Benefit-Cost Analysis Supplementary Documentation

2022 RAISE Grant Program

Reconnecting Neighborhoods in West Tulsa: W. 51st Street Extension Project

Oklahoma Department of Transportation

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Benefit-Cost Analysis Supplementary Documentation

1 Executive Summary

The Benefit-Cost Analysis (BCA) of this grant application compares the costs and benefits of the proposed investment project. To the extent possible, expected benefits were monetized. A qualitative discussion is presented for benefits that are more difficult to quantify.

The Reconnecting Neighborhoods in West Tulsa: W. 51st Street Extension Project (W. 51st Street Extension Project, or the Project) is located in Tulsa, Oklahoma, on the north side of the I-44 and US-75 interchange. The Project is in Census Tract 49, an Area of Persistent Poverty, Historically Disadvantaged Community, a designated Opportunity Zone, and a Priority Enterprise Zone.

Improvements to the I-44/US-75 interchange area are needed to address the growth occurring in the Tulsa metropolitan area as well as congestion and frequent collisions due to capacity constraints and obsolete design features. One of the challenges is maintaining and enhancing access, community connectivity, mobility, and safety for residents of local neighborhoods while making improvements to this major regional interchange. Some communities still face gaps in connectivity within their transportation networks.

As a part of proposed interchange improvements, the Oklahoma Department of Transportation (ODOT) proposes to reconstruct portions W. 51st Street and construct an underpass under US-75 connecting eastern and western parts of the roadway that were previously severed by US-75. The project will also implement other improvements and upgrades on W. 51st Street east of Union Avenue, including two 12-foot-wide concrete driving lanes (increased from 10'), curb and gutter, and sidewalks. In addition, the Project will include a pedestrian bridge over the Tulsa-Sapulpa Union (TSU) Railroad and a connection to the Arkansas River Trail. The Project will also include construction of new bridges on US-75 over W. 51st Street, as well as bridges on two ramps in the I-44/US-75 interchange needed to span the new W. 51st Street extension.

The Project will reconnect portions of W. 51st Street and the community bisected by the original construction of the highway. It will reduce distances for pedestrians and vehicular traffic, walk time and vehicle travel time on W. 51st Street for trips between locations on the east and west side of US-75 and facilitate the closure of local access ramps from I-44 to reduce peak-hour delays at intersections.

The Project will enhance the roadway network along W. 51st Street increasing mobility, comfort and safety for local non-motorized users, connectivity to amenities and destinations on both sides of US-75, such as grocery stores, local library, churches, transit network, and recreation areas around the Arkansas River Trail. This will increase transportation equity and accessibility for travelers in the historically disadvantaged communities in the area.

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

Table ES-1: Summary of 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 (2020$)
Improvements to the I-44/US-75 interchange area are needed to address the growth occurring in the Tulsa metropolitan area as well as congestion and frequent collisions in the corridor. One of the challenges is maintaining and enhancing access, community connectivity, mobility and safety for residents of local neighborhoods while making improvements to this major regional interchange. Some communities still face gaps in connectivity within their transportation networks.	ODOT proposes to reconstruct portions W. 51st Street and construct an extension under US-75 connecting eastern and western parts of the roadway as well as implementing other improvements and upgrades on W. 51st Street east of Union Avenue. The Project will reconnect portions of W. 51st Street and the community bisected by the original construction of the highway. It will reduce distances for pedestrians and vehicular traffic, walk time and vehicle travel time on W. 51st Street for trips between locations on the east and west side of US-75 and facilitate the closure of local access ramps from I-44 to reduce peak-hour delays at intersections. The Project will also enhance comfort and safety for pedestrians, connectivity to amenities and destinations on both sides of US-75, such as grocery stores, local library, churches, transit network, or recreation areas around the Arkansas River.	Economic Competitiveness: Travel time savings	Auto Users, Truck Operators	Travel time savings to local traffic due to shorter distances on W. 51st Street, improved traffic circulation, reduced delays at intersections	$13.1
		Economic Competitiveness: Vehicle operating cost savings	Auto Users, Truck Operators	Vehicle operating cost savings due to shorter distances on W. 51st Street, reduced delays at intersections/less fuel use	$2.0
		Economic Competitiveness: External highway use cost savings	Residents in the communities around W. 51st Street	Reduction in VMT, road congestion and noise.	$0.5
		Safety Benefits: Reduction in accident costs	Auto Users, Truck Operators, society	Reduction in number of crashes, injuries, property losses due to reduced VMT and roadway safety improvements	$2.7
		Quality of Life: Pedestrian Benefits	Residents in the communities around W. 51st Street; pedestrians, cyclists	Improved comfort and safety to pedestrians using W. 51st Street due to sidewalks and other improvements on W. 51st Street	$0.1
		Environmental Sustainability: Emissions costs savings	Residents of Tulsa	Reduced vehicle emissions and emissions costs due to shorter distances on W. 51st Street, reduced delays at intersections/less fuel use	$0.3
		Agency Costs Savings	City of Tulsa, ODOT	Savings in major rehab work that would have to be undertaken in Project absence.	$0.6
		Residual Value of Project Assets	City of Tulsa, ODOT	Value of investment remaining at the end of analysis period	$2.2

The period of analysis used in the estimation of benefits and costs is 21 years, including one year of project development and construction and 20 years of operations.[1] Total project development and construction costs are estimated at $19.98 million in 2022 dollars. For this BCA, costs were de-escalated to 2020 dollars using the GDP deflator. The total (undiscounted) project costs are estimated at $18.7 million.

All relevant data and calculations used to derive the benefits and costs of the project are shown in the BCA model that accompanies this grant application. Based on the analysis presented in the rest of this document, the Project is expected to generate $21.4 million in discounted benefits, $13.6 million in discounted capital costs, and maintenance costs of $0.2 million, using a 7 percent real discount rate. Therefore, the Project is expected to generate a Net Present Value of $7.6 million and a Benefit/Cost Ratio of 1.55 as shown below in Table ES- 1.

