May 6, 2024

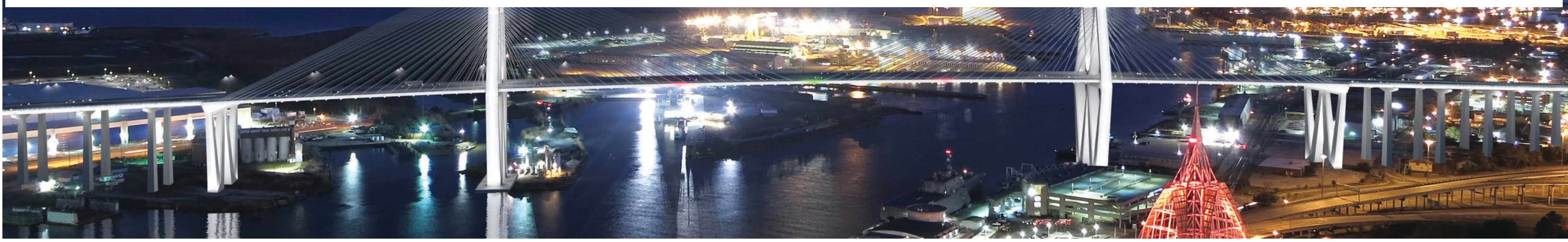
FY 2025-2026 Multimodal Project Discretionary Grant Opportunity (MPDG)

MOBILE RIVER BRIDGE & BAYWAY

I-10 MOBILE RIVER BRIDGE AND BAYWAY MULTIMODAL PROJECT

BCA Narrative

For more information, please visit: https://mobileriverbridge.com/fy25-26-mega-grant/



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Executive Summary

The benefit-cost analysis conducted for this grant application compares the costs associated with the proposed investment to the benefits of the project. To the extent possible, benefits have been monetized. Where not possible to assign a dollar value to a benefit, efforts have been made to quantify it. A qualitative discussion is also provided when a benefit is anticipated to be generated but is not easily monetized or quantified.

The I-10 Mobile River Bridge and Bayway project proposes to increase the capacity of I-10 by constructing a new six-lane cable-stayed bridge (3 lanes in each direction) with 215 feet of vertical clearance and 1,430 feet of horizontal clearance across the Mobile River in the State of Alabama. In addition, the project would reconstruct the existing I-10 bridges across Mobile Bay (known as the I-10 Bayway) from four to six lanes (from 2 lanes each way to 3 lanes each way). Other project improvements include an interchange at I-10/Virginia Street (the approximate west project terminus south of downtown Mobile, AL), improvements to the I-10/US 90/US 98 interchange (the approximate east project terminus at Spanish Fort, AL), and improvements to additional interchanges at I-10/Water Street, East Wallace Tunnel at US 90, and I-10 Bayway/US 90 Causeway at Mid-Bay Interchange.

The I-10 Mobile River Bridge and Bayway project is anticipated to have substantial improvements which include but are not limited to the following:

- Provide significant travel time savings for private and commercial drivers along the corridor;
- Improve the movement of people along the corridor by reducing congestion;
- Achieve significant reduction in traffic fatalities and serious injuries by virtue of providing more miles of safer highway infrastructure; and
- Reduce emissions for pollutants such as nitrogen oxides (NO_x), fine particulate matter (PM2.5), sulfur dioxide (SO_x) and carbon dioxide (CO_2);
- Provide resiliency against severe storms;
- Avoid the high costs to renovate and rehabilitate existing infrastructure in the future;

Table ES-1 summarizes the changes expected from the project and associated benefits. Both monetized and non-monetized benefits are shown in the table.

Table ES-1: Merit Criteria and Cost-Effectiveness - Summary of Infrastructure Improvements and Associated Benefits, Millions of 2022 Dollars

Current Status or Baseline & Problems to be Addressed	Changes to Baseline/Alternatives	Types of Impacts	Benefits	Summary of Results (Discounted 2022 $)
High congestion on and low capacity on I-10. **Bayway vulnerable to extensive storm damage**	The I-10 Mobile River Bridge and Bayway project will add an alternate route around the Mobile River, replace the existing four-lane I-10 Bayway bridges across the Mobile Bay with 6 lanes, reconstruct seven interchanges along I-10, and add other facility enhancements to improve traffic safety and reliability.	Improved Travel Time across the Mobile River by reducing congestion	Annual Travel Time Savings	$258,849,580
		A slight increase in greenhouse gas emissions due to increased vehicle miles traveled for passenger vehicles the project area	Emission (dis)benefits	-$58,012,630
		Reduced number of total crashes in the project area due to reducing congestion	Safety Benefits	$327,232,328
		Avoided damages and traffic diversion from severe storms	Resiliency Benefits	$2,958,722,610
		Avoid constructing necessary upgrades to the project area in the future	Avoided Rehabilitation Benefits	$83,533,559
		Useful life beyond the period of analysis	Residual Values	$473,068,517

Note: the detailed discussion on estimating project benefits is in Section 7.1.

The period of analysis used in the estimation of benefits and costs corresponds to 34 years, including 4 years of project support and construction (e.g., preliminary engineering, administrative/legal costs) and 30 years of operation.[1] The total project costs are $3,015.82 million (year of expenditure) are expected to be financed by Federal funds, State funds, bonds and loans. These costs are reported in Year of Expenditure dollars and include capital costs (construction costs, lifecycle costs, and other costs such as right of way, preliminary engineering, administrative and legal, etc.). The breakdown of project costs in 2023 dollars is presented **Table ES-2**.

Table ES-2: Summary of Project Costs

Cost Category	2023 Dollars
Project 1 – 6-lane Main Span/HLAs, 12 ft lanes, 10 ft outside/8 ft inside shoulder, Broad St Interchange, Virginia St Interchange, Texas/Water/Canal St Interchange	**$1,345,000,000**
Project 2 – 6-lane Bayway, 12 ft lanes, 10 ft outside/8 ft inside shoulder, West Tunnel Interchange, Mid-bay Interchange, Eastern Shore Interchange, Bayway Demo	**$960,000,000**
Additional Costs – Design, CEI, Utility, Mobilization, Change Orders, Contingency, etc.	**$376,000,000**
Previously Incurred Costs	**$179,000,000**
Total 2023 Dollars	**$2,860,000,000**

A summary of the relevant data and calculations used to derive the benefits and costs of the project are shown in the BCA model (in 2022 dollars). Based on the analysis presented in the rest of this document, the project is expected to generate $4,043 million in discounted benefits and $2,428 million in discounted costs, using a 3.1 percent real discount rate for most benefit categories and a 2.0 percent real discount rate for CO_2 emissions. Therefore, the project is expected to generate a net present value of $1,616 million and a **benefit-cost ratio of 1.67**. In addition to the monetized benefits presented, the project would generate other benefits that are difficult to monetize, which are summarized below:

The higher speeds and greater reliability along the corridor imply that trucks spend less time on the road and can reach their destination faster, leading to **inventory cost savings**;

[1] Both structures, like most large bridges, will last much longer than 30 years; the bridge is currently expected to last at least 75 years.

