REIMAGINE WACO TRANSIT

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INTRODUCTION

INTRODUCTION

Since 2013, the City of Waco, Waco Transit System (WTS), and Waco Metropolitan Planning Organization (MPO) have been studying various options to redesign the regional fixed-route public transportation system. The current system is a slightly modified hub and spoke design implemented during the 1950s that has not been changed significantly since 2003. As a result, transit-dependent populations utilizing the fixed-route system often need to transfer at the Downtown Intermodal Center and may have a one-way travel time of up to 2 hours.

The Reimagine Waco Transit project examines the existing fixed-route bus services provided by WTS and identifies opportunities to increase mobility. This study focuses specifically on the Waco Urbanized Area, as defined by 2019 US Census data (Figure 1).

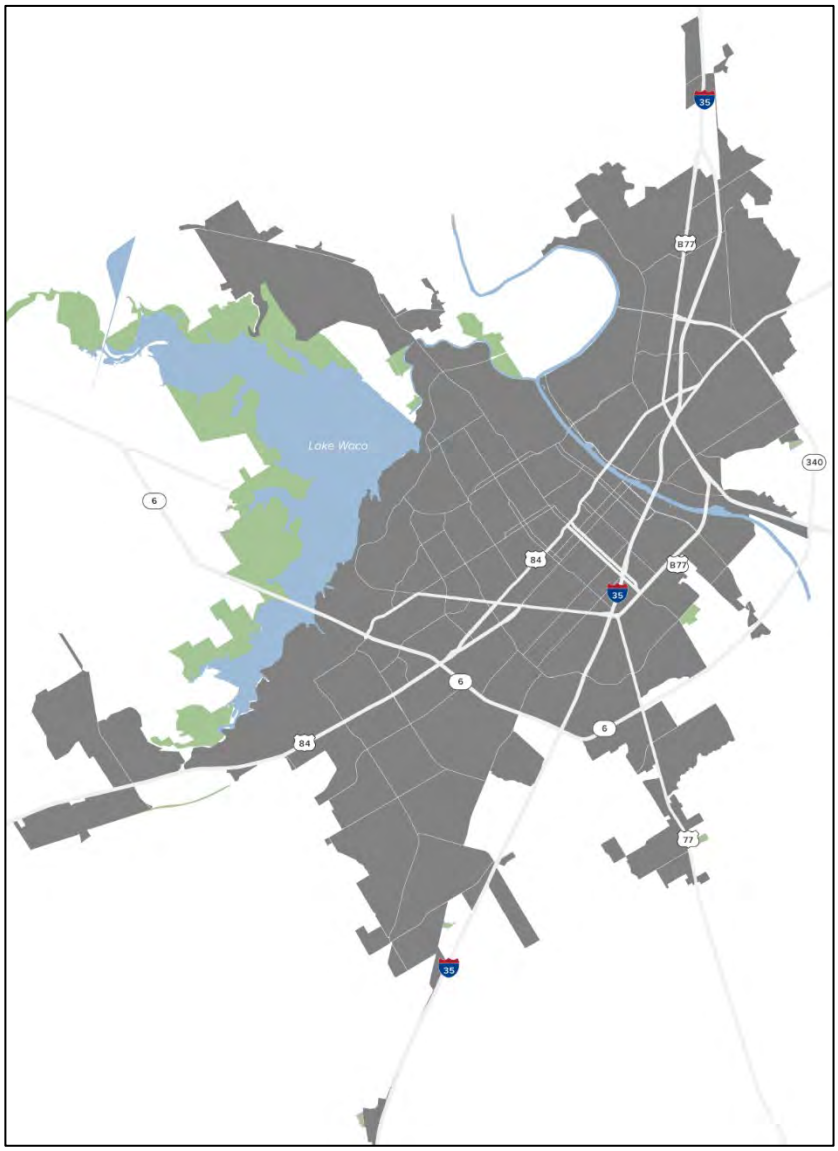
The main objective of the Reimagine Waco Transit project is to redesign the existing transit system to enhance mobility and connectivity for the residents of Waco. The first step in developing recommendations involved establishment of a baseline and understanding the existing transit system. This process helps pinpoint the strengths and eliminate the weaknesses of the system in a manner that improves transit for existing passengers while simultaneously working to attract new passengers.

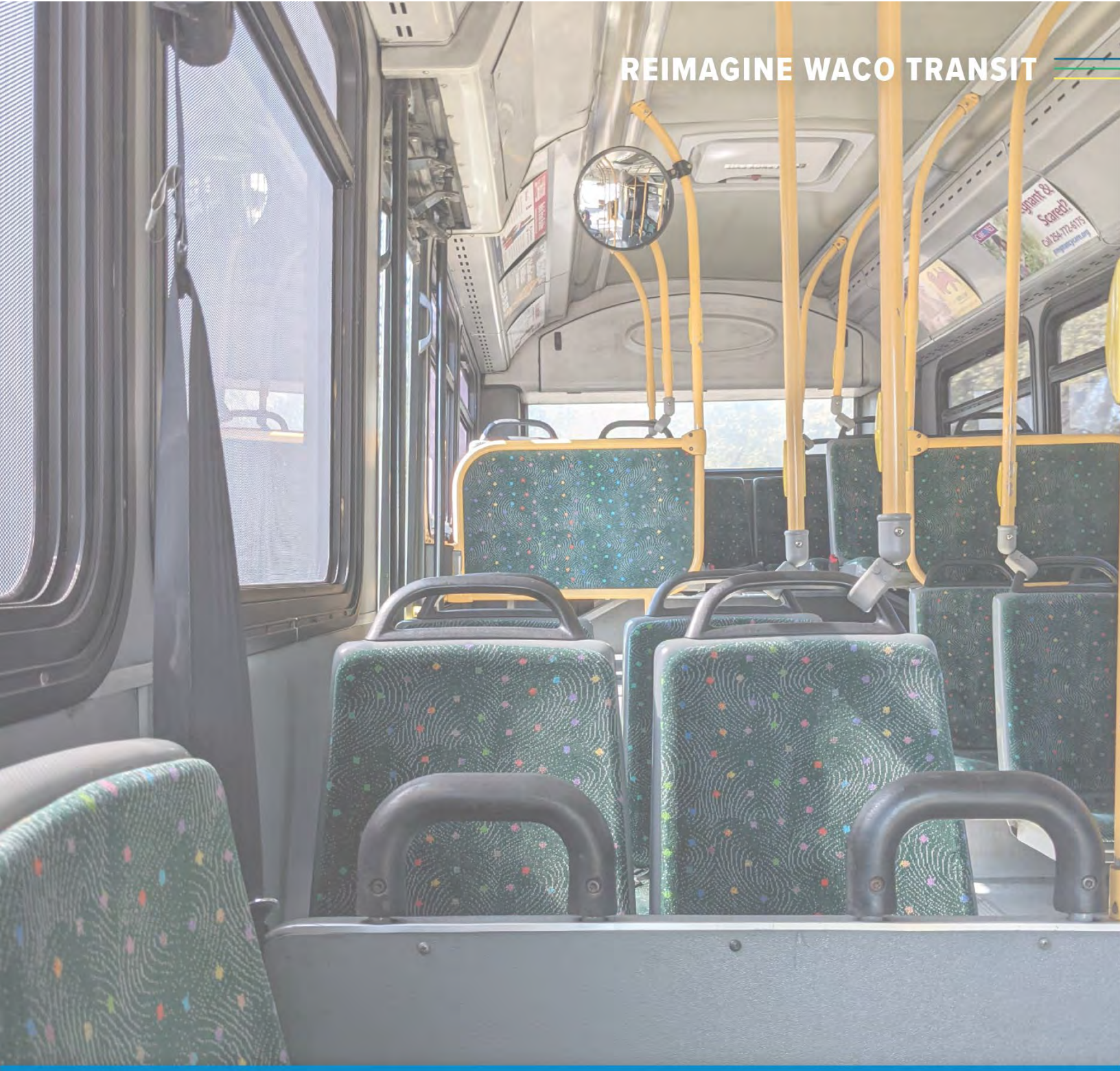
Creation of the baseline required a multifaceted approach that included the following types of analyses:

- Operational
- Ridership
- Transit Market
- Travel Patterns

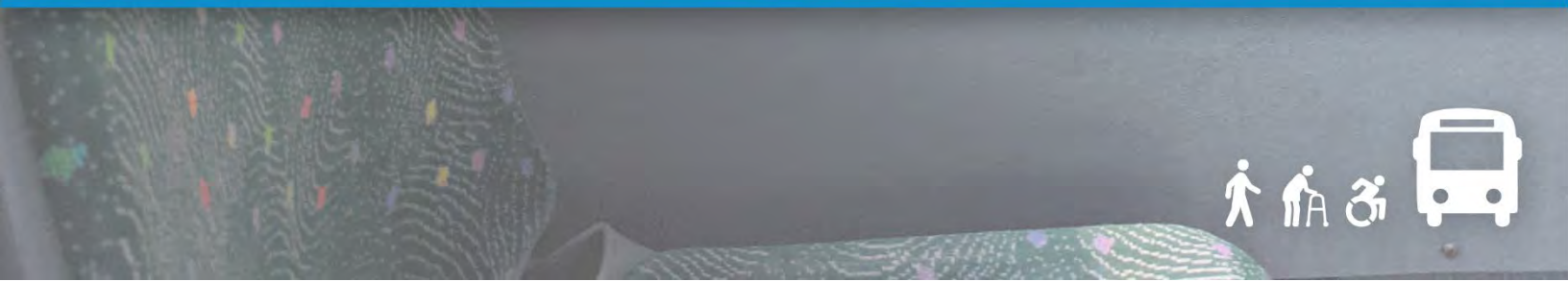
Each of these components is discussed in greater detail to assess the existing transit system and identify areas for improvement.

FIGURE 1: WACO URBANIZED AREA





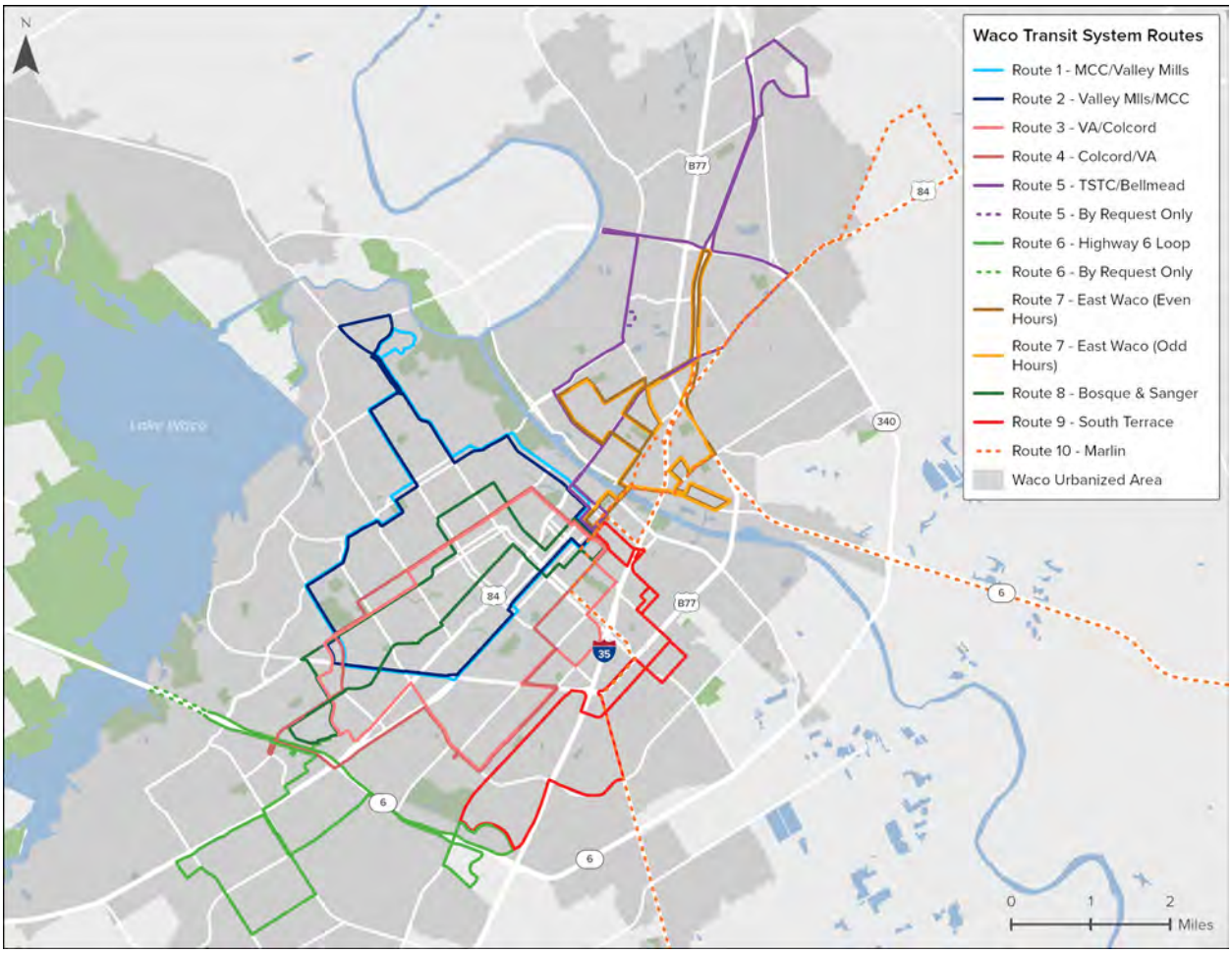
CHAPTER 2
OPERATIONAL ANALYSIS



OPERATIONAL ANALYSIS

Currently, Waco Transit System (WTS) operates ten fixed-route buses within the City of Waco. Buses originate at the Waco Transit Center, located at 8th Street and Mary Avenue. The exception is Route 6 - Highway 6 Loop, which requires a transfer to reach the city center. In addition to buses serving the city proper (Figure 2), WTS operates the Silo District and La Salle shuttles, the Baylor University Shuttle (BUS), and a Demand Response Service for individuals with disabilities.

FIGURE 2: EXISTING WACO TRANSIT ROUTES



The Baylor University Shuttle is a fixed-route system focusing on quick connections on class days from 7:25 AM to 5:25 PM, except for the Gold route that provides service until 6:30 PM. The Baylor University Shuttle also offers two late-night services, Afterhours A and B, which provide service until 1:30 AM. Table 1 outlines the span, frequency, and service days for public transportation that operate within the Waco Urbanized Area. In general, the fixed-routes servicing the city operate at a frequency of 60 minutes, while the university shuttles operate at a 10–20-minute frequency.

Demand Response Service operates as an on-demand paratransit service for riders who cannot embark or disembark from the fixed-route system due to a disability. Passengers may schedule

trips up to 14 days in advance, schedule regularly recurring subscription trips, or make same-day requests. In accordance with the Americans with Disabilities Act (ADA), paratransit services are provided within a ¾ of a mile area on either side of the fixed-route lines.

TABLE 1: CURRENT ROUTE OPERATIONS

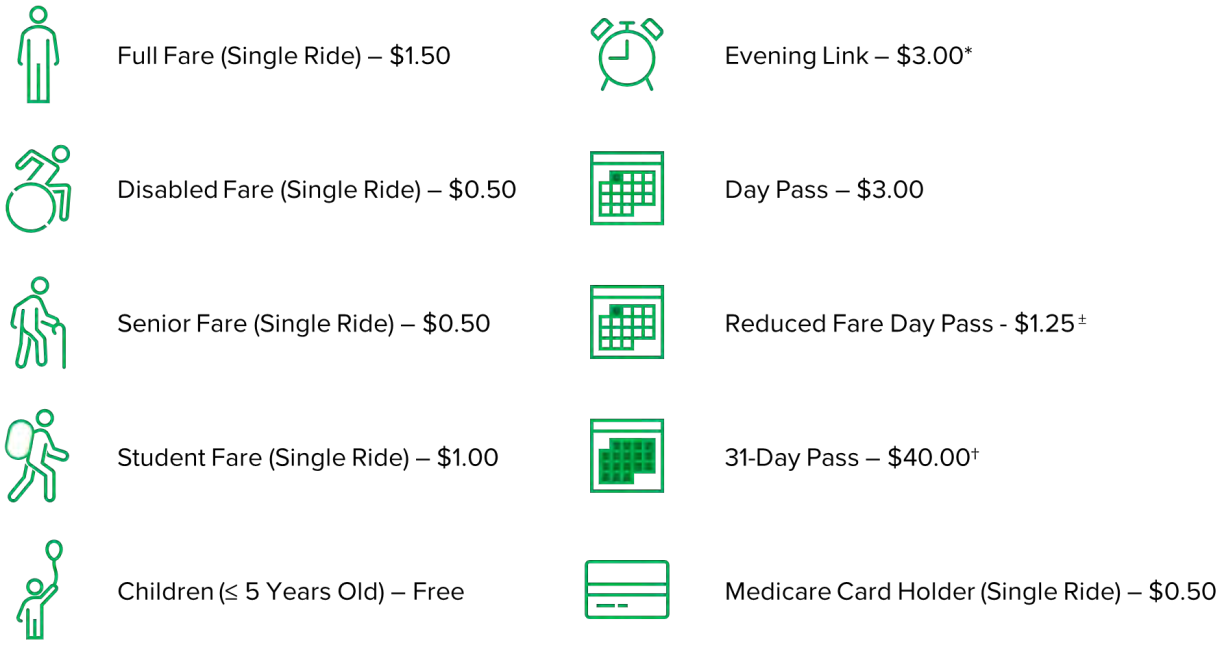
SYSTEM	ROUTE	SERVICE DAY	SPAN (WEEKDAY)	SPAN (WEEKEND)	FREQUENCY
WTS	Route 1	Mon. – Sat.	5:15AM – 7:15PM	6:15AM – 8:15PM	60 min.
WTS	Route 2	Mon. – Sat.	6:15AM – 7:15PM	7:15AM – 8:15PM	60 min.
WTS	Route 3	Mon. – Sat.	6:15AM – 7:15PM	7:15AM – 8:15PM	60 min.
WTS	Route 4	Mon. – Sat.	6:15AM – 7:15PM	7:15AM – 8:15PM	60 min.
WTS	Route 5	Mon. – Sat.	6:15AM – 7:15PM	7:15AM – 8:15PM	60 min.
WTS	Route 6	Mon. – Sat.	6:42AM – 7:15PM	7:42AM – 8:15PM	60 min.
WTS	Route 7 (Odd Hours)	Mon. – Sat.	5:15AM – 7:15PM	6:15AM – 8:15PM	120 min.
WTS	Route 7 (Even Hours)	Mon. – Sat.	5:15AM – 7:15PM	6:15AM – 8:15PM	120 min.
WTS	Route 8	Mon. – Sat.	6:15AM – 7:15PM	7:15AM – 8:15PM	60 min.
WTS	Route 9	Mon. – Sat.	5:15AM – 7:15PM	6:15AM – 8:15PM	60 min.
WTS	Route 10	Mon. – Sat.	5:50AM – 6:30PM	6:50AM – 5:30PM	Two AM and two PM trips
WTS	Demand Response	Mon. – Sat.	5:15AM – 7:15PM	6:15AM – 8:15PM	N/A
BUS	Blue	Mon. – Fri.	7:25AM – 5:25PM	--	15 min.
BUS	Green	Mon. – Fri.	7:25AM – 5:25PM	--	10 min.
BUS	Gold	Mon. – Fri.	7:25AM – 6:30PM	--	10 min.
BUS	Red	Mon. – Fri.	7:25AM – 5:25PM	--	12 min.
BUS	Silver	Mon. – Fri.	7:25AM – 5:25PM	--	20 min.
BUS	After Hours A	Mon. – Thurs.	5:30 PM – 1:30 AM	--	30 min.
BUS	After Hours B	Mon. – Thurs.	5:30 PM – 1:30 AM	--	20 min.

Fare Structure

Fares for the Waco Transit System currently cost $1.50 per-ride for adults aged 19 to 64. Using an official Waco Transit identification card, reduced fares are available to riders with disabilities, senior citizens (65 and older), Medicare cardholders, and students. Children aged five or younger may ride free with an adult. Day passes are available for $3 and monthly passes are available for $40. Free rides are available to students currently enrolled at the McLennan Community College, Texas State Technical College, and Waco Independent School District (Figure 3).

Baylor University Shuttles are available at no cost for all enrolled students. Passengers who make trip connections from the BUS to the Waco Transit System are encouraged to purchase day passes or monthly passes.

FIGURE 3: WACO TRANSIT SYSTEM BUS FARE



** Service is limited and reservations are required.*
± ID is required for senior citizens and those with disabilities
† Discounted rate of $20 for K-12 Students

Transit Connections

Each Waco Transit System (WTS) route includes a possible connection to another route. For example, Routes 3 and 4 operate on the same path but in different directions. Other routes extend to rural areas and have limited connection opportunities (Table 2).

Route 7, which offers a slightly varied route at odd and even hours, has the most connections. The only route that does not directly connect with Route 7 is Route 6. Route 6 services west of Waco, while Route 7 services east of Waco.

Route 9 is the only WTS route that connects to the Baylor University campus and goes through campus twice per hour.

Route 10 has one of the broadest service areas but only three direct connections to other routes. This route serves to connect southeast Waco to central Waco. Route 10 connects to Routes 5, 7, and 9, providing access to the medical facilities in southwest Waco and additional connections to other routes.

TABLE 2: WACO TRANSIT SYSTEM CONNECTIONS

ROUTE	SERVICE AREA	CONNECTED ROUTES*									
		1	2	3	4	5	6	7	8	9	10
Route 1	MCC / Valley Mills		✓	✓	✓				✓		
Route 2	Valley Mills / MCC	✓		✓	✓				✓		
Route 3	VA / Colcord	✓	✓		✓				✓		
Route 4	Colcord / VA	✓	✓	✓			✓		✓		
Route 5	TSTC / Bellmead	✓	✓	✓				✓	✓		
Route 6	Highway 6 Loop				✓					✓	
Route 7	East Waco	✓	✓	✓	✓	✓			✓		✓
Route 8	Bosque & Sanger	✓	✓	✓	✓			✓			
Route 9	South Terrace						✓				✓
Route 10	Waco / Marlin / Sanderson Farms					✓		✓		✓	

**This table excludes connections at the Transit Center, where all routes originate from.*

Reducing redundancy in service can increase efficiency and allow Waco Transit System to increase the frequency or expand service. The existing system is based on a hub and spoke model that is anchored at the transit center at 8th and Mary. While multiple routes are available for north-south connections, the city lacks a substantial east-west connection below Downtown.

On-Time Performance

Sample data from TransLoc On-Time Reports from August through October 2021 were used to determine the departure and arrival times for vehicles on each route. This data was evaluated to determine how well the system is performing with respect to its published schedule.

Buses that arrived before their scheduled arrival time were considered "Early." Those that arrived at the scheduled arrival time, or within two minutes after their scheduled arrival time, were considered "On-Time." Vehicles that arrived three or more minutes after their scheduled arrival time were considered "Late." Some of the routes included data that did not indicate a scheduled arrival or departure time; these timestamps were considered incomplete, so their on-time status was labeled 'Missing' (Table 3).

TABLE 3: ON-TIME PERFORMANCE DESIGNATION

STATUS	TIME PERFORMANCE
Early	Before Arrival Time
On-Time	At Scheduled Arrival Time or Within 2 mins
Late	More than 3 mins after Scheduled Arrival Time
Missing	Not Reported

Approximately 50% of the buses during the analysis period were "On-Time" or "Early." Buses were rarely late between August and October in 2021. In fact, buses on half of the routes were **more likely to arrive early than on-time**. During this timeframe, Route 10 demonstrated an equal occurrence of either arriving "Late" or "On-Time." Inefficiencies in the route may be attributed to the wide service area that the route covers. Across the entire timeframe, approximately 34% of the data available were noted as "Missing" (Table 4).