Table ES- 1: Summary of BCA Outcomes, in Millions of Dollars of 2020*

Project Evaluation Metric	Undiscounted	Present Value at 7% Discount Rate	Present Value at 3% Discount Rate
Total Benefits	$64.4	$21.4	$38.8
Total O&M Costs	$0.9	$0.2	$0.4
Total Capital Costs	$18.7	$13.6	$16.3
Net Present Value	$44.8	$7.6	$22.1
Benefit / Cost Ratio	3.40	1.55	2.36
Internal Rate of Return (%)	12.1%		

Note: *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:

- Improved mobility and community connectivity. By reconnecting the bisected neighborhood along W. 51st Street and improving W. 51st Street itself, the Project will improve access to amenities on both sides of US-75 such grocery stores, local library, churches, parks, and Arkansas River Trail which provides further connection to Turkey Mountain Urban Wilderness area. After the connection under US-75 is completed, many pedestrians will experience shorter walking distances and walking times to these destinations. The Project will also improve transit travel times for routes passing the area and connections to other transit routes west of US-75 which will benefit transit users in the Project area. Improved mobility of area residents can then be expected to reduce barriers to opportunities more generally, including barriers to education and employment.
- Increased transportation choices. The area lacks a connected sidewalk network connecting its residents to a variety of destinations. By providing a safer and shorter pedestrian connection, the Project will increase transportation choices for non-motorized travelers.
- State of good repair and resiliency. The Project involves reconstruction of an existing road upgrading it to today's engineering standards. The new roadway will also include a new

[1] Sensitivity analysis also considered an evaluation period with 30 years of Project operations. The results of this analysis (for Project NPV and BC ratio) are reported in Section 8 while the BCA spreadsheet model submitted with this application contains full results.

enclosed storm drain system resulting in improved stormwater management and will contribute to improved resiliency of the transportation network.

2 Introduction and Methodological Framework

This document provides detailed technical information on the benefit-cost analysis (BCA) conducted in support of the grant application for the W. 51st Street Extension project.

The BCA 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.[2]

While a 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.[3]

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

- Establishing existing and future conditions under the build and no-build scenarios;
- Assessing benefits with respect to project requirements listed in RAISE Notice of Funding Opportunity (NOFO) document
- 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, and safety benefits, while relying on industry best practices for the valuation of other effects;
- Discounting future benefits and costs with the real discount rate recommended by USDOT (7 percent, except for carbon dioxide which should be discounted at 3 percent); and
- Conducting a sensitivity analysis to assess the impacts of changes in key input assumptions.

The remainder of this document is organized as follows.

- Section 3, 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 4, General Assumptions, discusses the estimation of project costs and benefits.
- Section 5, Demand Projections, provides estimates of travel demand and traffic growth in the Project Area.
- Section 6, Benefits Measurement, Data and Assumptions, outlines specific data elements and assumptions pertaining to the long-term outcome selection criteria.

[2] USDOT, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 2022 Revised.
[3] Ibid.

- Section 7, Summary of Findings and BCA Outcomes, presents estimates of the project's benefit estimates, net present value (NPV), its benefit-cost ratio (BCR), and other project evaluation metrics.
- Section 8, 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 and the prepared BCA.[4]

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

3 Project Overview

3.1 Project Description, Current Conditions and Challenges

The Reconnecting Neighborhoods in West Tulsa: W. 51st Street Extension Project (W. 51st Street Extension Project, or the Project) is located in Tulsa, Oklahoma, on the north side of the I-44 and US-75 interchange. The project is located within Census Tract 49 in Tulsa County. According to guidance provided by USDOT, this tract meets both the definition of an Area of Persistent Poverty and a Historically Disadvantaged Community. Census Tract 49 is also a designated Opportunity Zone and a Priority Enterprise Zone.

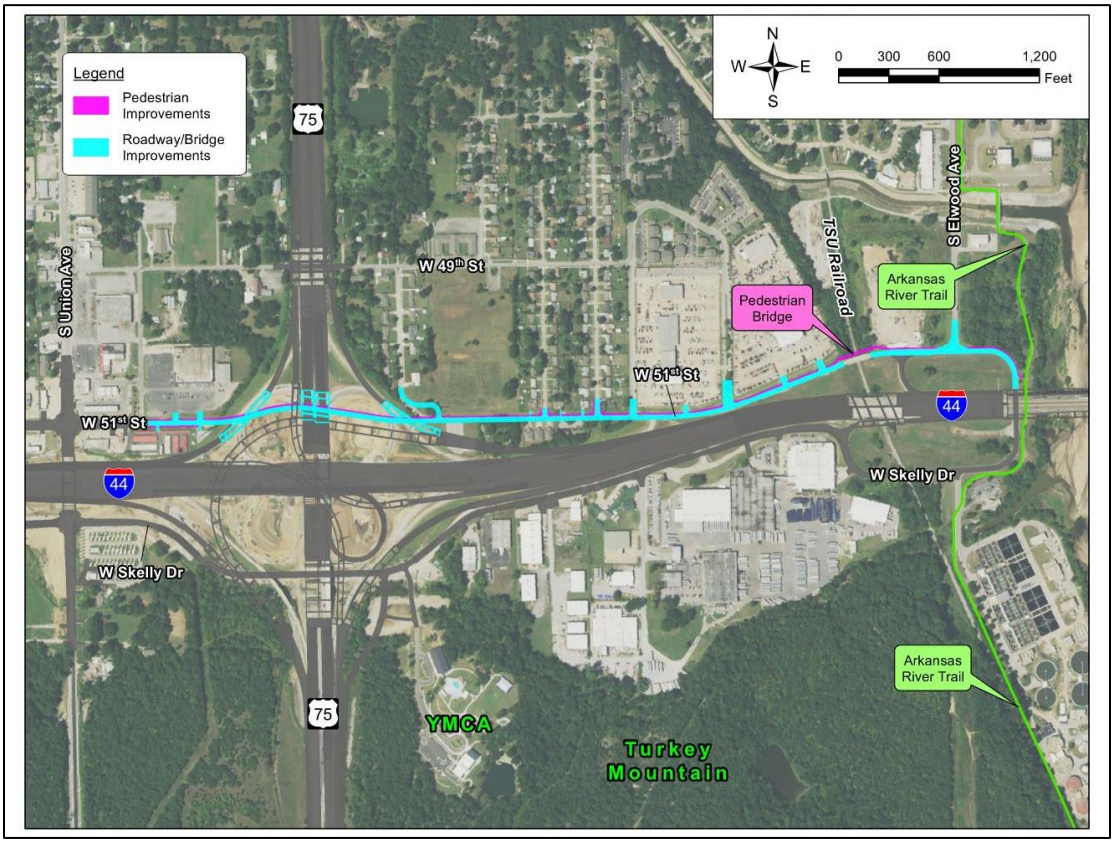
As a part of proposed improvements to that interchange, Oklahoma Department of Transportation (ODOT) proposes to construct an extension of W. 51st Street under US-75, thereby reconnecting portions of a community bisected by the original construction of the highway and providing additional transportation choices to the residents of these underserved communities. The proposed extension of W. 51st Street has been part of the plan to improve the interchange since ODOT's original corridor study of US-75 in the late 1990s. As the project has advanced through preliminary engineering and public involvement, ODOT has enhanced the non-motorized aspects of the Project, including sidewalks with lighting, a pedestrian bridge over the TSU Railroad, and a connection to the Arkansas River trail system.

