Benefit-Cost Analysis Supplementary Documentation

BUILD Grant Program

Altus Economic Loop

City of Altus

May 18, 2020

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Benefit-Cost Analysis Supplementary Documentation

1. 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. A qualitative discussion is also provided when a benefit is anticipated to be generated but is not easily monetized or quantified.

The Project for which this BUILD grant is requested is the Altus Economic Loop Project (the Project) located in the City of Altus, Jackson County, Oklahoma. The Project entails extensive improvements and upgrades to approximately 6 miles of existing roadways west of central Altus to create a bypass, or a loop, as an alternative route to US-283 through downtown Altus while also improving freight access to businesses and land development opportunities.

The existing loop route is a series of city and county-maintained roads that are in poor condition and are well beyond their design life, below current engineering standards, and not suitable to carry large volumes of heavy truck traffic. In addition, the road frequently experiences flooding due to flat grades that hinder the drainage of stormwater runoff. According to Jackson County maintenance records, in the last few years flooding occurred on average six times per year and resulted in road closures to traffic for several days.

The proposed Project includes three components which are interconnected and necessary to realize full benefits of the Project. The components include the following:

- A 22-acre (1,600 x 600 feet) stormwater facility, or a detention pond, designed to accommodate the 100-year storm event, a necessary first step to prevent flooding of the future roadway.
- Altus Economic Loop Phase 1, consisting of improvements to approximately 1 mile of Ridgecrest Road from US-283 west to Carver Road, and 2 miles of Carver/Market Roads north to Bradford Avenue.[1]
- Altus Economic Loop Phase 2, consisting of improvements to approximately 2 miles of Market Road north from Bradford Avenue to Heritage Road, and 1 mile of Heritage Road (CR E1610) east to US-283, completing the loop.

A table summarizing the changes expected from the Project, and the associated quantified benefits, is provided below.

[1] Note that south of US-62 the road is known as Carver Road. North of US-62 it is Market Road.

Table ES- 1. Summary of Project Infrastructure Improvements and Associated Quantified Benefits

Current Status or Baseline & Problems to be Addressed	Changes to Baseline / Alternatives	Type of Impacts	Population Affected by Impacts	Economic Benefit/Impact	Benefit Value, $ Millions
Ridgecrest Road, Carver Road, and Market Road are currently city/county roads in western part of Altus. The roads are in poor condition, well beyond their design life, well below current engineering standards and not suitable to carry large volumes of heavy trucks. In addition, the roads frequently experience flooding due to storm water drainage issues. This hinders freight access to existing businesses and development opportunities for vacant parcels. At the same time, US-283 through downtown Altus experiences heavy congestion with approximately 25% truck share that negatively affect public safety and perceptions of the quality of life.	The proposed Project (the Economic Loop) entails extensive improvements and upgrades to Ridgecrest Road, Carver Road, and Market Road as well as construction of a storm water facility (the Detention Pond) that would significantly reduce the risk of flooding. This is expected to increase the quality and reliability of travel and increase operating speed (posted speed limit will be increased). The improved road will also offer an alternative route with travel time savings to some through auto and truck trips on US 283 currently travelling through downtown Altus. Reduced traffic in downtown Altus will help improve public safety and quality of life in this part of the City.	Safety: reduction in number of crashes in downtown Altus due to diversion of some traffic to the Economic Loop	Auto Users, Truck Operators, residents living in or visiting downtown Altus	Reductions in fatalities, injuries, and property losses, reduction in accident costs on highway segment.	$10.2
		Economic Competitiveness: Travel time savings due to improved driving conditions on the Economic Loop and traffic diversion from congested downtown Altus	Auto Users, Truck Operators	Travel time savings to no Build and Build motorists diverting to the Economic Loop.	$8.9
		Economic Competitiveness: impact on travel times and vehicle operating costs due to avoidance of flooding and traffic detours	Auto Users, Truck Operators,	Travel time savings and vehicle operating cost savings to existing users of the Economic Loop.	$0.9
		Agency Cost Savings / State of Good Repair	City of Altus	Saving in costs of road repair and rehabilitation that would need to be incurred in the absence of this Project.	$2.2
		Residual Value of Project Assets	City of Altus	Value of investment remaining at the end of analysis period	$0.9

Note: All monetary values in the table above are in millions of 2018 discounted using a real discount rate of 7 percent.

