix A.

[9] BEBR, April 2023.

Table 6: Projected Quality of Life and Equity Benefits (in millions of 2022$) *

Benefits Category	Total Discounted Quality of Life Benefits
Health and Amenity	$1.9
Emergency Response	$59.3
Total	**$61.2**

* Values are discounted at an annual rate of 3.1%, and are rounded.

5.6 Innovation

The project will include innovative techniques leading to an accelerated construction schedule. These will include off-site fabrication and precasting of the pier pile caps. The innovative design calls for full off-site prefabrication and testing of the movable span, movable span machinery, and movable span control system. This reduces the time required in the field, during the detour, for installation, commissioning and testing of these critical elements. In addition, the concrete caps for the two abutments and four intermediate piers are precast off-site and assembled onto the piles in one section. Overall, such an innovative approach will accelerate the bridge construction reducing the related detour by six months (from 30 to 24).

This innovation benefit was monetized by using the estimate of the construction-related dis-benefits (as summarized in Section 3.3 above) related to a 12-month detour, and applying a scalar of about half (six months compared to twelve). This results in the innovation benefit of about $0.6 million in discounted terms, as shown in Table 7. This innovation benefit is captured under Other Benefits in the BIP Tool and BCA summary tables.

Table 7: Projected Innovation Benefits (in millions of 2022$) *

Benefits Category	Total Discounted Innovation Benefits
Innovation (Accelerated Construction)	$0.6

* Values are discounted at an annual rate of 3.1%, and are rounded.

6. Summary of BCA Findings

The tables below summarize the BCA findings. Annual costs and benefits are computed over the full period of analysis (46 years). As stated earlier, the initial 16-year investment is expected to be completed in 2027, with the benefits accruing during the 30-year period of operations, from 2028 through the end of 2057.

Total benefits and costs, expressed in 2022 dollars, for the analysis period are shown in Table 8. This table reflects a summation of the annualized benefits and costs for each year between 2012 and 2057. In accordance with the US DOT guidance for benefit-cost analysis, the annualized benefits and costs were discounted to reflect the time value of money using the real discount rate of 3.1 percent.[10]

Table 8: Benefit-Cost Analysis Results (in millions of 2022$) *

Benefit and Cost Metrics	2012-2057 Totals Discounted at 3.1%[11]
Project Benefits	
Safety	$6.3
Travel Time	$70.3
Vehicle Operating Cost	$18.4
Health and Amenity	$1.9
CO_2 Emissions	$4.2
Non-CO_2 Emission	$0.5
Other Environmental	$0.1
Maintenance	$1.2
Residual Value	$6.7
Other Benefits	$59.8
Total Discounted Benefits	**$169.4**
Total Discounted Costs	**$32.8**
Key Metrics	
Benefit-Cost Ratio	**5.2**
Net Present Value (NPV)	**$136.7**

* Unless specified otherwise. The numbers are rounded.

Considering all monetized benefits and costs, the investment in the proposed Bridge Replacement can be expected to yield a **net present value of $136.7 million**, and a **Benefit-Cost ratio of 5.2**, indicating that the project returns about $5.2 in benefits for every dollar of capital costs.

Among the project benefits, the travel time benefits ($70.3 million, in present value terms over 30 years) are projected to be the largest category, followed by other benefits (emergency response improvements, and innovation combined at $59.8 million), vehicle operating cost savings ($18.4 million), residual value ($6.7 million), safety ($6.3 million), emission savings along with other environmental benefits ($4.9 million), facility amenity benefits ($1.9 million), and maintenance benefits ($1.2 million).

[10] Except for CO_2 emissions, for which a real discount rate of 2 percent was applied.

[11] This discount rate (including the 2% for CO_2 emissions) is in accordance with the US DOT BCA Guidance, December 2023.

6.1 Aggregate Annual Benefits and Costs

This section reports the aggregate benefits and costs associated with the proposed Bridge Replacement project in annual discounted terms, as shown in Table 9. As can be seen in the table, the total discounted benefits of the project start in the minus $1.2 million in the pre-opening years (construction disbenefits), then increase to $3.7 million in the first year of operations/benefits, rise to $7.9 million in 2034, and then gradually decrease (due to discounting) to $4.7 million by 2056, followed by a jump to $11.2 million (due to the residual value addition) in the last year of the analysis horizon, totaling $169.4 million for the entire period through 2057.

When the total discounted capital costs ($32.8 million) are accounted for, the net discounted benefits go down to negative $34.0 million in the pre-opening period, and total (NPV) $136.7 million over the entire project analysis period through 2057.

6.2 Conclusion

Overall, the BCA results indicate that this Bridge Replacement project looks strong from an economic feasibility standpoint as the projected benefits outweigh the projected costs by about 5.2 to 1, yielding about $136.7 million in discounted net benefits.

Table 9: Annual Projections of Total Project Benefits and Costs (in millions of 2022$) *

Calendar Year	Project Analysis Year	Total Discounted Benefits	Total Discounted Costs	Total Net Discounted Benefits
Pre-Benefits Period	0	($1.2)	($32.8)	($34.0)
2028	1	$3.7	$0.0	$3.7
2029	2	$3.1	$0.0	$3.1
2030	3	$3.0	$0.0	$3.0
2031	4	$2.9	$0.0	$2.9
2032	5	$2.8	$0.0	$2.8
2033	6	$2.7	$0.0	$2.7
2034	7	$7.9	$0.0	$7.9
2035	8	$7.7	$0.0	$7.7
2036	9	$7.5	$0.0	$7.5
2037	10	$7.4	$0.0	$7.4
2038	11	$7.2	$0.0	$7.2
2039	12	$7.0	$0.0	$7.0
2040	13	$6.8	$0.0	$6.8
2041	14	$6.7	$0.0	$6.7
2042	15	$6.5	$0.0	$6.5
2043	16	$6.4	$0.0	$6.4
2044	17	$6.2	$0.0	$6.2
2045	18	$6.1	$0.0	$6.1
2046	19	$5.9	$0.0	$5.9
2047	20	$5.8	$0.0	$5.8
2048	21	$5.7	$0.0	$5.7
2049	22	$5.5	$0.0	$5.5
2050	23	$5.4	$0.0	$5.4
2051	24	$5.3	$0.0	$5.3
2052	25	$5.1	$0.0	$5.1
2053	26	$5.0	$0.0	$5.0
2054	27	$4.9	$0.0	$4.9
2055	28	$4.8	$0.0	$4.8
2056	29	$4.7	$0.0	$4.7
2057	30	$11.2	$0.0	$11.2
Totals (2012-2057)		**$169.4**	**$32.8**	**$136.7**

* Values are discounted at an annual rate of 3.1%, except for CO_2 emission savings that are discounted at the annual rate of 2%. The values are rounded.