Another benefit that was identified but not monetized as part of the BCA is **travel time reliability.** As the rates of crashes decrease and as overall capacity increases, the occurrence of irregular delays will decrease, which is particularly valuable to freight movements on the corridor;

Substantially reducing the risk of crashes and congestion in neighborhoods in downtown Mobile adjacent to the tunnel will likely improve the value of some parcels in those areas and **improve the economic development potential** of those parcels;

The increased capacity will lead to **faster emergency response times** along the corridor;

The added capacity will **improve evacuation speed and efficiency during catastrophic weather events**, as the Bayway and bridge can carry more vehicles per hour;

The Mobile River Bridge will allow for a more direct crossing of the Mobile River, one which diverts vehicles transporting hazardous materials out of downtown Mobile, which leads to **reduced risk of crashes of trucks carrying hazardous materials in residential communities;**

The inclusion of these benefits would increase the net present value and overall benefit-cost ratio.

The project will improve short and long-term employment by increasing access to existing and new jobs. Furthermore, the I-10 Mobile River Bridge and Bayway project will create employment in project planning and construction.

It is important to mention that toll revenues are not estimated in the BCA to avoid double-counting as tolls are just transfers between different members of society. Tolls represent a source of revenue to the agency responsible for collecting tolls along the corridor at the expense of roadway users who incur it as an out-of-pocket cost.

1.0 Introduction

This document provides detailed technical information on the economic analysis conducted in support of the grant application for the I-10 Mobile River Bridge and Bayway project.

Section 3, Methodological Framework, introduces the conceptual framework used in the benefit-cost analysis (BCA). To the extent possible, and as recommended in the Notice of Funding Opportunity (NOFO), monetized benefits and costs are estimated within the BCA framework described in this section.

Section 4, Project Overview provides an overview of the project, including a brief description of existing conditions and proposed alternatives; a summary of cost estimates and schedule; and a description of the types of effects that the I-10 Mobile River Bridge and Bayway project is expected to generate. Monetized, quantified, and qualitative effects are highlighted.

Section 5, General Assumptions, discusses the general assumptions used in the estimation of project costs and benefits, while estimates of travel demand and traffic growth can be found in Section 6, Demand Projections.

Specific data elements and assumptions pertaining to the merit criteria are presented in Section 7, Estimation of Economic Benefits, along with associated benefit estimates.

Estimates of the project's net present value (NPV), its benefit-cost ratio (BCR) and other project evaluation metrics are introduced in Section 8, Summary of Findings and BCA Outcomes.

Section 9, BCA Sensitivity Analysis, provides the outcomes of the sensitivity analysis.

Additional data tables are provided in Section 10, Summary of Benefits and Costs, including annual estimates of benefits and costs to assist USDOT in its review of the application.

2.0 Methodological Framework

A benefit-cost analysis (BCA) is a conceptual framework that can be used to evaluate the cost-effectiveness of transportation infrastructure projects. A BCA attempts to describe, quantify, and monetize the societal benefits and costs generated by a particular project. A project's societal return-on-investment is estimated by comparing the monetized benefits against the project's total costs.

The benefits of the project are based on the expected impacts on both users and non-users of the facility. In addition, a BCA evaluates the benefits and costs over the entire life cycle of the project. Therefore, all benefits and costs that occur in future years need to be discounted to present values in order to be compared equitably. A real discount rate based on U.S. Department of Transportation (U.S. DOT) BCA guidance has been identified for this purpose.

The BCA produced several important measures to assess the cost-effectiveness of a proposed project. The benefit-cost ratio (BCR), calculated by dividing the project's discounted societal benefits by its discounted costs, measures the societal return on each dollar spent in project costs. In other words, a BCR greater than 1.0 indicates that for every dollar spent in project costs, more than one dollar will be generated in benefits. The net present value (NPV), calculated by subtracting the discounted project costs from the project's discounted societal benefits, measures the total benefit that society enjoys as a result of the project improvements.

The specific methodology for the I-10 Mobile River Bridge and Bayway project was developed using the BCA guidance published by U.S. DOT in December 2023.[2] In particular, the methodology involves:

- Establishing existing and future conditions under the build and no-build scenarios.
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement.
- Using U.S. DOT guidance for the valuation of travel time savings, safety benefits, amenity benefits, and reductions in air emissions, while relying on industry best practice for the valuation of other effects.
- Discounting future benefits and costs with the real discount rate of 3.1 percent for most categories and using the real discount rate of 2.0 percent for CO_2 emissions, as recommended by U.S. DOT.
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.

3.0 Project Overview

The I-10 Mobile River Bridge and Bayway project extends approximately 10 miles through Mobile and Baldwin Counties, Alabama and falls within two U.S. Census defined urbanized areas: Mobile and Daphne-Fairhope, Alabama. The western terminus of the project is located on the southern edge of the downtown of the City of Mobile in Mobile County. The project continues eastward across the Mobile River and Mobile Bay. The project's eastern terminus lies within the City of Daphne, just south of the City of Spanish Fort in Baldwin County. The project is part of I-10, a key component of the Interstate Highway System. I-10 links the Port of Mobile to the western U.S. Port of Los Angeles approximately 2,030 miles away and to the eastern Port of Jacksonville approximately 420 miles away.

The I-10 Mobile River Bridge and Bayway project will improve safety, efficiency, reliability, and increase mobility for residents and businesses on I-10. It will be designed to increase capacity, alleviate congestion, reduce crashes, provide a direct interstate route for hazardous material transport, minimize adverse impacts to the maritime industries, and improve resiliency and susceptibility to storm surges.

3.1 Base Case and Alternatives

The no build scenario (base case) as defined in this project is the status quo, or the existing infrastructure within I-10 off the Mobile Bay. This scenario leaves gaps in the overall connectivity

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[2] U.S. DOT. *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*. December 2023.

of the region due to the capacity constraints of I-10 and renders the project areas vulnerable to storms and resilience events that could devastate the infrastructure entirely. This scenario also assumes that major rehabilitation to the existing infrastructure will be necessary by 2037.

