Multimodal Project Discretionary Grant
Benefit-Cost Analysis Narrative

Roosevelt Memorial Bridge Investment Project

Bryan and Marshall Counties, Oklahoma

May 2024

OKLAHOMA Transportation

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Benefit-Cost Analysis

Executive Summary

The Benefit-Cost Analysis (BCA) for the Roosevelt Memorial Bridge Investment Project application compares the costs and benefits of the proposed Project. This BCA uses the Bridge Investment Program Benefit-Cost Analysis Tool v.1.0.4 (12/28/2023 BCA Tool) and associated User Manual released by the US Department of Transportation (USDOT) for the 2023-2026 Bridge Investment Program (BIP). Because the Roosevelt Bridge Project is a bridge project, the BIP BCA Tool appropriately captures all costs and benefits. Version 1.0.4 of the BCA Tool adjusts all costs and benefits to 2022 dollars and accounts for the adjusted discount rates established by the USDOT in their Benefit Cost Analysis Guidance 2024 Update (3.1% overall and 2% for CO_2 emissions). To the extent possible, expected benefits were monetized. A qualitative discussion is presented for benefits that are more difficult to quantify.

Specific adjustments to model inputs were made based on USDOT feedback on both the original FY 2023-2024 BIP submittal and the FY 2023-2024 MPDG submittal for the same project. These adjustments include:

- **Use of a 20-year analysis period (cell B36)**. Per USDOT feedback, the capacity improvements on the bridge (i.e. widening from 2 to 4 lanes) are not expected to have value beyond 20 years.
- **Use of NBIAS posting and closure years (Table 24)**. Per USDOT feedback, the justification for using earlier posting and closure years was not substantiated by the data presented. Dates of posting and closure for the Roosevelt Bridge were updated in this analysis to reflect the NBIAS data. Based on recent inspections and documented concerns with the existing bridge condition, ODOT estimates that posting and closure of the Roosevelt Bridge would occur earlier than NBIAS data indicates. Scenarios using earlier years of posting and closure were included in a sensitivity analysis.
- **Use of multiple Crash Modification Factors (CMF) (Table 39)**. USDOT feedback indicated uncertainty around the calculation of the 0.44 CMF used in the original analysis, as well as concern with potential overlap of the CMFs used (e.g. adding lighting and median barrier). In response, the analysis was updated to include only one CMF (ID 7566) for converting a 2-lane roadway to a 4-lane roadway.

Other areas of uncertainty noted by USDOT were related to the traffic volumes and collision data presented, specifically fatalities. More information is provided in this Technical Memo to support these inputs, and additional supporting data is attached.

The Oklahoma Department of Transportation (ODOT) proposes to construct a new multimodal bridge across Lake Texoma in Bryan and Marshall Counties, Oklahoma. Specific improvements planned as part of the project include:

- Construction of a new 4-lane bridge with standard shoulders, center median barrier, and bicycle/pedestrian accommodations carrying US-70 over Lake Texoma.

- Widening US-70 between State Park Road and Willow Springs Road to a 5-lane section (two driving lanes in each direction and a center turn lane) to provide continuity with the sections to the east and west.
- Providing safety features such as improved lighting and rumble strips, turn lanes where needed at intersections, and a traffic signal and crosswalk at the State Park Road intersection to accommodate traffic from adjacent development.

Table 1 below summarizes the changes expected from the project, and the associated quantified benefits. The period of analysis used in the estimation of benefits and costs is 25 years, including two years of project design, three years of construction, and 20 years of operations. While the Project will construct a new facility with a 75-year design life, the capacity improvements are expected to have an operational life of 20 years; therefore, a 20-year analysis period was selected for benefit calculations. Total project development and construction costs are estimated at $250.6 million. Costs were entered into the BCA Tool in today's dollars and automatically de-escalated to 2022 and discounted for a total discounted capital cost of $214.2 million.

All relevant data and calculations used to derive the benefits and costs of the project are shown in the BCA Tool that accompanies this grant application. Based on the analysis presented in the rest of this document, the Project is expected to generate $354.8 million in discounted benefits and $214.2 million in discounted capital costs (**Table 1**). Therefore, the Project is expected to generate a Net Present Value of $140.6 million and a Benefit/Cost Ratio of 1.66 as shown below in **Table 2**.

Table 1: Summary of Monetized Benefits

Baseline Status and Problems to be Addressed	Change to Baseline	Types of Impacts & Benefits	Population Affected by Impacts	Benefit Value ($2022 millions, 3.1% discount)
The existing bridge is functionally obsolete and at-risk of becoming structurally deficient. Without improvement, level of service (LOS) on the bridge would decline to LOS E due to projected traffic growth. The Roosevelt Bridge has a demonstrated history of high collision rates on and near the bridge, particularly severe collisions such as injuries and fatalities. The existing bridge is narrow and does not provide any pedestrian or bicycle accommodations.	ODOT proposes to construct a new four-lane bridge with standard shoulders and bicycle/pedestrian accommodations carrying US-70 over Lake Texoma, widen US-70 between State Park Road and Willow Springs Road to a five-lane section, and provide turn lanes where needed at intersections, and a traffic signal and crosswalk at the State Park Road intersection to accommodate future traffic demand.	***Impact*** – Additional lane in each direction and 10' standard shoulder widths producing a crash modification factor of 0.341. ***Benefit*** – Fewer collisions and reducing the rate of injury and fatal collisions to below the state average.	Vehicle Owners and Truck Operators	$ 128.6
		Impact - Reduced vehicular delays due to congestion and poor Level of Service and avoided detours due to load posting of the bridge ***Benefit*** - Reduction in travel times due to reduced delay and eliminated detour distance.	Vehicle Owners, and Truck Operators	$ 86.1
		Impact - Reduced vehicular delays due to congestion and poor Level of Service and avoided detours due to load posting of the bridge ***Benefit*** - Reduced vehicle operating costs (fuel reduction) due to reduced delay and eliminated detour distance.	Vehicle Owners and Truck Operators	$ 93.1
		Impact - Reduced vehicular delays due to congestion and poor Level of Service and avoided detours due to load posting of the bridge ***Benefit*** - Emissions reduction due to reduced delay and eliminated detour distance.	Vehicle Owners, Truck Operators, and Residents of adjacent communities	$ 33.7
		Impact - Removal of overhead truss structure ***Benefit*** – Elimination of bridge hits	Vehicle Owners, Truck Operators, and ODOT	$ 0.15
		Impact – Raise in profile grade of new bridge and approaches ***Benefit –*** Avoidance of closures due to flooding	Vehicle Owners, Truck Operators, and ODOT	$ 2.0
		Impact – Avoided noise impacts to communities on the detour route ***Benefit*** – Noise reduction	Vehicle Owners, Truck Operators, and Residents of adjacent communities	$ 0.26
		Impact – New structure with less frequent maintenance requirements ***Benefit*** – Maintenance cost savings.	ODOT	$ 10.9
Total				**$ 354.8**