TABLE 4: ON-TIME STATUS

ROUTE*	PERCENT EARLY	PERCENT ON-TIME	PERCENT LATE	PERCENT MISSING
Route 1	40%	37%	4%	19%
Route 2	30%	47%	9%	14%
Route 3	46%	34%	5%	15%
Route 4	46%	44%	5%	5%
Route 5	34%	50%	11%	5%
Route 6	55%	19%	7%	19%
Route 7	41%	19%	13%	27%
Route 8	33%	49%	7%	11%
Route 9†	0%	0%	0%	100%
Route 10	13%	28%	26%	33%

**Routes 5, 7, and 10 offer different routes at different times of the day, or by request. This graphic shows the on-time status for each of those routes together.*

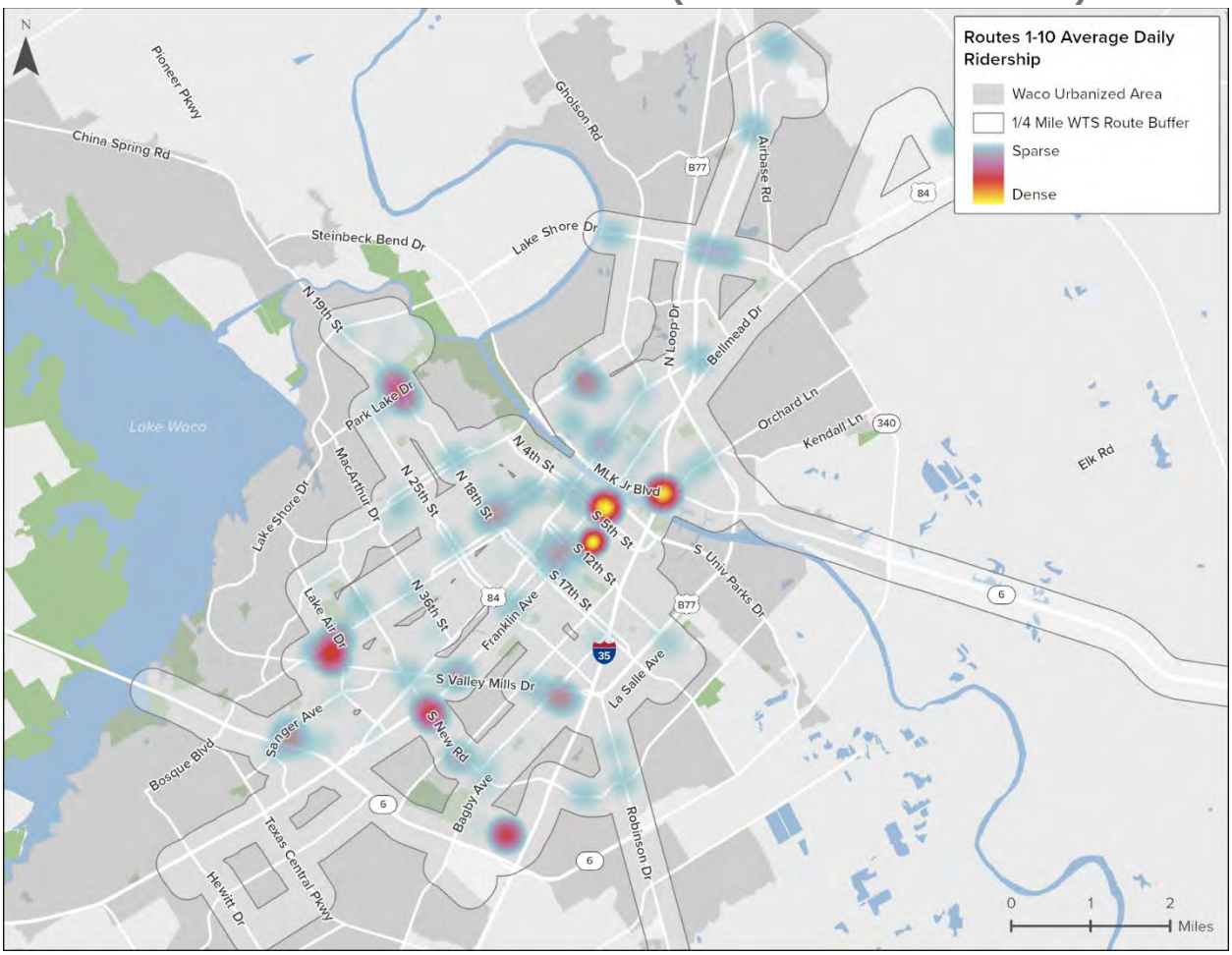
†While data was available for Route 9, none of the information included the scheduled arrival or departure times. Due to the lack of available information, Route 9's on-time status during this period is 'Missing'.

Ridership Analysis

Ridership data highlights when and where people access the bus system and which routes are the most productive. In May 2021, Waco Transit System installed Automatic Passenger Counters (APC) which count the number of passengers boarding and disembarking the bus. Waco Transit System currently utilizes a flag-a-stop system, which allows a rider to access the bus at any point on the route. Using GPS technology, these counters provide accurate ridership data and allow the transit system to see exactly where the greatest boardings and alightings occur.

This study analyzed APC data from August to October of 2021 to provide a snapshot of WTS ridership at a period that was minimally impacted by local university activity. During this period, Waco Transit System APCs recorded 96,309 boardings. Figure 4 displays a heatmap of ridership activity that indicates where the highest number of boardings and alightings occurred within the Waco Urbanized Area. Ridership hotspots are located near 8th and Mary Avenue, Franklin Avenue and 3rd, MLK Jr. Boulevard and Orchard Lane, Lake Air Drive and S Valley Mills Drive, Park Lake Drive and N 19th Street, and the Central Texas Marketplace.

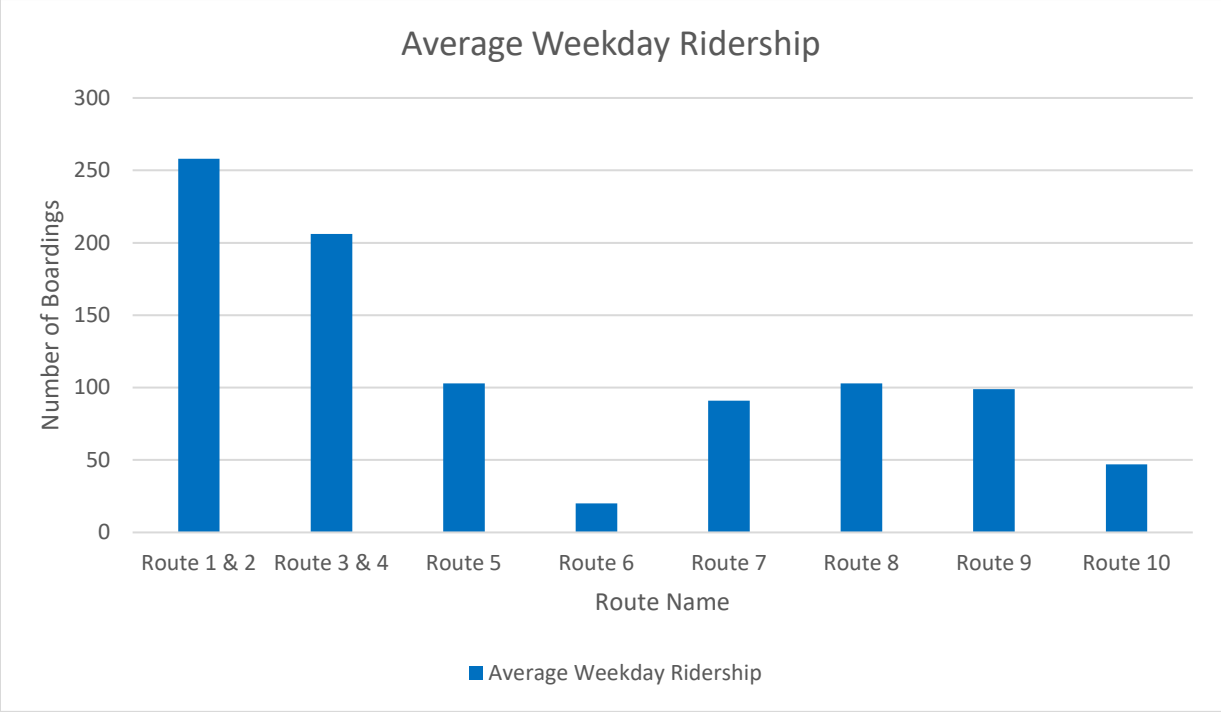
FIGURE 4: AVERAGE DAILY RIDERSHIP (AUG. 2021 – OCT. 2021)



Ridership hotspots such as these can inform where future timepoints, transit hubs, and connections might be successful. As expected, there is high ridership Downtown, near the Lake Air Mall, Baylor University, and along major arterials such as Franklin Avenue.

Alternatively, ridership can be analyzed at the route level to inform productivity. Figure 5 compares average weekday daily ridership at the route level. Four of the Waco Transit System fixed-routes operate as one-way pairs. These routes travel the same path but operate in different directions. Rather than viewing the APC data for these routes separately, their information is combined to provide a more precise interpretation of route ridership. Routes 1, 2, 3, and 4 had the highest average weekday boardings. While some routes averaged only ten riders during the weekday, these routes averaged 100-140 riders. Even after combining the one-way pairs, Routes 5, 8, and 9 still have less than half the average daily weekday ridership compared to Routes 1 & 2 and Routes 3 & 4.

FIGURE 5: WACO TRANSIT SYSTEM RIDERSHIP (AUG. 2021 - OCT. 2021)



**Routes 5, 7, and 10 offer different routes at different times of the day, or by request. This graphic shows onboarding for each of those routes together.*

The median weekday ridership during this timeframe was 99 riders. Seven of the ten fixed-routes average 100+ weekday riders and the remaining routes averaged 10 to 66 weekday riders. Route 6 had the lowest average ridership during this timeframe; however, this is the only route throughout the system that provides service within walking distance to Ascension Providence Hospital.

Route Productivity

Average productivity is one way to measure how well transit service is performing. Productivity can be defined as “boardings per revenue hour,” or in other words, the number of people that board the bus, divided by the total number of hours in the day when service is running. The more boardings that occur per hour for fixed-route services, the more productive the service is. The formula below illustrates this calculation.

$$Productivity = \frac{Avg.\,Daily\ Boardings}{Daily\ Revenue\ Hours}$$

Similar to the ridership analysis, one-way pairs (Routes 1 & 2 and Routes 3 & 4) will be assessed together because they serve the same path and stops. Figure 6 highlights routes by their average weekday productivity. However, productivity is an assessment of boardings per revenue hour. Route 1-10 offer similar hours of service; therefore, productivity is driven by ridership in this scenario. Route pairs 1 & 2 are the most productive because they have the highest ridership. Contrastingly Route pairs 3 & 4, 5, and 8 demonstrate a similar level of productivity because each route’s ridership ranges from 100-125 boardings per day. Route 6 has the lowest productivity because it averages 20 daily boardings. Route 10 is more productive than Route 7 because it has a shorter span of service with a similar level of ridership.

FIGURE 6: AVERAGE WEEKDAY PRODUCTIVITY BY ROUTE

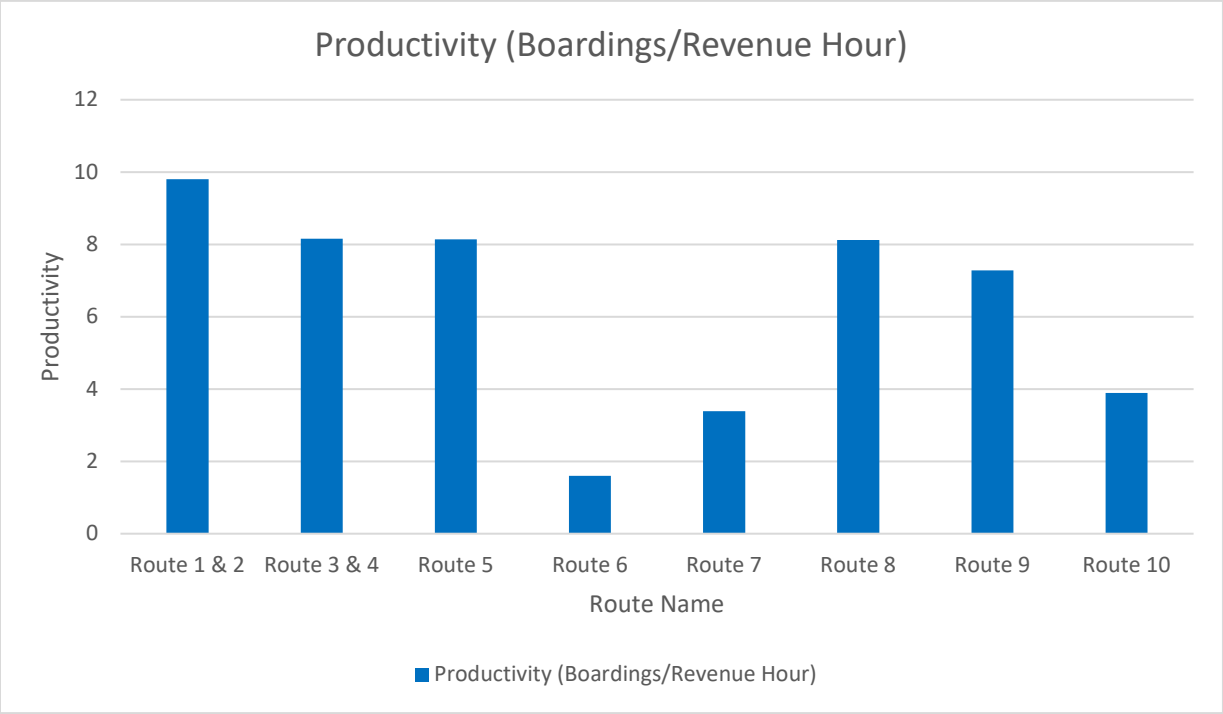
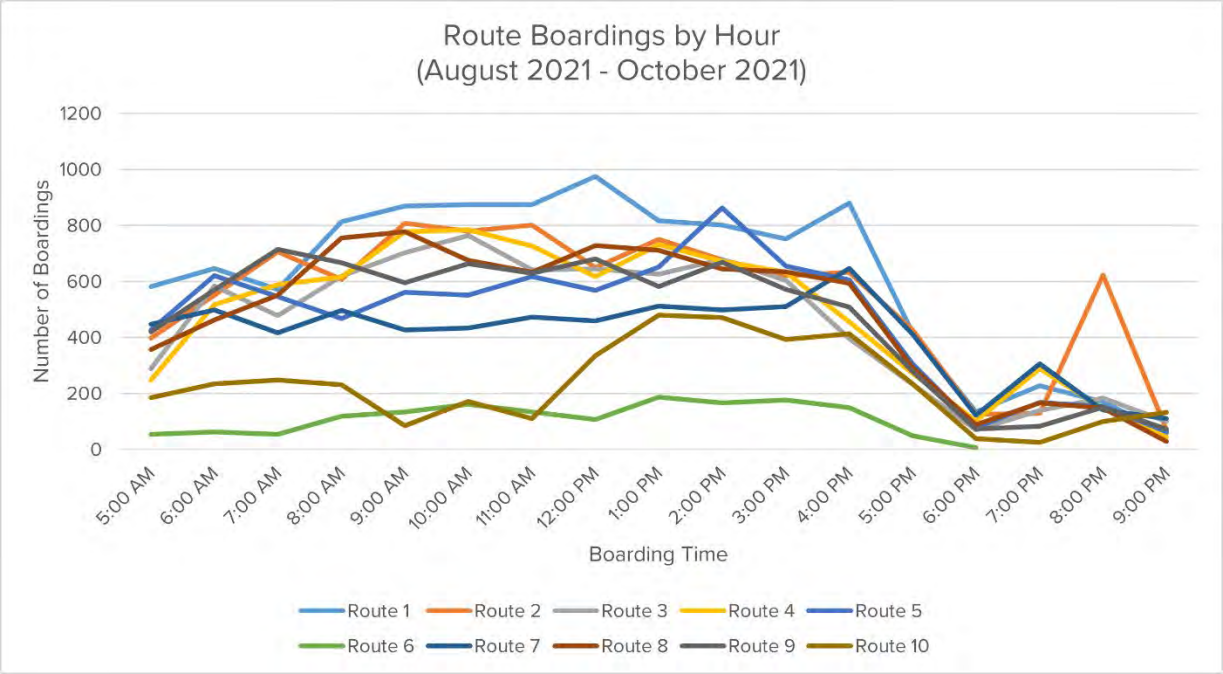


Figure 7 depicts ridership by the hour for Waco Transit System routes. Like the figure above, Route 6 demonstrates the lowest number of boardings compared to other WTS routes. Route 1 demonstrates the highest system-wide ridership, especially at 12:00 PM. In general, ridership remains fairly consistent among other routes from 8:00 AM to 4:00 PM and declines drastically between 4:00 PM and 6:00 PM.

FIGURE 7: BOARDINGS BY HOUR (AUG. 2021 – OCT. 2021)



Of course, productivity within the existing system is relative. While Route pairs 1 & 2 demonstrate the highest productivity within the current system, improvement may still be warranted. Likewise, routes with low productivity do not always indicate lower demand for transit services. For instance, Route 6 demonstrated the lowest productivity, yet it serves some of the citizens most dependent on transit. Routes that demonstrate low productivity indicate where operational and service planning improvements can be made to improve mobility.

Operational Key Findings

In general, operational efficiencies can be improved through scheduling or route design. As noted earlier, almost half the routes are more likely to arrive early than on-time. While this may appear to be a positive indication of performance, transit systems perform at their peak when there are little to no “recovery times” (i.e., a period of time when the service is not being utilized).

Concerning ridership, one-way route pairs (i.e., Routes 1 & 2 and 3 & 4) out-perform the rest of the system. While many factors impact ridership, route design may provide a simple and effective solution. For instance, by converting circular routes to a bi-directional design, WTS can increase the frequency and decrease wait times for passengers. Increasing operational efficiencies allows transit systems to provide a consistent, high quality of service to their riders.

CHAPTER 3
TRANSIT MARKET ANALYSIS

TRANSIT MARKET ANALYSIS

Public transit systems are effective when they are supported by a robust underlying transit market. Transit is **most successful** when the community it operates within is comprised of transit-supportive land uses with dense populations of people who are more likely to use transit. Further, it is important that the road network is also designed and built to support transit vehicles and foster multimodal connectivity, and that areas with active transportation networks complement transit and help to provide seamless transitions between modes.

Balancing Choice and Captive Rider Needs

Passengers using public transportation are typically classified as either choice or captive. A choice rider is someone who chooses to take public transportation over another possible method of transportation, such as a car or bicycle. Captive riders represent a group whose only viable option is to use transit due to lack of other transportation options.

Analyses focused on captive riders will look at where the 'need' or 'dependence' in the community is concentrated by identifying population groups characterized by low income, the elderly, or people with disabilities, whereas analysis that focuses on choice riders will isolate the population and employment densities so they can maximize the greatest 'potential' or 'propensity' to attract transit riders.

When recommendations are formed with a mindset that distinguishes between these two groups, questions regarding efficiency vs. coverage are often raised. Solutions with captive riders tend to focus on higher-coverage solutions, such as less frequent circulator routes that serve a larger area. In contrast, solutions with choice riders in mind tend to be more focused on efficiency, which may be characterized by frequent routes that run on intuitive alignments.

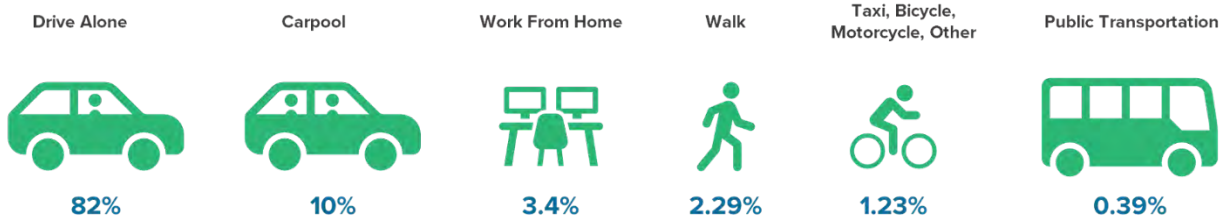
To balance the needs of both groups, this market analysis and subsequent recommendations of this plan do not fall into one specific category. Instead, they are based on a holistic analysis of the community and an understanding of all the micro-markets that drive transit, whether they be from need or potential.

By developing an in-depth understanding of all the markets in the region, the project team was able to develop tailored solutions that match service delivery tools with the appropriate markets. In addition to feedback from the public and steering committee, the following data from the market analysis were used to inform these solutions: transit potential, key destinations, travel patterns, and social vulnerability.

Transit Potential

A transit market analysis is a holistic approach to understanding which areas support and/or need transportation services. In general, Waco is an auto-centric community, with over 90% of people choosing to use a car to either drive alone or carpool to work.[1] The main objective of this project is to create a system that will continue to support existing transit users and encourage non-transit users to utilize WTS services (Figure 8).

FIGURE 8: MODES OF TRANSPORTATION TO WORK (2019)



To capture both captive and choice riders, this analysis reviews transit need, propensity, and key destinations to provide a clear understanding of the market as it exists today. Socioeconomic indicators, such as languages spoken and household composition, were also analyzed to highlight existing and future transit potential in the study area.

Areas that may have a greater need for transportations services were identified using an analysis of both *Target Transit Riders (TTR)* and *Transit Dependent Populations (TDP). TTRs* and *TDPs* can be identified with the following demographic subgroups (Table 5):

TABLE 5: DEMOGRAPHICS OF TARGET TRANSIT RIDERS AND TRANSIT DEPENDENT POPULATIONS

TARGET TRANSIT RIDERS	TRANSIT DEPENDENT POPULATION†
Impoverished Population	Population in Group Quarters (Non-Institutionalized)
Minority Population	Population Under 18
Non-Driving Population (Age < 18 OR ≥ 65)	Drivers without Access to a Vehicle±
Populations with Disabilities	
Population with Limited English Proficiency	
Population w/o Access to a Personal Vehicle	

†"Transit dependence" is measured according to the APTA's definition. Specifically, this applies to a person who lives in a household where no private vehicle is available.
±This is an estimate based on the number of eligible drivers and the number of personal vehicles available.

[1] 5-Year Estimates: 2019 American Community Survey

Data from 2019 American Community Survey 5-Year Estimate Tables were used in the following section to conduct this analysis (Table 6). Demographic characteristics identified in Table 5 were ranked individually and then compiled into an overall score to illustrate concentrations of target transit and transit dependent populations. The *TTR* and *TDP* will be used to identify areas with the greatest transit potential.