The build scenario being considered includes the following improvements:

Mobile River Bridge: Construction of a new six-lane state-of-the-art cable stayed bridge with a minimum 215 feet of Air Draft Clearance (ADC) across the Mobile River channel. The bridge will add an alternate route across the Mobile River crossing in addition to the Wallace Tunnel, which is currently I-10's primary route.

A portion of the bridge (approximately 2,550 feet) will use cable-stay construction, supported from two pylon locations. The west pylon will be on land near the Mobile River; the eastern pylon will be in open water near the Pinto Pass peninsula.

The bridge high level approach spans will begin approximately 5,500 feet east and west of the navigation channel to achieve required vertical clearance and to minimize impacts to the shipping industry and environment. Approaches start just east of Virginia Street in Mobile and end between the existing Bayway Bridges.

Bayway: Replacing the existing four-lane I-10 Bayway Bridges across the Mobile Bay with six-lane bridges built above the 100-year storm maximum wave height. The Bayway will include two parallel structures, three lanes each, which will run in tandem approximately 7.4 miles from the high-level approach spans to the Eastern Shore US 90/98 interchange in Daphne. The portal connecting the Bayway to the Wallace Tunnel will be replaced or rehabilitated.

Interchanges: Five interchanges along I-10 will be reconstructed – Virginia Street, Canal / Water Streets, East Tunnel Portal (US 90/98), Mid-bay (US 90/98), and the Eastern Shore (US 90/98 in Daphne) to improve the geometrics and local connections to US 90 and the Port of Mobile.

Other Enhancements: A new intelligent transportation system (ITS), tolling facilities and other enhancements will be included.

3.2 Types of Impacts

The I-10 Mobile River Bridge and Bayway project will address known deficiencies by providing a more convenient, efficient, and comfortable roadway network to existing users, and increase the network's attractiveness to new users. The new six-lane Bridge, the Bayway reconstruction, and interchange improvements will make it a high-quality link in the region's transit network, in turn improving the travel time and safety of users as well as reducing vehicle emissions.

The project will provide consistent and reliable access to job markets for workers who rely on I- 10 for commuting. Commute times would be significantly shortened, thereby providing expanded access to employment centers currently too far for a daily commute and improving the quality of life for residents who will experience reduced commute times.

The map below shows the communities surrounding the project location and their level of distress.[3] This level is based off an index of data from the U.S. census that considers criteria such as high school degrees, housing vacancy, adults not working, poverty, median income relative to the state, and change in employment. The higher the score, the greater the distress.

Figure 1: Distressed Communities in the Project Area

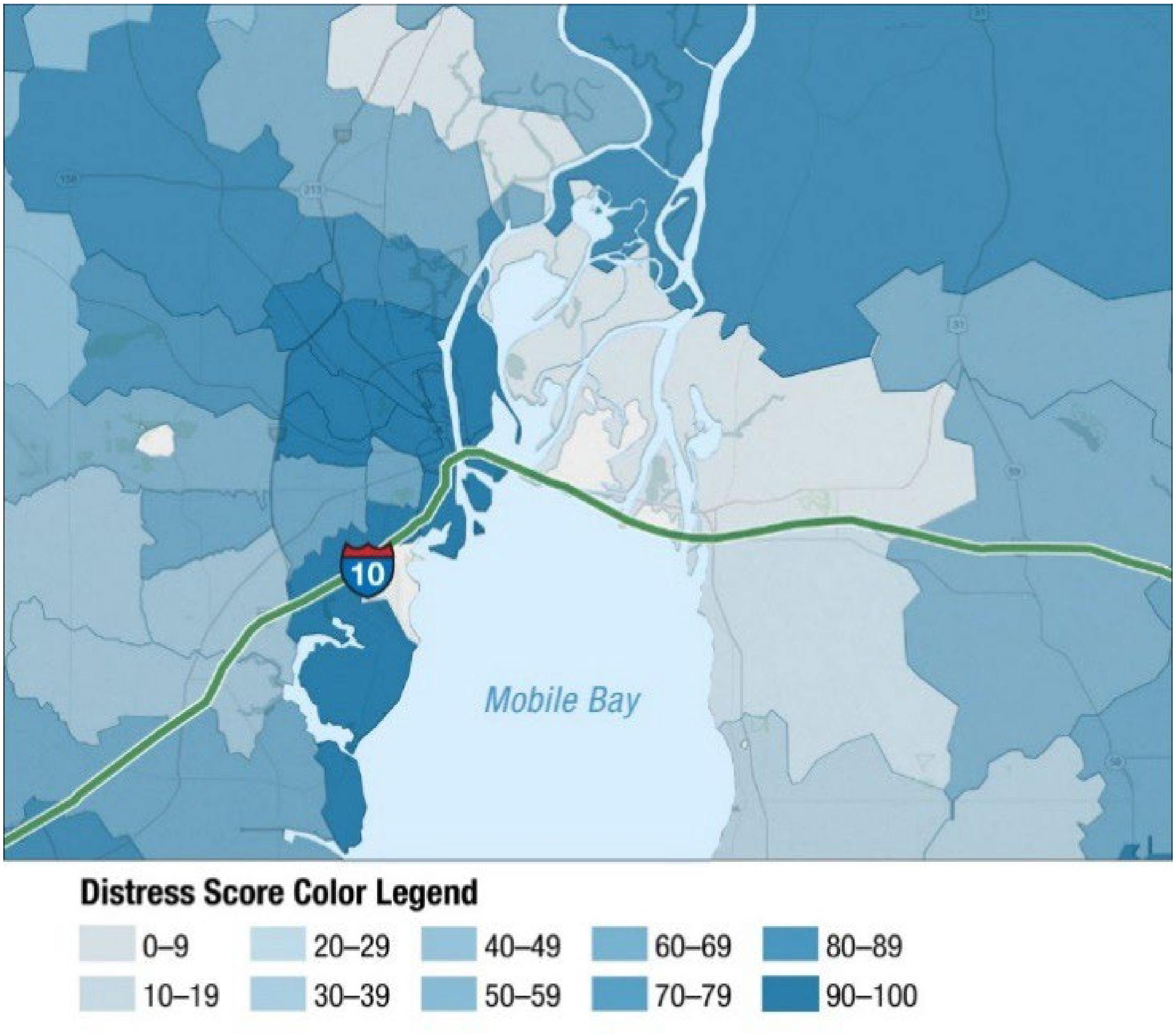


Table 1 provides detailed metrics for the State of Alabama and Mobile County.