The period of analysis used in the estimation of benefits and costs is 35 years, including approximately 5 years of project development and construction and 30 years of operation. Total project development and construction costs are estimated at $19.9 million in 2020 dollars. For the purpose of this BCA, the costs were de-escalated to 2018 dollars using the GDP deflator. The total (undiscounted) Project costs adjusted in this way are estimated at $19.1 million. Incremental operations and maintenance are $2 million.

All relevant data and calculations used to derive the benefits and costs of the Project are shown in the BCA model that accompany this grant application. Based on the analysis presented in the rest of this document, using a real discount rate of 7 percent, the Project is expected to generate $23 million in benefits, $15.2 million in capital costs, and $0.4 million in operations and maintenance costs. Therefore, the Project is expected to generate a Net Present Value of $7.5 million and a Benefit-Cost (BC) ratio of 1.5 as shown below in the table below. Using a real discount rate of 3 percent, the net present value of the Project is $31.4 million and the BC ratio is 2.8.

Table ES- 2: Summary of BCA Outcomes, in Millions of Dollars of 2018*

Project Evaluation Metric	Undiscounted	Present Value at 7% Discount Rate	Present Value at 3% Discount Rate
Total Benefits	$98.0	$23.0	$49.6
Total O&M Costs	$2.0	$0.4	$1.0
Total Capital Costs	$19.1	$15.2	$17.3
Net Present Value	$76.9	$7.5	$31.4
Benefit / Cost Ratio	5.0	1.5	2.8
Internal Rate of Return (%)	10.1%		

**Unless indicated otherwise*

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

- Economic Competitiveness: Contribution to local economic development and growth. Improved infrastructure will enhance the opportunities for continued growth related to the growing, processing and shipping of cotton in the region. Examples of potential cotton related developments include cotton seed oil plant, distribution and warehousing centers for cotton as well as other essentials such as fertilizer and chemicals, sales of equipment and equipment repairs, textile mill and manufacturing. The Economic Loop will also have the advantage of easy access to existing rail infrastructure. In addition, the area is located ¾ mile from Altus Municipal Airport offering opportunities for the development of aviation related industries, or industries relying on air freight transportation. The City of Altus has an available facility that is suitable for manufacturing, air freight warehousing, and cargo. It should also be pointed out that the Economic Loop will be located in an area that has already experienced traffic related growth (with a new Hampton Inn hotel and Applebee's Restaurant) which is expected to continue. Diversion of trucks away from downtown will also create opportunities for businesses that support the trucking industry.
- Quality of Life: Increase in quality of life to residents and visitors in downtown Altus. Diversion of traffic, in particular heavy trucks, away from downtown Altus will reduce congestion and crash exposure. This, in turn, will increase public safety, or perceptions of

it, to downtown residents and visitors. Access to downtown businesses including government, shopping, and restaurants will be improved with the removal of heavy trucks from the highway. With US-283 carrying a higher percentage of local traffic in the future, it will function more as "Main Street" than a through highway, improving quality of life for residents.

- Environmental Protection: Reduction in environmental emissions in downtown Altus. Diversion of some autos and trucks from downtown Altus to the Economic Loop will reduce idling at traffic signals and air pollution in a congested urban area where there may be many people exposed to it and transfer it to an area with rural characteristics and small population. The Project also mitigates flood risk and provides a system to control stormwater. This allows stormwater to be contained and released at a controlled rate, reducing flooding and improving water quality. Agricultural and developed lands will be better protected, and the Economic Loop roads will have enhanced resiliency.

2. Introduction

This document provides detailed technical information on the economic analyses conducted in support of the grant application for the Altus Economic Loop Project. The remainder of this document is organized as follows.

- Section 3, Methodological Framework, introduces the conceptual framework used in the BCA.
- Section 4, Project Overview, provides a summary 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 Project is expected to generate.
- Section 5 discusses the general assumptions used in the estimation of Project costs and benefits.
- Section 6, Demand Projections, provides estimates of travel demand and traffic growth in the Project Area.
- Section 7, Benefits Measurement, Data and Assumptions, outlines specific data elements and assumptions pertaining to the long-term outcome selection criteria along with associated benefit estimates.
- Section 8, Summary of Findings and BCA Outcomes presents estimates of the Project's Net Present Value (NPV), its Benefit/Cost (BC) ratio, and other Project evaluation metrics.
- Section 9, BCA Sensitivity Analysis, provides the results of the sensitivity analysis. Note that additional data tables are provided within the BCA model including annual estimates of benefits and costs to assist the U.S. Department of Transportation (USDOT) in its review of the application.[2]

[2] While the models and software themselves do not accompany this appendix, they are provided separately as part of the application.