As shown in Figure 1**,** the proposed Project will reconstruct W. 51st Street under US-75, from east of S. Union Avenue east approximately 1 mile to W. Skelly Drive at the Arkansas River. The W. 51st Street roadway will have two 12-foot-wide concrete driving lanes, curb and gutter, and a 7-foot-wide concrete sidewalk (5-foot regular sidewalk and 2-foot decorative strip) on the north side. Sidewalk will also be included on the south side of W. 51st Street west of US-75. In addition to the sidewalk, active transportation improvements will include a separate pedestrian bridge over the Tulsa-Sapulpa Union (TSU) Railroad and a connection to the Arkansas River Trail. Connections to local streets and driveways will be reconstructed and maintained.

The project also includes construction of new bridges on US-75 over W. 51st Street, ramp consolidation to improve current safety issues, as well as new bridges on the southbound to westbound and westbound to northbound ramps in the I-44/US-75 interchange. These bridges are necessary to span the new W. 51st Street Extension.

Improvements to the I-44/US-75 interchange area are needed to address the growth occurring in the Tulsa metropolitan area as well as congestion and frequent collisions in the corridor. One of the challenges with this project is maintaining access, community connectivity, and mobility for local residents while making needed improvements to this major regional interchange. Improvements to the local street network around W. 51st Street will increase mobility, comfort and safety for local non-motorized users, increase connectivity, reduce walk or cycle distances and walk/cycle times to amenities and destinations on both sides of US-75, such as grocery stores, local library, or churches. This will encourage use of active transportation (or lower carbon emission) modes, and increase equity and accessibility for travelers in the historically disadvantaged communities in the area.

Figure 1. I-44/US-75 interchange and the proposed reconnection of W. 51st Street.



The Project will also reduce travel distances and travel time for traffic on W. 51st Street travelling between locations on the east and west side of US-75 while new bridges and ramps are expected to improve traffic flow around the interchange and reduce peak-hour delays at intersections.

3.2 Base Case and Alternative

The Base Case for the W. 51st Street Reconnection Project is defined as the "No Build" scenario. This scenario reflects the full construction of I-44 and US-75 mainline and ramp improvements but does not reflect the improvements and linkage of both ends of W 51st Street. With the ramp access consolidation planned as part of the interchange improvements, increased traffic volume would use the current W 49th Street underpass to flow across US-75.

The Alternative Case is defined as the Build scenario that also includes reconstruction of W. 51st Street.

3.3 Types of Impacts

The proposed Project is expected to have the following impacts:

- Reduction in travel times for automobiles and trucks from faster travel times and reduced delays at surrounding intersections;

- Reduction in vehicle operating costs due to reduced travel distances and reduced fuel used during intersection delays;
- Reduction in externalities arising from highway congestion and noise;
- Improved vehicle safety due to new traffic lights at stop-controlled intersections and reduced travel distances;
- Improved pedestrian comfort and safety due to new sidewalks;
- Improved mobility for pedestrians and cyclists (with reduced distances and walk/cycling times); and
- Reduction in emissions due to reduced travel distances, faster driving speeds, and reduced time spent idling during intersection delays.

3.4 Project Cost and Schedule

Total project capital development and construction costs are estimated at $19.98 million in 2022 dollars. For this BCA, costs were adjusted to 2020 dollars using a GDP deflator.[5] The adjusted project development and construction cost amounts then to $18.7 million in 2020 undiscounted dollars and $13.6 million discounted at 7 percent. Project construction is anticipated to start in 2024 and take about two years with completion by end of 2025. Therefore, 2026 is assumed as the Project opening year and first year of Project-related benefits.

The Project will require major maintenance every 5 years starting from 2030 estimated at $25,000 per year as well as major rehabilitation in 2040 estimated at $875,000 (all in 2022 dollars). In 2020 dollars, total maintenance and major rehabilitation costs are estimated at about $0.9 million undiscounted and $0.2 million discounted at 7 percent. Table 1 below provides a summary of costs.

Table 1: Summary of Project Costs Over Project Life-Cycle, Millions of 2020 Dollars

Cost Category	In Constant Dollars	Discounted at 7 Percent	Discounted at 3 Percent
Construction & Development Costs	$18.7	$13.6	$16.3
Operations and Maintenance	$0.9	$0.2	$0.4
Total	**$19.5**	**$13.8**	**$16.7**

3.5 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 2.

[5] The adjustment amounted to dividing 2022 costs by the deflator index of 1.071 based on the GDP deflator for the years 2020 – 2022 (Office of Management and Budget of the White House, Table 10.1, https://www.whitehouse.gov/omb/historical-tables/) (accessed April 4, 2022).

Table 2. Benefit Categories and Expected Alignment with Project Requirements

Merit Criteria	Benefits	Type of Impacts	Monetized or Qualitative
Economic Competitiveness	Travel Time Savings	Improved travel times due to a faster and shorter route for travel between the eastern and western sides of W. 51st Street compared to current/No-Build conditions.	Monetized
		Reduced peak-hour intersection delays in areas surrounding US-75 and I-44 interchange due to improved traffic flow.	Monetized
	Vehicle Operating Cost Savings	Reduced vehicle operating costs due to shorter travel distance after reconnecting east and west side of W. 51st Street.	Monetized
		Reduced fuel use and fuel costs due to reduction in peak-hour intersection delays (from reduced idling during delays).	Monetized
	External Highway Use Cost Savings	Reduced costs of local congestion and noise due to reduced VMT.	Monetized
Safety	Avoided Vehicle Accident Costs	Reduced crashes and accident costs due to reduced VMT and installation of traffic lights at a stop-controlled intersection.	Monetized
Quality of Life	Pedestrian Benefits	Improved pedestrian comfort, convenience, and safety due to installation of sidewalks on W. 51st Street	Monetized
Environmental Sustainability	Emission Cost Savings	Reduced emissions due to a faster and shorter route for travel between the eastern and western sides of W. 51st Street compared to current/No-Build conditions.	Monetized
		Reduced emissions due to reduced peak-hour intersection delays in areas surrounding US-75 and I-44 interchange.	Monetized
Quality of Life, Mobility, and Community Connectivity	Mitigating Physical Barriers	Improved access to amenities on both sides of US-75 such grocery stores, local library, churches, the YMCA, and parks by reconnecting the bisected neighborhood along W. 51st Street.	Qualitative
	Increased Transportation Choices	Increased accessibility for non-motorized travelers by providing a safer and shorter pedestrian and bicycle connection to a variety of destinations.	