[3] Economic Innovation Group, Distressed Community Index http://eig.org/dci

Table 1: Distressed Indicators for the State of Alabama and Mobile County

Variable Name	Alabama	Mobile County, AL
No High School Degree	16%	15%
Housing Vacancy Rate	12%	13%
Adults Not Working	48%	48%
Poverty Rate	19%	20%
Median Income Ratio	100%	101%
Change in Employment	2.2%	**-0.6%**
Change in Business	**-1.7%**	**-2.9%**
Distress Score		**67.7**

3.3 Project Cost and Schedule

The project costs in **Table 2** include capital costs (construction and other costs such as preliminary engineering, administrative and legal, etc.). These costs are necessary in order to improve and enhance the I-10 Mobile corridor. The project capital costs (project support and construction) are spent between 2023 – 2029.

Table 2: Project Cost Summary, in Millions of 2022 Dollars

Calendar Year	Capital Expenditures (2022 $)
2023	$173,165,341
2024	$129,524,610
2025	$518,098,439
2026	$647,623,049
2027	$647,623,049
2028	$518,098,439
2029	$129,524,610
Total	**$2,763,657,535**

4.0 General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of design, engineering, and construction and including 30 years of operations.

The monetized benefits and costs are estimated in 2022 dollars with future dollars discounted in compliance with MPDG requirements using a 3.1 percent real rate most categories and using a 2.0 percent real discount rate for CO_2 emissions.

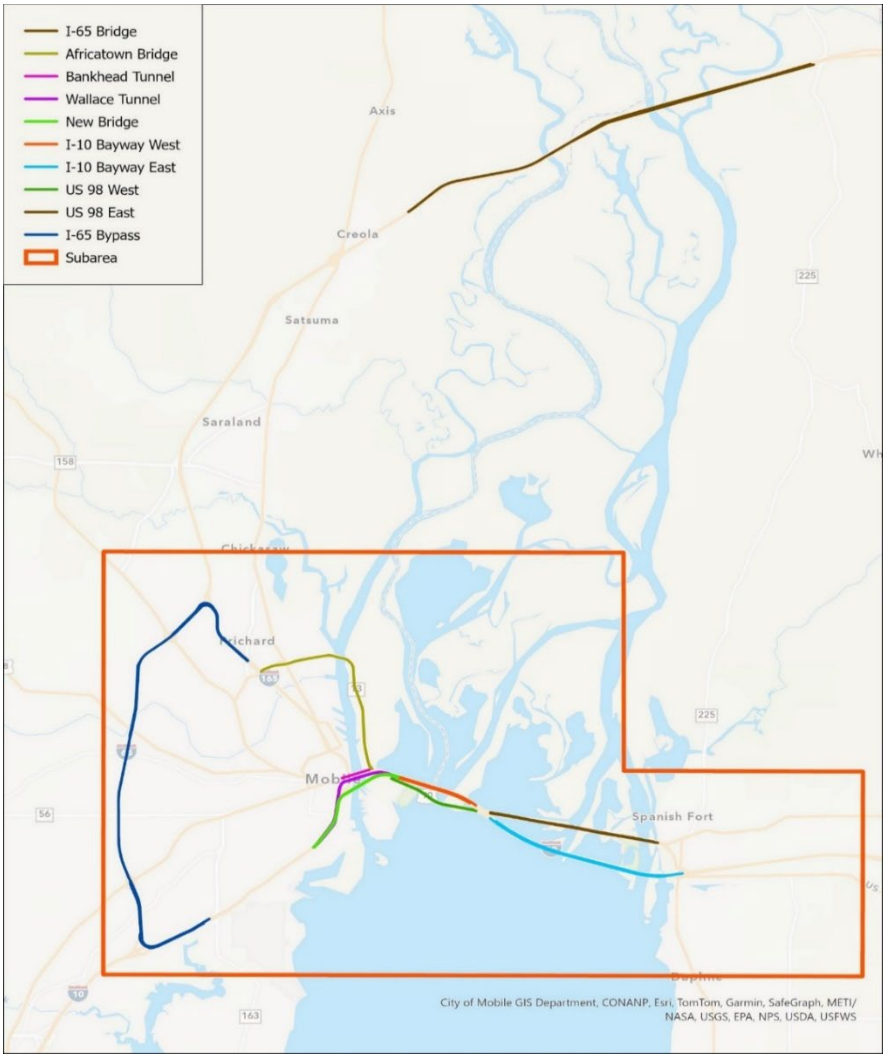
The methodology makes several important assumptions. Specifically:

- Input prices are expressed in 2022 dollars;
- The period of analysis begins in 2022 and ends in 2057. It includes project development and construction years (2024-2029) and 30 years of operations (2029-2058);
- A constant 3.1 percent real discount rate is assumed throughout the period of analysis. A 2.0 percent real discount rate is used for sensitivity analysis;
- Opening year demand is an input to the BCA and is assumed to be fully realized in 2029.

5.0 Demand Projections

Demand projections are used to derive vehicle miles traveled (VMT) and vehicle hours traveled (VHT) which are the base for estimating travel time savings. This section describes the travel demand model's outputs that are inputs for calculating VMT, speeds, and VHT. The demand estimates were calculated from a project-specific travel demand model developed by CDM Smith in 2019 for a Traffic and Revenue Analysis on the proposed Mobile River Bridge, which was refined and updated in 2022, prepared for the Alabama Department of Transportation. CDM Smith used traffic counts from over 220 regular count locations using both ALDOT permanent and limited period counter stations and independently at 35 locations for a one week period in September 2021 broken into 13 vehicle classes.[4].

Figure 2: Map of Project Area



For this BCA, VMT and VHT estimates were prepared for both the No Build and Build scenarios for the area which includes: the Cochrane–Africatown Bridge, the Bankhead Tunnel (Mobile River), the Wallace Tunnel (Mobile River), the New I-10 Bridge (Mobile River – Build scenario only), I-10 Bayway (West of Mid-Bay), I-10 Bayway (East of Mid-Bay), US 90/US 98 Causeway (West of Mid-Bay), US 90/US 98 Causeway (East of Mid-Bay), I-65 North, I-65 Bypass (see map).