3. Methodological Framework

The BCA conducted for this Project includes the monetized benefits and costs measured using USDOT guidance, 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.[3]

While BCA is just one of many tools that can be used in making decisions about infrastructure investments, USDOT believes that it provides a useful benchmark from which to evaluate and compare potential transportation investments.[4]

The specific methodology adopted for this application is based on the BCA guidance developed by USDOT and is consistent with the BUILD program guidelines. In particular, the methodology involves:

- Establishing existing and future conditions under the build and no-build scenarios;
- Assessing benefits with respect to the selection criteria identified in the Notice of Funding Opportunity (NOFO);
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using USDOT guidance for the valuation of travel time savings, safety 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 rates recommended by USDOT (7 percent, and 3 percent for sensitivity analysis); and
- Conducting a sensitivity analysis to assess the impacts of changes in key input assumptions.

4. Project Overview

4.1 Project Description, Current Conditions and Challenges

The Altus Economic Loop Project (the Project) is located in the City of Altus, Jackson County, Oklahoma. The Project includes improvements to approximately 6 miles of existing roadways west of central Altus to create an alternative route to US-283 through downtown Altus and enhance economic development.

The purpose of the Project is to reduce pass-through traffic in downtown Altus, in particular heavy truck traffic – currently estimated at 20 percent or more (depending on road segment). This reduction will improve public safety and reduce congestion while also improving freight access to local businesses and reliability of freight transportation. The Project intersects a federal economic

[3] USDOT, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020.
[4] Ibid.

opportunity zone with various agricultural production and warehousing facilities and development lands located near the route. The Project is thus also intended to improve freight access to these businesses and stimulate future economic development.

The existing route is a series of city/county-maintained roads that are now well beyond their design life, below current engineering standards, and not suitable to carry large volumes of heavy truck traffic. Approximately two miles of the proposed loop route consist of gravel paving rather than asphalt or concrete. The remaining four miles of paved road are in poor condition, with widespread cracking and potholing. Even though the posted speed limit on the road is 40 mph, traffic observations and historic data from Google Maps show that vehicles typically do not travel at speeds higher than 35 mph because of poor road conditions.

In addition, the road frequently experiences flooding due to flat grades that hinder the drainage of stormwater runoff. According to Jackson County maintenance records, in the last few years the road that is the subject of this Project experienced flooding on average six times per year to the point that it needed to be closed to traffic for several days.

The proposed Project includes three components which are interconnected and necessary to realize full benefits of the Project. The components include the following:

- A 22-acre (1,600 x 600 feet) stormwater facility, or a Detention Pond, designed to accommodate the 100-year storm event, a necessary first step to prevent flooding of the future roadway.
- Altus Economic Loop Phase 1, consisting of improvements to approximately 1 mile of Ridgecrest Road from US-283 west to Carver Road, and 2 miles of Carver/Market Roads north to Bradford Avenue.[5]
- Altus Economic Loop Phase 2, consisting of improvements to approximately 2 miles of Market Road north from Bradford Avenue to Heritage Road, and 1 mile of Heritage Road east to US-283, completing the loop.

Roadway improvements (Phase 1 and 2) include reconstruction of the existing pavement to two 12-foot driving lanes with 3-foot outside shoulders and 4-foot drainage slopes. Curb and gutter will be provided near existing at-grade railroad crossings and at the approaches to the US-62 intersection. Concrete pads will be provided at all of the railroad crossings to improve drainage, safety, and long term performance of the crossings. The proposed pavement sections consists of a stabilized subgrade, aggregate base, and 5-inch asphalt to accommodate heavy truck traffic. The new roadway will have a speed of limit of 45 miles per hour (mph) after completion, compared to 40 mph today.

The proposed improvements will help divert pass-through traffic from downtown Altus, including heavy truck traffic, and stimulate economic developent opportunities along the route by improving freight access to existing businesses and creating more attractive access to existing parcels for additional development.

[5] Note that south of US-62 the road is known as Carver Road. North of US-62 it is Market Road.

4.2 Base Case and Alternative

The Base Case for the Altus Economic Loop Project is defined as the No-Build scenario. The No-Build scenario reflects the continuation of current conditions. The auto and truck traffic through central Altus will continue at relatively high volumes with a large heavy truck component while Carver and Market Road will remain relatively underutilized with some unrealized economic potential due to the poor/deteriorating condition of the current roads.