4 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. [6]

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

- Input prices, costs, and benefits are expressed in 2020 dollars;
- The period of analysis begins in 2024 and ends in 2045. It includes two years of project development and construction in 2024 and 2025 and 20 years of operations (2026 – 2045);
- A constant 7 percent real discount rate is assumed throughout the period of analysis, except for benefits impacts related to greenhouse (GHG) emissions which are discounted at a 3 percent real discount rate. As a sensitivity test, project outcome results are also provided using a 3 percent real discount rate for all benefits and costs; and
- 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 2026 (no ramp-up).

[6] Sensitivity analysis also considered an evaluation period with 30 years of Project operations. This longer evaluation period for Project operating years may be relevant since the Project involves extensive reconstruction work. The results of this analysis (for Project NPV and BC ratio) are reported in Section 8 while the BCA spreadsheet model submitted with this application contains full results.

5 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. Current and future volumes were established for vehicular traffic and pedestrian traffic.

Vehicular Traffic

Because the Project will benefit primarily travel on W. 51st Street east and west of US-75, traffic volumes for this BCA were narrowed down to two sets of OD pairs as defined by their travel path towards Union Avenue: (1) W. 51st Street east of US-75 to Union Ave north of W. 49th Street, and (2) W. 51st Street east of US-75 to Union Ave south of W. 49th Street and west part of W. 51st Street. Current traffic volumes (at 2016 levels) and 2045 projections are shown in the table below. In the BCA, traffic volumes in the years between these two years were interpolated. The same traffic volume was assumed for the No-Build and Build scenarios, which reflects the local demand on W. 51st Street traveling across US-75 once the I-44 local access ramps are removed from the current collector-distributor system as part of the larger interchange project.

Table 3. Traffic Volumes on W. 51st Street, by Origin-Destination Pairs

Origin-Destination Pair	Average Daily Traffic (ADT)		Rate of Growth; Average Annual, Percent (%)	Share of Trucks
	2016	2045		Percent (%)
W. 51st Street East – Union Ave North	1,280	1,600	0.77%	8%
W. 51st Street East – Union Ave South & 51st Street West of US 75	3,520	4,160	0.58%	8%
Total	**4,800**	**5,760**	**0.63%**	**8.0%**

Source: Garver. Traffic volumes on W. 51st Street were derived in prior studies of the interchange for ODOT, including*: Interstate 44 from I-244 Junction to the Arkansas River Access Justification Report,* April 2020, https://oklahoma.gov/content/dam/ok/en/odot/federal-grants/infra/2021/i-44-us-75/reports-and-technical-info/access-justification-report.pdf.

Pedestrian Traffic

Data on pedestrian traffic is challenging to establish as it is not routinely collected by transportation agencies at the same detail and frequency as for vehicular traffic. An emerging practice entails using census data on the number of people who report walking as their transportation mode for work commuting. The project area is in Census Tract 49 (CT 49) which had a working-age population (16 years and over) of 709 in 2019. Of this population, 2.4 percent indicated walking as their commuting mode while 1.4 percent indicated transit. This implies 17 people who commute to work by walking and 10 people who take transit.

Recognizing that walk commuting captures walk trips for only one specific purpose, National Household Transportation Survey (NHTS) data is then used to extrapolate walk trips for other purposes such as recreation, or shopping and errands. The methodological idea behind this approach is that walk commuting accounts for a certain fixed percentage of total walk trips – therefore if we know this percentage estimate and the number of walk commuting trips, we can extrapolate the total number of walk trips. For example, Table 4 shows that nationally there were 2.52 billion walk trips to or from

work while total number of walk trips amounted to 38.9 billion. For each one work trip, there were 14.4 trips for other purposes, including 7.3 trips for recreation, 4.6 shopping and errand trips, and 1.6 trips to school or church across the nation.

Table 4: Patterns of Walk Trips in the United States, by Purpose

	To/From Work (Work trips)	Work-related Business	Shopping and Errands	School or Church	Social and Recreation	Other / Miscellaneous	Total Trips
Number of Trips (Millions)	2,523	510	11,496	4,146	18,483	1,790	**38,948**
Distribution	6.5%	1.3%	29.5%	10.6%	47.5%	4.6%	
As Trip Ratio to Work Trips – "Walk Multipliers"	1.0	0.2	4.6	1.6	7.3	0.7	

Source: FHWA, "Summary of Travel Trends: 2017 National Household Travel Survey", July 2018, Table 9a.

Based on this data, the entire population of CT 49 can be expected to make about 525 walk trips each day for a variety of purposes, including commuting to work, as well as trips such as a walk to get lunch or coffee while at work, a walk with a family dog, a walk to a bus stop, or a walk to a neighbor's house.

Since NHTS data represents a national aggregate and captures all trips made over a course of a day, additional assumptions are needed to narrow down total number of walk trips to those made in the geographic area of interest, which is the Project area of W. 51st Street. Based on the assumptions and methodology presented in the Appendix, about half of total walk trips made by CT 49 population are estimated to be made specifically in CT 49, and about one third of those are estimated to be taking place on W. 51st Street or diverting to it under the Build scenario. Table 5 below shows the results of the analysis. As shown in the table, the number of walk trips on an average work day expected to use W. 51st Street, or diverting to it under the Build scenario, is estimated at 97 (at 2019 level).

Table 5: Number of Walk Trips on 51st Street, Average Work Day, by Purpose, 2019 Level

Purpose	Average Daily Number
Work	17
Transit Access When Going to/from Work	12
Work-related business	0
Shopping and Errands	29
School or Church	4
Social and Recreation	31
Other	3
Total	**97**

For this BCA, it is assumed that the number of walk trips will grow at the same rate as vehicular traffic.

6 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 methodologies and assumptions.

6.1 Economic Competitiveness

Economic Competitiveness criteria for RAISE grants include impacts such as improving system operations to increase travel time reliability and reduce transportation costs, as well as increasing transportation options and system connectivity. As discussed in Sections 3 and 5, the Project will reduce travel distances between eastern and western segments of W. 51st Street and Union Avenue and improve vehicle flow in the Project area, reducing delays at intersections during peak hours of travel.

Economic competitiveness is monetized through three benefit streams: travel time savings, vehicle operating cost (VOC) savings, and external highway use savings.

6.1.1 Travel Time Savings

Travel time savings will accrue due to a shorter route for travel between the eastern and western sides of W. 51st Street and due to a higher speed than currently allowed (35 mph posted speed under Build compared to 25 mph currently, or under No-Build).