Table 2: Summary of BCA Outcomes, Millions of 2022 Dollars

Category	Benefit	Percent of Total Benefits
Safety	$128,568,781	36%
Travel Time	$86,130,733	24%
VOC	$93,112,445	26%
Resilience	$2,035,622	1%
Health and Amenity	$-	0%
CO2 Emissions	$27,732,768	8%
Non-CO2 Emissions	$5,972,817	2%
Other Environmental	$260,997	<1%
Maintenance	$10,864,118	3%
Residual Value	$-	0%
Other Benefits	$153,420	<1%
Total Benefits	$354,831,700	100%
Total Discounted Costs	$214,240,958	N/A
BCR	1.66	N/A
Net Present Value (NPV)	$140,590,742	N/A

In addition to the monetized benefits, the project is expected to generate benefits that are more difficult to quantify. A brief description of those benefits is provided below. More detail is presented in the **Merit Criteria** section of the application narrative.

- **Economic Impacts, Freight Movement, and Job Creation**: The existing Roosevelt Bridge does not have sufficient capacity to accommodate the anticipated traffic demand (see the Traffic Volumes discussion below). US-70 is an important link on the National Highway System (NHS) and provides critical east-west connectivity across southern Oklahoma, linking major freight routes such as I-35, US-69, and US-75. The City of Ardmore at I-35 and US-70 is home to several large distribution centers including DOT Foods, Dollar General and Best Buy. Congestion on I-35 is well documented and is the subject of a major study currently underway by ODOT. While travel time savings for the Project were quantified, potential supply chain impacts outside the Project area could also occur that were not included in the analysis. As congestion worsens on I-35, US-70 to US-69 becomes a more attractive route for the freight supply chain to the Dallas Metroplex.

- **Equity, Multimodal Options, and Quality of Life:** The Roosevelt Bridge Project will improve the quality of life for local and regional users. As a critical east-west link, the Roosevelt Bridge provides one of only two crossings of Lake Texoma within the 30 miles between Tishomingo, OK and Denison, TX. Improving the bridge to provide a safe, multimodal crossing with sufficient capacity to meet current and future demand will improve mobility for all users for future generations. Reliability will be improved with increased capacity providing improved traffic flow, as well as additional bridge width to provide a safer

facility, allow collisions to be cleared more quickly, and provide emergency responders better access. The Project will provide accommodation for pedestrians and bicyclists where none exists today. A new multimodal crossing of Lake Texoma would offer opportunity to all sectors of the population. Given the location of Lake Texoma within a Historically Disadvantaged Community and Area of Persistent Poverty, providing bicycle and pedestrian accommodations on the bridge would increase affordable mobility options for local underserved communities. While pedestrian and bicycle travel time savings can potentially be quantified, without sufficient data on existing pedestrian and bicycle trips this benefit was not monetized in this application.

- **Innovation Areas: Technology, Project Delivery, and Financing:**
  Progressive Design Build (PDB): ODOT intends to deliver the Roosevelt Bridge Project as the state's first PDB project. The complexity of the US-70 over Lake Texoma Bridge has many features that would benefit from early owner and contractor collaboration. PDB allows the owner and design-builder to collaborate at the earliest stages of the project development.

  While not part of the BCA model, the benefits of the PDB delivery method were quantified. Compared to a traditional Design-Bid-Build delivery for the Roosevelt Bridge Project, PDB is anticipated to save ODOT approximately 16 months. This time delay would result in increased costs due to inflation. In general, costs of materials and labor are anticipated to increase year over year, resulting in a higher total project cost the longer a project takes to deliver. Using the FHWA's National Highway Construction Cost Index (NHCCI), construction costs increased by 15.9% from Q2 of 2022 to Q2 of 2023[1]. If increasing the delivery schedule of the Project by 16 months meant 15.9% per year increase in cost, this would result in a substantial overall Project cost increase:

  - Cost assuming project is delivered in 4 years (from PDB contract award to construction completion as presented in this application: $250,633,846
  - Cost assuming project is delivered in 5.3 years through traditional Design-Bid-Build: $306,097,688
  - Cost increase: $55,463,842

  Innovative Technology: ODOT commits to providing 3D computer models of the project as part of the contracting process. This technology will allow contractors to utilize the most recent GPS controlled equipment with Automated Machine Guidance in the construction process.

  Accelerated Bridge Construction (ABC): ODOT has considered ABC techniques under the assumption that a new bridge will be constructed to carry US-70 over Lake Texoma. The use of ABC techniques has the potential to shorten construction time, reduce construction costs, reduce traffic impacts, improve worker safety and improve the quality control of materials.

[1] National Highway Construction Cost Index 2023 Q2 (dot.gov)

Introduction and Methodology

This document provides detailed technical information on the benefit-cost analysis (BCA) conducted in support of the grant application for the Project. The BCA includes the monetized benefits and costs measured using the US Department of Transportation (USDOT) BCA Tool, as well as the quantitative and qualitative merits of the project. A BCA provides estimates 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. Costs include both the resources required to develop the project and the costs of maintaining the new or improved asset over time. Estimated benefits are based on the projected impacts of the project on both users and non-users of the facility, valued in monetary terms. While a BCA is just one of many tools that can be used in making decisions about infrastructure investments, it provides a useful benchmark from which to evaluate and compare potential transportation investments. This memo documents the assumptions used to produce the analysis, a description of the baseline, the sources of data used to project the outcome of the project, and the values of key input parameters. The methodology and calculations are derived from the USDOT BCA Tool.