TABLE 6: DATA SOURCES

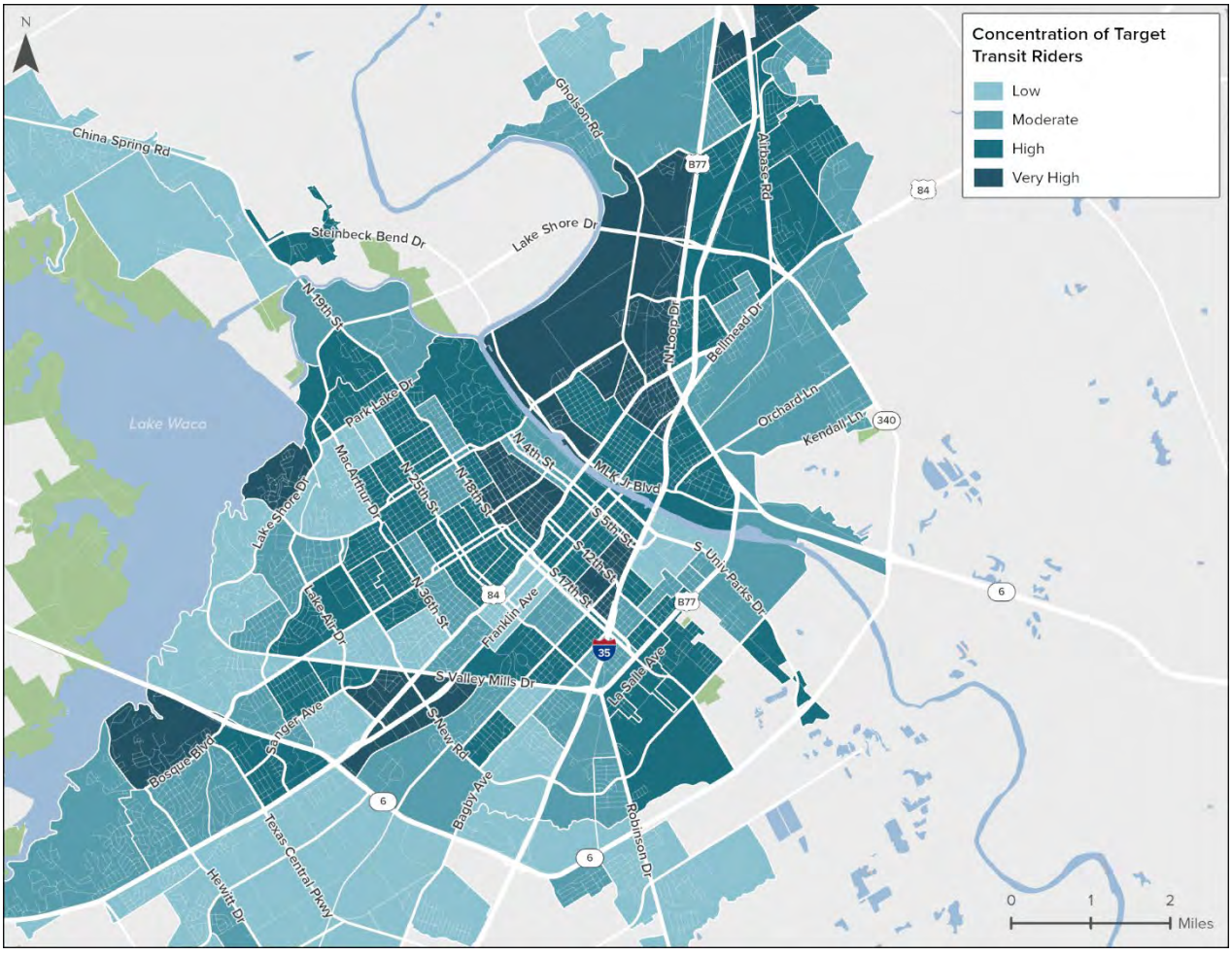
DATA SOURCE	DATA DESCRIPTION
B17021	Impoverished Population
B02001	Minority Population
B01001	Non-Driving Population (Age < 18 OR ≥ 65)
C21007	Populations with Disabilities
B16004	Population with Limited English Proficiency
B25044	Population w/o Access to a Personal Vehicle
B09019	Population in Group Quarters (Non-Institutionalized)

Target Transit Riders

Individuals identified as *Target Transit Riders* are assumed to make use of public transportation to meet many of their mobility needs. *Transit Dependent Populations* are characterized by their access to personal or household vehicles and their inability to drive.

Figure 9 illustrates the *Target Transit Riders* throughout the Waco Urbanized Area. Areas with the lowest *Target Transit Rider* scores are found along the southern outskirts of the urbanized area. There is a low to moderate dispersion of *Target Transit Riders* throughout the area with higher concentrations of *TTRs* to the north of the Brazos River.

FIGURE 9: TARGET TRANSIT RIDERS

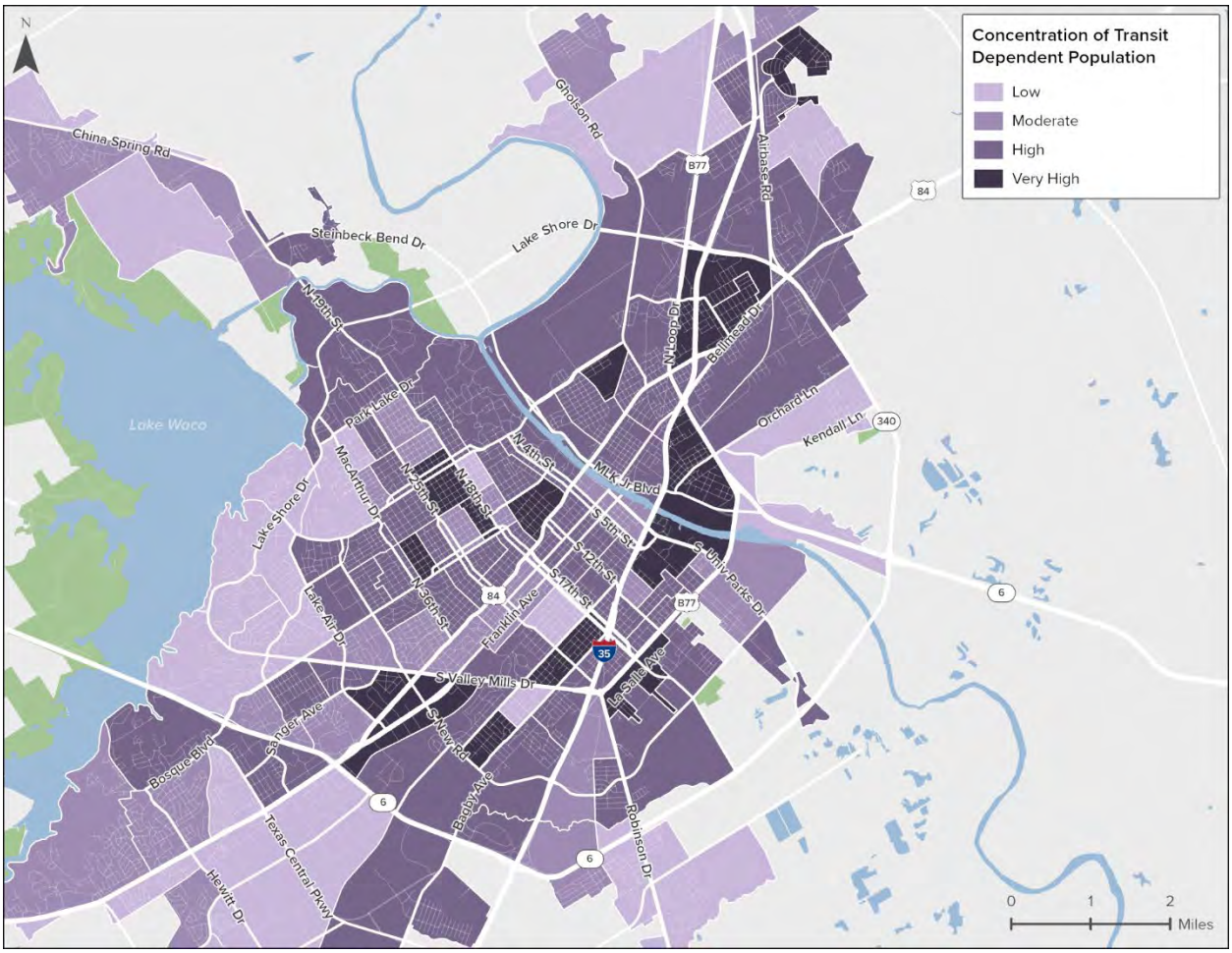


Transit Dependent Population

Transit Dependent Populations are considered to be reliant on public transportation because they are either ineligible to drive, due to age, institutionalized status, or because they do not have access to a personal vehicle.

Figure 10 displays the *Transit Dependent Population* in the study area. Many of the areas that are identified as *Target Transit Riders* in Figure 9 above are also identified as transit dependent here. The highest concentration of the *Transit Dependent Population* is in the center of the urbanized area and along Interstate 35. The lowest concentration is at the southern outskirts and near Lake Waco, to the west. In general, Figure 10 also illustrates a moderately high transit dependence throughout the region.

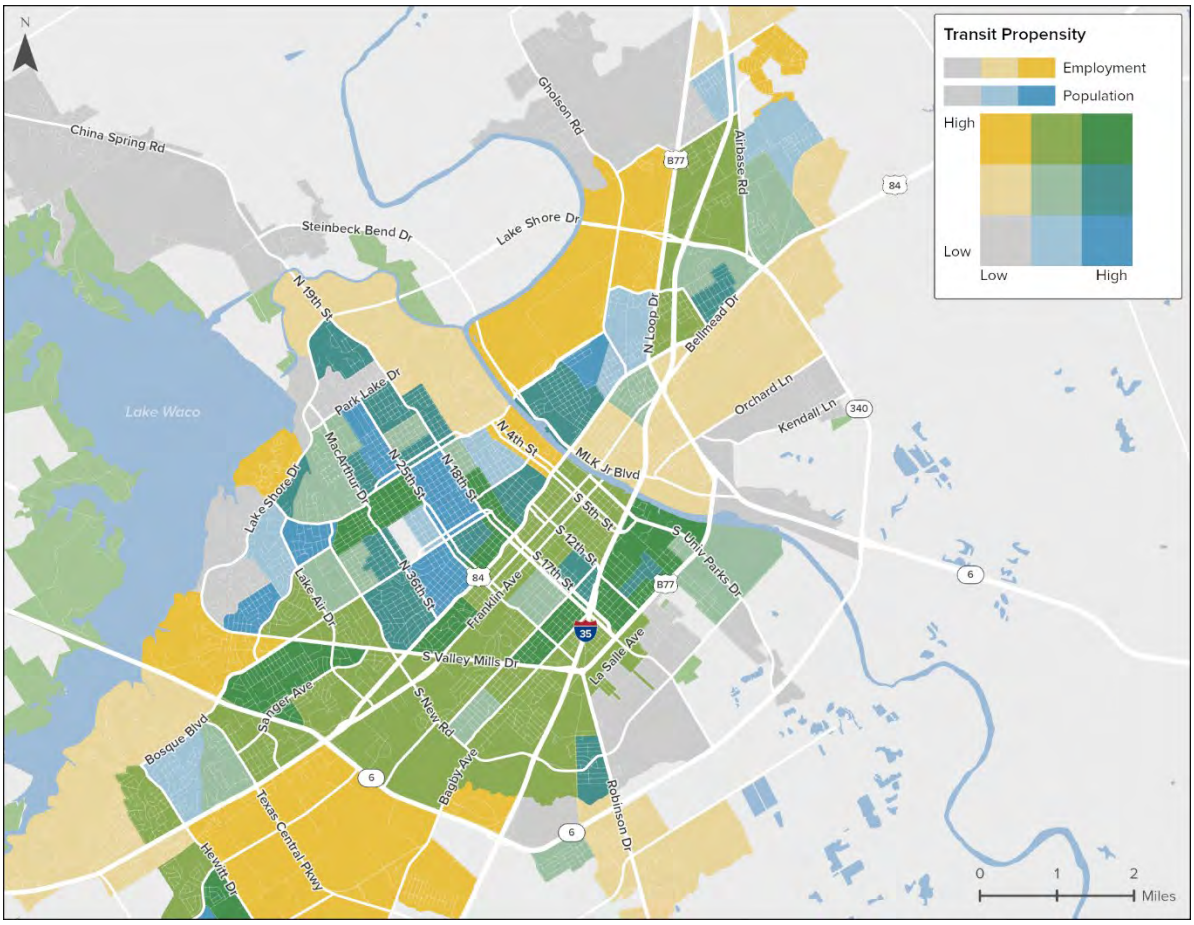
FIGURE 10: TRANSIT DEPENDENT POPULATION



Transit Propensity

Transit propensity highlights where people tend to live and work by examining both the population and employment density. In Waco, both the population and employment densities are centrally located, along Interstate 35 and US Route 84. The population density is highest in central and west Waco. On the other hand, key employment hubs are located south of Highway 6, west of US Route 84 north of the Brazos River, and southeast of Lake Waco (Figure 11).

FIGURE 11: WACO TRANSIT PROPENSITY



Connecting major employment hubs (yellow) to where residents live (blue) is a key objective of this redesign. Ensuring residents can easily commute to work and back home is a critical goal that serves most populations.

Transit Destinations

In the context of this report, key destinations refer to the locations transit passengers frequently visit. Accessibility to these destinations ensures that the goods and services necessary for daily life remain available to individuals who rely on public transportation.

Existing Key Destinations

Existing key destinations were identified by the City of Waco and highlight key community resources and services for residents. Access to the following destinations was considered to assess the overall connectivity of existing and future route recommendations (Figure 12):

- Community Resources
- Government & Public Services
- High-Density Residential Developments
- Job Locations
- Medical Services
- Services (Childcare, Hair Salon, etc.)
- Shopping Centers

FIGURE 12: EXISTING KEY DESTINATION BY CATEGORY

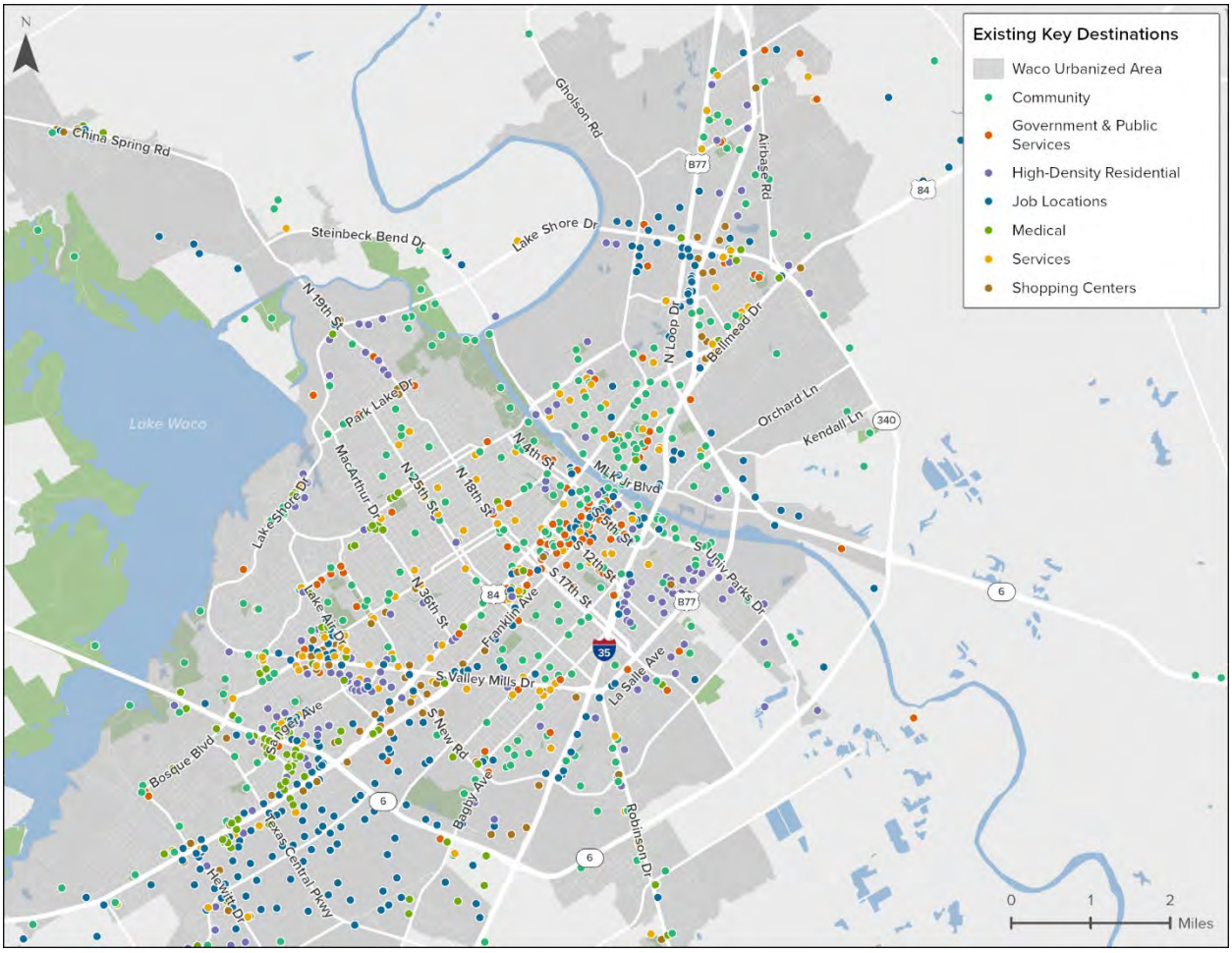
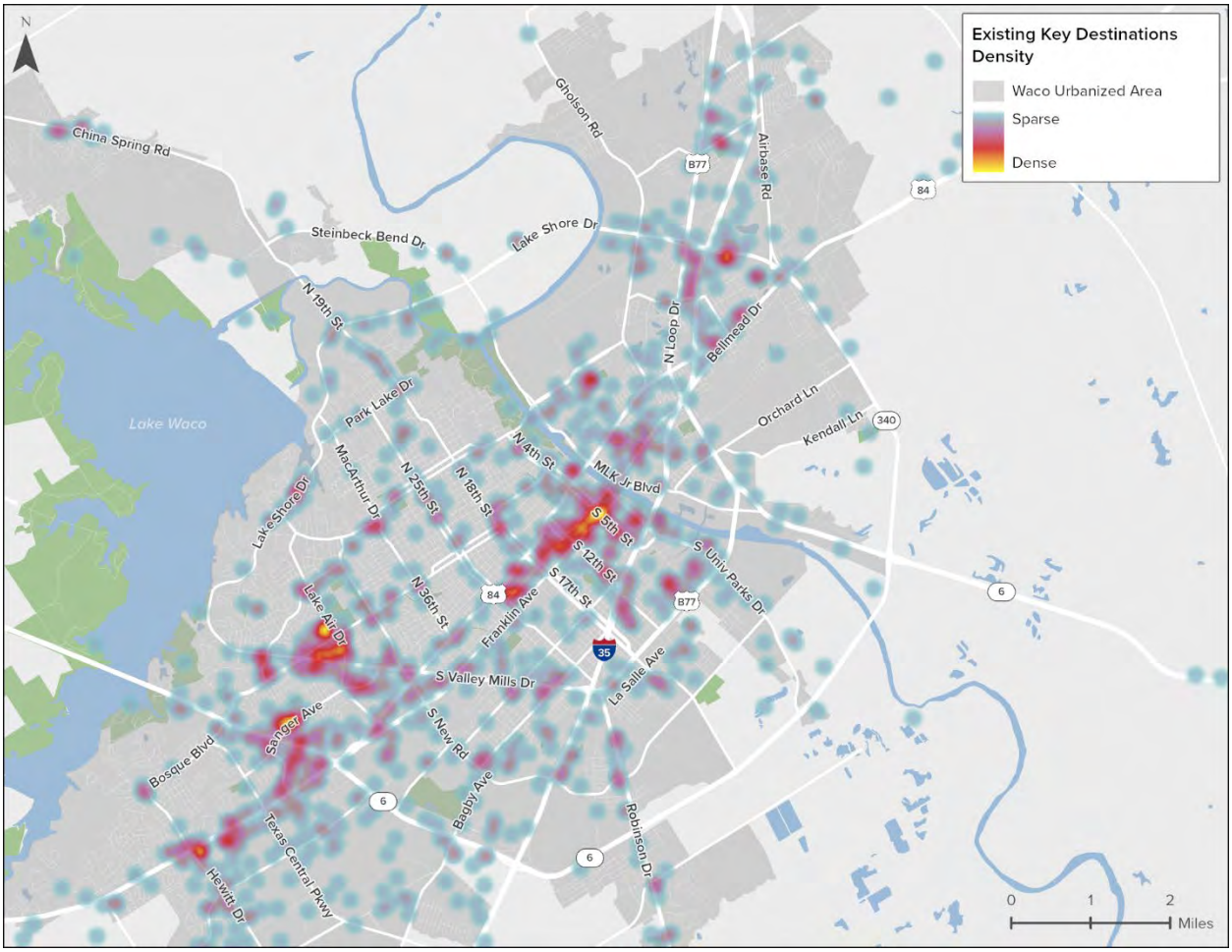


Figure 12 emphasizes the mix of uses along major arterials such as Franklin Avenue, US Route 84, 5th Street, 12th Street, and South Valley Mills Drive. Downtown and the intersection of Bosque Avenue and Lake Air Drive demonstrate a diverse mix of uses. Significant clustering can also be seen around the Downtown transit center, the H-E-B near Lake Air Drive, and Ascension Providence Hospital at the intersection of Highway 6 and Sanger Avenue.

South of Highway 6 is a significant employment hub in Hewitt, known for its manufacturing and industrial uses. Similarly, there is a clustering of high-density residential developments along Business 77, within proximity to Baylor University. In general, there is a high density of existing key destinations Downtown, along Lake Air Drive, Sanger Avenue, and along major arterials and highways (Figure 13).

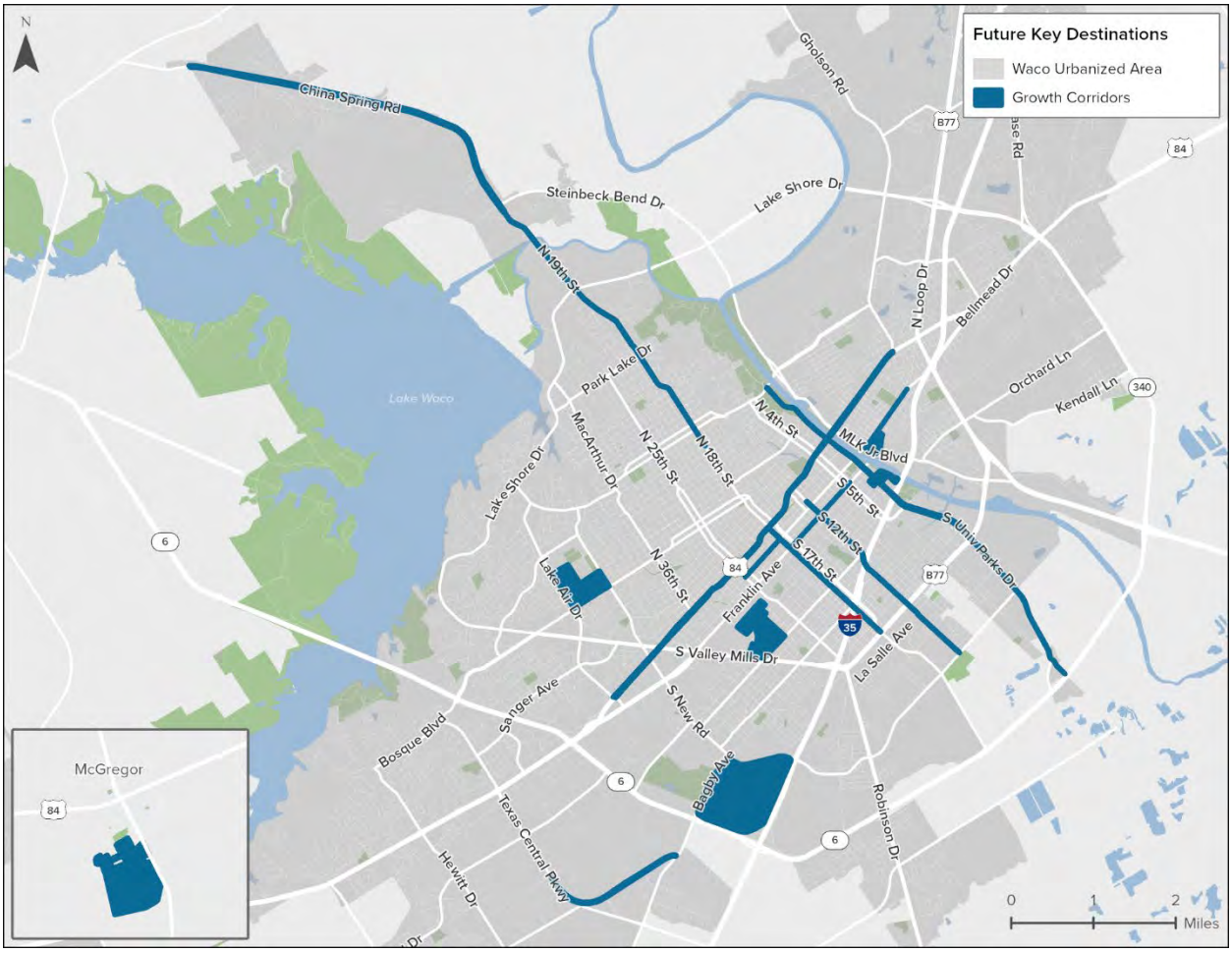
FIGURE 13: EXISTING KEY DESTINATIONS BY LOCATION



Future Key Destinations

While existing key destinations indicate where current demand is concentrated, future developments and growth indicate where demand for transit may rise. Figure 14 indicates where future commercial, retail, and residential growth is expected to occur. The growth within the core of Waco aligns with existing key destinations. However, additional developments north of Highway 6, along Lake Air Drive, and near McGregor (southwest of the City of Waco) indicate opportunities for future transit connections.