[4] CDM Smith model utilizes speed data from INRIX and travel pattern data from StreetLight Data Inc., both covering 2019.

VMT and VHT estimates from the model were provided for 2029 and 2055, separately for commercial vehicles and personal vehicles, and used to interpolate demand projections between those years.

Additionally, the interpolation of demand projections extended until the conclusion of the analysis period in 2058, ensuring a comprehensive assessment of vehicular trends for both commercial and personal vehicles.

Please refer to the BCA worksheet's *Traffic Data* tab.

The demand projections are summarized in **Table 3**.

Table 3: Daily Results of ALDOT Traffic Demand Model (2029 – 2055)

Metric	VMT		VHT	
	2029	2055	2029	2055
Personal Vehicles				
No Build	20,098,232	25,096,970	522,871	715,872
Build	20,273,270	25,400,403	522,475	713,573
Reduction in VMT/VHT	(175,037)	(303,433)	397	2,299
Commercial Vehicles				
No Build	1,563,974	2,193,877	31,493	47,566
Build	1,560,569	2,187,654	31,269	46,583
Reduction in VMT/VHT	3,405	6,223	224	983

6.0 Estimation of Economic Benefits

6.1 Benefits Measurement, Data and Assumptions

This section describes the measurement approach used for each benefit or impact category identified in Section 4 (Types of Impacts) and provides an overview of the associated methodology, assumptions, and estimates.

6.1.1 List of Benefits Analyzed

The benefits assessed for the I-10 Mobile River Bridge and Bayway project are the following:

Travel Time Savings: captures the reduced travel time for automobiles and trucks under the build scenario as a result of the project's improvements. Travel time savings will be realized by personal vehicles, which will be able to take advantage of the higher speeds compared to those experienced in the no build scenario. Truck drivers will also benefit and save time.

Emissions Cost Reduction: captures the benefits of more consistent free-flow speeds resulting in reduced emissions pollutants, such as nitrogen oxides (NO_x), fine particulate matter (PM2.5), sulfur dioxide (SO_2), and carbon dioxide (CO_2).

Reduction in Crash Costs: captures the benefits of the I-10 corridor improvements in creating safer travel conditions for drivers of personal and commercial vehicles, resulting in fewer traffic fatalities, serious injuries, and property damage incidents.

Reconstruction & Diversion Avoidance Savings from Greater Resiliency: the current Bayway is in an area that is highly susceptible to sea-level rise and is susceptible to damage from storm surges, which can destroy portions of the facility. The new Bayway will be built above the 100-year storm event maximum wave height and will prevent damages to the Bayway. Greater resiliency savings captures the reduction in noise, vehicle crash impacts, and vehicle operating cost savings in diversion scenarios.

Avoided Rehabilitation: the current infrastructure in the project area will require major reconstruction and rehabilitation by the year 2037. The BCA model treats this as a future cost avoidance benefit in the build scenario.

Residual Value Savings: the current infrastructure in the project area has an expected useful life beyond the period of analysis. Therefore, there will be a residual value that captures the benefits of remaining infrastructure lifespan

6.1.2 Methodology

The methodology used for estimating each of the benefits listed is presented below:

Travel Time Savings: calculated based on VHT data derived from the travel demand model for 2029 and 2055 (no build and build scenarios) for personal vehicles and commercial vehicles. The data was then entered in the BCA model. Speed is calculated from the VHT. Average vehicle occupancy for both types of vehicles were entered in the model. The model multiplies the number of hours saved by personal and commercial vehicles drivers by their corresponding vehicle occupancy rates and values of time. Travel time costs are compared between the no build and build scenarios and the difference is the travel time savings.

Emissions Cost Reduction: There are four types of emissions measured in the analysis: nitrogen oxide (NO_x), fine particulate matter (PM 2.5), sulfur dioxide (SO_2), and carbon dioxide (CO_2). The emissions were quantified using EPA's MOVES software and monetized using the values from the USDOT BCA Guidance for Discretionary Grants (December 2023).

Reduction in Crash Costs: The project improvements will benefit safety in the corridor. These anticipated safety improvements were applied to the observed crashes using established safety factors to derive the overall safety benefits. To estimate the safety impacts, the number, and the severity of crashes in the project area were requested from ALDOT. The data was provided for 120 months (2019-2024). To determine the average number of accidents per year, the total number of automobile accidents by severity was divided by the number of months, and annualized. ALDOT estimates that the I-10 Mobile River Bridge and Bayway project proposed improvements will lead to a 50 percent reduction in annual accidents in the areas where they are implemented. This reduction was applied to the number of accidents in the study area to generate the overall safety benefits. A sensitivity analysis was also conducted with a change in the crash reduction factor from 50 to 45 and 55 percent.

Resiliency Benefits.

- **Reconstruction Savings from Greater Resiliency[5]:** The new Bayway portion of the project will provide resiliency against damages caused by severe storms as it will be constructed to a 100-year storm standard. The BCA models the effects of a 100-year storm and a 50-year storm. The 100-year storm is projected to destroy the majority of the Bayway. ALDOT would incur a reconstruction cost of $2.90 billion 2022 dollars in the no build scenario. After a 50-year storm, reconstruction costs would be $2.75 billion.
- **Traffic Impacts**. Resiliency benefits include the value of added travel time due to diversion, vehicle operating cost savings, noise and crash cost savings to total the effects of the 100-year storm and the 50-year storm, given the probability of each event happening. BCA models the avoided costs to users from the need to divert around the Bayway because a storm has made it unusable. The diversion is modeled in four stages, each with different diversion routes/patterns. The shortest detour for traffic on the Bayway is the smaller Causeway. But if a storm occurs, both the Bayway and the Causeway would be destroyed.
  - i. In stage one, the Bayway is closed as well as the smaller adjacent Causeway and all traffic is diverted to take Highway 165 to Highway 287 which has a net detour route of 40.6 (as estimated by FHWA[6]).
  - ii. In stage two, Bayway is still closed, but the Causeway parallel to the Bayway is open, and some traffic is diverted onto the Causeway (based on the Causeway's capacity).
  - iii. In stage three, one span of the Bayway is repaired for a single lane of traffic in each direction, while the new, resilient Bayway is constructed. Capacity is still below pre-storm levels.
  - iv. In stage four, traffic gradually returns to normal as repairs near completion.

  This analysis assumes that after a 50 or 100 year storm, the Causeway would be repaired and open to traffic in 8 months; the Bayway would take 3 years (36 months) to rebuild.