Project Overview

The proposed Project will construct a new multimodal bridge across Lake Texoma. The existing Roosevelt Bridge carries US-70 over Lake Texoma and provides a critical east-west connection across southern Oklahoma (**Figure 1**). The bridge is 4,943 feet long and carries two traffic lanes, one in each direction, on a 24-foot-wide deck with no shoulders. The bridge was constructed in 1945 and is composed of 87 spans, including a 250-foot-long Warren through-truss, and is eligible for inclusion in the National Register of Historic Places (NRHP). The bridge is functionally obsolete and in fair condition with a sufficiency rating of 42.30. The bridge currently carries 8,500 vpd. With major development underway, future traffic volumes are anticipated to exceed 27,000 vpd by 2050[2].

The Project will provide a new structure designed with a 75-year life to today's standards, with sufficient capacity to accommodate future traffic demand. The Project will significantly reduce fatalities and serious injuries, improve the efficiency and reliability of the movement of people and freight, increase resiliency to severe weather events, and provide affordable transportation options to a Historically Disadvantaged Community and Area of Persistent Poverty through accommodations for bicycles and pedestrians. More details about the Project's safety, state of good repair, economic, resiliency, and equity/quality of life outcomes are presented in the application narrative.

Specific improvements planned as part of the Project include:

- Construction of a new 4-lane bridge on a new alignment with 12-foot driving lanes and 10-foot outside shoulders, center median barrier, and barrier-separated bicycle/pedestrian accommodations carrying US-70 traffic over Lake Texoma.

[2] See discussion of traffic volumes below and in the Traffic Analysis Memo at ODOT Roosevelt Bridge

Figure 1: Roosevelt Bridge Location Map

- Widening of US-70 between State Park Road on the west side of the bridge and Willow Springs Road on the east side to a 5-lane section (two 12-foot driving lanes in each direction and center turn lane) to provide continuity with the sections to the east and west.
- Providing safety features on US-70 such as improved lighting and rumble strips, turn lanes where needed at intersections, and a traffic signal and crosswalk at the State Park Road intersection to accommodate traffic from adjacent development.

The Project includes replacement of the existing Roosevelt Bridge which is approximately one mile long. In addition to the existing bridge, the Project also includes reconstruction and widening of the US-70 roadway from State Park Road on the west to Willow Springs Road on the east for a total distance of 4.0 miles (**Figure 2**). The Project includes 0.3 mile of US-70 on the west (west approach), the bridge itself, the 0.95-mile lake causeway, and a 1.8-mile land causeway. These extents are included in the Project because they include the remaining 2-lane portions of US-70 between the adjacent 5-lane sections. The new bridge is anticipated to be approximately 2.0 miles long on a new alignment to the south. This new bridge would eliminate the lake causeway and would tie back into the land causeway. Improvements to the entire Project extents are necessary to accommodate the new bridge and to achieve the desired capacity and level of service. Improving just the one-mile bridge structure would not eliminate the existing bottleneck.

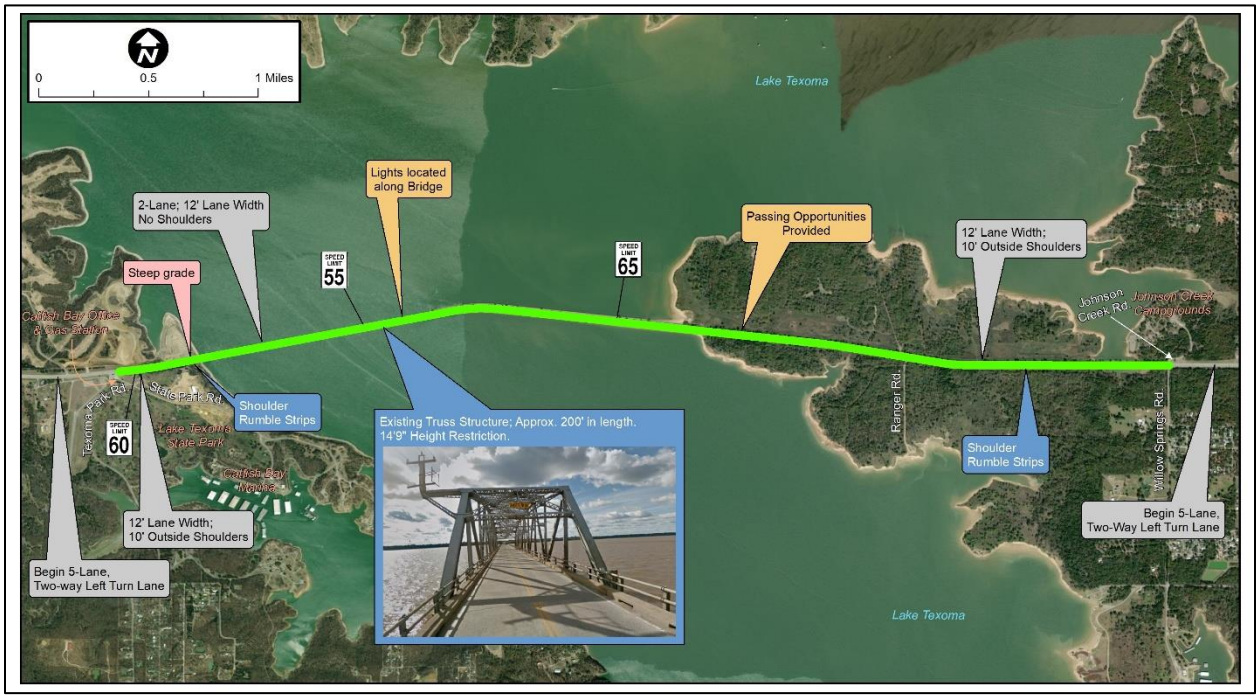

Figure 2: Roosevelt Bridge Project Extents

Base Case and Alternative

The Base Case for the Project is defined as the "No Build" scenario. This scenario reflects no capital improvements within the project limits but would require certain maintenance and rehabilitation costs over the analysis period. The Alternative Case is defined as the Build scenario described in the Project Description section above.