FIGURE 14: FUTURE GROWTH CORRIDORS



Travel Patterns

This analysis uses 2019 StreetLight data, and the 2040 regional Travel Demand Model (TDM), to examine where people are traveling within the Waco Urbanized Area. StreetLight is a crowd-sourced mobility database that collects a sampling of GPS data from smartphones and similar technology.

Existing Travel Pattern

Figure 15 is a conceptual flow diagram depicting current automobile travel patterns within the study area. Streetlight data indicates that the following district pairs experienced the highest travel in 2019:

- Baylor & Oakwood
- Downtown & Baylor
- Hewitt & West Waco
- Woodway & West Waco

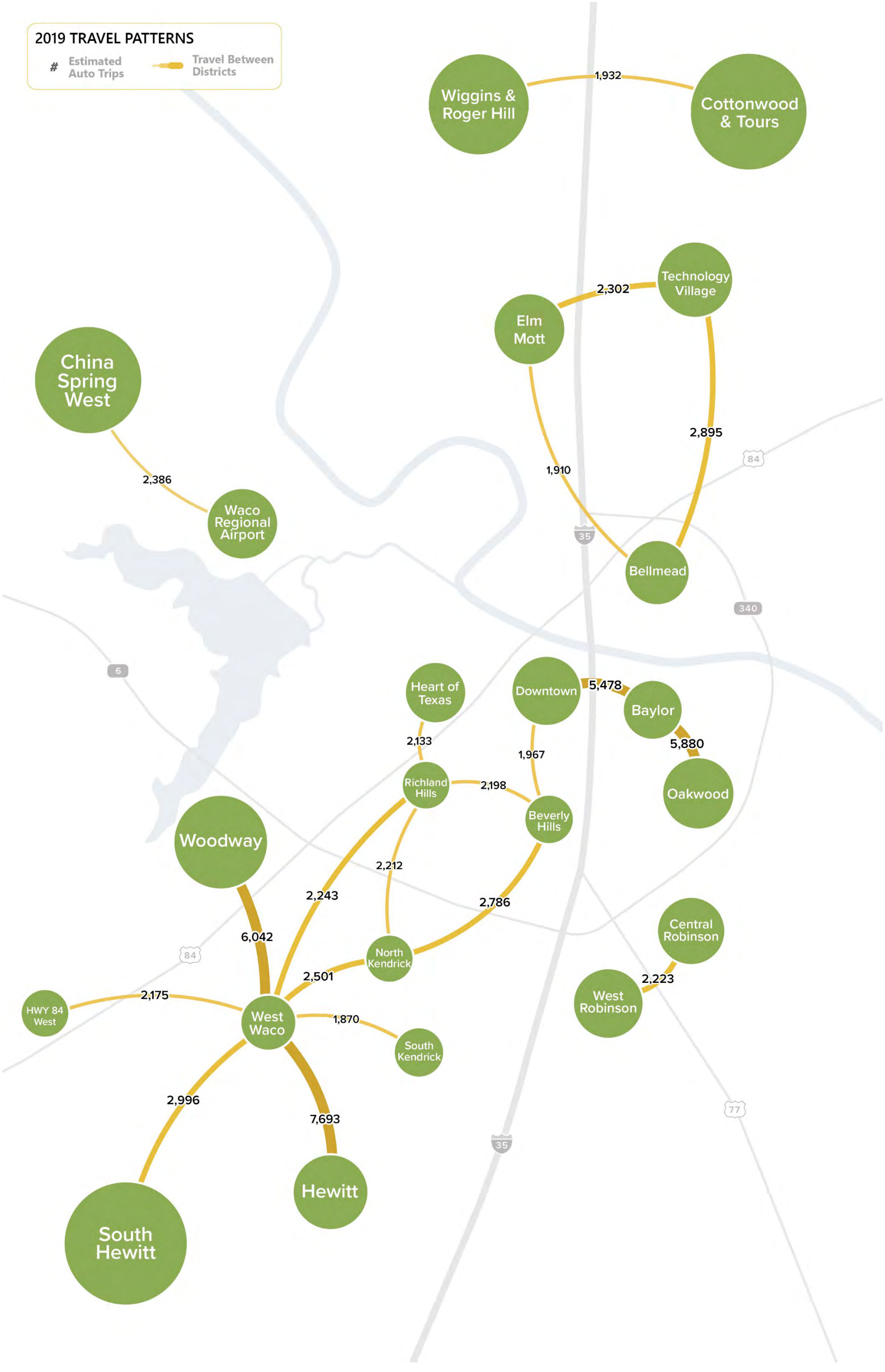
Figure 15 also demonstrates the top 20 travel patterns within the study area. Notably, there are significant spatial clusters and divides. In general, there is a natural north-south travel pattern among the residents of Waco; however, travel north of the Brazos River is isolated from the activity occurring Downtown and below. Similarly, China Springs and the airport are clustered with no significant travel patterns to or from Downtown or north of the Brazos River.

Technology Village, Bellmead, Lacy Lakeview, and Elm Mott represent neighborhoods closest to Downtown, just north of the Brazos River.[2] These four communities demonstrated significant travel between one another in 2019. Lastly, Robinson, although exhibiting a significant travel pattern within itself, demonstrated no significant travel patterns to Downtown Waco.

Isolated clusters such as these can indicate either an opportunity for a regional connection or increased transit services between the two destinations.

[2] Lacy Lakeview is accounted for within the Elm Mott district in the images below to reconcile difference between the 2019 and 2040 district boundaries.

FIGURE 15: EXISTING TRAVEL PATTERNS



Future Travel Patterns

While StreetLight data provides existing desire lines, the 2040 Travel Demand Model (TDM) was used to project travel patterns. Figure 15 is a conceptual map of the top-20 travel patterns for car trips within the Waco Urbanized Area. In parallel with future growth corridors and existing travel, patterns of increased travel within the core of Waco are expected. Specifically, there are indications that travel from West Waco to Downtown will increase, as well as travel from smaller neighborhoods in between these two districts.

The 2040 TDM is primarily based on population and employment projections, therefore, future travel patterns in Figure 16 would be considered reasonable.[3] Central Waco is one of the most densely populated areas within the study area and West Waco contains a majority of the employment and industrial services discussed in earlier sections. Continued growth within these regions would produce increased activity between existing transit-supportive neighborhoods.

FIGURE 16: FUTURE TRAVEL PATTERNS

[3] Note that 2019 StreetLight data validated 2019 Transportation Demand Model projections and its underlying assumptions.

Social Vulnerability Index

The Center for Disease Control (CDC) created the Social Vulnerability Index (SVI) to measure potential resilience to external stressors, such as natural disasters or displacement.[4] The SVI assesses communities at the Census Tract level and ranks their vulnerability based on 15 social factors, grouping them into four related themes to create an overall index.

To identify communities with limited mobility this analysis uses the 2018 CDC SVI to prioritize the needs of vulnerable populations. It considers the following themes of social determinants to understand the spatial distribution of various categories of vulnerability:

- Household Composition and Disability
- Housing Type and Transportation
- Minority Status and Language
- Socioeconomic Status

Household Composition & Disability

Indicators in the Household Composition & Disability theme evaluate the age of the residents, single parenthood, and disability status. The CDC has acknowledged that children and the elderly are among the most vulnerable populations; this is due to a tendency to rely on others for assistance.

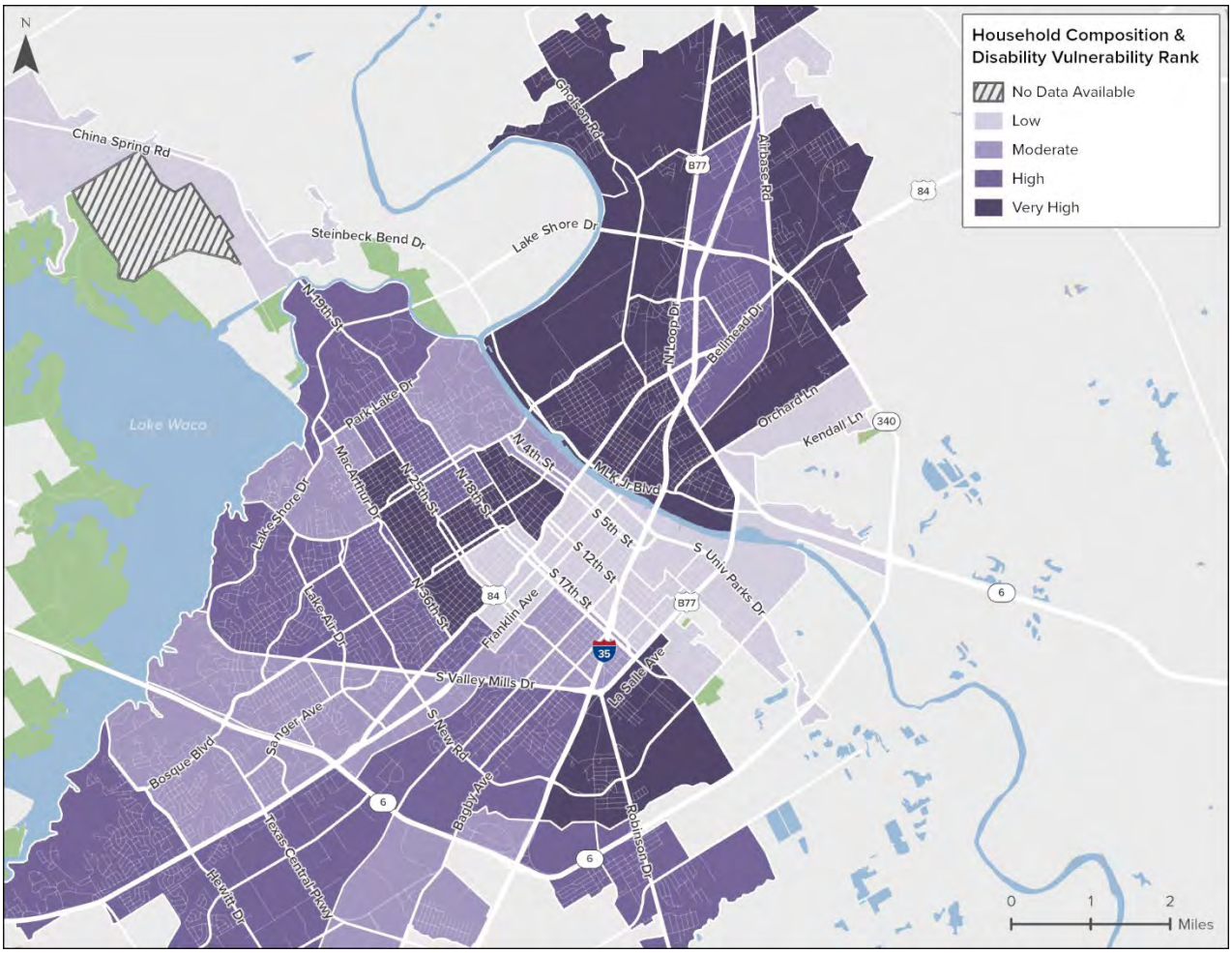
The specific Census demographic groups included in this category include:

- The number of individuals age 65+
- The number of households with children under 18 years old
- The number of households with only one parent or caretaker
- The number of individuals with a disability

In Figure 17, areas that have a greater number of these demographics are illustrated in a darker color. These households are dispersed throughout the urbanized area with high concentrations clustered in the north, central, and southeast regions. The greatest concentrations of households with age and disability vulnerabilities are in north Waco, north of the Brazos River.

[4] Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. CDC/ATSDR Social Vulnerability Index 2018 Database Texas. https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html. Accessed 2021.

FIGURE 17: HOUSEHOLD COMPOSITION & DISABILITY THEME



Housing Type & Transportation

The following indicators are assessed in the Housing Type & Transportation theme:

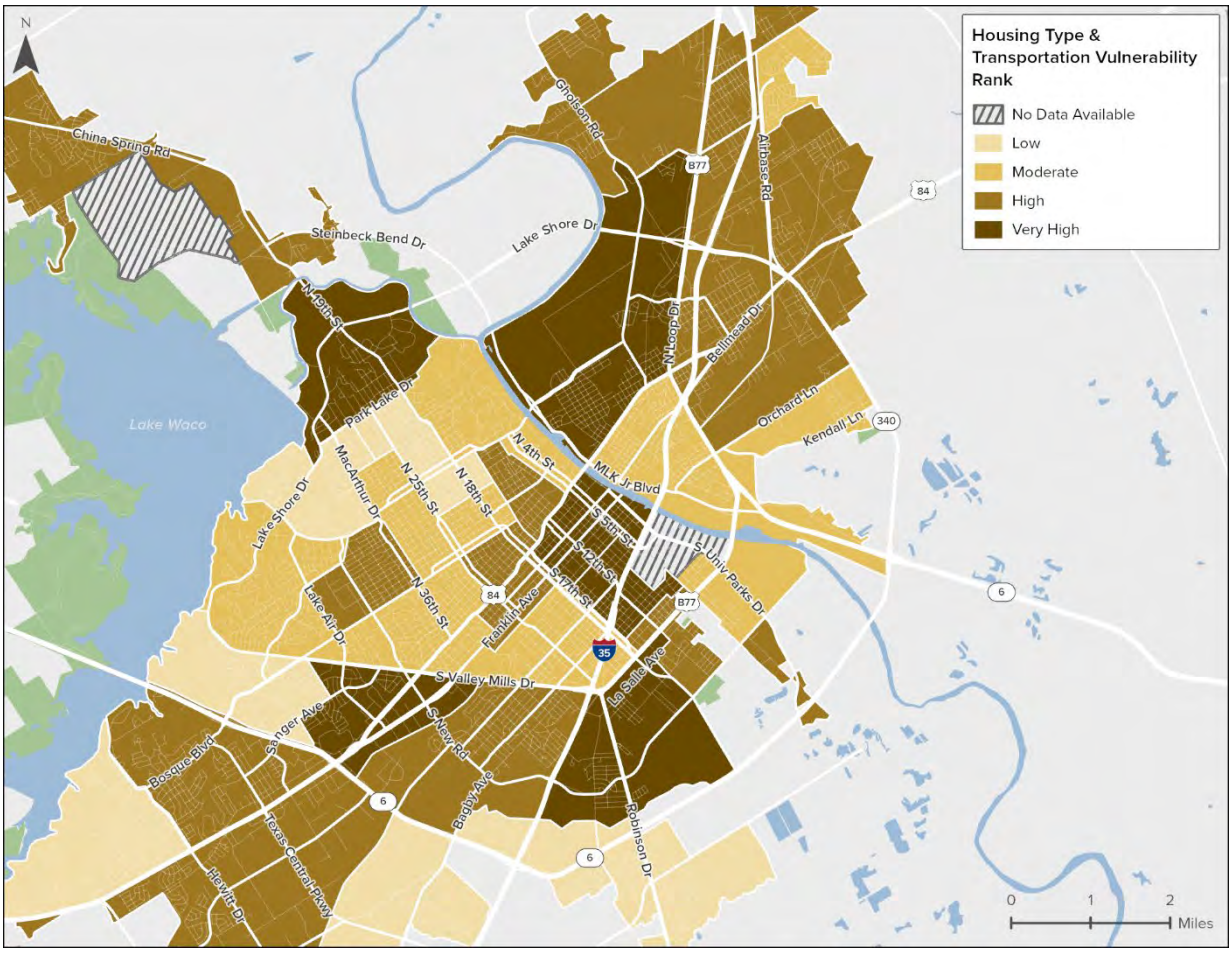
- Households without access to a vehicle
- Residents living in group quarters
- The number of mobile homes
- Housing unit development types

Certain housing types are more resilient than others, so housing quality can be a significant indicator of how households will fare to an external stressor. Additionally, households living in mobile homes, multi-unit housing, group quarters, or without a vehicle, face barriers to both short- and long-term mobility.

Figure 18 illustrates the Census Tracts where there may be existing vulnerabilities in housing and transportation. While there is a moderate mobility vulnerability in the central region, concentrations of vulnerable housing types and low mobility households are mostly dispersed along the outskirts of the urbanized area. The highest concentrations are clustered north of the

Brazos River, south of LaSalle Avenue, west of Park Lake Drive, and south of Valley Mills Drive. Tracts exhibiting low mobility vulnerability are those closest to Lake Waco.

FIGURE 18: HOUSING TYPE & TRANSPORTATION THEME



Minority Status & Language

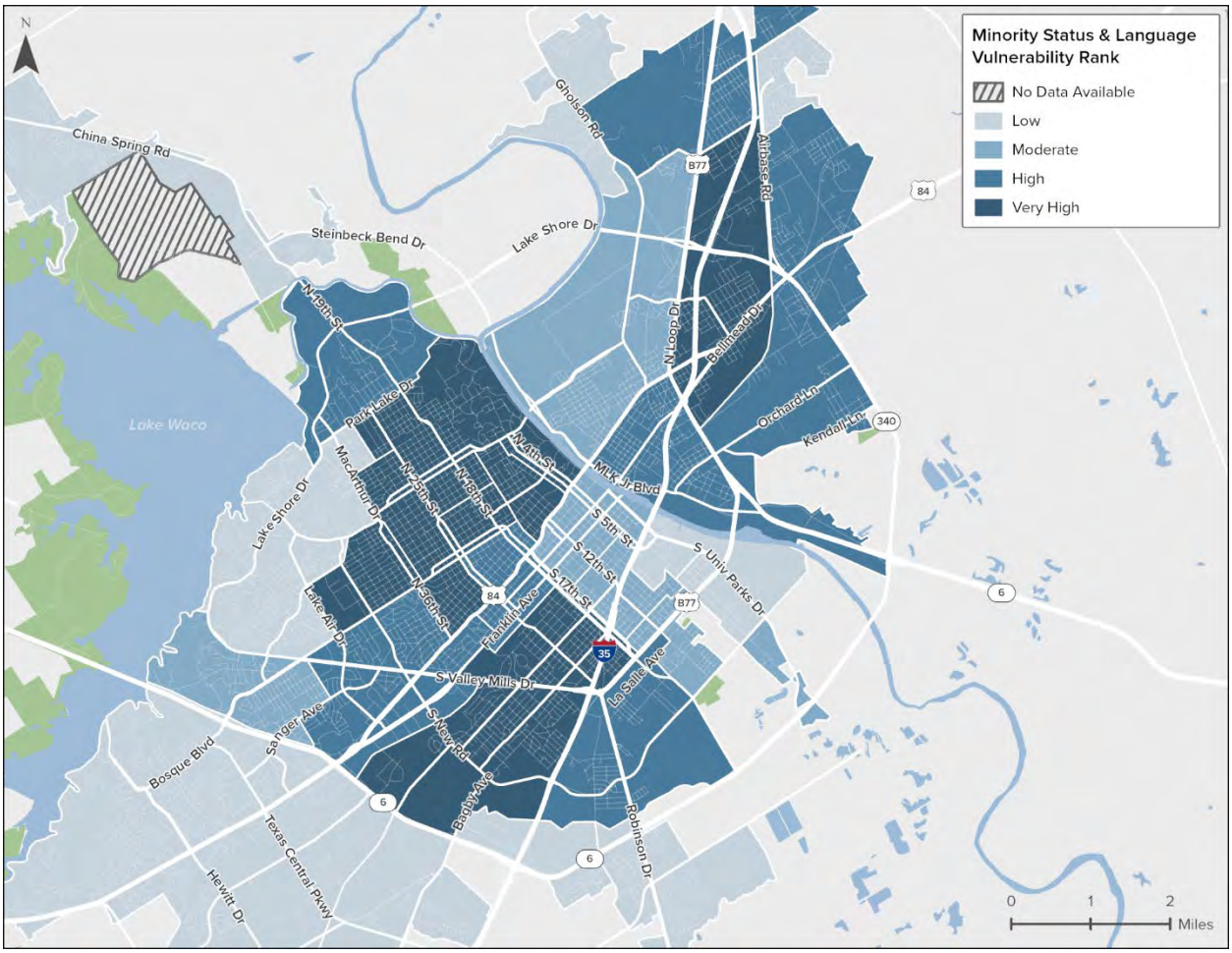
The Minority Status & Language theme acknowledges the ongoing effects of historic social and economic marginalization of racial and ethnic groups.

Figure 19 illustrates the following demographic groups:

- The non-white population
- The number of residents who speak English “less than well”

Historic practices of redlining, and other economic restrictions, make non-white populations more vulnerable to external stressors. Additionally, lower levels of English proficiency can be a significant barrier to resources. Minority individuals, or those with lower levels of English proficiency, are centrally located in the urbanized area north of Highway 6. There is also a moderate to very high concentration of these individuals west of Downtown and near Interstate 35. The lowest concentration of individuals in these demographic subgroups is to the south, below Highway 6, and to the west, bordering Lake Waco.

FIGURE 19: MINORITY STATUS & LANGUAGE THEME



Socioeconomic Status

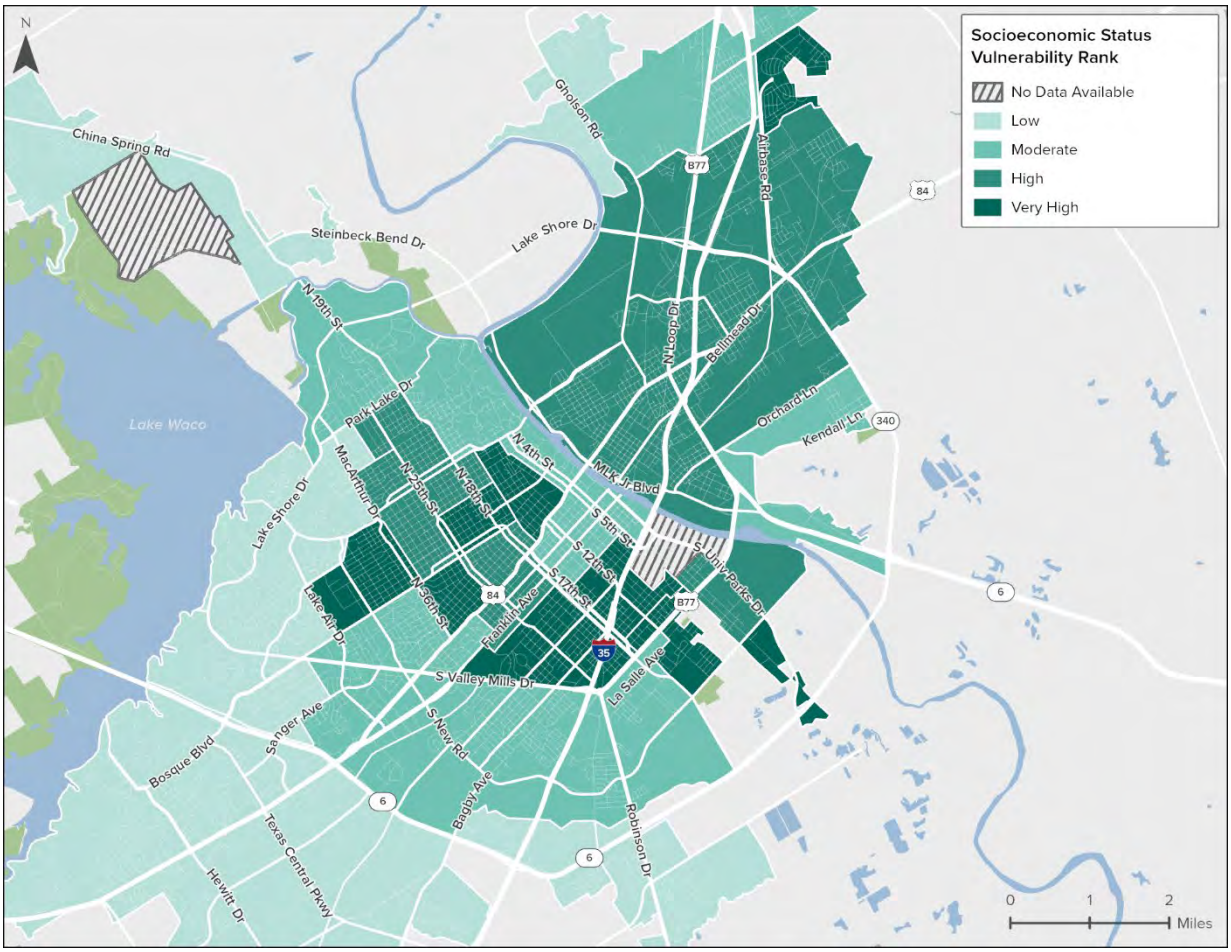
The Socioeconomic Status theme considers the following demographic indicators:

- Individuals living below the poverty line
- The unemployment rate
- The median household income
- Residents without a high school diploma

Higher levels of education are associated with greater access to resources and greater resiliency to external stressors. Conversely, people who are already impoverished, and/or unemployed, are more vulnerable to the same stressors.