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[5] Alabama Department of Transportation, Mobile Bay Bridge Storm Surge Impact Analysis, October 2016

[6] FHWA. "Sea Level Rise and Storm Surge Impacts on a Coastal Bridge: I-10 Bayway, Mobile Bay, Alabama." TEACR Engineering Assessment. FHWA-HEP-17-014. September 2016.

Each of these stages (or diversion scenarios) has a specific factor based on probability of occurrence month from storm occurrence to estimate the amount of traffic diverted and additional miles traveled until a new Bayway is open.

- **Probabilities of Occurrence for 50-year and 100-year storms:** The independent annual probability of a 50-year storm occurring is 2% and the individual independent annual probability of a 100-year storm occurring is 1%, which were used by KBR Kellogg Brown & Root Services to calculate the number of spans on the Bayway which would be damaged and need replacement after such a storm. In both the 50-year and 100-year storm scenarios the Bayway would likely be so damaged that it would be more cost efficient to replace it with a new, resilient bridge. To avoid double counting the replacement of the Bayway while modeling both potential storms, the cumulative probability of a 100 year storm occurring and a 50 year storm not occurring was calculated as (probability that a 50 year storm has not occurred) x (probability of a 100-year storm) or (1-2%) x (1%).

Vehicle Operating Cost Savings: calculated based on VMT data derived from the travel demand model for 2028 and 2055 (no build and build scenarios) for personal vehicles and commercial vehicles. The change in VMT between no build and build was monetized using the USDOT BCA Guidance for Discretionary Grants (December 2023). Vehicle operating cost savings were included when estimating the benefits of resiliency but not for changes in travel patterns due to the new Mobile River Bridge. These decisions were based on a) the uncertainty about whether or not the decreased vehicle operating costs from driving on a new bridge would offset any additional miles traveled (which would also occur during a trip taking less time) in the build scenario, and b) the assumption that diversion post natural disaster would have a greater negative impact on vehicle operating costs (higher fuel costs, greater vehicle wear and tear).

Rehabilitation Avoidance: Project infrastructure in a no build scenario will require significant ongoing investment to maintain it in a state of good repair. The BCA assumes that the construction of new infrastructure will eliminate significant future rehabilitation costs. To estimate the rehabilitation avoidance impacts, the future repair estimates were requested by ALDOT. The model measures the avoided rehabilitation costs as a benefit, adjusted in future discounted dollars.

Residual Value Savings: The new infrastructure will have an expected useful life that surpasses the period of analysis and will, therefore, have a residual value at the end of the BCA period of analysis. The BCA uses straight-line depreciation applied to the project cost estimate to calculate the residual value of the infrastructure after the 30-year analysis period.

6.1.3 Assumptions

The assumptions used in the estimation of economic benefits for I-10 Congestion Relief: Mobile River Bridge and Bayway project are summarized in **Tables 4-10.**

Table 4: General Assumptions used in the Estimation of Economic Benefits

Variable Name	Unit	Value	Source
Base Year (for discounting)	year	2022	U.S.DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs - December 2023
Analysis Start Year	year	2022	Alabama DOT; project assumptions
Project Open Year	year	2029	
Construction Start Year	years	2024	
Construction End Year	years	2029	
Benefits Period	years	30	Alabama DOT
General Discount Rate	percent	3.1%	U.S.DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs - December 2023
Environmental Discount Rate (CO2)	percent	2.0%	
Annualization Factor	days/year	260	Used to annualize VMT and VHT data

Table 5: Assumptions Used in the Estimation of Travel Time Savings

Variable Name	Unit	Value	Source
Passenger Vehicle Average Vehicle Occupancy (AVO)	persons/vehicle	1.67	U.S.DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs - December 2023
Truck Average Vehicle Occupancy (AVO)	persons/vehicle	1.00	

Table 6: Additional assumptions Used in the Estimation of Travel Time Savings

Variable Name	Unit	Value	Source/Notes
Value of Time, General Travel Time, All Purposes	2022 $/hour	$19.60	U.S.DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs – December 2023
Value of Time, Truck Drivers	2022 $/hour	$33.50	

Table 7: Assumptions Used in the Estimation of Emission Reduction Benefits

Variable Name	Unit	Value	Source/Notes
Idling Speed	mph	2.5	Assumption: 2.5 mph is midpoint estimate assuming speed of vehicles delayed are between 0-5mph. It is a conservative assumption (increasing

Variable Name	Unit	Value	Source/Notes
			idling speed for emissions estimation from delays will result in increased emissions benefits since as miles per hour increase so do the displaced emissions).
Average Speed in No Build	mph	55	Assumption based on Traffic Demand Model Results (Traffic Data worksheet)
Average Speed in Build	mph	55	Assumption based on Traffic Demand Model Results (Traffic Data worksheet)

Table 8: Assumption Used in the Estimation of Safety Benefits

Variable Name	Unit	Value	Source/Notes
Cost of Damaged Vehicle (PDO)	2022 $/vehicle	$5,000	U.S. Benefit-Cost Analysis Guidance for Discretionary Grant Programs - December 2023, Table A-2
Cost of Fatality (KABCO)	2022 $/fatality	$14,022,900	USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs - December 2023, Table A-1
Cost of Injury (Unknown)	2022 $/Injury	$313,000	
Cost of PDO Crash	2022 $/crash	$9,100	
Crash Reduction Factor	percent	50%	*Interstate 10 Mobile River Bridge And Bayway Widening: A Project Of National And Regional Significance - Survey Response Report*. (2014). Prepared by Atkins for the Alabama Department of Transportation.

Table 9: Assumptions Used in Estimation the Resiliency Benefits

Variable Name	Unit	Value	Source/Notes
100 Year Cost to repair / replace	2022 $	$2,902,495,417	HDR Bridge Engineers Calculation based on Escambia Bay Bridge Reconstruction post hurricane Ivan
Likelihood of 100-year event	%/year	0.98%	estimate (see BCA workbook)
50 Year Cost to repair / replace	2022 $	$2,746,493,805	calculation (see BCA workbook)
Likelihood of 50-year event	%/year	2.0%	estimate (see BCA workbook)

Table 10: Assumptions Used in Estimation of the No Build Construction Cost Avoidance

Variable Name	Unit	Value	Source/Notes
Year of construction costs	year	2057	Project Information
Construction costs	2022 $	$473,068,517	

6.1.4 Aggregation of Benefit Estimates

Table 11 presents the benefit estimates by benefit categories over the project's lifecycle. The discounted safety benefits ($327.2 million) and the discounted resiliency benefits ($2,958.7 million) represent the majority of total benefits, followed by the discounted residual value ($473.1 million). The increase in total mileage and maintenance in speeds resulted in a slight increase in emissions polluted by vehicles in the project area (-$58.0 million, discounted). The rehabilitation costs of the bridge in future years will be avoided, resulting in avoided rehabilitation benefits ($83.5 million, discounted). Most benefits are discounted by a 3.1% annual discount factor, while CO_2 emissions are discounted using a 2.0% discount rate.