Types of Impacts

The proposed Project is expected to have the following impacts:

- Reduction in expected number of crashes due to a wider roadway and bridge,
- Reduction in travel times and operating costs for automobiles and trucks from improved Level of Service and reduced delays, with minor disbenefits during construction,
- Reduction in travel times and vehicle operating costs due to avoidance of detours that would be required if the bridge is not improved,
- Improved resiliency to flooding events and avoidance of closures due to flooding,
- Reduction in noise and emissions due to avoided detours,
- Decreased maintenance costs of the US-70 bridge, and
- Reduced potential damage from bridge hits.

Project Cost and Schedule – Alternative Case

Total project capital development and construction costs are estimated at $250.6 million in today's dollars. The BCA Tool adjusted these costs to 2022 dollars and discounted them by 3.1%. The adjusted project development and construction cost amounts to $214.2 million in discounted dollars (Bridge Tab Table 12 of the BCA Tool). Project construction is anticipated to start in early 2026 and take three years with completion by early 2029. For simplicity, 2026 is assumed as the

first year of construction and 2029 is assumed as the Project opening year and first year of Project-related benefits.

The Project will require maintenance during the 20-year operating period that is estimated at $200,000 (Bridge Tab Table 17 of the BCA Tool). This consists of inspections on a 2-year frequency. No other maintenance is anticipated during the analysis period.

Project Cost – Base Case

The Base Case (No Build) assumes no capital development or construction. However, the Base Case would require major maintenance and rehabilitation over the next 23 years. Maintenance costs of the No Build include the following:

- Annual inspections (1-year frequency) - $50,000
- Deck replacement (25-year frequency beginning in 5 years) - $8,526,675
- Painting steel (20-year frequency beginning in 5 years) - $4,056,811
- Other miscellaneous repairs (20-year frequency beginning in 5 years) - $405,681

In addition to the annual inspections, each of these maintenance activities would occur once during the analysis period. The total major maintenance rehabilitation costs required are estimated at approximately $14.2 million. While the Alternative Case has maintenance costs associated with the project lifecycle planning, it is less than what would be incurred under the Base Case when discounted over time. Thus, the Alternative case creates a net savings in maintenance costs of approximately $10.9 million in discounted costs (BCA Tool Bridge Tab Table 17).

Alignment with Selection Criteria

The main benefit categories associated with the Project are mapped into the merit criteria set forth by U.S. DOT in **Table 3** below.

Table 3: Benefit Categories of the Project

Criteria	Benefit(s)	Description	Monetized	Qualitative
Safety	Increased vehicle safety	Widened bridge with shoulders and center median barrier is expected to reduce collisions and fatalities. Also savings from avoidance of detours as associated crashes.	Yes	Yes
	Added pedestrian and bicycle comfort and safety	The new pedestrian and bicycle accommodations will provide a safe environment for pedestrian and bicyclists	No	Yes
State of Good Repair	Reduced O&M Cost	Bridge replacement will reduce O&M	Yes	Yes
	Reduced bridge hits / damages	The removal of the truss is expected to reduce bridge hits	Yes	Yes
	Detour avoidance	Bridge replacement will avoid costly detours when the bridge is load posted.	Yes	Yes

Criteria	Benefit(s)	Description	Monetized	Qualitative
Economic Impacts, Freight Movement, and Job Creation	Travel time savings	Travel time reliability will increase the efficiency and movement of the goods and people surrounding the project.	Yes	Yes
	Support good paying jobs and strong labor standards	Construction will provide good paying jobs and will provide equal employment opportunities.	No	Yes
	Contribution to local economic development and growth	Economic impact of construction project and increased access to recreation areas and adjacent development.	No	Yes
Climate Change, Resiliency, and the Environment	Noise reduction	Detour avoidance will reduce noise impacts along the detour route.	Yes	Yes
	Flood Resiliency	The raise in elevation of the bridge and approaches will reduce future flood-related closures and detour delay	Yes	Yes
	Emissions reduction	Delay reduction and detour avoidance will reduce emissions.	Yes	Yes
Equity, Multimodal Options, and Quality of Life	Pedestrian and bicycle accommodation	The new pedestrian and bicycle accommodations will provide a safe environment for pedestrian and bicyclists to access for park users	No	Yes
Innovation Areas: Technology, Project Delivery, and Financing	Accelerated Bridge Construction	ABC has the potential to shorten construction time.	No	Yes
	Progressive Design Build (PDB)	The Project would be ODOT's first PDB Project and is anticipated to save approximately 16 months in project delivery time and $55 million in inflation savings.[3]	Yes	Yes
	Use of New Technologies	The use of 3D models, GPS controlled equipment, and E-construction methods will be utilized in the implementation of this project.	No	Yes

[3] See Innovation section of the Project Narrative. Savings related to the PDB delivery method are not included in the BCA model.

General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of construction and including 20 years of operations.[4] The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. These assumptions are documented in the USDOT BCA Tool. Specifically:

- Input prices, costs, and benefits are expressed in 2022 dollars.
- The period of analysis begins in 2029 and ends in 2048. The project includes one year of project development and three years of construction in 2026 - 2028 prior to the 20-year analysis period (2029 – 2048).
- A constant 3.1 percent real discount rate is assumed throughout the period of analysis, except for benefits impacts related to CO_2 greenhouse (GHG) emissions which are discounted at a 2 percent real discount rate.
- Opening year demand and benefits are inputs to the BCA and are assumed to be fully realized after construction is finished and project starts operations in 2029 (no ramp-up).

Traffic Volumes

The discussion below is taken from the Traffic Analysis Memo completed for the Project in 2021. This memo is available at ODOT Roosevelt Bridge. Traffic counts were collected in May 2021, to reflect warm-weather (recreation season) and school traffic volumes and were processed/summarized into design traffic. 24-hour turning movement counts were collected at the US-70 intersections with State Park Road and Willow Springs Road on a Tuesday, along with 7-day counts on US-70, to confirm the Tuesday values were representative of the entire week given the fluctuation in traffic common to recreational areas during warmer weather periods.