Figure 20 highlights the communities in the Waco Urbanized Area that are the most vulnerable to economic stressors. Census Tracts south of Highway 6 and those bordering Lake Waco exhibit a high resiliency to economic stressors. Tracts in the central region and north of the Brazos River indicate a moderate to very high vulnerability to the same stressors. The most vulnerable tracts are centrally located northwest of Valley Mills Drive and Interstate 35. These communities may be the most susceptible to displacement and other unintended impacts of transportation improvement.

FIGURE 20: SOCIOECONOMIC STATUS THEME



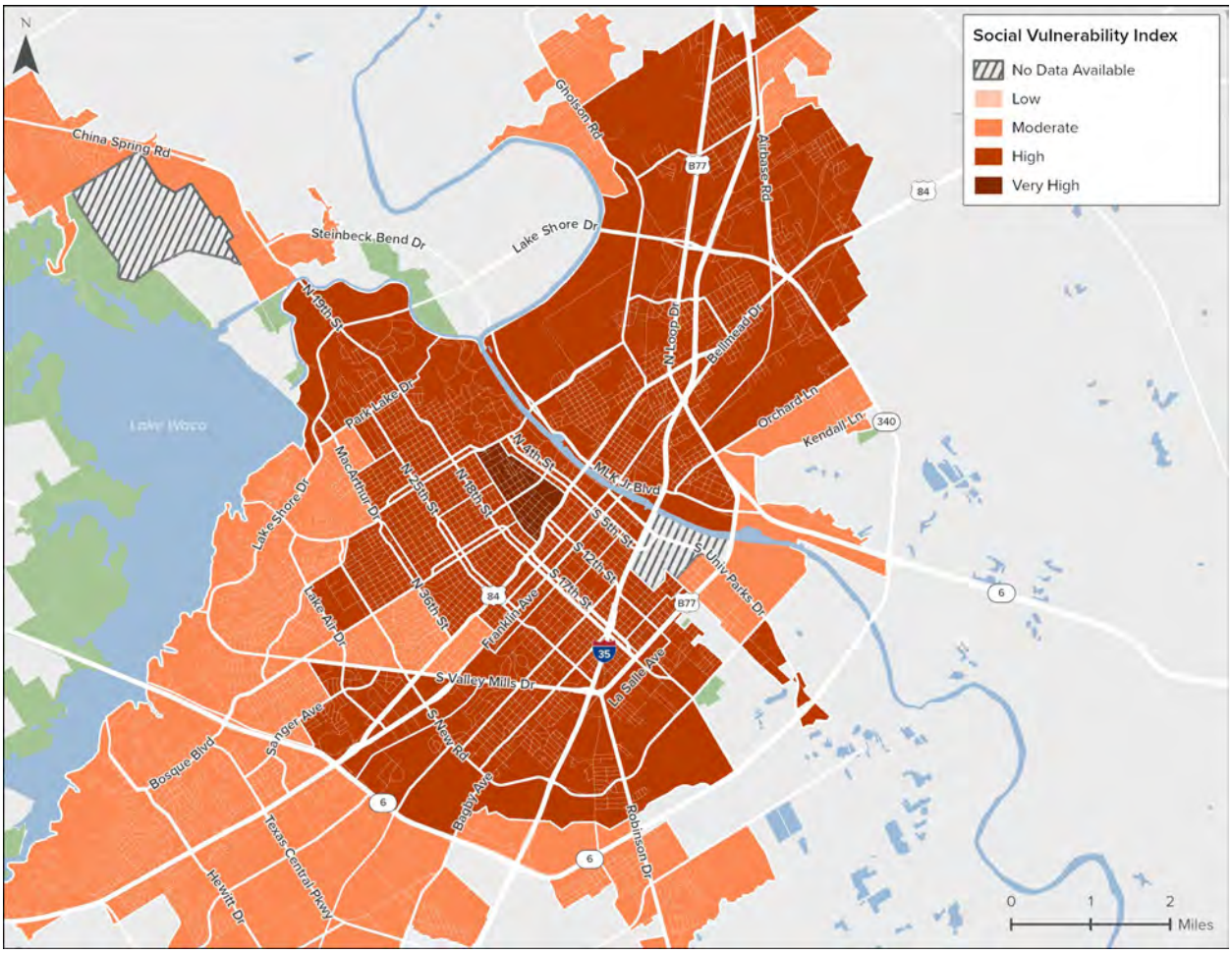
Composite Vulnerability

The four demographic themes discussed above were summarized and ranked by the CDC to create an overall composite social vulnerability index. When considering external stressors, tracts with a moderate to very high social vulnerability are the least likely to recover. If recovery is possible, the process will take longer without additional support.

Figure 21 reflects the overall social vulnerability of communities in the urbanized area. Given each of the themes, the study area overall exhibits a moderate to high vulnerability to external stressors. **None of the tracts in the urbanized area indicated a low social vulnerability.** Most of the tracts north of Highway 6 indicate a high vulnerability.

The greatest concentration of vulnerable communities is at the heart of the urbanized area, south of 4th Street and north of 18th Street. These tracts exhibiting 'very high' vulnerability may be the most likely to experience negative impacts or require additional support following external stressors.

FIGURE 21: COMPOSITE SOCIAL VULNERABILITY THEME



Key Findings

The Waco Transit System (WTS) has provided an affordable and vital service for its residents for decades. While the findings identified in this section will be used to guide recommendations for improved service, feedback from the public will validate key assumptions and the needs of the community. With the recent opportunity to redesign the fixed-route and on-demand transit services, WTS can increase connectivity, mobility, and equity through the following improvements:

- Reduce service redundancy and design more intuitive service
- Connect isolated transit markets and capture unserved travel patterns
- Improve on-time performance
- Increase service within the core of Waco and north of the Brazos River
- Serve future growth corridors and increase ridership and connectivity

CHAPTER 4
PUBLIC ENGAGEMENT

PUBLIC ENGAGEMENT

The Reimagine Waco Transit study presented a critical opportunity to engage a broad spectrum of stakeholders. The team used effective and inclusive approaches that encouraged open dialogue and generated informed feedback. Through this effort, the project team gained unique familiarity and understanding of the history of the transit system in Waco, including insights about the specific values and motivations of key stakeholders.

The engagement process aided the WTS project team in building trust and transparency within the community. Moreover, the Reimagine Waco Transit study team deployed a combination of online and in-person participation strategies based on lessons learned and best practices from previous transit studies in Waco, including the Waco Rapid Transit Corridor (RTC) Feasibility Study and the Waco Bus Rapid Transit (BRT) Preliminary Engineering and Environmental Review Study. The qualitative data from these sessions was used to supplement the quantitative research of the project team's existing conditions, scenario development, and recommendations.

Goals and Objectives

The overarching goal of the public engagement effort for the Reimagine Waco Transit study included providing continuity and education on transit realignment possibilities and collecting essential insights on opportunity areas. The team strived to foster respectful and informative community dialogue.

Stakeholder and public input were imperative to develop a plan that accurately identified and addressed rider needs. As part of the project team's engagement objective, the public was involved early by providing continuous, transparent, and effective access to information about the study and the decision-making process used to determine final recommendations. By involving the public throughout the life of the study, the project team employed a transparent decision-making process that encouraged the development of community-driven final outcomes.

Cultural knowledge of Waco from participants also helped articulate issues and establish additional project objectives. This feedback created dynamic solutions to enhance the fixed route transit system. A diverse project steering committee engaged a full range of voices in the regional planning area, especially disenfranchised communities historically excluded from decision making processes. Throughout this process, the project team remained committed to listening to and seeking input from throughout the community.

The following objectives were established and utilized to evaluate the success of the project's outreach efforts and to ensure the goal of the public engagement process was met:

- Establish early and continuous public participation opportunities that provide timely information to all interested parties.
- Provide access to quantitative findings on the project to enhance the public's knowledge and ability to participate in the development of the system realignment.
- Provide adequate notice of participation opportunities, plus time for public review and commentary at key decision points.

- Ensure public participation opportunities are held at convenient and accessible locations and times (in compliance with the Americans with Disabilities Act of 1990, as amended).
- Make information accessible using visualization techniques and appropriate electronically accessible formats.
- Include measures for seeking input from and for considering the needs of communities that are most affected by transit system changes and historically underserved populations.
- Collaborate with the stakeholders on identification of issues, prioritization of alternatives, and potential final recommendations.
- Provide a contact to listen, acknowledge, and respond promptly to public questions and issues.
- Target questions and conversations directly to performance measures that can enhance access and use of the bus system.

Who is "the public"?

The section below describes the various members of the public that were engaged as part of the Reimagine Waco Transit study.

General Public

The team engaged with residents throughout the Waco metropolitan area to understand their goals and priorities for the future of public transportation in the community. The project team gathered feedback to help better understand mobility issues in the area and implement changes to offer improved accessibility and connectivity. The team placed a focus on capturing input from a variety of different groups by making the process accessible to everyone.

Key Stakeholders

The Reimagine Waco Transit study identified key stakeholders in the metropolitan area of Waco based on previous studies and familiarity with the community. Stakeholders that were identified included university administration, elected officials, transit leaders, economic development professionals, and those with local expertise as well as a strong influence in the community. Engaging contributors to the success of the local transit system provided an unparalleled understanding of the challenges and threats within the area.

Steering Committee

A project steering committee consisted of a predetermined group of people that helped guide strategic decisions throughout the study process. The steering committee played a major role in the execution and maintenance of the recommendations that resulted from the study. The committee consisted of representatives from both the Waco Metropolitan Planning Organization (MPO) and Waco Transit System (WTS), in addition to other community leaders.

Public Engagement Process

The public engagement process for the Reimagine Waco Transit study took place between October 2021 and June 2022 and included the following three phases.

Public Engagement Phase 1

The first public engagement phase was designed to raise awareness about the Reimagine Waco Transit study and to gauge attitudes towards the current system and planning gaps. The input collected during this phase helped inform the needs assessment for the study and the development of future transit scenario recommendations.

Public Engagement Phase 2

The second public engagement phase focused on soliciting input on the future transit scenario recommendations that were created based on feedback from the previous public engagement phase and the results from the quantitative analysis of the transit system. Phase two emphasized the overarching themes from the input collected during the first public engagement phase. Public feedback results from this phase informed the final plan recommendations.

Public Engagement Phase 3

As part of the third public engagement phase, the final plan was presented to City Council along with any comments received during the period for final adoption and selection of a scenario.

Public Engagement Strategies

WTS utilized multiple strategies to support the engagement process for the Reimagine Waco Transit study.

Key strategies to support the public engagement effort for the study included a blend of socially distanced in-person events and online tools as a result of the COVID-19 pandemic. These strategies are described below.

In-Person Events

Meet the Public

Reaching the transit systems' customers was a critical goal for WTS. Further, the safe implementation of drop-in, pop-up tabling, and in-route advertising and engagement methods worked well to drive interest and increase feedback on the study. Meeting the public where they are helped facilitate crucial conversations for better understanding the daily uses of the transit system. Additionally, conversations helped build trust through transparency during the planning process. These small community discussions took place at public events, transit service locations, schools, community sporting events, and popular commercial areas.

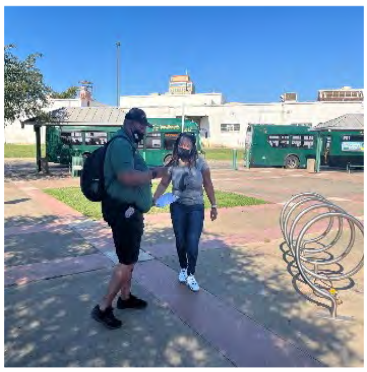
The following listing identifies the various events where the project team hosted information tables and interfaced with community members.

Public Engagement Phase 1

- Find Your Waco Life Festival - Oct. 22, 2021

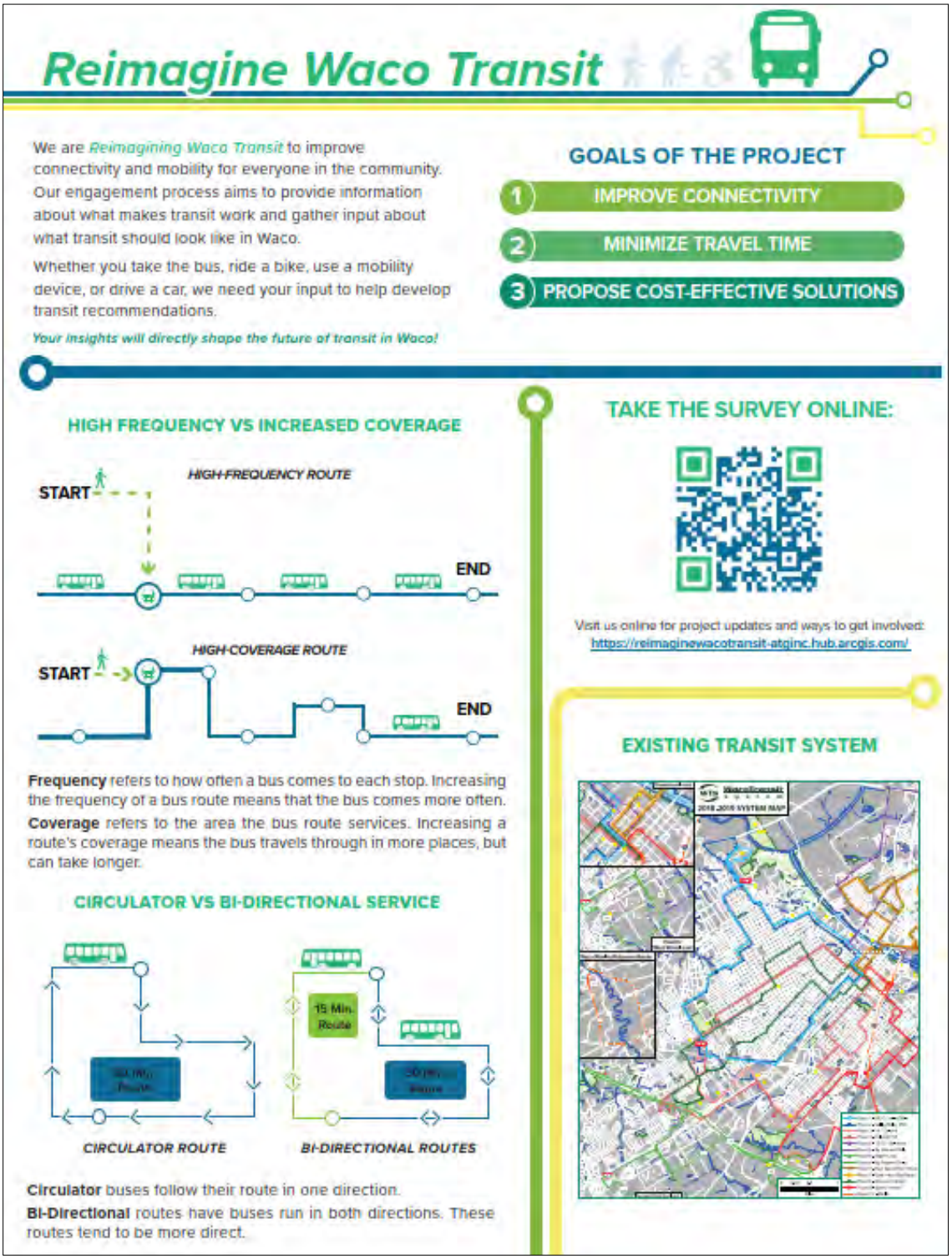

- CROCtober Fest - Oct. 22, 2021


- Waco Transit Center - Oct. 22, 2021

To help inform and educate the public and encourage their participation in the study, an informational display board was used at the in-person events conducted during Public Engagement Phase 1.

FIGURE 22: PROJECT INFORMATION DISPLAY BOARD

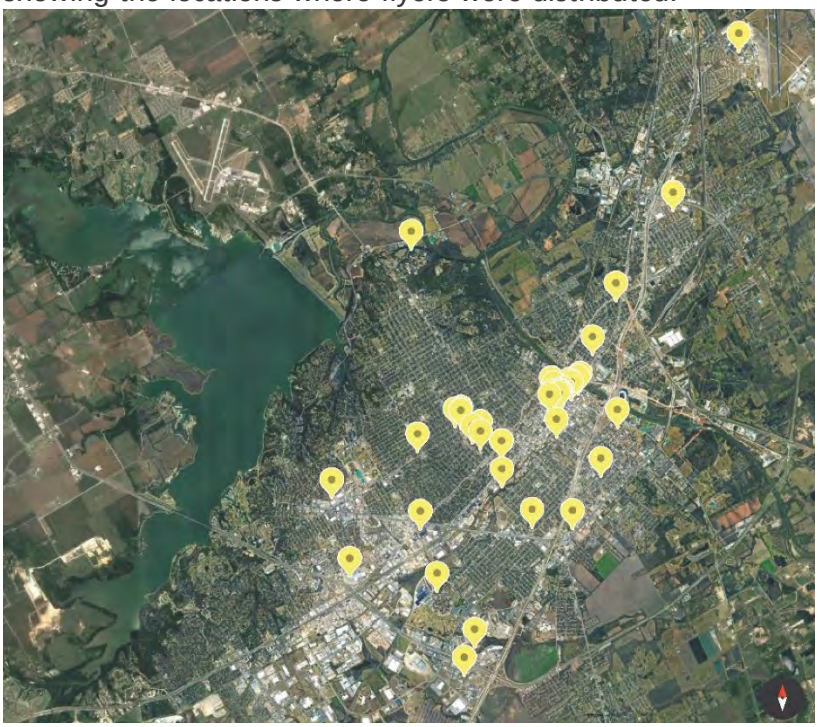


Public Engagement Phase 2

- **Kick Off** – April 7th, 2022

  The team kicked off Phase 2 with a presentation to the Waco Metropolitan Organization's Technical Advisory Committee.

  The project team created flyers to disseminate project information. Below is a map showing the locations where flyers were distributed.



- **Waco MPO Policy Board Meeting** – April 21st, 2022

- **Business Community Outreach Meeting (virtual)** – April 21st, 2022 at 10:00 a.m.

  This meeting directly engaged local businesses and business chambers. The Greater Waco Chamber of Commerce hosted this virtual meeting to hear more about the proposed changes to the transit system, ask questions, and learn how to promote the survey. The following participants were included in the meeting and invitees were encouraged to share information and survey materials with their members and networks. Organizing with the business community allowed the project team to expand its engagement reach to inform and engage residents:

  - AT&T
  - Catholic Charities of Central TX
  - Heart of Texas Workforce Solutions
  - City of Waco
  - Bitty & Beau's Coffee
  - Waco Hispanic Chamber of Commerce

- McGregor Chamber of Commerce
- Bear Mountain
- Friends for Life
- Mosaic Waco
- Hotel Indigo
- The Warren Group
- Cuppie Cakes
- Richland Mall

- **Open House at Waco Transit Center** – April 28th, 2022, at 12:00 p.m. and 6:00 p.m.

  The open house event held at the Waco Transit Center invited the community to learn about the proposed scenarios. The project team distributed printed material about the proposed scenarios, including time travel maps to illustrate changes in travel times between origins and destinations. The project team also informed residents about microtransit integration and had laptops on-site for attendees to complete surveys at the event.

- **Neighborhood Leaders' Network meeting –** April 28th, 2022, at 6:00 p.m.

  This network meeting brought together neighborhood associations of Waco to distribute information through their networks and encourage others to submit survey responses.

The neighborhood association representatives were able to serve as stewards of the plan and speak to the specific changes that would impact their neighborhood to community members. Attendees included representatives from the following neighborhood associations:

- Parkdale Viking Hills
- Brookview
- Alta Vista
- Cameron Park
- Brook Oaks
- Cedar Ridge
- Dean Highland
- Oakwood

Public Engagement Phase 3

Following final public comment, the final plan and alternative scenarios were submitted to Waco City Council for approval and a preferred alternative with public comments documented.

Public Survey

During Public Engagement Phase 1, a public survey was used to help the project team gain a better understanding of community concerns and ideas.

The survey served two purposes:

- Provided an opportunity for the public to provide valuable input about transit that was used to directly inform recommendations.
- Helped educate the public about what a great transit system can look like and accomplish.

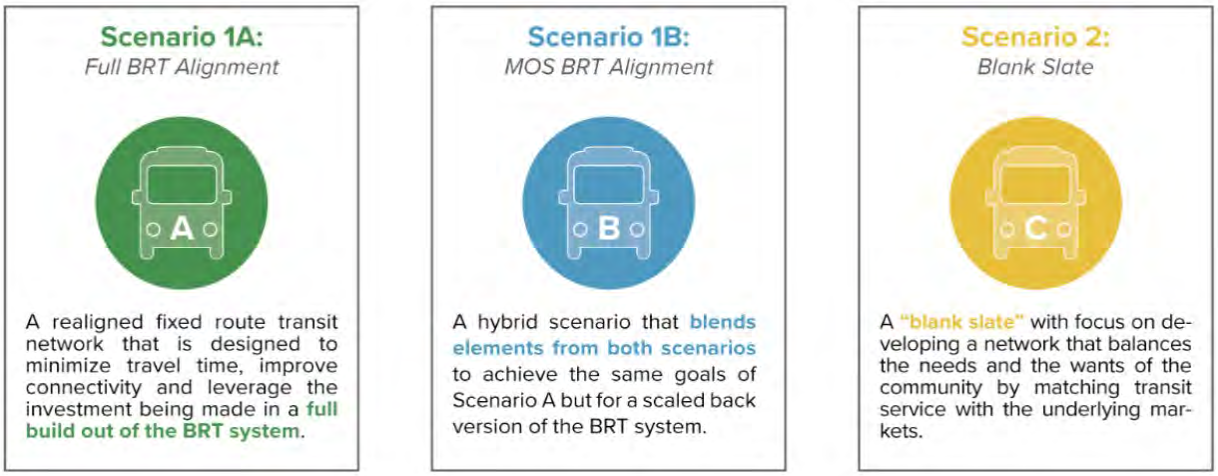
The survey was made available October 2021 through December 2021 and was distributed by email to key stakeholders, placed on the project webpage, and shared with the public at tabling events. A QR code was also developed to enable mobile access to the online survey at public transit stops and tabling events.

Multiple social media postings were placed on WTS's Facebook page to encourage community members to complete the online survey. Distributing surveys through both physical and digital mediums facilitated the opportunity for participants on both sides of the digital divide to provide meaningful feedback.

Hard copies of the survey that were made available to the public at events were coded to help track the results and trends associated with the event area or event. The hard copies of the survey and online survey were made available in English and Spanish.