Table 11: Estimates of Economic Benefits, Millions of 2022 Dollars

Benefits	Constant 2022 $	Discounted 2022 $
Travel Time Savings	$541.3	$258.8
Emission Reduction Benefits	-$91.3	-$58.0
Safety Benefits	$621.9	$327.2
Resiliency Benefits	$5,723.3	$2,958.7
No Build Construction Cost Avoidance	$120.9	$83.5
Residual Value	$1,419.8	$473.1
Total Benefits	**$8,336.0**	**$4,043.4**

6.2 Comparison of Benefits and Costs

The project's monetized benefits exceed the costs over the lifecycle of the project. The inclusion of non-monetized benefits would increase the overall benefits.

6.3 Benefits not Quantified or Monetized

In addition to the benefits monetized above, the I-10 Mobile River Bridge and Bayway project would generate significant other benefits that are difficult to monetize. These qualitative benefits of the project are presented below.

The higher and more regular speeds along the corridor mean that many trucks can spend less time on the road and can reach their destination faster. The faster delivery times will allow some shippers and manufacturers to keep lower inventories and/or keep their products in inventory for shorter periods, as many companies adopt versions of just-in-time shipping. These reductions can generate **inventory cost savings** for shippers and manufacturers. The U.S. Department of Transportation (USDOT) is developing a methodology to estimate inventory cost savings, but that methodology is not yet available.

Another benefit that was identified but not monetized as part of the BCA is **travel time reliability**. As congestion decreases and crashes and the associated irregular delays also decrease, the chances that travel time along this portion of the corridor remains predictably the same will increase. Studies have found that travelers place value of the reliability of a trip travel time, even more so than travel times which are shorter, on average, but less reliable. How best to characterize and estimate reliability continues to be debated in the field. One trip reliability measure is the buffer index, which is simply the additional time required to make the trip compared with uncongested conditions. Given that crashes and incidents can add to these times, these "buffers" indicate a high degree of future trip unreliability. With the proposed project, average speeds are estimated to increase over the period of analysis. The buffer index would be zero, indicating substantially improved reliability.

The current tunnel crossing under the Mobile River does not accommodate the transport of hazardous materials. Vehicles transporting hazardous materials along I-10 through Mobile must currently detour off I-10 and travel through downtown Mobile, through commercial and residential neighborhoods. Such travel carries risks of crashes with potentially very large negative impacts. The Mobile River Bridge will allow for a more direct crossing of the Mobile River, and one which diverts vehicles transporting hazardous materials out of downtown Mobile, meaning less transport and **reduced risk of crashes with hazardous materials in residential communities.**

The combination of a slight reduction in crashes (due to the more direct route) and removal of vehicles with unattractive or worrisome cargo is likely to lead to increases in the value of some parcels along routes that previously carried vehicles with hazardous materials. The faster, safer, and more reliable crossing of both the Mobile River and Mobile Bay is expected to encourage additional commercial development along some parcels, according to multiple conversations the city has had with interested parties. In addition, the removal of transport of hazardous materials in adjacent neighborhoods will increase their attractiveness for residential, retail, and other commercial purposes. Together, these two changes will foster **additional and/or greater value development adjacent to the I-10 corridor.**

The added physical capacities of the facilities will likely lead to **faster emergency response times**. The added capacity will reduce congestion as well as add additional space for maneuverability for emergency vehicles, decreasing their average response times.

The added capacity to I-10 from the project means that I-10 will be able to **carry more vehicles faster during emergency evacuations**. The region has been impacted by several major storms in recent years, requiring the evacuations of thousands of residents from Alabama, the Florida Panhandle and beyond. In fact, in 2017 traffic impacts from evacuations due to storms hitting Florida were felt on I-10 through the city of Mobile. This project will ensure faster evacuations which will in turn save time, reduce accidents, and possibly save lives.

7.0 Summary of Findings and BCA Outcomes

Table 12 summarize the BCA findings. Annual costs and benefits are computed over the lifecycle of the project. As stated earlier, construction is expected to be completed by 2029. Benefits accrue during the full operation of the project.

Table 12: Overall Results of the Benefit Cost Analysis, Millions of 2022 Dollars

Project Evaluation Metric	Constant 2022 $	Discounted 2022 $
Total Benefits	$8,336.0	$4,043.4
Total Costs	$2,763.7	$2,427.7
Net Present Value	$5,572.3	$1,615.7
Benefit-Cost Ratio	3.02	1.67
Payback Period (years)	14 years	20 years

With a 3.1 percent general discount rate and 2.0 percent discount rate for CO_2, the $2,428 million investment would result in a net present value of $1,616 million and a benefit-cost ratio of approximately 1.67. If some or all of the benefits, discussed in section 7.3 above, were monetized and included in the estimated benefits, the benefit-cost ratio and net present value would be higher. Thus, the net present value of the impacts which would actually be experienced will be higher than what is estimated here.

8.0 BCA Sensitivity Analysis

The BCA outcomes presented in the previous sections rely on a large number of assumptions and long-term projections, which are subject to considerable uncertainty.

The primary purpose of the sensitivity analysis is to help identify the variables and model parameters whose variations have the greatest impact on the BCA outcomes: the "critical variables."

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, in particular, whether the conclusions reached under the "preferred" set of input values are significantly altered by reasonable departures from those values.

The outcomes of the sensitivity analysis for the I-10 Mobile River Bridge and Bayway project are summarized in **Table 13**. The table provides the percentage changes in project NPV associated with variations in variables or parameters (listed in row) and the new benefit-cost ratios, as indicated in the column headers.