An analysis of the 7-day information on US-70 indicated Thursday data was approximately 15% higher than Tuesday data, so the 24-hour turning movements were adjusted accordingly. With the adjustment factor, US-70 carries approximately 8,500 vehicles per day across the Roosevelt Memorial Bridge with trucks accounting for 9% of the total volume. State Park Road carries approximately 1,750 vehicles per day, and Willow Springs Road/Johnson Creek Road carries approximately 1,200 vehicles per day.

An expansive development is planned west of the Roosevelt Memorial Bridge near the intersection of US-70 and State Park Road. This property, referred to as Pointe Vista Development[5], features approximately 2,700 acres of mixed-use development and includes the following features:

- 2,100 homes
- Three 4-star resort hotels
- Convention/conference center
- Championship golf course
- Caribbean Lagoon
- Chickasaw Nation Casino
- Full-service marina
- Waterfront town center
- Entertainment venues
- Aquatic center
- 25,000 SF of restaurants (assumed)
- 100,000 SF of retail shops (assumed)

[4] While the bridge will have a lifespan of much longer than 20 years, the capacity improvements are based on a 20-year forecast and are assumed to have no value after that time period.
[5] DEVELOPMENT | Pointevista

Conceptual analysis of this development property was considered in the development of future traffic volumes for this study. Volumes were projected for the year 2050 using a trip generation procedure consistent with *ITE's Trip Generation Manual*. A 20% mixed-use reduction was also applied to the initial trip-generated volumes under the assumption that vehicles will enter the property and visit multiple elements within the same trip.

With the assumed land use plan at full build out, the Pointe Vista Development would generate approximately 30,000 trips per day with 10% assumed to be traveling north/south between the development. Of the remaining trips, it was assumed that 45% of the vehicles would be oriented to the west (I-35) and 55% would travel from the east (US-75). The additional demand brought forth by this development would significantly increase traffic volumes on US-70 within the study area. Projected 2050 traffic volumes inclusive of the development were estimated at approximately 28,200 and 26,700 vehicles per day east and west of the bridge, respectively. The bridge itself is projected to carry approximately 27,300 vehicles per day. These volumes are reflected in Table 53 in the BCA Tool.

Delay Forecasts

The delay forecast is a critical component of the BCA as multiple benefits depend on the vehicle delays using the project area roads under No-Build and Build scenarios. In the BCA Tool, delay savings is estimated as a function of the increase in speeds anticipated with the Project (i.e. from 55 to 65 mph as shown in Bridge Tab Table 43). While this estimate was used in the calculation

Table C-3 – 2050 with Development No Build Analysis Results

Time Period	Analysis Means	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
US-70 at State Park Road															
AM	HCM	LOS		n/a[1]	n/a[1]	B	n/a[1]		C						A
		Delay		n/a[1]	n/a[1]	12.8	n/a[1]		16.9						0.7
	Sim Traffic	LOS		A	A	C	A		F		A				A
		Delay		8.3	2.6	18.7	0.6		114.3		2.6				6.2
PM	HCM	LOS		n/a[1]	n/a[1]	B	n/a[1]		F						B
		Delay		n/a[1]	n/a[1]	14.6	n/a[1]		145.4						14.4
	Sim Traffic	LOS		A	A	C	A		F		F				F
		Delay		7.1	3.0	21.8	0.7		1191.2		1051.8				70.9
US-70 at Willow Springs Road/Johnson Creek Road															
AM	HCM	LOS	B	n/a[1]		B	n/a[1]		F			E			A
		Delay	10.8	n/a[1]		12.5	n/a[1]		181.3			46.9			7.9
	Sim Traffic	LOS	A	A	A	C	A	A	E	n/a[1]	A	E	C	B	A
		Delay	2.4	2.2	0.1	16.0	5.1	1.2	36.2	n/a[1]	4.4	43.6	15.8	14.0	3.7
PM	HCM	LOS	B	n/a[1]		B	n/a[1]		F			F			E
		Delay	14.7	n/a[1]		13.0	n/a[1]		1833.8			66.1			41.1
	Sim Traffic	LOS	A	A	A	C	C	A	F	F	F	F	F	F	C
		Delay	7.9	2.7	0.3	23.9	17.8	5.9	529.0	361.9	384.2	311.5	172.5	97.1	22.7

[1] free movement

Figure 3: Roosevelt Bridge Project Extents

of Project benefits, this number is likely underestimated. In the final year under the No-Build condition, speeds on the bridge are likely to be less than 55 mph due to congestion and decreased Level of Service (estimated at LOS E by the Project traffic analysis) due to the operations at the adjacent intersections which will require signalization to reduce side street delay. Synchro 11 analysis software was used to evaluate traffic operations at the study intersections and produce Level of Service values for both Build and No-Build and existing and future conditions (see **Figure 3**). More detail can be found in the Traffic Analysis Memo at ODOT Roosevelt Bridge.

Bridge Posting and Closure Dates

The BCA Tool uses FHWA's National Bridge Investment Analysis System (NBIAS) to estimate the years that the bridge would require posting and ultimately be closed, based on statistical data. Based on the NBIAS data, the Roosevelt Bridge would require posting for 50% of trucks and buses in 2033, full posting (all trucks and buses) in 2048 and would require closure in 2052. While these years were used in the BCA, ODOT's estimates differ. Based on the extensive analysis of the existing bridge completed by ODOT, multiple deficiencies in numerous components were identified that suggest load posting and closure would likely occur much sooner. The concrete deck has multiple large spalls throughout and areas where the deck lifts off the steel floor beams due to pack rust. All joints have lost their seals allowing water to flow onto the steel beams and girders supporting the deck. Many of the steel floor beams in the approach spans have significant corrosion and section loss resulting in substantial member capacity reduction. Numerous bearings have sheared bolts and shifted bearing plates. The metal bridge rail has numerous connections that are sheared, missing, or other failed connections. The rail has also been impacted multiple times by vehicles resulting in misalignment and damaged posts throughout. See the Analysis of Existing Bridge Report for more details, available at ODOT Roosevelt Bridge.