Table 6 provides travel distances and travel times estimated for the two sets of origin-destination pairs of traffic expected to benefit from the Project (shown previously in Table 3). Travel times were calculated considering the length of the alignment and posted/travel speeds (25 mph under No-Build and 35 mph under Build scenario). The table shows that the average travel times per vehicle are expected to decline from 82 to 59 seconds for vehicles traveling from W. 51st Street to Union Avenue North and from 98 to 41 seconds for vehicles traveling to Union Avenue South.

Table 6: Travel Distances and Travel Times for Origin-Destination Traffic, No-Build and Build

Origin-Destination		Distance (miles) - Build	Travel Time (s) - Build	Distance (miles) - No Build	Travel Time (s) - No Build	Daily Traffic Volume (2016)	Daily Traffic Volume (2045)
51st East	Union North	0.57	59	0.57	82	1,280	1,600
51st East	Union South/51st West	0.4	41	0.73	98	3,520	4,160

Source: Garver. Traffic volumes on W. 51st Street were derived in prior studies of the interchange for ODOT, including*: Interstate 44 from I-244 Junction to the Arkansas River Access Justification Report,* April 2020, https://oklahoma.gov/content/dam/ok/en/odot/federal-grants/infra/2021/i-44-us-75/reports-and-technical-info/access-justification-report.pdf.

Total annual travel time savings from the shorter and faster route on W. 51st Street were then estimated by multiplying travel time savings per vehicle by the annual traffic volume estimated for each year over the analysis period. Travel times per vehicle were assumed constant over the analysis period.

Additionally, the Project is expected to streamline traffic in the vicinity of the US-75 and I-44 interchange. Existing and future year arterial intersection analysis was performed using Synchro/SimTraffic software for a study area that included West Skelly Drive, W. 51st Street, and W. 49th Street from the Arkansas River on the east side to include Union Avenue and the button-hook ramps to I-44 just west of Union Avenue. The network was analyzed both with the 51st Street connection (the Build scenario) and without the 51st Street connection that assumed usage of the W. 49th Street underpass of US-75 for east-west connectivity (the No Build scenario). Network-wide measures of effectiveness were compared between the Build and No-Build networks for total network delay (vehicle-hours), total network delay per vehicle, network speeds, and network fuel consumed. Traffic volumes, including truck percentages, were applied using data from the *Interstate 44 from I-244 Junction to the Arkansas River Access Justification Report*. The results of the simulations covering the local network of 12 intersections is shown in Table 7 below.

Table 7: Intersection Delays in Project Area, No-Build and Build Scenarios

Time Period	Model	Total Daily Delay (hr)	Total Delay/Vehicle (seconds)	Fuel Used (gal)
2016 AM	No Build	15.5	24.9	73.8
	Build	12.7	21.5	66.8
2016 PM	No Build	25.5	35	86.8
	Build	19.3	27.8	80.1
2045 AM	No Build	35.2	44.1	97.5
	Build	21.2	28.3	85.5
2045 PM	No Build	78.5	83.2	117.3
	Build	33.2	37.8	100.5

Source: Garver

The table shows that at the 2016 traffic level, delays during morning peak hour (one hour) under the No-Build conditions were estimated at 15.5 hours. Under the Build conditions, the delays were estimated to decline to 12.7 hours.

Total annual travel time savings from reduced delays at intersections were then estimated by annualizing delays shown in Table 7 and assuming 2 hours for each morning AM and evening PM peak period. The calculations were conducted for 2016 and 2045 and interpolated for intermediate years.

Estimated vehicle hours of travel time savings were then monetized using values of time and vehicle occupancy assumptions recommended by US DOT and shown in the table below.

Table 8: Assumptions Used in Estimation of Travel Time Savings

Variable Name	Units	Value	Source
Average Vehicle Occupancy – Auto	persons/vehicle	1.67	US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, March 2022 Revised; Table A-4.
Average Vehicle Occupancy – Truck	persons/vehicle	1.00	

Variable Name	Units	Value	Source
Value of Time – Auto (all Purpose Travel)	$/hour	$17.80	US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, March 2022 Revised; Table A-3
Value of Time – Truck	$/hour	$32.00	
Share of Trucks in Total Traffic	Percent	8.00%	Transportation model for I-44 & US-75 area; Garver.

6.1.2 Vehicle Operating Cost Savings

Vehicle operating costs are anticipated to decline for motorists travelling west or southwest from the eastern end of W. 51st Street due to a shorter distance through the street extension under US-75. Furthermore, motorists travelling through the intersections surrounding W. 51st Street during peak-hours will experience fewer delays which will reduce fuel use.

These benefits were estimated using the US DOT recommended values for vehicle operating costs (in 2020 dollars per mile) multiplied by the vehicle miles traveled (VMT) where the VMT were derived from the ADT and travel distances shown in Table 6. The difference in total vehicle operating costs between the No-Build and Build scenarios is the benefit due to the Project.

Additional savings from reduced fuel use due to reduced intersection delays were calculated using fuel usage estimates from transportation modelling results shown in Table 7 and projected fuel prices from the 2022 Annual Energy Outlook by the US Energy Information Administration.

The values for vehicle operating costs and fuel prices are shown in Table 9 below. Costs for light duty vehicles and motor gasoline were used for automobiles, and costs for commercial trucks and diesel fuel were used for trucks.

Table 9: Assumptions Used in Estimation of Vehicle Operating Cost Savings

Variable Name	Units	Value	Source
Vehicle Operating Cost – Light Duty Vehicles	$/mile	$0.45	US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, March 2022 Revised, Table A-5.
Vehicle Operating Cost – Commercial Trucks	$/mile	$0.94	
Fuel Price – Motor Gasoline (Net of Federal and State Tax), 2030	$/gallon	$2.39	US EIA, Annual Energy Outlook 2022. Values vary by year; 2030 values shown for illustration. Converted from 2021 dollars to 2020 dollars using a GDP deflator.
Fuel Price – Diesel Fuel (net of Federal and State Tax), 2030	$/gallon	$3.05	

6.1.3 External Highway Use Cost Savings

External highway use costs refer to the monetized impact of congestion and noise resulting from highway travel. By reducing travel distances, total VMT in the Project area will decline, reducing social costs of road use.

These benefits were estimated using unit values of external highway use (for congestion and noise) provided in Table A-13 of the USDOT BCA guidance (March 2022 edition) and shown here in Table 10. These values represent the cost of congestion and noise per VMT and are multiplied by the total

VMT on W. 51st Street. The difference in costs under the No-Build and Build scenarios represents the benefit due to the Project.