Table 13: Assessment of BCA Sensitivity, Summary

Parameters	Change in Parameter Value	Current NPV	New NPV	Change in NPV	New B/C Ratio
Discount Rate	Reducing the general discount rate to 2 percent	$1,615,727,982	$2,635,660,123	63.1%	2.04
Period of Analysis	Reduce period of analysis from 30 to 20 years		$898,192,728	-44.4%	1.37
Annualization Factor	Increase Annualization Factor from Weekdays(260/year) to Daily(365/year)		$2,349,246,351	45.4%	1.97
50-Year Storm Occurrence	Remove the probability of a 50-year storm		$699,086,594	-56.7%	1.29
Value of Time	25% Increase in Value of Time for Passenger Vehicles and Trucks		$2,056,596,779	27.3%	1.85
	25% decrease in Value of Time for Passenger Vehicles and Trucks		$1,174,859,184	-27.3%	1.48
Capital Construction Costs	25% increase in Construction Costs		$1,008,811,486	-37.6%	1.33
Crash Reduction Factor (CRF)	Increasing the CRF to 0.55		$1,648,451,214	2.0%	1.68
	Reducing the CRF to 0.45		$1,583,004,749	-2.0%	1.65

9.0 Summary of Benefits and Costs

Table 14 presents the benefits and costs of the project in 2022 dollars discounted.

Table 14: Summary of Benefits and Costs, Discounted

CY	Travel Time Savings	Emissions Cost Savings	Crash Cost Savings	Resiliency Cost Savings	Avoided Rehab-ilitation	Residual Values	Total Benefits	Total Capital Costs	Net Present Value
2023	$0	$0	$0	$0	$0	$0	$0	$167,958,624	-$167,958,624
2024	$0	$0	$0	$0	$0	$0	$0	$121,852,645	-$121,852,645
2025	$0	$0	$0	$0	$0	$0	$0	$472,755,171	-$472,755,171
2026	$0	$0	$0	$0	$0	$0	$0	$573,175,522	-$573,175,522
2027	$0	$0	$0	$0	$0	$0	$0	$555,941,341	-$555,941,341
2028	$0	$0	$0	$0	$0	$0	$0	$431,380,284	-$431,380,284
2029	$4,304,434	-$1,833,255	$14,649,161	$105,247,986	$0	$0	$122,368,326	$104,602,397	$17,765,929
2030	$4,861,879	-$1,825,930	$14,337,104	$107,440,576	$18,944,303	$0	$143,757,931	$0	$143,757,931
2031	$5,381,910	-$1,821,672	$14,031,694	$109,215,528	$0	$0	$126,807,461	$0	$126,807,461
2032	$5,866,274	-$1,800,494	$13,732,790	$110,840,028	$0	$0	$128,638,598	$0	$128,638,598
2033	$6,316,644	-$1,789,627	$13,440,254	$110,986,588	$0	$0	$128,953,858	$0	$128,953,858
2034	$6,734,627	-$1,768,991	$13,153,949	$110,413,951	$0	$0	$128,533,536	$0	$128,533,536
2035	$7,121,764	-$1,745,364	$12,873,743	$109,775,411	$61,797,214	$0	$189,822,768	$0	$189,822,768
2036	$7,479,531	-$1,767,503	$12,599,506	$109,075,446	$0	$0	$127,386,979	$0	$127,386,979
2037	$7,809,345	-$1,794,744	$12,331,111	$108,318,329	$0	$0	$126,664,040	$0	$126,664,040
2038	$8,112,563	-$1,808,590	$12,068,433	$107,508,129	$0	$0	$125,880,535	$0	$125,880,535
2039	$8,390,487	-$1,827,553	$11,811,351	$106,648,723	$0	$0	$125,023,007	$0	$125,023,007

CY	Travel Time Savings	Emissions Cost Savings	Crash Cost Savings	Resiliency Cost Savings	Avoided Rehab-ilitation	Residual Values	Total Benefits	Total Capital Costs	Net Present Value
2040	$8,644,363	-$1,851,589	$11,559,745	$105,743,802	$2,792,042	$0	$126,888,362	$0	$126,888,362
2041	$8,875,387	-$1,868,456	$11,313,498	$104,796,880	$0	$0	$123,117,309	$0	$123,117,309
2042	$9,084,702	-$1,890,365	$11,072,498	$103,811,301	$0	$0	$122,078,137	$0	$122,078,137
2043	$9,273,406	-$1,905,169	$10,836,631	$102,790,247	$0	$0	$120,995,115	$0	$120,995,115
2044	$9,442,549	-$1,924,976	$10,605,789	$101,736,741	$0	$0	$119,860,103	$0	$119,860,103
2045	$9,593,137	-$1,937,759	$10,379,864	$100,653,658	$0	$0	$118,688,900	$0	$118,688,900
2046	$9,726,132	-$1,965,773	$10,158,751	$99,543,729	$0	$0	$117,462,839	$0	$117,462,839
2047	$9,842,456	-$1,993,039	$9,942,349	$98,409,547	$0	$0	$116,201,314	$0	$116,201,314
2048	$9,942,992	-$2,019,555	$9,730,557	$97,253,575	$0	$0	$114,907,570	$0	$114,907,570
2049	$10,028,584	-$2,039,379	$9,523,276	$96,078,149	$0	$0	$113,590,630	$0	$113,590,630
2050	$10,100,039	-$2,064,400	$9,320,411	$94,885,483	$0	$0	$112,241,533	$0	$112,241,533
2051	$10,158,131	-$2,082,757	$9,121,867	$93,677,676	$0	$0	$110,874,918	$0	$110,874,918
2052	$10,203,598	-$2,100,394	$8,927,553	$92,456,719	$0	$0	$109,487,476	$0	$109,487,476
2053	$10,237,147	-$2,117,316	$8,737,378	$91,224,492	$0	$0	$108,081,701	$0	$108,081,701
2054	$10,259,454	-$2,110,099	$8,551,254	$89,982,778	$0	$0	$106,683,387	$0	$106,683,387
2055	$10,271,164	-$2,102,347	$8,369,094	$88,733,262	$0	$0	$105,271,173	$0	$105,271,173
2056	$10,272,895	-$2,094,084	$8,190,816	$87,477,535	$0	$0	$103,847,161	$0	$103,847,161
2057	$10,265,236	-$2,085,334	$8,016,335	$86,217,100	$0	$0	$102,413,336	$0	$102,413,336
2058	$10,248,749	-$2,076,117	$7,845,570	$27,779,243	$0	$473,068,517	$516,865,963	$0	$516,865,963
Total	**$258,849,580**	**-$58,012,630**	**$327,232,328**	**$2,958,722,610**	**$83,533,559**	**$473,068,517**	**$4,043,393,965**	**$2,427,665,984**	**$1,615,727,982**