While ratings on the bridge may not fall to a 2 or a 3 before posting/closure, there are safety risks associated with the bridge that demand a quicker response. The bridge railing would likely fail today if struck during a collision. Fatality rates on the bridge are double the statewide average. ODOT's study of the bridge and understanding of the safety risks the bridge presents suggest that load posting could occur as soon as next year. A sensitivity analysis was performed on the BCA assuming the bridge would be posted to 100% of trucks and buses in 2033, with full closure in 2043. See the Sensitivity Analysis section of this memo.

Benefits

This section describes the measurement approach used for each quantifiable benefit or impact category identified in **Table 1** and provides an overview of the methodologies and assumptions. A summary of all benefits is presented in **Table 2**.

Safety Benefits

There were 58 total collisions on the Roosevelt Bridge and approaches from 2016 to 2020[6], including 18 injury collisions and four fatal collisions (**Figure 4**). The corridor crash rate (85 crashes per 100 million vehicle miles traveled [MVMT]) was somewhat higher than the statewide crash rate (75 per 100 MVMT). However, the **fatal crash rate for the corridor** was over twice as large at 5.9 per 100 MVMT than the statewide fatal crash rate at 2.6 per 100 MVMT. The locations of the fatal collisions are shown on the Fatality Analysis Reporting System (FARS) map in **Figure 5**. As the Project will make safety improvements to the entire 4-mile area between State Park Road and Willow Springs Road, all the collisions within this portion of US-70 were included in the analysis. All collision data and maps are available at ODOT Roosevelt Bridge.

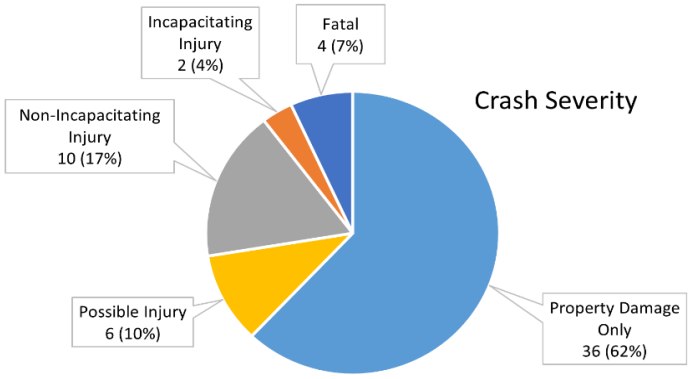

Figure 4: Roosevelt Bridge Crash Severity, 2016-2020

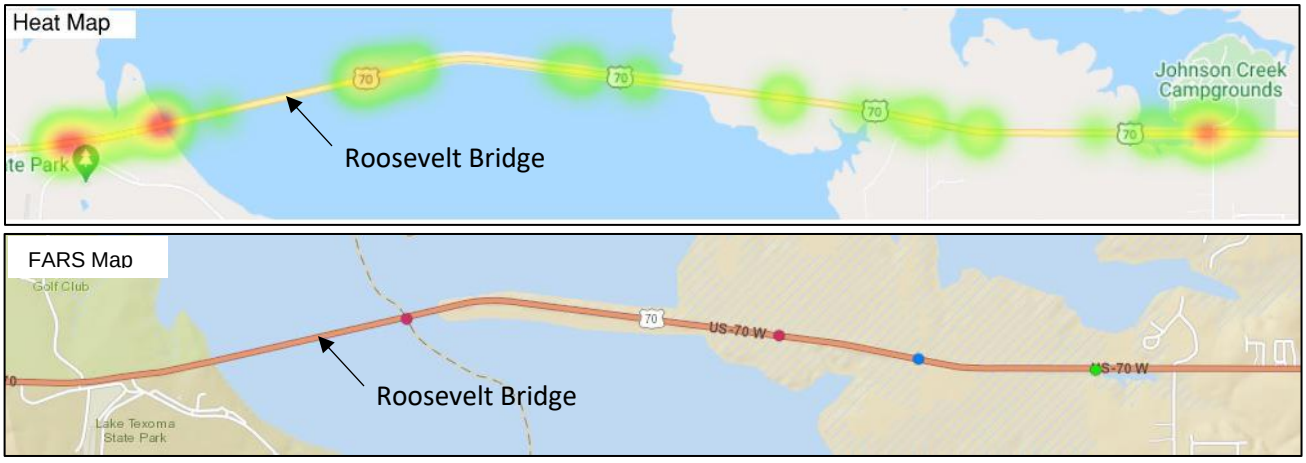

Figure 5: Collision Frequency Heat Map and FARS Map, 2016-2020

The Traffic Analysis Memo at ODOT Roosevelt Bridge describes the methodology used to predict potential future collision reductions as a result of the Project. Quantified safety benefits in the traffic analysis included reduction in expected number of crashes through safety enhancements including widening from 2-lanes to 4-lanes, shoulder rumble strips, lighting, and median barrier. A crash modification factor (CMF) is used to compute the expected number of crashes after implementing a countermeasure on a road or intersection. Several countermeasures with beneficial CMFs will be included in the Project to reduce the number of collisions that occur on the route:

[6] See ODOT Collision Report at ODOT Roosevelt Bridge

- Convert 2-lane roadway to a 4-lane divided roadway = 66% reduction (CMF ID: 7566)[7]
- Installation of any type of median barrier = 43% reduction (CMF ID: 42)
- Installation of street lighting (along the entire route) = 37% reduction of night-time collisions (CMF ID: 7774)

USDOT feedback on the initial application expressed uncertainty about using multiple CMFs to predict collision reduction for the Project. In particular, CMFs for median barrier and for lighting were thought to include overlapping benefits. For simplicity and based on USDOT feedback, the BCA analysis selected one CMF (ID:7566) to predict collision reduction. CMF 7566 is for conversion of urban and rural 2-lane roadways to 4-lane divided roadways[8]. This was considered appropriate since the Project will widen US-70 from a 2-lane undivided roadway to a 5-lane roadway (4 lanes with center turn lane). The new bridge will also be widened to 4 lanes and divided with a center median barrier. ID 7566 produces a CMF of 0.34 or a 66% reduction in crashes. This rate is expected to reduce average annual crashes by 7.6 (Table 39 in the BCA Tool).