The Build scenario assumes that the Carver and Market Road will be reconstructed as planned and discussed above (including the Detention Pond), improving freight access to existing businesses located in Altus west of US-283, providing an incentive to future economic development along Market Road, and providing an alternative transportation route to pass-through traffic compared to congested downtown Altus streets.

4.3 Types of Impacts

The Altus Economic Loop Project is expected to generate the following impacts:

- Safety benefits due to diversion of some traffic from US-283 in downtown Altus to the improved and less congested Altus Economic Loop.
- Travel time savings to auto and truck traffic diverting from US-283 around downtown Altus to the Altus Economic Loop roads.
- Travel time savings to existing traffic on the Economic Loop roads due to improved pavement surface, widths, and increased speed limit.
- Reduced risks of road flooding and avoidance of corresponding detours and travel time costs after construction of the detention pond.
- Improvement in the state of repair of roads on the Economic Loop and avoidance of future costs of resurfacing and repairs
- Improved access to existing and future businesses located along the Economic Loop.

4.4 Project Cost and Schedule

Total future Project development and construction costs are estimated at $19.9 million in 2020 dollars. For the purpose of this BCA, all costs were de-escalated to 2018 dollars using the GDP deflator.[6] The adjusted cost is $19.1 million in 2018 undiscounted dollars and $15.2 million discounted at 7%. Design and environmental process work related to the Detention Pond will begin later this year. Construction of the pond and the roadway will start in July 2021 and will be completed in May 2024. Over the Project life-cycle, total operations and maintenance costs

[6] The adjustment amounted to dividing 2020 costs by the deflator index of 1.0395 based on the GDP deflator for the years 2018 – 2020 (Office of Management and Budget of the White House, Table 10.1, https://www.whitehouse.gov/omb/historical-tables/)

(including pond maintenance as well as road resurfacing every 10 years and rehab in year 24 and 30) are estimated at $0.4 million discounted at 7%.

Table 1. Summary of Costs, 2018 Dollars (Millions)

	Over the Project Lifecycle		
	In Constant Dollars	Discounted at 7 Percent	Discounted at 3 Percent
Construction & Development Costs	$19.1	$15.2	$17.3
Operations and Maintenance	$2.0	$0.4	$1.0
Total	**$21.1**	**$15.6**	**$18.2**

4.5 Effects on Selection Criteria

The main benefit categories associated with the Project are mapped into the selection criteria set forth by USDOT in the Notice of Funding Opportunity in the table below.

Table 2. Benefit Categories and Expected Effects on Selection Criteria

Selection Criteria	Benefit or Impact Categories	Description	Monetized	Qualitative
Safety	Reduction in number of traffic crashes, fatalities and injuries	Reduction in property losses, injuries, and deaths due to diversion of some traffic from downtown Altus to less congested roads.	Yes	Yes
State of Good Repair	Reconstruction of a deficient road	Reconstruction of a deficient road to update it to modern engineering standards.	Yes	Yes
Economic Competitiveness	Travel time savings due to diversion to Economic Loop	Travel time savings to roadway users diverting from congested downtown Altus to less congested roads on the Economic Loop.	Yes	
	Travel time savings due to higher speed on Economic Loop	Travel time savings to existing road users due to improved driving conditions and increased speed limit.	Yes	
	Travel time savings due to reduced risk of floods	Travel time savings and travel costs savings to existing motorists due to avoided floods and detours.	Yes	
	Contribution to local economic development and growth	The Project will improve freight access to existing and future businesses and development lands.		Yes
Quality of Life	Impacts on overall traffic in downtown Altus	The Project will help divert some traffic from congested downtown Altus which may help improve the perceptions of safety and livability in the city.		Yes

Selection Criteria	Benefit or Impact Categories	Description	Monetized	Qualitative
Environmental Protection	Impacts on vehicle emissions in downtown Altus	The Project will help divert some traffic from congested downtown Altus and reduce vehicle emissions in densely populated areas.		Yes

5. General Assumptions

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

The monetized benefits and costs are estimated in 2018 Dollars with future dollars discounted in compliance with BUILD requirements using a 7 percent real rate, and sensitivity testing at 3 percent.

The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are expressed in 2018 dollars;
- The period of analysis begins in 2020 and ends in 2054. It includes project development and construction years (2020 – 2024) and 30 years of operations (2025 – 2054);
- A constant 7 percent real discount rate is assumed throughout the period of analysis. A 3 percent real discount rate is used for sensitivity analysis;
- Opening year benefits are inputs to the BCA and assumed to be fully realized in the first year of full operations after construction is finished in 2025 (no ramp-up); and
- Unless specified otherwise, the results shown in this document correspond to the effects of the Full Build alternative, construction of Altus Economic Loop with three Project components as outlined in Section 4.1.