Table 10: Assumptions Used in Estimation of External Highway Use Cost Savings

Variable Name	Cost per Vehicle Mile Travelled			Source
	Congestion	Noise	Total	
Light-Duty Vehicles - Urban	$0.1240	$0.0017	$0.1257	US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, March 2022 Revised; Table A-13
Buses and Trucks - Urban	$0.3100	$0.0393	$0.2317	

6.2 Safety Benefits

The Project will generate safety benefits due to two interrelated effects:

(1) Reduction in VMT, and

(2) Presence of a traffic signal along the connected route at W. 51st Street and S. Union Avenue

Number of crashes by severity for the No-Build scenario were estimated based on typical trip length, traffic volume, and crash rates for a similar type of arterial road (based on crash data for nearby Union Avenue). Number of crashes for the Build scenario were estimated in the same way to obtain baseline estimates. A crash modification factor (CMF) was then applied to estimate the reduction in the number of crashes due to the presence of a traffic signal (at W. 51st Street and Union Avenue) versus use of a stop-controlled intersection (at W. 49th Street and Union Avenue (CMF ID# 7848). This calculation was conducted for 2016 and 2045 and interpolated for years between.

The number of crashes were broken down by severity into five categories of accidents: fatality, serious injury, non-incapacitating injury, possible injury, and property damage only (PDO) based crash profile data for Union Avenue used to estimate the total number of crashes.

Total accident cost under the No-Build and Build scenarios were calculated by appying unit social costs of accidents recommended by USDOT. The difference between the two scenarios is the benefit of the Project.

The assumptions used in this methodology are summarized in Table 11 below.

Table 11: Assumptions Used in Estimation of Safety Benefits

Variable Name	Unit	Value	Source
Accident Costs			
Fatality	$/victim	$11,600,000	US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, March 2022; Table A-1
Suspected Serious Injury	$/victim	$554,800	
Non-Incapacitating	$/victim	$151,100	
Possible Injury	$/victim	$77,200	
Property Damage Only (PDO)	$/vehicle	$4,600	
Crash Rate Estimates			

Variable Name	Unit	Value	Source
Expected Number of Crashes, 2016	accidents/year	4.27	Calculated based existing number of crashes on Union Ave converted to a crash rate to represent crash rate on an urban collector facility and applied to traffic on 51st Street (crash rate of 434.9/100M VMT).
Expected Number of Crashes, 2045	accidents/year	5.10	
Share of Accidents – Fatality	percentage	0.3%	
Share of Accidents – Suspected Serious Injury	percentage	2.9%	
Share of Accidents – Non-Incapacitating Injury	percentage	19.8%	
Share of Accidents – Possible Injury	percentage	25.6%	
Share of Accidents – PDO	percentage	51.4%	
Crash Modification Factor	percentage	39.0%	CMF Clearinghouse, ID# 7848: Install Traffic Lights at stop-controlled intersection.
Number of Injured per Injury Crash	victims/crash	1.44	California Department of Transportation, TASAS Unit, 2010 to 2013 average
Number of Vehicles per PDO Crash	vehicles/crash	1.9	

6.3 Quality of Life / Pedestrian Benefits

Adding sidewalks to W. 51st Street is anticipated to increase the comfort, convenience, and safety of the facility for pedestrian use. The separated sidewalk will allow for distance between pedestrians and traffic, leading to improved safety, decreased noise exposure, and increased comfort.

These benefits were estimated using unit values of benefits from facility improvements expressed in dollars per person-mile walked provided in Table A-8 of the USDOT BCA guidance and shown here in Table 12. The unit value of sidewalk improvement was multiplied by the number of pedestrians, the width of the new sidewalk, and the assumed average trip length in the Project area. Table 12 provides a summary of all assumptions.

Table 12: Assumptions Used in Estimation of Pedestrian Benefits

Variable Name	Unit	Value	Source
Number of Pedestrian Trips on 51st Street			
No Build/Build, 2019	Daily Number	97	Estimated by HDR (see Section 5 and the Appendix). As a conservative assumption, the number of walk trips under Build is assumed to be the same as under No-Build scenario.
Average Annual Rate of Growth	%	0.63%	Rate of growth assumed equal to rate of growth in auto traffic. The same rate of growth for No Build and Build conditions.
Annualization Factor for Pedestrian Traffic	Number	260	Annualization factor is equal to the number of work days since volumes were extrapolated based on daily work commuting trips.
Measures of Pedestrian Benefits			
Width of Sidewalk to be Installed	feet	7.0	Project design.
Unit Monetary Benefit of Improved Sidewalk	$/foot per person-mile	$0.10	US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, March 2022, Table A-8

Variable Name	Unit	Value	Source
Total Benefit of Improved Sidewalk	$/foot per person-mile	$0.70	Calculated from inputs above.
Average pedestrian trip length	miles per person	0.4	Assumption, approximately half of the maximum/cap distance for walk trips recommended by USDOT; most trips in the project area expected to be short.

6.4 Environmental Sustainability Benefits

The Project is expected to reduce environmental emissions in two ways:

1. Avoidance of emissions generated through fewer VMT, as drivers will have access to a shorter and faster travel route; and
2. Avoidance of emissions generated through reduction of delays at intersections and reduction of idle fuel use.

To capture the two effects, the amounts of emissions for the No-Build and Build scenarios were estimated including the amounts related to vehicle mileage and the amounts related to intersection delays. The estimated tons of emissions, by pollutant, were multiplied by unit social costs of emissions recommended by USDOT. The difference between the No-Build and Build scenario provided the benefit estimates.

The amounts of emissions related to mileage driven were calculated by multiplying the vehicle miles travelled by the emissions rate (in grams per mile) applicable for the prevailing speed. To calculate the amount of emissions from idling, the number of hours spent idling (also used to estimate travel time savings) were converted to hypothetical vehicle miles travelled using a speed of 2.5 mph and emission rates were then applied to this distance.

The assumptions are summarized in Table 13 below.