Hosting in-person events and conducting the survey helped the project team better understand community values in relation to transit service.

During Public Engagement **Phase 2**, community survey responses were collected in person and online at various outreach meetings. The survey presented maps of the three draft scenarios:

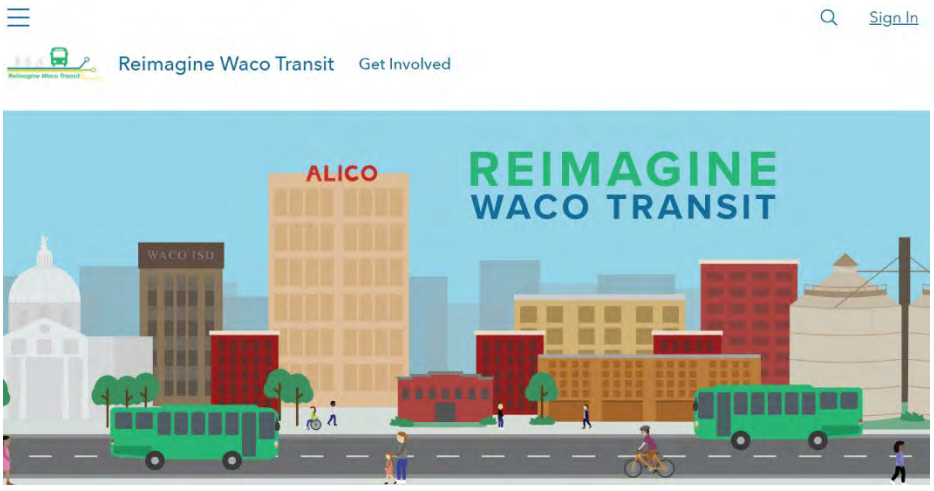


The survey had a system map for each scenario with information on destinations, and a question about whether the proposed scenario would save the respondent's time or not. Space was provided below the prompt to check a box so that respondents could explain why they selected a response.

Webpage

A webpage with key information about the study and details about how to stay involved in the project was made available throughout the entire study process. As the study progressed, the webpage was updated to reflect key updates and public input opportunities. The webpage was also linked to the WTS and Waco MPO websites.

FIGURE 23: REIMAGINE WACO PROJECT WEBPAGE



Information Distribution Through Third-Party Organizations

English and Spanish language project-related marketing materials designed for website and social media use were shared with various third-party organizations such as local universities, politicians, business interest groups, and small businesses. The organizations were requested to help inform their respective audiences about the Reimagine Waco Transit study and the opportunities to inform the study.

Project-related marketing materials were provided to the following organizations:

Public Engagement Phase 1

- Art Locally Waco
- Downtown Waco
- Prosper Waco
- Waco Bicycle Club
- Waco Walks

Public Engagement Phase 2

- Union Food Hall
- Running Home
- Letterpress
- Coming Home to Waco
- EOAC Community Services
- City of Waco Development Center
- Spice Village
- Bitt and Beau's Coffee
- Fabled Bookshop and Café
- Provident Heights Elementary School
- Poco Loco Supermercado
- Waco Car Audio
- Twenty-Fifth Street Bazaar
- N&S Grocery Store
- Pollos El Rey
- Waco Charter School
- Pinewood Coffee Bar
- Yaki Texas Food Truck
- South Waco Recreation Center
- Waco Ale Company
- Downtown Barbershop
- New Day Bar
- Waco Work
- Lighthouse Coffee & Wine

FIGURE 24: MARKETING MATERIALS (PUBLIC ENGAGEMENT PHASE 1)

FIGURE 25: MARKETING MATERIALS (PUBLIC ENGAGEMENT PHASE 1)

Email Updates

Email messages were distributed to over 325 stakeholders using the listservs from the previous RTC Feasibility and BRT studies; including stakeholders that provided comments on the Reimagine Waco Transit study and/or that requested to be added to the listserv for the study. The email messages were used to create awareness about the Reimagine Waco Transit study, provide key updates about the study, and encourage stakeholder participation.

FEEDBACK RESULTS

As mentioned earlier in this plan, the project team incorporated survey feedback into the scenario plans and made changes to routes in response. By using surveys and soliciting feedback, the team was able to craft system plans that respond to resident needs.

FIGURE 26: PUBLIC SURVEY RESULTS (PUBLIC ENGAGEMENT PHASE 1)

CONCLUSION

The Waco community demonstrated overwhelming support for rethinking and realigning public transit and expressed the desire and need for transit growth and expansion. Stakeholder support and participation ensured that public engagement efforts had broad reach using both traditional in-person and virtual methods. Comments from both bus operators and members of the public stressed the need for improving connectivity and the desire for more intuitive route design, as well as for greater frequency and span of service.

As the City of Waco continues to grow and invest in transformational projects such as the Riverfront Development and the Franklin conversion, so must the investment and expansion of its transit system. Buses that come more often and provide greater connection to the places riders want to go will create a more convenient system, saving transit users time. This exhaustive and robust public engagement effort has ensured that the technical recommendations of each scenario are truly representative of the Waco community.

CHAPTER 5
SCENARIO DEVELOPMENT

SCENARIO DEVELOPMENT

Before a locally preferred alternative (LPA) could be selected, various scenarios needed to be constructed to acknowledge past transit efforts, the transit market analysis, and public feedback. Further, as Waco continues to grow, the city and its residents will be faced with the decision to either move forward with the implementation of a BRT alignment or to redesign the transit system before implementation of the new alignment. To mimic these scenarios, the Reimagine Waco Team has outlined three possible scenarios.

Scenario 1A explores how WTS's fixed-route system would feed into the full BRT alignment with overall increased levels of service and crosstown connections. In this scenario, the proposed BRT stations would act as small-scale transportation hubs where transfers could easily be made.

Scenario 1B leverages the minimum operating segment (MOS), where a limited stop express service would be offered along the BRT alignment. This scenario is largely similar to 1A, but BRT service would not be as extensive. This scenario is defined by a moderate increase in service and crosstown connections made through banding routes and staggering schedules to maximize service coverage.

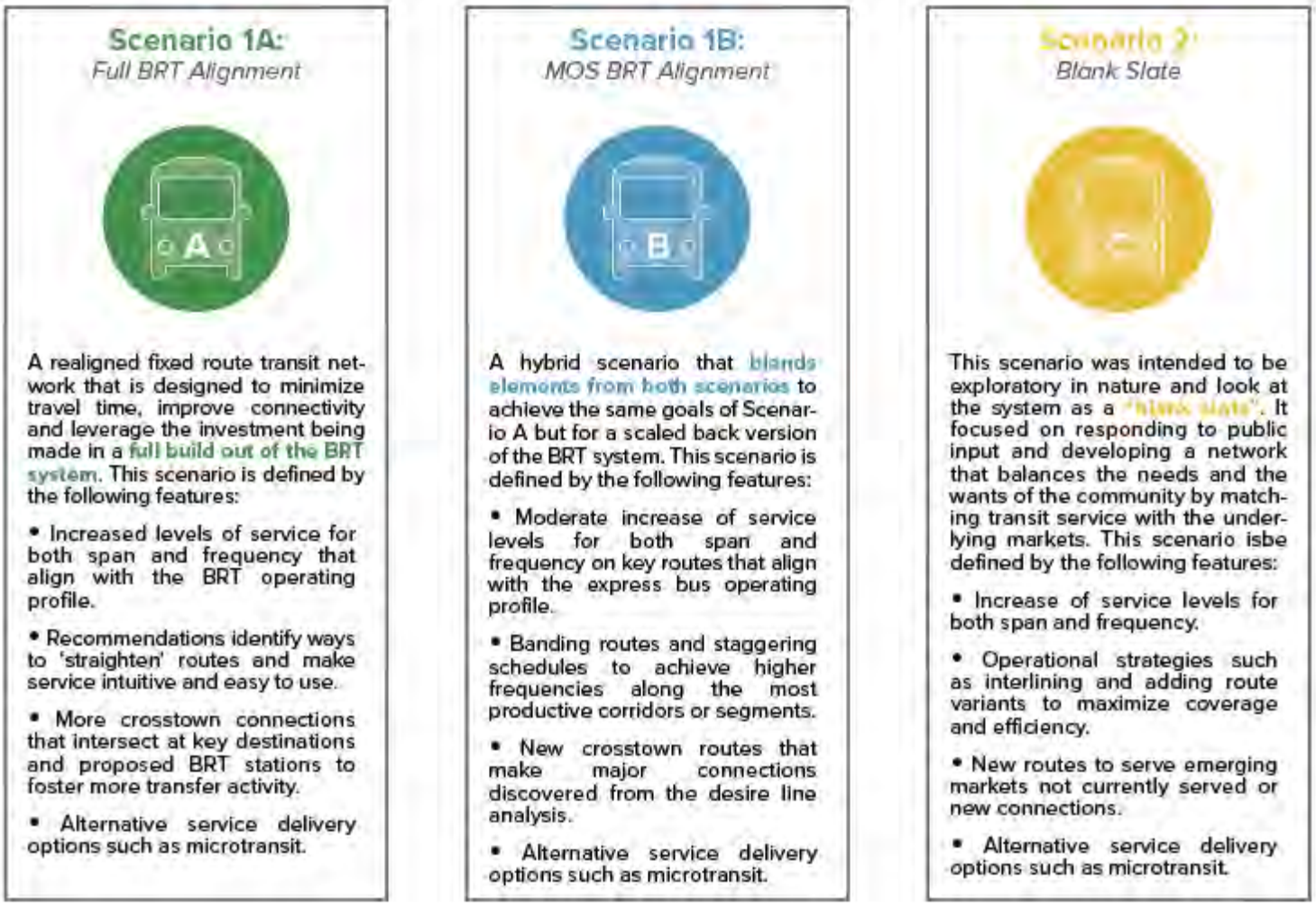
Scenario 2 was conceived as a "blank slate" that could be constructed from scratch according to public input, and thus prioritize the transportation needs and wants of the community. Like Scenario 1B, this scenario explored innovated service design and scheduling alternatives such as interlining and designing route variants to increase the system's overall efficiency.

Bus Rapid Transit in Waco

In 2018, Waco Transit System (WTS) and the Waco Metropolitan Planning Organization (MPO) finalized the Waco BRT Feasibility Study. The result of this community-driven effort was the identification of the BRT corridor with the greatest potential to support transit investment improvements, designated as a locally preferred alternative (LPA). The BRT route is a 13-mile northeast-southwest route that would serve industrial and commercial employment centers, the Central Business District, as well as important retail centers for residents and visitors, if implemented. It would also connect Waco with the adjacent cities of Woodway, Beverly Hills, Bellmead and Lacy-Lakeview. The proposed BRT route would also provide better and more efficient transfers to other routes operated by Waco Transit System by providing buses every 15-minutes during peak service hours on weekdays and Sunday until 10:00 PM.

FIGURE 27: LPA BRT ALIGNMENT

FIGURE 28: SCENARIO PROFILES



Scenario 1

Scenarios 1A and 1B were finalized in almost entirely the same form except for the length of the BRT route. The difference is indicated in Figure 24, in which the pink dotted line indicates the length of the full BRT as in scenario 1A, from Woodway Drive at Poage Park in the southwest to Loop 340 at New Dallas Highway in the northeast. Scenario 1B's BRT route, in purple, extends from Woodway Drive at Hewitt Dr. to the Eastland Shopping Center at Bellmead Dr. and State Highway 31 Texas Marketplace to other areas of Waco and several other bus routes including the BRT and microtransit zones, all of which provide direct connections to the BRT line, as well as to other fixed-route bus lines. A map of the proposed service under Scenario 1 is displayed on Figure 29 (following page).

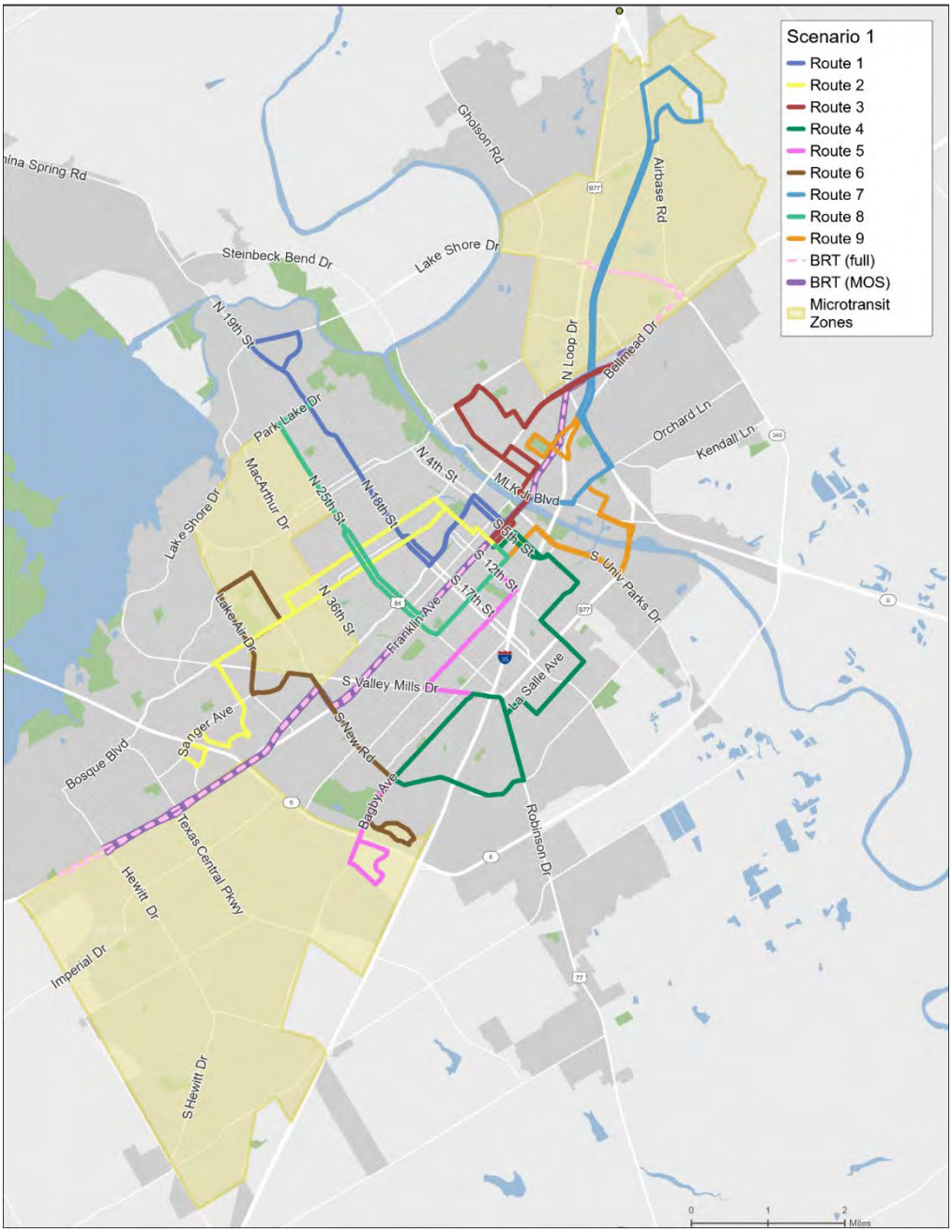


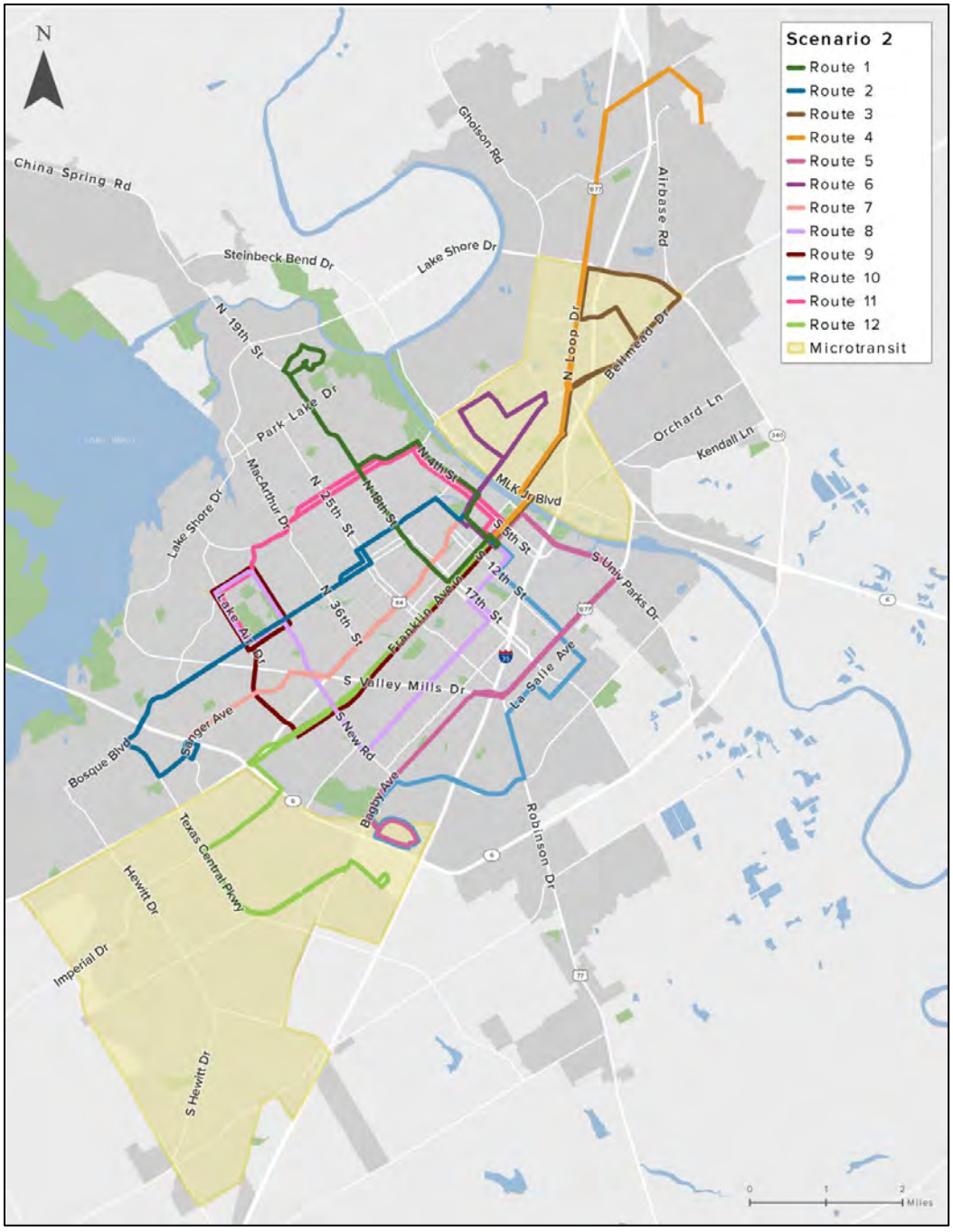
FIGURE 29: SCENARIO 1 SERVICE PLAN

Scenario 2

Scenario 2 reimagines the transit system to provide crosstown connections and expand service. Three routes connect the government offices in the Heart of Texas neighborhood to the Downtown Transit Terminal via different routes, increasing service between these points.

Scenario 2 includes two microtransit zones, one in East Waco and one in West Waco. A map of proposed service under Scenario 2 is displayed on Figure 30 (following page).

FIGURE 30: SCENARIO 2 SERVICE PLAN



CHAPTER 6
SCENARIO EVALUATION

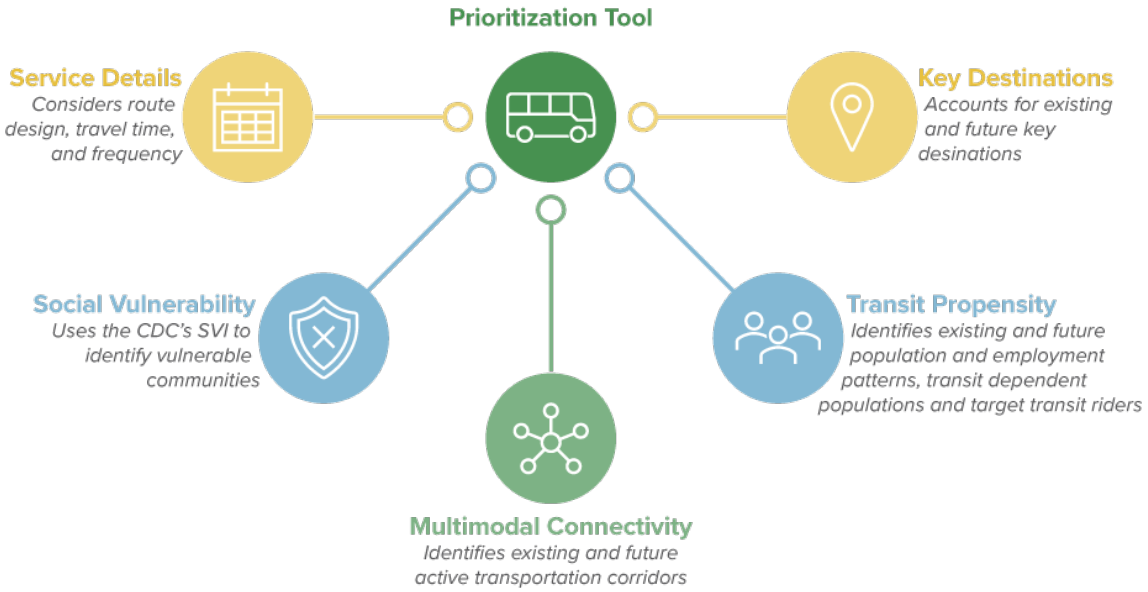
SCENARIO EVALUATION

In order to evaluate how well the proposed alternatives compare against the existing transit system, this chapter will use several types of analysis to evaluate the scenarios in terms of how much access to destinations they provide, how many people they serve (especially Target Transit Riders and other users with high dependency on transit).

Prioritization Tool

In addition to the four data-driven indicators identified above, community feedback on the existing system were also incorporated into the prioritization tool. The five indicators shown in Figure 31 have been developed to help inform the level of performance for proposed routes within each scenario. Each indicator is a combination of existing and future characteristics which informs sustainable recommendation for alternate transit routes within the urbanized area.

FIGURE 31: PRIORITIZATION TOOL FRAMEWORK



Service Details

The service details consider the operational aspects of each route such as the route design (i.e. bi-directional or circular design), overall travel time, and frequency for routes within each scenario. These three factors are then scored and based on universal benchmarks shown in Table 7. Scoring for the frequency benchmarks are shown in Table 8. Note, that the scoring shown in the tables below reflects the wants of the community based on a public feedback survey conducted during Phase 1 of the public involvement effort.

TABLE 7: SERVICE DETAIL SCORE - ROUTE DESIGN BENCHMARKS

Directionality	Score
Bi-Directional	2
One-Direction	1

TABLE 8: SERVICE DETAIL SCORE - FREQUENCY BENCHMARKS

Frequency (mins)	Score
<= 15	4
15 - 20	3
21 - 30	2
31 - 60	1
> 60	0

Social Vulnerability

As discussed earlier in the plan, the social vulnerability score uses the CDC's Social Vulnerability Index (SVI) to identify vulnerable population based on the following four major demographic themes[5]:

- Socioeconomic Status
- Household Composition
- Race, Ethnicity, and Language
- Housing and Transportation

Multimodal Connectivity

The composite transit market score also takes multimodal connectivity into consideration. Routes that are connected to other modes of transportation provided better first and last mile connectivity and encourages ridership. This score is based on the spatial distribution of the following transportation infrastructure:

- Existing Sidewalks
- Planned Sidewalks
- Existing Bike/Pedestrian Facilities
- Planned Active Transportation Projects
- Existing Wheelchair Ramps

Transit Propensity

The combined transit propensity score considers existing and future population and employment as well as the concentrations of transit dependent population and target transit riders. This score aids in the development of routes that can balances the needs of captive and choice riders.