6. Demand Projections

The traffic forecast is a critical component of the benefit-cost analysis as many benefits depend on the number of vehicles using the Project area roads under No-Build and Build scenarios.

For the Altus Economic Loop Project, the relevant roads include the Economic Loop itself as well as downtown Altus roads from which some vehicles would be expected to divert to the Economic Loop, including US-283 and US-62.

Current traffic volumes for 2020 and 2045 forecasts are shown in the table below for both No-Build and Build conditions. 2045 No-Build forecasts represent existing growth trends and developments expected to take place even in the absence of the Project. Build forecasts represent the No-Build plus diversions from downtown roads.

Existing year average daily traffic volumes and truck composition on area roads within Altus were obtained from ODOT. Turning movements at Economic Loop and major US-283 intersections as well as mid-block demand were estimated based on daily control counts and relative development

density. To develop 2045 traffic volumes, a background growth rate of approximately 2% on US-283 and 1% on other area roads was calculated from the ODOT data. This annual rate was applied to the 2020 data in addition to specific trip generation along the current loop roads (50 acres of industrial/manufacturing, agriculture-related retail, and hotel, restaurant, and car sales land uses). Table 3 provides the No-Build traffic volumes. As shown, US-283 traffic volumes will grow from approximately 12,000 vehicles per day to nearly 19,000 vehicles per day in central Altus by 2045 without the improved Economic Loop.

For the Build condition, the 2020 existing and 2045 No-Build data was diverted using origin-destination pairs that offered an anticipated travel time advantage. Current travel time information from Google was used as an estimate and indicated that travel time advantages would exist for trips on US-283 traveling the duration of the loop or to the Tamarack Road area as well as trips using US-62 from west Altus to areas both north and south of downtown Altus (see Table 5 for detailed estimated travel time savings)**.** For the Economic Loop, an average free-flow travel speed of 50 mph was estimated due to the improved facility, lack of intervening driveways, and absence of congestion.

Table 3. Traffic Projections for Project Area

Road Segment	No Build		Build	
	2020	2045	2020	2045
Economic Loop				
Ridgecrest west of US 283	700	1,720	2,170	4,920
Carver Road between Ridgecrest and US 72	800	1,220	2,270	4,900
West Loop between US 62 and Bradford	1,800	2,910	3,490	7,440
West Loop between Bradford and Tamarack	1,600	3,230	3,160	7,500
West Loop north of Tamarack	200	770	1,050	3,890
US 283				
Between US 62 and Ridgecrest	7,400	12,510	5,930	8,830
Between US 62 and Bradford	12,000	18,920	10,450	14,590
Bradford to Tamarack	11,600	18,090	10,040	13,820
North of Tamarack	9,200	16,060	8,350	12,940
US 62				
East of US 283	7,800	10,100	7,300	9,270

Traffic volumes for the years between 2020 and 2045 were interpolated while traffic beyond 2045 was extrapolated assuming the same continuing rate of growth.

Truck share on the Project area roads varies by segment and over time but in general will be quite high. On the Economic Loop road segments, the truck share varies between 20 percent and 42 percent. On the Altus downtown segments, the truck share varies between 15 percent and 22 percent. The Economic Loop was assumed to attract both truck and passenger car trips due to the anticipated travel time advantage.

7. Benefits Measurement, Data and Assumptions

This section describes the measurement approach used for each quantifiable benefit or impact category identified in Table 2 and provides an overview of the associated methodology, assumptions, and estimates.

7.1 Safety Benefits Impacts

Quantified safety benefits include reduction in expected number of collisions due to diversion of some traffic away from US-283 and US-62 in downtown Altus to the Economic Loop roads.[7]

Collision rates on US-283 in the study area are more than three times as common as the statewide rate for similar roads. Over the years 2008 to 2017, the number of collisions amounted to 1,052. In addition, US-62 features a collision rate 1.6 times the statewide rate for the segment just west of the Economic Loop to just east of US-283 (151 total collisions in 10 years). By comparison, the 6-mile Economic Loop has witnessed just 38 collisions over the same period. The Economic Loop features fewer stops and traffic signals and will have significantly less driveway/intersection conflict points and thus less collision exposure. A comparison of the existing collision rates is presented below:

- US-283 from south of Ridgecrest Drive to north of CR 1610: **598 collisions per 100 MVMT**
- US-62 from west of the Economic Loop to east of US 283: **480 collisions per 100 MVMT**
- Economic Loop (Ridgecrest/Carver/Market/CR 1610): **150 collisions per 100 MVMT**

The safety benefit is estimated for the VMT on US-283 and US-62 in downtown Altus that is reduced under the Build scenario compared to the No-Build scenario. The number of accidents expected for this traffic volume under No-Build is estimated using the current accident rate in downtown Altus. The number of accidents expected under Build for the Economic Loop is estimated using the state-wide average rate of 190 crashes per 100 MVMT for similar facilities, which is higher than the current rate of the Economic Loop but reflective of increased activity under the Build scenario. In both cases, the distribution of the number of accidents by severity is estimated on the basis of the actual distribution of accidents over the years from 2008 to 2017.

Safety benefits impacts were then estimated based on the number of accidents, by type, expected under No-Build versus the Build scenario and monetized using the social values of accident costs by type recommended by USDOT.

The assumptions used in the estimation of safety benefits are summarized in the table below.

Table 4. Assumptions Used in the Estimation of Environmental Protection Benefits

Variable Name	Unit	Value	Source
Social Costs of Accidents			US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, January 2020.
Fatality	$/Victim	$9,600,000	

[7] Under Build, safety is also likely to improve on the Economic Loop roads due to an improvement in the state of repair of those roads. These benefits are more difficult to quantify and are considered in this BCA qualitatively.

Variable Name	Unit	Value	Source
Injury	$/Victim	$174,000	
No Injury/ PDO	$/PDO Crash	$4,400	
Current Accident Rate in Project Area, US 283/US 62	Rate, number per 100 million VMT	597.83	Oklahoma Department of Transportation-Collision Analysis and Safety Branch.
State-wide Crash Rate	Number per 100m VMT	190.85	Oklahoma Department of Transportation
Distribution of Accidents by Severity	% of total		Calculated from ODOT collision data for study area over period 2008-2017
Fatal Accidents	% of total	0.10%	Calculated from ODOT collision data for study area over period 2008-2017
Incapacitating Injury	% of total	2.47%	
Non-Incapacitating Injury	% of total	5.70%	
Possible Injury	% of total	19.11%	
Property Damage Only	% of total	72.62%	
Number of injuries per injury accident	Number per event	1.40	Calculated from ODOT collision data for study area over period 2008-2017
Number of damaged vehicles PDO crashes	Number per event	1.59	California Department of Transportation, TASAS Unit, 2010 to 2013 average.

7.2 Economic Competitiveness

Economic Competitiveness criteria for BUILD grants include impacts such as improving the efficiency of movements of goods and people leading to a reduction in the costs of doing business and burden of commuting as well as improvements in overall well-being.

The Altus Economic Loop Project is expected to have significant economic competitiveness impacts aligned with the above description of these merit criteria. The benefits quantified in this BCA can be grouped under two broad categories of impacts:[8]

(1) Travel time savings to existing and diverting users:

   a. Travel time savings to existing/No-Build users of Economic Loop roads due to improved driving conditions;

   b. Travel time savings to road users diverting to the Economic Loop roads under Build conditions; and

(2) Travel time and costs savings to existing/No-Build users of the Economic Loop roads due to avoided road flooding and resulting detours.

[8] The Project will also provide significant support to economic development and growth along the Economic Loop route. However, these benefits are more difficult to quantify and are considered here qualitatively.

Estimation of the above benefits is briefly discussed below. The table that follows provides the input assumptions.

Travel Time Savings to No-Build Users due to Improved Driving Conditions

Under the Build, the roads on the Economic Loop will be substantially reconstructed and upgraded to modern engineering standards with a pavement section capable of carrying the substantial heavy truck traffic, and consistent shoulders. Two miles of existing gravel roadway will be paved, and the speed limit will be increased from 40 mph to 45 mph. Faster speed allowed due to better road conditions will generate travel time savings to motorists. As stated earlier, poor road conditions on the Economic Loop roads currently limit the actual speed to no more than about 35 mph. On the other hand, it may be expected that on the improved road, motorists will drive somewhat faster than the posted speed limit of 45 mph. Therefore, this benefit is calculated as the difference in travel times on the Economic Loop roads at the speed of 35 mph versus 50 mph.[9] This benefit is then applied to the No-Build traffic volume to calculate total vehicle-hours of savings and multiplied by the value of time for autos and trucks to calculate the monetary value of travel time savings.