Table 13: Assumptions Used in Estimation of Emissions Costs

Variable Name	Unit	Value	Source
Nitrogen Oxides (NOx)	$/metric ton	$18,100	US DOT, Benefit-Cost Analysis Guidance for Discretionary Grants Program, March 2022 Revised; Table A-6. Note that values vary by year. Values shown are for 2030
Sulfur Oxides (SOx)	$/metric ton	$49,100	
Fine Particulate Matter (PM2.5)	$/metric ton	$867,600	
Carbon Dioxide (CO2)	$/metric ton	$62	
NOx Emission Rate	grams/mile	*Varies by year, speed, and vehicle*	Estimates from MOVES run based on Tulsa, Oklahoma. Speed bins of 2.5 mph were used to represent idling vehicles; speed bins of 25 mph were used for the no-build case; and speed bins of 35 mph were used for the build case. Truck data is based on combination short-haul trucks using diesel fuel. Values were gathered for 2020, 2030, 2040, 2050, and 2060, and interpolation was used to estimate years in between.
SOx Emission Rate	grams/mile	*Varies by year, speed, and vehicle*	
PM2.5 Emission Rate	grams/mile	*Varies by year, speed, and vehicle*	
CO2 Emission Rate	grams/mile	*Varies by year, speed, and vehicle*	

6.5 Project Residual Value and Agency Costs Savings

Project costs of construction and development were reviewed to determine the residual project value at the end of the analysis period. Costs elements related to engineering and design were assumed to have no residual value at the end of the analysis period. On the other hand, right-of-way costs were determined to retain the full value. Costs related to roadway utilities were assumed to have a lifespan of 50 years. Assuming a straight-line depreciation rate, they will have a remaining 30 years of useful life. Major rehabilitation anticipated for 2045 (the last year in the analysis period) and included in maintenance costs will contribute to asset preservation.

The residual value of project costs estimated in this way amounts to $12.0 million in 2020 undiscounted dollars ($9.5 million roadway plus $2.5 million right of way). In the BCA, this value was entered as project benefit in the last year of the analysis period.

In addition, the Project is expected to generate savings to the agency operating and maintaining the roadway. In the absence of the Project, W. 51st Street would require major rehabilitation work estimated at $902,400 in 2022 dollars. If the Project goes ahead, this work will not be required. Therefore, in this BCA this saving is considered as the “agency” cost saving.

The assumptions are summarized in the table below.

Table 14: Assumptions for Calculation of Project Residual Value and Agency Costs Savings

Variable Name	Units	Value	Source/Comment
Project Costs by Cost Element	$M		ODOT, cost estimate in 2022 dollars was deflated to 2020 dollars.
Roadway Construction		$15.0	
Design		$1.3	
Right of Way		$2.5	
Utilities		$0.6	
Total Cost		$19.3	
Estimated Project Useful Life	Years	50	Assumption.
No-Build Major Rehabilitation	$M	$0.9	ODOT, cost estimate in 2022 dollars was deflated to 2020 dollars.

7 Summary of Findings and BCA Outcomes

The table below summarizes the BCA findings. Annual costs and benefits were estimated over the lifecycle of the project (years from 2024 to 2045).

Table 15. Overall Results of Benefit Cost Analysis, Millions of 2020 Dollars*

Project Evaluation Metric	Undiscounted	Present Value at 7% Discount Rate	Present Value at 3% Discount Rate
Total Benefits	$64.4	$21.4	$38.8
Total O&M Costs	$0.9	$0.2	$0.4
Total Capital Costs	$18.7	$13.6	$16.3
Net Present Value	$44.8	$7.6	$22.1
Benefit / Cost Ratio (Ratio)	3.40	1.55	2.36
Internal Rate of Return (%)	12.1%		

*Unless indicated otherwise

As stated earlier, construction is expected to be completed by the end 2025. Benefits accrue during the operation of the project (over the years 2026-2045).

Considering all monetized benefits and costs, the estimated internal rate of return of the project is 12.1 percent. With a 7 percent real discount rate, the $13.6 million investment would result in $21.4 million in total benefits, net present value of $7.6 million, and a Benefit/Cost ratio of approximately 1.55. With a 3 percent real discount rate, the net present value of the project is $22.1 million, with a Benefit/Cost ratio of 2.36.

The table below provides the monetary estimates of the quantified and monetized benefits of this Project.

The table shows that total Project benefits are estimated at $21.4 million in 2020 dollars discounted at 7%. Travel time savings account for the largest share of benefits at $13.1 million (or 61.2 percent of total) followed by accident cost savings at $2.7 million (12.8 percent of total) and vehicle operating cost savings of $2.0 million (9.1 percent of total).

Table 16: Summary of Project Benefits; Millions of 2020 Dollars

Benefit Categories	Over Project Lifecycle		
	Undiscounted	Present Value at 7% Discount Rate	Present Value at 3% Discount Rate
Travel Time Savings	$37.1	$13.1	$23.1
Vehicle Operating Cost Savings	$5.3	$2.0	$3.4
Highway Use Cost Savings	$1.4	$0.5	$0.9
Reduction in Accident Costs	$7.3	$2.7	$4.7
Pedestrian Benefits	$0.2	$0.1	$0.1
Environmental Cost Savings	$0.5	$0.3	$0.3
Agency Costs Savings	$0.8	$0.6	$0.7
Residual Value	$11.8	$2.2	$5.7
Total Benefits	**$64.4**	**$21.4**	**$38.8**

Table 17 below shows additional non-monetary measures of Project's benefits to society. Over 20 years of Project life analyzed in this BCA, the Project is expected reduce person-hours of travel time by over 2 million hours, reduce VMT by nearly 10 million, avoid 73 accidents, and reduce GHG emissions by 4,732 metric tons.

Table 17: Other Measures of Quantified Project Benefits

Impact	Over Project Analysis Period	Average Annual
Person-Hours of Travel Time (Thousand Hours)	2,028	101
VMT Avoided (Thousand VMT)	9,940	497
Fuel Saved (Gallons)	502,150	25,108
Accidents Avoided (Total Number)	73	4
GHG Emissions Avoided (Metric Tons)	4,732	234

8 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 value of travel time, value of statistical life, capital cost estimate, as well as years of operations included in Project BCA analysis. The outcomes of the analysis are summarized in the table below. The table provides the percentage changes in project NPV associated with variations in variables or parameters (listed in row), as indicated in the column headers.

Table 18: Summary of Quantitative Assessment of Sensitivity

Parameters	Change in Parameter Value	New NPV	% Change in NPV	New B/C Ratio
Value of Travel Time	Lower Bound of Range Recommended by US DOT (Auto $12.46 and Truck $25.60)	$3.8	-49.6%	1.28
	Upper Bound of Range Recommended by US DOT (Auto $21.36 and Truck $38.40)	$10.2	34.6%	1.75
Value of Statistical Life	Lower Bound of Range Recommended by US DOT ($6.96 million)	$6.5	-14.0%	1.48
	Upper Bound of Range Recommended by US DOT ($16.24 million)	$8.6	14.0%	1.63
Capital Cost Estimate	20% Reduction	$9.9	30.3%	1.90
	20% Increase	$5.3	-30.3%	1.32
Evaluation Period /Years of Project Operation	30 Years of Project Operation	$12.4	64.4%	1.91

The table demonstrates that under the alternative parameter values that may depress Project NPV as well as higher costs, the Project maintains NPV above zero and BC Ratio of 1.28 or higher.