[5] Additional information regarding the CDC's methodology and resources can be found at: Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. CDC/ATSDR Social Vulnerability Index 2018 Database Texas, URL: https://www.atsdr.cdc.gov/placeandhealth/svi/index.html.

Key Destinations

The key destination score identifies areas that have the greatest number of existing and future key destinations by square mile. Connecting transit with commercial areas, community resources, health centers, and job centers ensures that residents are able to access key destinations without a personal vehicle.

A table displaying the composite scores and rankings of all proposed lines under each scenario is found below. The scores for each route were used to identify the most productive routes and where increased service can have the most impact.

TABLE 9: SCENARIO PRIORITIZATION TOOL

Rank	Scenario	Route Name	Service Details Score	Transit Propensity Score	Transit Attractor Score	Multimodal Connectivity Score	Social Index	Composite Transit Market Score
1	1	BRT MOS	1.00	0.38	0.27	0.30	0.39	0.45
2	1	1 MCC	0.67	0.41	0.27	0.45	0.49	0.45
3	2	Route 9	0.50	0.49	0.35	0.37	0.43	0.43
4	1	2 Bosque	0.67	0.45	0.25	0.37	0.43	0.43
5	1	BRT Full	1.00	0.35	0.24	0.25	0.39	0.43
6	2	Route 1	0.67	0.37	0.24	0.41	0.46	0.42
7	1	3 North Waco	0.67	0.37	0.24	0.34	0.48	0.42
8	1	8 25th Street	0.50	0.39	0.22	0.43	0.45	0.40
9	2	Route 7	0.50	0.40	0.27	0.35	0.39	0.38
10	2	Route 3	0.50	0.36	0.22	0.27	0.49	0.38
11	1	4 East Waco	0.67	0.36	0.24	0.34	0.36	0.38
12	2	Route 11	0.50	0.38	0.23	0.39	0.39	0.37
13	2	Route 8	0.50	0.39	0.24	0.32	0.39	0.37
14	2	Route 6	0.50	0.34	0.24	0.35	0.43	0.37
15	2	Route 2	0.50	0.40	0.21	0.35	0.39	0.37
16	1	5 IH35	0.50	0.36	0.23	0.33	0.41	0.37
17	1	9 Univ. N. Waco	0.50	0.37	0.20	0.36	0.38	0.36
18	2	Route 5	0.50	0.36	0.23	0.34	0.36	0.35
19	1	7 TSTC	0.50	0.32	0.19	0.19	0.46	0.35
20	2	Route 10	0.50	0.31	0.20	0.28	0.33	0.32
21	2	Route 12	0.50	0.32	0.24	0.23	0.30	0.31
22	2	Route 4	0.50	0.26	0.17	0.20	0.36	0.30
23	1	6 Crosstown	0.50	0.34	0.20	0.21	0.25	0.29

Cost Estimates

Planning-level cost estimates for each scenario were developed using figures provided by Waco Transit System for the cost of existing bus routes and capital expenditures. In Table 10 below, figures were broken out by the local share of each cost (15% for operations vs. 20% for capital) as compared against the share borne by other sources (federal, state, and fare revenue). Of the three scenarios, Scenario 1A has the highest operations cost increase relative to existing, in addition to the highest capital cost. Scenario 2 has the smallest operations cost increase from existing service and, since it does not include BRT, the lowest initial capital cost. Interlining routes to improve operational efficiency can further reduce the cost of Scenario 2: the project team has identified potential interlines that can reduce operations cost by as much as 17%.

To expand on the cost of BRT as compared to other fixed-route transit, Table 11 breaks down the costs of each scenario by the type of bus route.

TABLE 10: PLANNING-LEVEL COST ESTIMATES

Scenario	Operations Cost ($)	Capital Cost ($)	% Increase in Operations Cost
Existing	4,280,000	N/A	N/A
1A	9,070,000 – 9,980,000	27,380,000	112% – 133%
1B	8,790,000 – 9,700,000	25,380,000	106% – 127%
2	8,080,000 – 9,440,000	250,000	89% – 121%
2 with interlining improvements	6,720,000 – 8,080,000	2,500,000	57% – 89%

TABLE 11: PLANNING-LEVEL COST ESTIMATES

Scenario	Bus Rapid Transit (BRT)				Fixed-Route			
	Operations Cost ($)		Capital Cost ($)		Operations Cost ($)		Capital Cost ($)	
	Local Share (15%)	Other Revenue Sources (85%)	Local Share (20%)	Other Revenue Sources (80%)	Local Share (15%)	Other Revenue Sources (85%)	Local Share (20%)	Other Revenue Sources (80%)
Existing	N/A	N/A	N/A	N/A	640,000	3,640,000	N/A	N/A
1A	390,000	2,230,000	5,400,000	21,600,000	970,000 - 1,100,000	5,490,000 - 6,260,000	80,000	310,000
1B	350,000	1,990,000	5,000,000	20,000,000	970,000 - 1,100,000	5,490,000 - 6,260,000	80,000	310,000
2	N/A	N/A	N/A	N/A	1,110,000 - 1,420,000	8,020,000 – 7,640,000	50,000	200,000
2 with interlining improvements	N/A	N/A	N/A	N/A	1,010,000 – 1,210,000	5,710,000 – 6,870,000	50,000	200,000

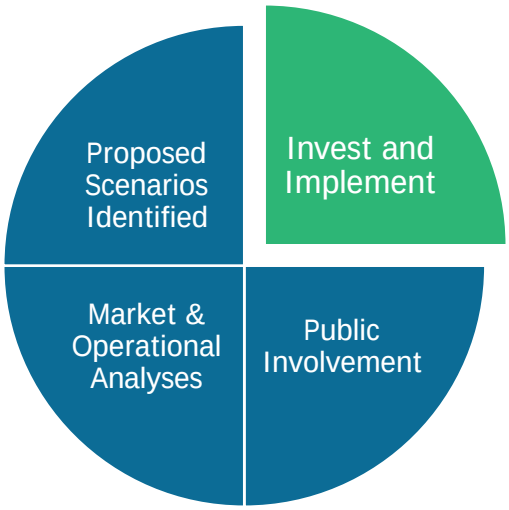
These cost estimates were developed using the following assumptions:

1. WTS will maintain a 20% spare ratio.
2. Each microtransit zone will be served by one vehicle.
3. The BRT PR & NEPA Study were used to generate cost estimates for BRT.

CHAPTER 7
IMPLEMENTATION PLAN

OVERVIEW

Reimagine WTS aims to improve connectivity, minimize travel time, and provide freedom through transit within the City of Waco. Chapters 1, 2, and 3 evaluated the existing system, current and projected demographic and market conditions, and incorporated community feedback to craft a transit system that best serves the community.

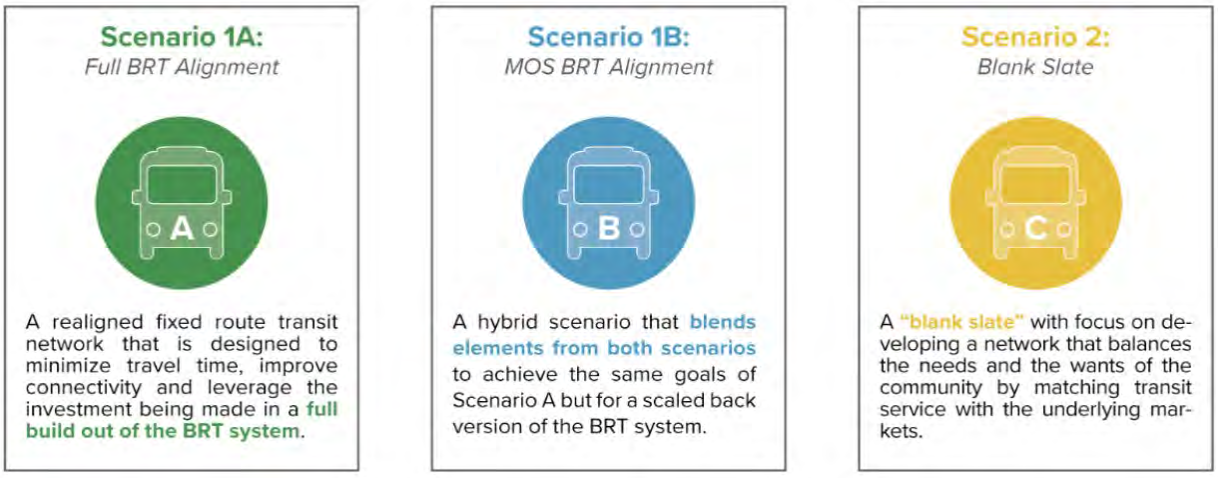


This chapter documents the financial assumptions for each of the three scenarios, specifically the capital cost and operations and maintenance (O&M) methodologies utilized to identify the financial considerations and/or tradeoffs for each scenario's impact on future WTS operations. The chapter begins by describing the O&M and capital cost methodology for each scenario including implementation of innovative service design and scheduling alternatives such as interlining. This section also describes how the proposed system changes can be implemented in tandem with other community investments including replacing the existing flag stop system with bus stops and bus amenities and deploying battery-electric buses (BEBs) to bring cleaner air to the Waco urbanized area. The chapter concludes with a summary of the existing WTS financial condition, revenue assumptions for each of the three scenarios, and identifies funding opportunities that may be available to WTS in the future as part of the Infrastructure and Investment Jobs Act (IIJA). The goal of this chapter is to document the financial assumptions for each service scenario and describe the short-term and long-term resources and funding opportunities that may be available to leverage to sustain the service and capital changes recommended.

SCENARIOS

Reimagine WTS resulted in three scenarios, as shown in Figure 32 - Scenario 1A, Scenario 1B, and Scenario 2. Scenario 1A proposes a realigned network of fixed routes and a full build out of a BRT line. Scenario 1B is a modified version of Scenario 1A and offers an initial investment version of a truncated BRT line. Scenario 2 is a redesigned "blank slate" system focused on aligning transit service with the underlying local market. All three scenarios include Microtransit Zones where riders can request a vehicle to pick them up and drop them off at user-specified locations. Community engagement efforts solicited public feedback on the proposed scenarios and cost estimates were developed for each of the scenarios and the existing system for comparison as described below.

FIGURE 32: PROPOSED SCENARIO DESCRIPTIONS



Scenario 1A

Scenario 1A would realign the existing transit system to connect into the BRT lines to increase connectivity and improve travel times. This scenario includes 9 fixed routes and 3 microtransit zones. Microtransit service is a form of demand response bus service that offers flexibility and greater service coverage for lower cost. The microtransit zones would serve lower density areas of Waco not well served by fixed route service. Many routes currently operate only in one direction and Scenario 1A would introduce bi-directional service. Transit market analysis identified 3 routes for 30-minute headways: Route 1, Route 2, and Route 3. The BRT lines would operate on 15-minute headways and all other routes would run on 1-hour headways.

Scenario 1B

Scenario 1B is nearly identical to Scenario 1A but leverages a Minimum Operable Segment (MOS) serving the majority of the corridor except for two stations on the northern extent. In this scenario, WTS would leverage a portion of the BRT alignment or "core" of the BRT where high-capacity transit is provided between end points. An MOS may be a cost-effective solution to provide the speed and reliability benefits of BRT without investing in the full buildout of the corridor. This scenario would still leave the opportunity for a full build out of the BRT corridor in the future. Scenario 1B would include 3 microtransit zones, bi-directional service and increased frequency.

Scenario 2

Scenario 2, the "blank slate" scenario, would balance the needs and wants of the community by matching services with underlying markets. Several routes are realigned in this scenario, expanding service, improving frequency, and increasing connectivity. The scenario includes 12 fixed routes and 3 microtransit zones: East Waco, West Waco, and South Waco. The proposed system map is shown in Figure 2.

The transit market analysis identified two fixed routes for 30-minute headways: Route 1 and Route 9. All other fixed routes would run on 1-hour headways. Scenario 2 also presents opportunities for interlining bus routes, which would lower the number of vehicles necessary for peak operations.

FIGURE 33: SCENARIO 2 PROPOSED SYSTEM MAP

Selected for Implementation: Scenario 2

The project team presented scenario assumptions to WTS staff, Waco City Council, the City Manager, and other key stakeholders for analysis and review. All three scenarios were identified by the public as likely to save riders time and projected to increase total systemwide ridership by 2040. Likewise, all three scenarios would increase O&M costs and add capital costs. Scenario 2 was selected as it offered ridership improvements at lower costs by more closely aligning routes with riders and destinations, saving costs via interlining, and forgoing immediate BRT construction. Though BRT will not be included in Reimagine WTS, the redesign does not preclude advancing BRT in the future. In addition to the selection of Scenario 2, the final approval of this scenario included the potential for an additional microtransit zone in the eastern

part of the city. As part of a phased approach and due to the flexibility of microtransit, this additional zone can be simply achieved over time.

Table 12 displays WTS's local cost share by scenario relative to the existing O&M and capital cost share. The capital cost share includes costs associated with BRT infrastructure (as applicable), microtransit, and software costs. Fixed route O&M costs have been calculated using 2022 dollars (2022$) while BRT costs were developed as part of a separate Waco BRT Feasibility Study in 2021 and are presented in 2021 dollars (2021$). These estimates reflect the methodology and assumptions outlined in the following sections.

The total projected 2040 daily system ridership is also shown for the existing system, Scenario 1A, 1B, and 2. While Scenarios 1A and 1B were projected to increase systemwide ridership more than Scenario 2, O&M and capital costs associated with the redesign are significantly lower for Scenario 2 implementation. The existing system currently costs approximately $4.3 million in total O&M costs and the total daily system ridership is projected to reach 5,075 riders in 2040 in a No-Build scenario. Scenarios 1A and 1B are projected to increase total ridership to about 6,200 daily riders with significant capital costs. Scenario 2 is estimated to increase total system ridership by nearly 1,000 more daily riders than the No-Build scenario with significantly lower capital costs and lower O&M costs compared to Scenarios 1A and 1B.

TABLE 12: WTS LOCAL COST SHARE BY SCENARIOS (2022$)

	Local O&M Cost Share	Local Capital Cost Share	% Increase Total Operation Cost	Total Daily System Ridership (2040)
Existing	$640,000	N/A	N/A	5,075
1A	$970,000	$5,500,000	51%	6,202
1B	$970,000	$5,100,000	51%	6,202
2*	$1,000,000	$86,000	57%	5,940

**Scenario 2 costs reflect interlining assumptions described below.*

OPERATIONS AND MAINTENANCE

This section[6] outlines the methodology used to calculate projected costs used for scenario deliberation and for scenario implementation. Several assumptions are built into these calculations. O&M cost calculations assume worst-case scenario operating requirements for the proposed routes by rounding up vehicle and service requirements to the nearest full bus, by route.

Operations and Maintenance Cost Methodology

O&M costs were calculated as the product of total vehicle revenue hours multiplied by the unit cost assumption per hour. Unit costs per revenue hour of service were based on 2020 NTD data and escalated to a 2022-dollar value based on GDP chained price index[7]. Table 13 displays the original 2020 cost per revenue hour, the escalation factor, and the final estimated 2022-dollar amount used in operating cost calculations.

TABLE 13: COST PER REVENUE HOUR 2020 TO 2022

Cost Per Revenue Hour (2020$)	GDP Chained Price Index 2022/2020	Cost Per Revenue Hour (2022$)
$98.00	1.07	$105

Calculating O&M costs for the transit system required key inputs such as route length, frequency, and operating hours to produce an estimate of annual vehicle revenue hours reflecting service and schedule assumptions. The following schedule assumptions were applied to all proposed microtransit and local bus routes:

- 14-hour service day (from approximately 6:00 a.m. to 8:00 p.m.)
- Consistent 30- or 60-minute headways throughout the day
- 312 days of service per year (Monday through Saturday)

Such that *Annual Vehicle Revenue Hours = Days of Service x Service Hours x Vehicles* or 312 days/year multiplied by 14 hours/day multiplied by the number of vehicles needed to operate the proposed service (excluding BRT).

The number of vehicles required was informed by the route length, travel times and desired headway. First, all routes in the system and the round-trip distance and running time to serve each route was identified. Layover time, the amount of time scheduled for waiting at stops or operator breaks, was assumed to be a minimum of 10% of the total cycle time or no less than 5 minutes. In practice, layover will include this necessary recovery time as well as additional time needed to maintain scheduled meets at the transit center. This schedule-based layover is accounted for through the rounding of peak vehicles (calculated as the ratio of the minimum

[6] Source: AECOM, 2022

[7] Whitehouse Office of Management and Budget, Table 10.1 Gross Domestic Product and Deflators used in the Historical Tables 1940-2027, Historical Tables - The White House, Accessed August 2022.

cycle time to the desired headway) to highlight opportunities for interlining. Table 14 shows an example peak bus calculation where the layover and dwell time have been factored into the total running time of each bus on a route to determine the minimum cycle time.

TABLE 14: EXAMPLE PEAK BUS CALCULATION

Route	Minimum Cycle Time	Headway	Peak Bus
Route 2	0:53	0:30	1.77

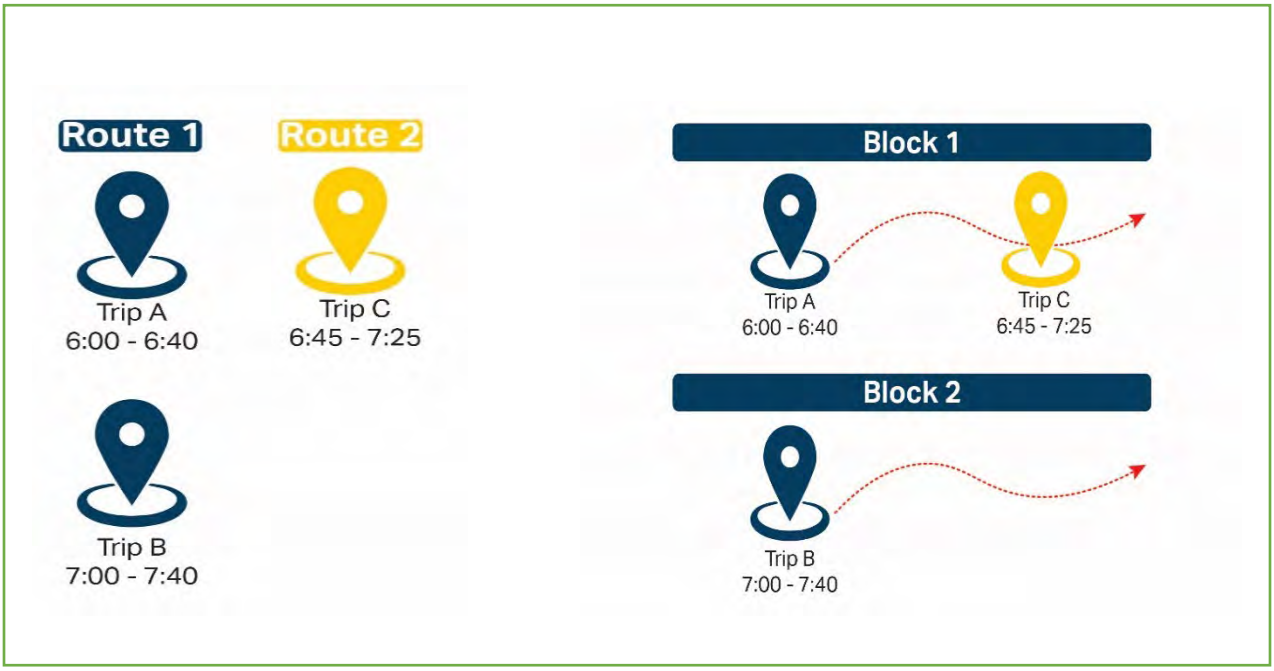
In most cases, the vehicle requirement is rounded up to the nearest whole number, unless identified for interlining, as described in the next section. For each proposed route, the number of buses required during peak operations was multiplied by the 14-hour span, 312-day schedule, and unit cost assumptions to produce O&M cost estimates per route. The cost estimates for all routes were totaled for the existing system and the proposed system.

Interlining

Interlining is a common practice for transit agencies to boost efficiency within their systems that can also offer greater convenience for passengers and support operators being better stewards of the system. This practice is primarily used for bus routes that begin and end at a common hub, such as the Downtown Waco Transit Terminal. Interlining is primarily done to optimize blocking, which is the process of assigning vehicles with a series of trips to specific buses. The blocking process results in blocks which make up the assignment for each bus in a single workday. The process also incorporates layovers (times between scheduled arrival and departure) to ensure that buses have enough round-trip time to stay on schedule.

Figure 34 illustrates the interlining process for two hypothetical routes. Each trip (Trip A, Trip B, Trip C) is completed as part of Route 1 or Route 2. Each trip takes 40 minutes to complete and runs during distinct time windows. Figure 34 shows how trips, such as Trip A and Trip C, on separate routes can be served by the same vehicle. The vehicle that completes Trip A ends the trip at 6:40. Trip C begins at 6:45 and so the vehicle serving Trip A can then serve Trip C with a 5-minute layover. Combining trips this way allows for greater vehicle and scheduling efficiency. Rather than having a vehicle and operator completing Trip A, waiting 20 minutes, and then beginning Trip B, interlining allows one vehicle and one operator to complete trips with appropriate layovers scheduled.

FIGURE 34: INTERLINING TRIPS*



**Routes presented are examples only and do not reflect WTS Route 1 or WTS Route 2.*

Scenario 2 offers three opportunities for strategic interlining which increase resource and cost efficiency. The project team identified routes with underutilized buses where the number of required peak buses would lead to very long layover times and evaluated which routes could be paired for interlining savings. As all routes share a common point, the team considered local travel patterns, socioeconomic and demographic characteristics, and overall user experience. Leveraging GIS analysis, the team identified route pairs to create efficiencies as well as enhancing the comfort and experience of riders. Recommended interline pairs are shown in Figure 35. Among these, three interlined pairs offer an opportunity to optimize schedules and reduce costs and have been incorporated into the assumptions informing the financial plan. Other interline opportunities can be implemented at WTS discretion without impact to costs.

The first recommended optimized interline is between Route 2 and Route 3 which will provide trips from Bellmead to Heart of Texas. Trips between Bellmead and Heart of Texas are expected to increase; thus, interlining will improve riders' experiences as well as operational efficiency. Similarly, there is high travel demand between Richland Hills and Beverly Hills with demand projected to continue growing. Interlining Route 5 and Route 7 creates one-seat travel opportunities for rider trips between these destinations. Route 10 and Route 11 are two other candidates for interlining that will provide an east-west connection across Waco. Combining Route 10 and Route 11 also improves connections to many other system routes, as shown in Figure 35.

FIGURE 35: INTERLINED SYSTEM ROUTES

The interlined routes identified will lower the number of total buses necessary for peak operations. Interlining would remove 3 vehicles from the peak bus total. Though interlining Route 6 and Route 8 does not lower the number of peak vehicles or impact financial

assumptions, interlining these routes will serve residents of vulnerable neighborhoods around Oscar DuConge Park. Residents boarding in these neighborhoods would then have a one-trip access to job opportunities, shops, and entertainment centers. Similarly, Route 4 and Route 12 could also be interlined to provide a single north-south single bus ride through the spine of Waco that would resemble the BRT alignment and allow WTS to observe how this would impact travel patterns as they continue to evaluate BRT investment.

Operations and Maintenance Cost Results

O&M cost estimates are shown below in Table 15. As discussed in the methodology section, O&M costs are split between the local share and other sources, based on revenue assumptions from WTS. Revenue assumptions are discussed in greater detail in the **Financial Resources** section. The table below shows costs for fixed route O&M as well as estimated BRT O&M costs. BRT costs are only shown for Scenarios 1A and 1B as BRT is not currently part of the existing system, nor included in Scenario 2.