Travel Time Savings to Road Users Diverting to the Economic Loop under Build

Improved Economic Loop is expected to attract some motorists away from US-62 and US-283. Travel time savings to diverting traffic may differ depending on the origin and destination of the trips. These travel time savings were estimated directly for several combinations of origin-destination (OD) pairs. The resulting estimates of travel time savings by OD pair are applied to the corresponding OD pair volume diverting to the Economic Loop. This is then multiplied by the value of time for autos and trucks to calculate the monetary value of travel time savings to traffic diverting to the Economic Loop.

Travel Time Savings to No-Build Users due to Avoided Road Flooding

When the Economic Loop road segments are flooded, vehicles that would normally use that road are forced to take a detour incurring an additional travel time cost and vehicle operating cost. The road segment affected by frequent flooding is along Market Road between US-62 and Bradford Road. The detour route identified by the City of Altus is a loop along US-62 to US-283, then along US-283 to Bradford Road, and along Bradford Road back to the Economic Loop, a distance of about 3 miles. Based on Google maps, the travel time on this detour route is about 9 minutes, without traffic. This travel time is applied to the vehicle volume expected to traverse that road segment to calculate vehicle hours of detour travel avoided under Build. This is then multiplied by the value of time for autos and trucks to calculate the monetary value of detour travel time avoided. Vehicle

[9] The BCA was also conducted for a scenario that assumes the driving speed on the Economic Loop under Build equal to the speed limit of 45 mph. This scenario produces somewhat lower traffic volumes diverted to the Economic Loop with lower travel time savings. The results of this analysis (net present value and Benefit-Cost Ratio) are shown in Section 9 under sensitivity analysis.

operating costs avoided are then calculated on the basis of the detour route length and unit vehicle operating costs recommended by USDOT.

The specific assumptions are shown in Table 5 below.

Table 5. Assumptions Used in the Estimation of Economic Competitiveness Benefits

Variable Name	Unit	Value	Source
Driving Speed on Economic Loop Road	mph		
No Build		35	Observed typical driving speed; reduced below speed limit due to poor road conditions.
Build		50	Assumed typical free flow speed on the new route
Duration of flood and road closure	days per year	12	City of Altus. Flooding occurs on average 6 times a year with road closures for 2 days.
Detour Length under Flooding on Economic Loop	miles	3	City of Altus
Additional travel time to traffic unable to use Economic Loop due to flooding	min per mile per vehicle	9	Travel times based on Google over the detour route (US 62 - US 283 - Bradford), about 3 miles without traffic.
Travel Time Savings to Traffic Diverting to Economic Loop	Minutes per vehicle		Travel times estimated using Google travel times for current route and free flow speed plus turning/stop time penalties on Economic Loop Route
US 283/Ridgecrest to US 283/CR 1610		1.99	
US 283/Ridgecrest to US 283/Tamarack		1.99	
US 62/Carver Road to US 283/CR 1610		4.71	
US 62/Carver Road to US 283/Tamarack		4.71	
US 62/Carver Road to US 283/Bradford		2.68	
US 62/Carver Road to US 283/Ridgecrest		1.68	
Volumes of Traffic Diverting to Economic Loop, 2045	ADT		Traffic projections conducted for this Project; autos and trucks. Volumes for other years are shown in accompanying BCA model.
US 283/Ridgecrest to US 283/CR 1610		2,300	
US 283/Ridgecrest to US 283/Tamarack		1,730	
US 62/Carver Road to US 283/CR 1610		480	
US 62/Carver Road to US 283/Tamarack		170	
US 62/Carver Road to US 283/Bradford		190	
US 62/Carver Road to US 283/Ridgecrest		160	

Value of Travel Time			US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, January 2020.
Autos	$/h	$15.20	
Trucks	$/h	$29.50	
Average Vehicle Occupancy - Auto	persons per vehicle	$1.67	US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, January 2020.
Average Truck Share	%		Travel demand model.
Economic Loop Segments, Total Traffic		30.0%	
Traffic Diverting to Economic Loop		41.0%	
Vehicle Operating Costs	$/mile		US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, January 2020.
Auto		$0.41	
Trucks		$0.96	

7.3 Agency Costs Savings / State of Good Repair

The condition of the road segments on the proposed Economic Loop is poor. Pavement exhibits widespread cracking and potholing, in part due to the heavy truck traffic that utilizes the route. The segment between US-62 and Bradford Road experiences frequent flooding which causes additional stress on the road. In the absence of the Project, in the next few years all road segments will require extensive surface repairs and rehabilitation.