In addition, the Project will realize safety benefits from avoided detouring. Under the Base Case, the existing bridge would require posting for 50% of all trucks and buses in 2033, 100% in 2048, and full closure in 2052, at which point all vehicles would be required to use a 21.5-mile detour. The 50% posting and the 100% posting years are captured in this analysis.

In total, safety benefits of the Project are estimated at $128.6 million. Safety benefits are reduced somewhat by the increased collision risk due to the presence of work zones on the bridge approaches during construction. This disbenefit was estimated by using a CMF to reduce shoulder width that would suggest a 2% increase in crashes.[9] This value was entered into Bridge Tab Table 19 and resulted in a safety disbenefit of $574,081.

Travel Time Savings

The Roosevelt Bridge project will add a lane in each direction to US-70 and will provide travel time and mobility related benefits in addition to those from the avoidance of detours due to bridge posting/closure. Using Table 43 in the BCA Tool Bridge Tab, the average travel time savings is 0.67 minutes/vehicle. Under the No Build scenario, the posted speed limit would remain 55 miles per hour (mph). With the additional lanes and added shoulders the new speed limit on the bridge would be 65 mph. Travel time savings due to delay reduction and avoided detours results in a $86.1 million benefit. However, as discussed above, this benefit is likely underestimated since congestion and delay from the Pointe Vista intersections in 2048 under the Base Case scenario would be expected to reduce speeds below 55 mph.

The project is also anticipated to provide travel time savings to pedestrians and cyclists. The project will add a designated pedestrian and bicycle facility across Lake Texoma where none exists today. It is anticipated this facility will attract users from among the visitors to Lake Texoma as well as from those looking for a more affordable mode of transportation. However, these benefits are not monetized in the BCA due to a lack of data on how many pedestrians and cyclists would use the

[7] Selected due to the anticipated traffic volumes and future signal at State Park Road
[8] CMF Clearinghouse ID: 7566
[9] CMF 886 assuming reduction in shoulder width from 6’ to 5’.

future facility. Since there is no facility today there is no count data or other sources to form the basis of an estimate.

Travel time savings will also be realized through the avoidance of detours. As shown in **Figure 6**, a closure of the Roosevelt Bridge would result in a detour of approximately 39.1 miles (red and green routes). For the purpose of determining a detour distance, it is assumed the majority of the traffic is travelling a distance at minimum of 17.6 miles between Kingston and Durant (green route), creating a 21.5-mile detour. The impact of detours related to structural degradation assumed the bridge would be load posted to 50% of trucks and buses in 2033 and 100% trucks and buses in 2048. The closest detour to cross Lake Texoma is to use Route 199 to the north. As described above, according to the ODOT State Bridge Engineer, it is likely the existing bridge will require posting and closure in the near term. However, to be conservative, full posting and closure were not included in the analysis period. A sensitivity analysis was included to reflect the earlier posting and closure dates estimated by ODOT. See the Sensitivity Analysis section of this memo.

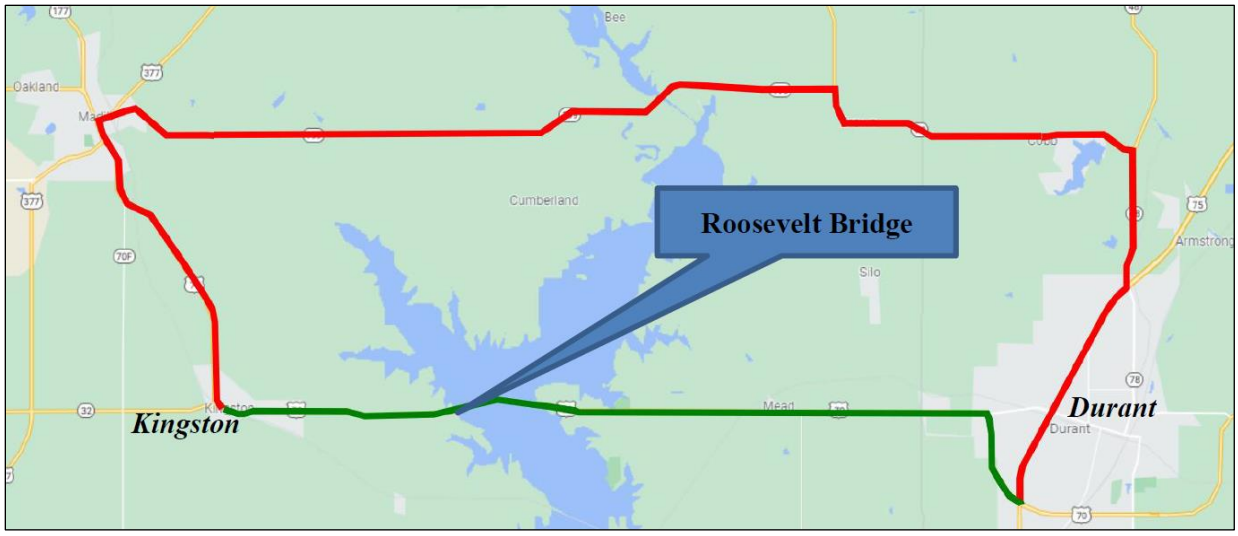

Figure 6: Roosevelt Bridge Detour

Travel time savings are reduced somewhat by delays during construction. It is estimated that work zones will be in place approximately 270 days for each of the last two years of construction. Because much of the new bridge can be constructed without affecting existing traffic, no impacts were assumed in year one. Disbenefits of work zone delays are estimated at $430,958.