When the number of years of Project operations is increased from 20 to 30, Project NPV increases by 64.4 percent to $12.4 and the BC ratio increases to 1.91.

Appendix: Developing Estimates of Pedestrian Trips in Project Area

This Appendix describes the methodology used to develop estimates of walk trips on W. 51st Street in the Project Area. The methodology involved estimation of total household walk trips in the Census Tract that covers the Project Area, Census Tract 49[7], and narrowing down this initial estimate to trips which take place on W 51st Street or which would likely divert there after Project completion. Given the primarily residential nature of CT 49, number of walk trips by residents of other census tracts is expected to be small. The methodology is described below.

Step 1: Determine the number of average total daily walk trips made by households residing in Tulsa Census Tract 49

The methodology combined US census data on commuting to work by walking and National Household Transportation Survey (NHTS) data to extrapolate walk commuting to walk trips for other purposes. As shown in Table 19, 2.4 percent of 709 workers in CT 49, or a total of 17, reported that they usually walk to work. Assuming 2 daily trips per worker, this implies 34 daily walk commuting trips.

Recognizing that walk commuting captures walk trips for only one specific purpose, NHTS data was then used to extrapolate walk trips for other purposes such as recreation, or shopping and errands. This was done using trip ratios, or "walk multipliers" for each trip purpose category shown in the bottom row of Table 4. For example, the number of walk trips for shopping and errands was estimated as 34*4.6=155.1.

The methodology also accounts for walk as a mode used to access transit for transit commuters. Given that 1.4 percent of workers, or a total of 10, reported transit as their usual commuting mode, about 33 daily walk trips can be expected to/from transit stops.

Based on this methodology, the total average daily number of walk trips taken by residents of CT49 is estimated at 558.

Table 19: Total Walk Trips by Households in CT 49

Item and Factor	Unit	Value	Source and Comment
Workers 16 Years and over in Tulsa CT 49		709	US Census Bureau; ACS 5-Year Estimates Subject Tables, 2019.
Means of transportation to work, Share	% of Total		US Census Bureau; ACS 5-Year Estimates Subject Tables
Walk		2.4%	
Public Transportation		1.4%	Including public transportation trips in pedestrian volumes as walking is needed to access it.
Work Commuting	Number of People		Calculated from inputs above.
Walk		17	
Public Transportation		10	

[7] Census Tract 49 (CT 49) covers the Project area and is the most disaggregated geographic level area for which comprehensive socioeconomic data is available from US Census Bureau.

Item and Factor	Unit	Value	Source and Comment
Number of trips per person	Number	2	Assuming a return trip by the same mode
Percent of Public Transport trips with walk as access/egress mode	% of Total	83%	Based on NTHS data.
Number of Walk Trips Related to Work	Daily Number		
Work/Walk Commuting		34	
Transit Access		33	
Other Walk Trips Made by Household Members, by Purpose	Average Daily Number		Extrapolated from walk commuting trips and walk multipliers for walk trips for other purposes shown Table 4
Work-related business		6.9	
Shopping and Errands		155.1	
School or Church		55.9	
Social and Recreation		249.3	
Other		24.1	
Total Walk Trips by Households in CT 49	**Average Daily Number**	**558**	**Calculated as sum of walk trips, by purpose, shown above.**

Step 2: Determine the number of walk trips made locally within Census Tract 49

NHTS data represents a national aggregate developed based on a survey that captured respondents' travel behavior over a course of the entire day. It may thus include a walk from home to a local school/church as well as a walk trip from work place/office to get lunch at a local restaurant.

The next step of the methodology involved then narrowing down the estimate of walk trips developed in the previous step to walk trips taking place locally, or around home. This was done based on reasoned assumptions considering the nature of the various trips. The table below provides assumptions for each category of trips and the resulting estimates. Based on this methodology, the number of daily walk trips in CT 49 is estimated at 268.

Table 20: Local Walk Trips by Households in CT 49

Walk Trips by Purpose	Percent in CT 49	Number in CT 49 - Average Daily	Comment
Work	100%	34	Typical walk commuting expected to start and end at home and thus have a local segment.
Work-related business	0%	0	Many such trips can be expected to start and end at work place, and to be short trips in dense employment areas. Such trips are unlikely in CT 49.
Shopping and Errands	25%	39	CT 49 has a rather low density of places such as shops and services where people would be going for errands. Most errands and shopping with walk mode likely taking place in another CT.
School or Church	75%	42	Most to/from school and church trips with walk mode can be expected to be local, e.g., children walking to school locally.

Social and Recreation	50%	125	Many walk trips in this category can be expected to be local by their nature, e.g., walking a dog, visiting a neighbor, or going out for a walk. 50% share is assumed as a conservative assumption.
Other	50%	12	Similar as above.
Transit Access	50%	16	Only half of transit access trips will be local (from home to transit stop on the way to work and from transit stop to home on the way back), the other half will be in the vicinity of workplaces, likely located in another CT.
Total		**268**	**Sum of trips by purpose listed above.**

Step 3: Determine number of walk trips which take place on W 51st Street or which would likely divert there after Project completion

The number of trips developed in the previous step was narrowed down to those that either already may be taking place on W. 51st Street, or would likely divert to the improved W. 51st Street. This was done based on reasoned assumptions considering the nature of the various trips. The table below provides assumptions for each category of trips and the resulting estimates. Based on this methodology, the number of daily walk trips on W.51st Street is estimated at 97. For this BCA, it is assumed that increase in the number of walk trips in CT 49 under the Build scenario will be insignificant.

Table 21: Walk Trips on W. 51st Street

Walk Trips by Purpose	Percent on 51st Street	Average Daily Number	Comment
Work	50%	17	Conservative assumption used without knowledge of workplace and home locations. However, improved 51st Street may be seen as attractive for using it for walk commuting.
Transit Access	75%	12	Transit stops located on 51st St and 49th St.
Work-related business	0	0	
Shopping and Errands	75%	29	Concentration of establishments on west end of 51st St can be expected to make the improved 51st St convenient for access.
School or Church	10%	4	Percentage expected to be small; two churches located at west end of 51st Street, other located further away.
Social and Recreation	25%	31	Conservative assumption, street will provide good access to trails along Arkansas River. However, given its location on the southern edge of CT 49 its use for other social and recreational uses may be less practical.
Other	25%	3	As above.
Total		**97**	**Sum of trips by purpose listed above.**