The City of Altus provided estimates of these costs over the next 30 years. The costs include chip and seal at $80,000 annually and major rehab every four years estimated at $392,270. Under the Build scenario, these costs represent effective cost savings to the City which will offset construction costs of the new road.

For the purpose of the BCA, these cost savings are assumed to begin in 2021. Each annual cost is converted to 2018 dollars using a GDP deflator.

7.4 Residual Value

The residual value of Project assets was calculated assuming a straight-line depreciation and Project life of 60 years. The residual value was added to Project benefits in the last year of the analysis period, i.e. in year 30.

8. Summary of Findings and BCA Outcomes

The tables below summarize the BCA findings. Annual costs and benefits are estimated over the lifecycle of the Project (from 2020 to 2054). As stated earlier, construction is expected to be completed in May 2024. Benefits accrue during the operation of the Project (over the years 2025-2054) as well as during Project construction in the form of savings on road repairs and rehabilitation costs.

Table 6 present the overall outcomes of the benefit-cost analysis with Project performance metrics.

Table 6. Overall Results of the Benefit Cost Analysis, Millions of 2018 Dollars*

Project Evaluation Metric	Undiscounted	Present Value at 7% Discount Rate	Present Value at 3% Discount Rate
Total Benefits	$98.0	$23.0	$49.6
Total O&M Costs	$2.0	$0.4	$1.0
Total Capital Costs	$19.1	$15.2	$17.3
Net Present Value	$76.9	$7.5	$31.4
Benefit / Cost Ratio	5.0	1.5	2.8
Internal Rate of Return (%)	10.1%		

**Unless indicated otherwise*

Considering all monetized benefits and costs, the estimated internal rate of return of the Project is 10.1 percent. With a 7 percent real discount rate, the $15.2 million investment would result in $23 million in total benefits, net present value of $7.5 million and a Benefit/Cost ratio of 1.5.

With a 3 percent real discount rate, the Net Present Value of the Project is $31.4 million, for a Benefit/Cost ratio of 2.8.

The table below compiles all Project benefits evaluated. The largest benefit component is reduction in accident costs which accounts for 44.3 percent of total benefits. Travel time savings account for 38.5 percent of total benefits while avoidance of detours due to flooding accounts for 3.7 percent of total benefits. Agency cost saving account for 9.4 percent, while residual value accounts for 4 percent of total benefits.

Table 7. Overall Benefits, Millions of 2018 Dollars

Benefit Categories	Over Project Lifecycle		
	Undiscounted	Present Value at 7% Discount Rate	Present Value at 3% Discount Rate
Travel Time Savings	$37.1	$8.9	$19.0
Avoidance of Detours due to Flooding	$3.2	$0.9	$1.7
Reduction in Accident Costs	$41.8	$10.2	$21.7
Costs Savings due to Project	$6.0	$2.2	$3.6
Residual Value	$9.9	$0.9	$3.5
Total Benefits	**$98.0**	**$23.0**	**$49.6**

9. BCA Sensitivity Analysis

The BCA outcomes presented in previous sections rely on a large number of 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 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 sensitivity analysis was conducted with respect to the value of travel time, value of statistical life, capital cost estimate, and driving speed on the Economic Loop roads.

The outcomes of this analysis are presented in the table below. The table provides new NPV associated with variations in variables or parameter assumptions (listed in row), percentage change in NPV, as well as the new BC ratio.

For all scenarios examined, the BC ratio remains well above 1. In particular, when the driving speed on the Economic Loop is reduced from 50 mph to the speed limit of 45 mph, NPV remains positive and BC ratio equals 1.2.

Table 8. Quantitative Assessment of Sensitivity, Summary

Parameters	Change in Parameter Value	New NPV	% Change in NPV	New BC Ratio
Value of Travel Time	Lower Bound of Range Recommended by US DOT ($10.63 for autos and $23.58 for trucks)	$5.5	-26.6%	1.4
	Upper Bound of Range Recommended by US DOT ($18.17 for autos and $35.42 for trucks)	$9.3	24.9%	1.6
Value of Statistical Life	Lower Bound of Range Recommended by US DOT ($5.4 million)	$6.7	-9.6%	1.4
	Upper Bound of Range Recommended by US DOT ($13.4 million)	$8.1	8.7%	1.5
Capital Cost Estimate	25% Reduction	$9.7	30.5%	1.8
	25% Increase	$5.2	-30.5%	1.3
Driving Speed on Economic Loop Roads under Build Scenario	Reduction from 50 mph to 45 mph	$3.06	-59.0%	1.2