Resiliency

The Project will provide resiliency benefits through avoided detours due to flood events. Historic floods have forced closure of the Roosevelt Bridge in multiple instances for several days. The most recent in 2015 saw record floodwaters (645.72 feet, the highest since the lake was constructed in 1945) and resulted in a full closure in both directions for nine days. To prepare for future floods and ensure long term resiliency, the Roosevelt Bridge Project will construct the new bridge and approaches approximately 5-10 feet higher than the existing. The elevation of the bridge approaches (causeway) will be raised approximately five feet to 650 feet and the bridge will be raised to 655 feet to allow the low beam of the new bridge (with an assumed 8-foot structural

depth) to remain above the water surface elevation at the 200-year storm event. The entirety of the Project will be above the elevation of the 500-year storm (**Figure 7**).

Frequency	Annual Frequency	Pool Elevation
0.99	1-Yr	611.0
0.5	2-Yr	621.0
0.2	5-yr	628.8
0.1	10-Yr	636.0
0.05	20-Yr	641.0
0.04	25-yr	642.0
0.02	50-Yr	646.0
0.01	100-Yr	646.5
0.005	200-Yr	647.0
0.004	250-Yr	647.1
0.002	500-Yr	647.3

Figure 7: Lake Texoma Storm Event Summary (USACE)

Based on historical data, flood events that force the Roosevelt Bridge to be closed due to high water occur once every 25 years and require closures to all traffic of roughly seven days on average. While this frequency may increase in the future due to climate change and more extreme weather events, the same 4% annual probability was assumed from opening year to final year. No structural damage was assumed due to lack of data, although this certainly may occur due to stress on the substructure. The Project will reduce the flooding potential to essentially zero (0.005%). Savings from these resiliency improvements is estimated at $2.0 million. The project will be consistent with the Federal Flood Risk Management Standard.

Reduced Vehicle Operating Costs

According to the BCA Tool User Manual, vehicle operating costs are captured in the benefits of delay savings and detour avoidance. Estimated vehicle operating cost savings of the Roosevelt Bridge project are $93.1 million.

Emissions Reduction

Emissions reduction benefits are captured in the delay savings and detour avoidance benefits. Emissions reduction benefits for the Roosevelt Bridge are estimated at $27.7 million for CO2 and $6.0 million for non-CO2 emissions.

Other Environmental

The BCA Tool calculates noise reduction benefits due to detour avoidance. The benefit is calculated at $260,997.

Maintenance Savings

As described above, the total major maintenance and rehabilitation costs required under the Base Case are estimated at about $14.2 million, compared to the Alternative Case at approximately $0.2 million. While the Alternative Case has maintenance costs associated with the project lifecycle planning, it is less than what would be incurred under the Base Case when discounted over time. Thus, the Alternative case creates a net savings in maintenance costs of approximately $10.9 million in discounted costs (BCA Tool Bridge Tab Table 17).

Reduced Bridge Hits

The Project will replace the existing bridge structure that has a truss span with insufficient vertical clearance and is more subject to vehicle hits. The Project would construct a new bridge without the truss span, eliminating the potential for a vehicle hit. These benefits are included in Bridge Tab Table 51 of the BCA Tool and are based on the assumptions in **Table 4**. Given that a bridge hit

occurs approximately once every six years at an average cost of approximately $75,000 based on historical ODOT data, the benefit of the project is assumed to be approximately $12,500 annually. This results in a total benefit of $153,420 over the life of the project.

Table 4: Bridge Hit Reduction

Variable	Unit	Value
Number of Bridge Hits	count	3
Period of Bridge Hits Analyzed	years	18
Probability of Bridge Hit	incidents / Period	300.00%
Probability of Bridge Hit	incidents / year	16.67%
Bridge Replacement Cost	$	Full replacement cost not considered
Average bridge damage per hit	$	$ 75,000
Total cost of bridge hit	$/incident	$ 75,000

Source: ODOT

BCA Sensitivity Analysis

The BCA outcomes presented in the previous sections rely on many assumptions and long-term projections, both of which are subject to considerable uncertainty. The primary purpose of the sensitivity analysis is to help identify the "critical variables"—the variables and model parameters whose variations have the greatest impact on the BCA outcomes.

The sensitivity analysis can also be used to:

- Evaluate the impact of changes in individual critical variables—how much the final results would vary with reasonable departures from the "preferred" or most likely value for the variable, and
- Assess the robustness of the BCA and evaluate whether the conclusions reached under the "preferred" set of input values are significantly altered by reasonable departures from those values.

The sensitivity analysis was conducted with respect to changes in the traffic volumes, detour assumptions, value of CMFs, number of fatal collisions, and capital cost included in the Project BCA analysis. The outcomes of the analysis are summarized in **Table 5** on the next page. The table provides the percentage changes in project NPV associated with variations in variables or parameters.

Table 5: BCA Sensitivity Analysis

Parameters	Change in Parameter Value	New NPV (millions of discounted $)	% Change in NPV	New B/C Ratio
As Presented	**N/A**	**$140.6**	**N/A**	**1.66**
Traffic Volumes	Use of default NBI Traffic data (including 25% trucks)	$244.7	+74%	2.14
Future Detour Timing (full detour)	Full posting 2033, Closure 2043	$987.0	+602%	5.61
CMF	20% Reduction	$127.3	-9%	1.59
Fatalities	Reduction from 4 to 2 fatalities	$83.0	-41%	1.39
Capital Cost	20% Increase	$100.3	-29%	1.39

The table demonstrates that under the alternative parameter values that may depress the Project NPV, the Project maintains NPV above zero and a BC Ratio of 1.39 or higher. Using the traffic volumes included in the NBI data results in a higher BC Ratio, despite the overall volumes being lower. The NBI data includes 25% trucks versus 9% from the 2021 Traffic Study which increases the detour savings significantly given the bridge would be posted for 50% of trucks in 2033 and 100% of trucks in 2048. Reduction of the CMF (0.341) by 20% (0.41) decreases the NPV to $127.3 million and decreases the BC Ratio to 1.59. Reducing the number of fatalities included in the analysis reduces the NPV to $83.0 million and the BC Ratio to 1.39. A 20% cost increase would also result in a BC Ratio of 1.39. When the years of posting and closure are changed to 2033 (full posting) and 2043 (full closure), the NPV increases to $987.0 million and the BC Ratio increases to 5.61.