TABLE 15: O&M COSTS BY SCENARIO (2022$)

Scenario	Fixed Route Local Share	Fixed Route Other	BRT Local Share	BRT Other	Total	% Increase
Existing	$640,000	$3,600,000	N/A	N/A	$4,300,000	N/A
1A	$970,000	$5,500,000	$390,000	$2,300,000	$9,100,000	112%
1B	$970,000	$5,500,000	$350,000	$2,000,000	$8,800,000	106%
2	$1,000,000	$6,900,000	N/A	N/A	$7,900,000	84%

All three scenarios are estimated to require greater O&M costs when compared to the existing system. The O&M costs of the existing system total about $4.3 million, with an estimated local share of nearly $650,000. Scenario 1A would cost about $9 million annually to operate with an estimated local share of approximately $1.4 million. Scenario 1B O&M costs are slightly lower at $8.8 million annually in total and a $1.3 million local share. Scenario 2, without BRT, has the lowest O&M cost of the three scenarios. The total O&M costs are approximately $7.9 million, and the local share is about $1 million. See the **Revenue Assumptions** section for additional information.

As discussed in the methodology section, the implementation of interlining will offer significant cost savings. The total O&M cost of three buses is nearly $1.4 million. Subtracting this cost from Scenario 2 lowers the total O&M cost from $7.9 million to $6.5 million. This would lower the estimated local share to under $1 million.

CAPITAL

This section outlines the methodology used to calculate projected costs used for scenario deliberation and for scenario implementation. Capital cost calculations used vehicle cost estimates provided by WTS, including microtransit vehicle costs. WTS currently employs a flag-stop system, which means that rather than boarding and alighting at designated bus stops, riders may flag the operator to board the bus anywhere along the route. Reimagine WTS includes the implementation of bus stops which will require capital investment in stop amenities such as benches and shelters.

Capital Cost Methodology

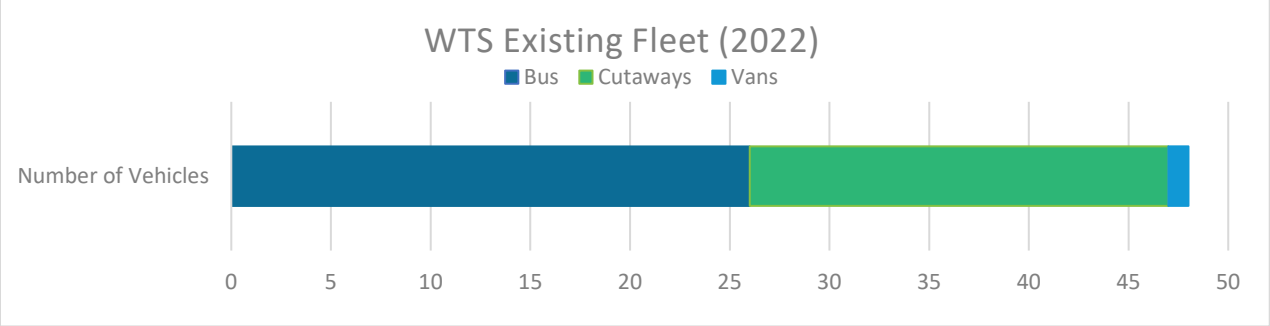
Preliminary capital costs for each of the three scenarios were developed in accordance with industry standard unit costs and are reflective of costs encountered by transit agencies of similar size and service.

Fixed-route capital costs are presented in 2022 dollars (2022$). Note that year of expenditure (YOE) dollars may fluctuate due to external factors including inflation, availability of supplies, and/or vendors selected for fleet electrification, as applicable. BRT capital costs were developed as part of a separate Waco BRT Feasibility Study in 2021; therefore, BRT capital costs for the BRT are presented in 2021 dollars (2021$). The following section details the capital cost methodology for each service scenario.

Assumptions

As of 2022, the WTS fleet (shown in Figure 36) consists of diesel buses, cutaway buses designated for paratransit on-demand service, and a passenger van to be used by WTS as needed on routes. While WTS operates on-demand transit service for paratransit, the transit agency does not currently offer microtransit service: an on-demand service available to all riders regardless of eligibility.

FIGURE 36: WTS EXISTING FLEET (2022)



Source: WTS System, 2022

For each scenario, capital cost estimates were developed in 2022$ using the number of vehicles required for each scenario (e.g. buses and cutaways) and recent WTS purchase prices for buses and cutaways from vehicle vendors. Table 16 demonstrates the vehicles necessary for each scenario.

TABLE 16: VEHICLE ASSUMPTIONS BY OPERATING SCENARIO

SCENARIOS	TOTAL FIXED ROUTE PEAK VEHICLES	MICROTRANSIT VEHICLES	SPARES*	TOTAL FLEET WITH SPARES
1A	12	3	3	18
1B	13	3	3	19
2 *(assumes interlining)*	14	3	3	20

**Spares assumed for Fixed Route only*

Table 17 below shows the capital costs associated with the implementation of 3 microtransit zones. As described in the methodology section, costs for microtransit vans were provided by WTS and are an estimated $128,000 per vehicle. The microtransit costs for Scenarios 1A, 1B, and 2 are identical as they each require 3 peak vehicles for microtransit service (Table 6). The estimated total is approximately $382,000 per scenario. Detailed assumptions regarding the local share and non-local share of the cost are described in the **Revenue Assumptions** section below. Additionally, there would be a capital cost associated with implementing the microtransit technology or Software as a Service (SaaS), a cloud-based subscription system that requires software to allow users to purchase passes and request riders. WTS would need to procure a SaaS vendor, software, and any necessary on-board hardware if required by the SaaS vendor selected.

TABLE 17: CAPITAL COSTS FOR MICROTRANSIT (2022$)

Capital Costs for Microtransit	All Scenarios
Microtransit Vehicle Costs (2022$)	$382,000
Software as a Service (SaaS)	$50,000
Total Cost	$432,000

Source: WTS, 2022

In addition to the capital costs for microtransit implementation, Scenarios 1A and 1B assume BRT operation and capital expenditures, while Scenario 2 assumes no BRT. Scenario 1A assumes the full build out of the proposed BRT lines and Scenario 1B assumes a partial BRT build out. As a result, BRT capital costs are lower for Scenario 1B when compared to Scenario 1A. The total capital cost difference between Scenario 1A and 1B is about $2 million, or $400,000 for the assumed local share.

TABLE 18: CAPITAL COSTS FOR BRT

Capital Costs	Scenario	
	1A	1B
Total (2021$)*	**$27,000,000**	**$25,000,000**
Local Share (20%)	$5,400,000	$5,000,000
Non-Local Share (80%)	$21,600,000	$20,000,000
Total (2022$)**	**$29,200,000**	**$27,000,000**
Local Share (20%)	$5,840,000	$5,400,000
Non-Local Share (80%)	$23,360,000	$21,600,000

**WTS System Rapid Transit Corridor Study, 2021*

***Preliminary Estimate assuming 8.5% inflation from 2021 to 2022$ for comparison purposes only.*

Capital Cost Results

The capital costs assumed for each scenario inclusive of fixed route and BRT are summarized in Table 19. Scenarios 1A and 1B contribute to higher capital costs compared to Scenario 2 due to the costs associated with the BRT infrastructure required. Scenarios 1A and 1B range between $25.3 and $29.5 million whereas Scenario 2 requires significantly less capital investment by removing the BRT.

TABLE 19: CAPITAL COSTS TOTAL BY SCENARIO

Scenario	Fixed Route Total	BRT Total		Capital Cost Range Total
	2021$	2021$	2022$	(2021$ - 2022$)
1A	$382,000	$27,000,000	$29,200,000	$27.3 M - $29.5 M
1B	$382,000	$25,000,000	$27,000,000	$25.3 M - $27.4 M
2	$255,000	$0	$0	$255,000

Bus Stops and Amenities

WTS currently employs a flag-a-stop system where riders signal bus operators anywhere along the route to board at a safe location, rather than waiting at designated stops. The flag-a-stop system can offer convenience benefits for riders but implementing marked stops for boarding and deboarding offers safety, wayfinding, and quality of service benefits for both riders and operators. Additionally, stops are a convenient place to distribute information system-wide. The implementation of bus stops presents additional capital costs for purchasing and installing stops, shelters, and other stop amenities. These costs have been split into 2 implementation phases to alleviate agency budget pressures and ensure efficient deployment of stop amenities.

Estimated unit costs for stop amenities are included below in Table 20 and are reflective of costs encountered by transit agencies of similar size and service. Phase 1 of bus stop implementation would include pole and sign stops every half mile of each route and in each direction of travel. Phase 1 costs also account for added ADA upgrade costs at 20% of stops.

The project team recommends collecting boarding data for one year to determine which 2 stops on each route have the highest number of boardings. These high ridership stops will then advance to Phase 2 implementation for shelter installation. By equally distributing the number of shelters across all routes of the system, WTS can ensure riders across the city equal access to stop amenities.

TABLE 20: UNIT COSTS FOR BUS STOPS (2022$)

Stop Type	Cost (2022$) per Unit
Pole and Sign	$105
ADA Approach Upgrades	$2,170
Shelter	$13,125

Table 21 includes the route length in miles and the estimated number of stops per route at a rate of one stop every half-mile of route length. The table provides approximate costs for Phase

1, Phase 2, as well as the estimated total cost for both phases of bus stop implementation. Phase 2 costs are identical from route to route as the costs are comprised of two shelters per route.

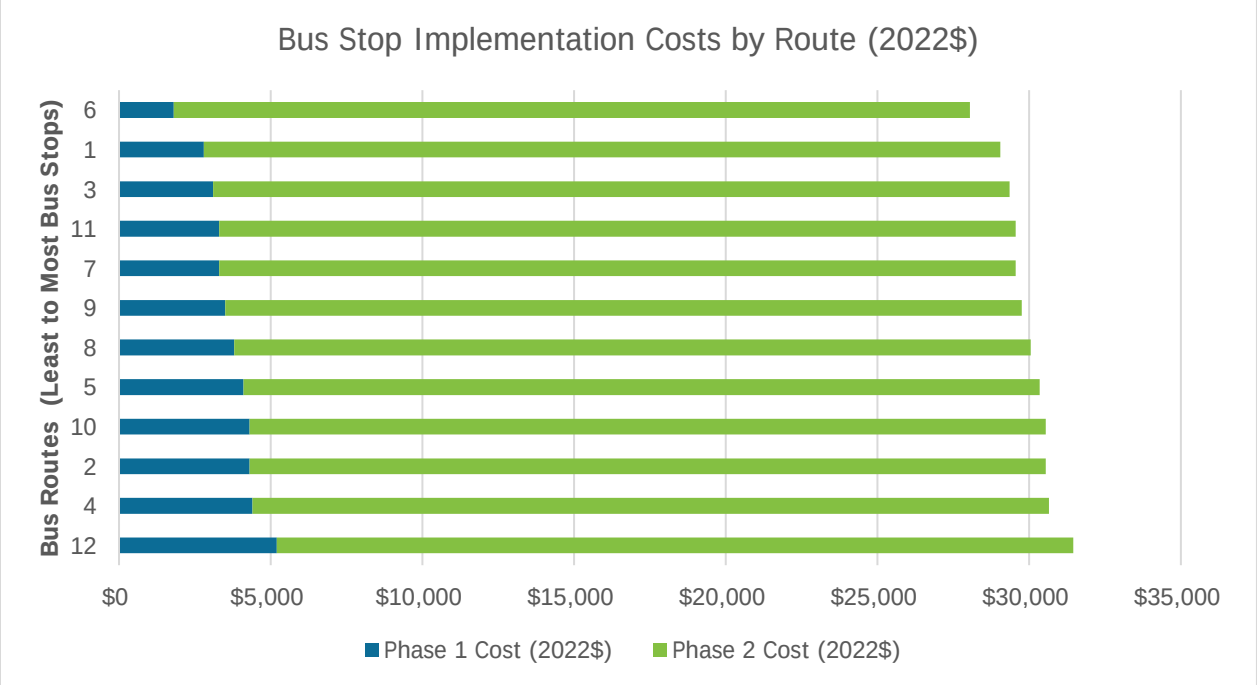
TABLE 21: ESTIMATED BUS STOP IMPLEMENTATION COSTS (2022$)

Route	Length (Mi)	# Stops	Phase 1 Cost*	Phase 2 Cost	Total Cost
1	10.43	5	$2,800	$26,250	**$29,050**
2	15.97	8	$4,300	$26,250	**$30,550**
3	11.33	6	$3,100	$26,250	**$29,350**
4	16.31	8	$4,400	$26,250	**$30,650**
5	15.32	8	$4,100	$26,250	**$30,350**
6	6.52	3	$1,800	$26,250	**$28,050**
7	12.86	6	$3,300	$26,250	**$29,550**
8	14.09	7	$3,800	$26,250	**$30,050**
9	12.86	6	$3,500	$26,250	**$29,750**
10	15.82	8	$4,300	$26,250	**$30,550**
11	12.23	6	$3,300	$26,250	**$29,550**
12	19.09	10	$5,200	$26,250	**$31,450**
Total	**162.1**	**81**	**$43,900**	**$323,530**	**$367,430**

**Assumes 20% of the bus stops include ADA upgrades.*

Figure 37 organizes the WTS routes by number of bus stops recommended for implementation, by phase, from least to the greatest number of stops.

FIGURE 37: BUS STOP IMPLEMENTATION COSTS BY ROUTE (2022$)



FLEET ELECTRIFICATION

Fleet electrification presents additional cost considerations compared to diesel bus fleets. The cost of the vehicles as well as the costs associated with the necessary charging equipment.

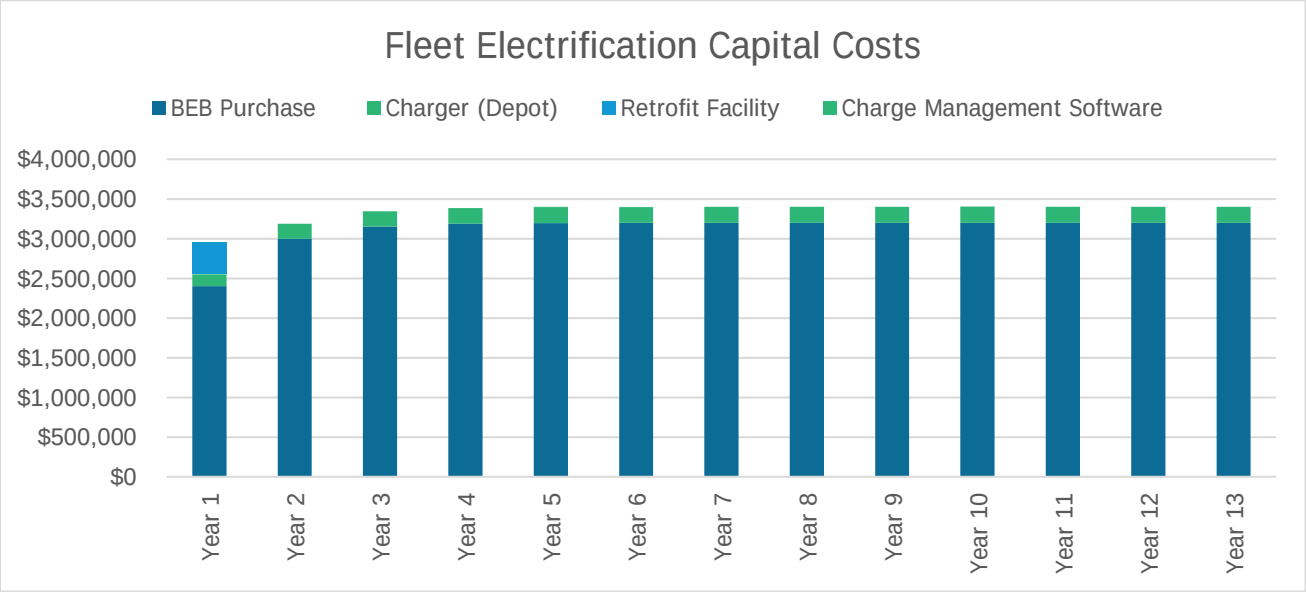
Table 22 below shows fleet electrification cost assumptions, along with facility retrofit costs to support electrification. This table represents battery-electric bus (BEB) costs in 2022$ and assumes purchase of 2 BEBs, depot charging equipment with 2 charging connections, a retrofit of the existing WTS facility to accommodate electric buses and charging software to manage electricity and monitor performance.

TABLE 22: FLEET ELECTRIFICATION COST ASSUMPTIONS (2022$)

	Unit Cost	Quantity	Total
Charger Management & Software Site Setup	$5,000	1	$5,000
Facilities Retrofit	$400,000	1	$400,000
Depot Charging Equipment	$150,000	1	$150,000
Charger Management Software	$2,500	1	$2,500
Battery Electric Bus (BEB)	$1.2 Million	2	$2.4 Million
Subtotal (Year 1 Startup Cost)			**$2.9 Million**
Incremental Annual Cost			**$2.5 Million**

The costs shown in the table above are displayed again in Figure 38, assuming a purchase of 2 BEB's each year, charging equipment, and charge management software. If WTS were to replace its entire 26 vehicle diesel fleet, it would take approximately thirteen years assuming 2 buses are purchased each year. Total capital costs for vehicles and other equipment may vary depending on the bus vendor selected, year of purchase, and inflation rates. However, it is recommended that WTS consult with their existing Transit Asset Management (TAM) Plan and Useful Life Benchmarks for the vehicles to determine when a diesel vehicle would be eligible for replacement by a BEB. It is recommended that as vehicles reach their ULB, WTS consider the benefits and challenges associated with converting to fleet electrification as described in the section that follows. A zero-emission fleet transition plan should be prepared to identify a more detailed phasing plan for vehicles, facility modification, and charging preferences as described further in the sections that follow.

FIGURE 38: FLEET ELECTRIFICATION PHASING



Source: Industry Standard Unit Costs; Assumes a 25% increase on unit prices through Year 13.

Long-term financial plans for transit fleets should include flexibility to support the incremental costs of electrification. As more regional and national government entities are requiring zero-emission (ZE) fleet transitions, electric and hydrogen fuel cell buses will become not just a consideration, but the baseline expectation. Due to this, it is important to have a strategy to incorporate one or both of these fuel types into the fleet.

Zero-emission vehicles for transit include two primary technology types as the current market-leaders – battery electric buses (BEBs) and hydrogen fuel cell electric buses (FCEBs). Each of these vehicles require unique operational and infrastructure considerations, both from conventionally-fueled vehicles and from each other.

BEBs use an electric motor rather than combustion engine for propulsion, and onboard battery packs for power and "fuel" rather than conventional fuels such as diesel or compressed natural gas (CNG). Because of this, BEBs are known for having the benefit of lower maintenance costs as they experience less wear-and-tear on internal moving parts. BEBs can also be more cost-effective to operate depending on local electric utility costs; this can vary greatly from utility to utility, and therefore should be evaluated prior to deployments.

While BEBs can provide these benefits, there are a multitude of challenges associated with their deployment that require additional planning and assessment. These include operating cost variability, along with range limitations. With the variability of operating costs, these can result from changing energy use throughout the year as the result of heating and cooling as seasons change, as well as changes in demand costs based on charging strategy. In reference to the range limitations, these result from the limited battery capacity, and while this challenge can be overcome with on-route charging, there are operational difficulties with this deployment strategy.

On-route charging is the practice of using overhead conductive or in-ground inductive charging to replenish energy during scheduled layovers. This can introduce its own complexities to a

deployment by planning around peak-period demand costs with the utility and ensuring there is adequate time available to charge. These types of high-powered chargers are therefore often more expensive to operate than plug-in depot chargers, in addition to being more expensive both to purchase and install. While depot charging equipment and installation can run about $150k per unit as listed above, overhead chargers will cost closer to $2M to purchase, construct, and install.

Based on WTS's service, it is expected that BEBs operated using depot-charging only will not have adequate range to complete the projected block mileage for the interlined service. Therefore, it is likely that on-route charging or additional vehicles will be needed to cover the anticipated duty cycles based on typical energy use and battery capacity in today's BEB market. While vehicle range is rapidly expanding as technology improves, it is difficult to accurately predict when adequate range will become available for different service applications.

It should be noted that FCEBs do not have the same operational challenges as BEBs, as their range is much closer to that of a full day's service for a typical transit bus. While they may still run up against limitations for longer blocks, they can be operated more similarly to a conventionally-fueled vehicle. The challenge with FCEBs comes with the fueling infrastructure: while BEBs require only the purchase and installation of new charging infrastructure when new depot-charged vehicles are acquired, FCEBs require the installation of tanks, compressors, and dispensers. In this way, hydrogen infrastructure is similar to that of CNG in its complexity.

FCEB fueling infrastructure can therefore be prohibitively expensive for smaller fleet sizes but can represent cost and space savings over BEBs when compared to 2:1 charger installation. Because of this, a cost evaluation for an FCEB fleet has not been included in this assessment but could be reviewed at a later date. While the flexibility of deployment for the vehicles may be a good fit for WTS to consider down the line, the challenges must also be considered.

Because of all of these challenges, full fleet zero-emission transition plans can help agencies position for long-term success when considering the dynamics of zero-emission fleets. Planning infrastructure installations in a phased approach to meet the needs of a changing fleet can help not only save money for the agency by batching design and construction work but can also ensure that the local electric utility is positioned to supply both the power and energy required when it is needed. As further described in the **Funding Opportunities** section, if WTS plans to apply for Federal discretionary (competitive) funding they are required to prepare and submit a zero-emission transition plan. Given the time and information required to develop this plan, it is recommended to prepare this planning document well before the grant cycle, typically in early spring (February/March) of each year.

FINANCIAL RESOURCES

Existing WTS Financials

As an enterprise fund of the City of Waco, WTS is financed and operated in a manner similar to a private business. WTS can leverage dedicated funding from the City of Waco's Transit Fund; however, the amount available can fluctuate year to year based on need, changes in capital expenditures, and grants received.

On an average year, WTS local revenues consist of generated fare revenues from transit operations (*e.g.,* bus, paratransit, trolleys) and revenue from the City of Waco. Additionally, WTS receives other funds from the FTA and the Texas Department of Transportation (TxDOT). The FTA supplies the largest share of funding for WTS including formula funding from Section 5307 Urbanized Area Formula Program, Section 5310 Enhanced Mobility of Seniors and Individuals with Disabilities Formula Program, and Section 5339 Buses and Bus Facilities Formula Program. In FY2020, WTS also received funding from the FTA in Coronavirus Aid, Relief, and Economic Security (CARES) Act funding to support operating, administrative, and preventative maintenance costs to respond and recover from the COVID-19 pandemic.

For each scenario, WTS would be responsible for a local share of capital and operating costs. The specific local share assumptions are outlined below and are directed by WTS based on historical financial data and anticipated revenue. Funding from other sources would supplement local funding contributions. WTS could, for example, use FTA formula or discretionary grant funding as supplemental source for increased operating costs or capital investments.

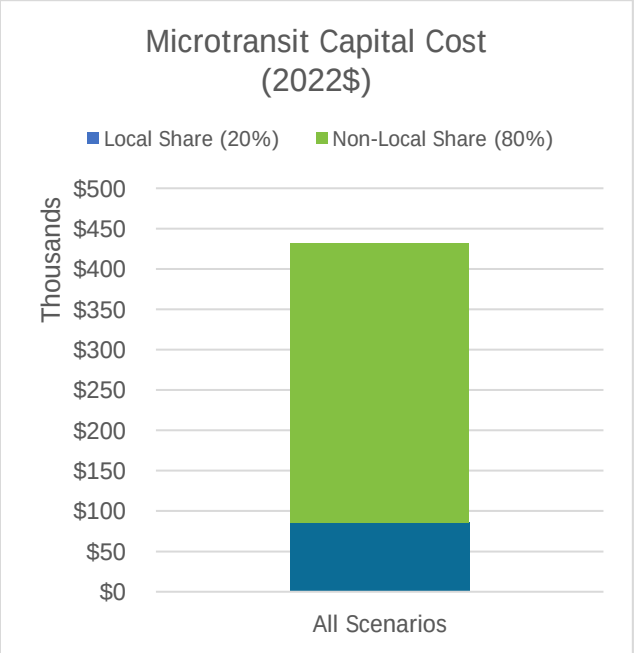
Revenue Assumptions

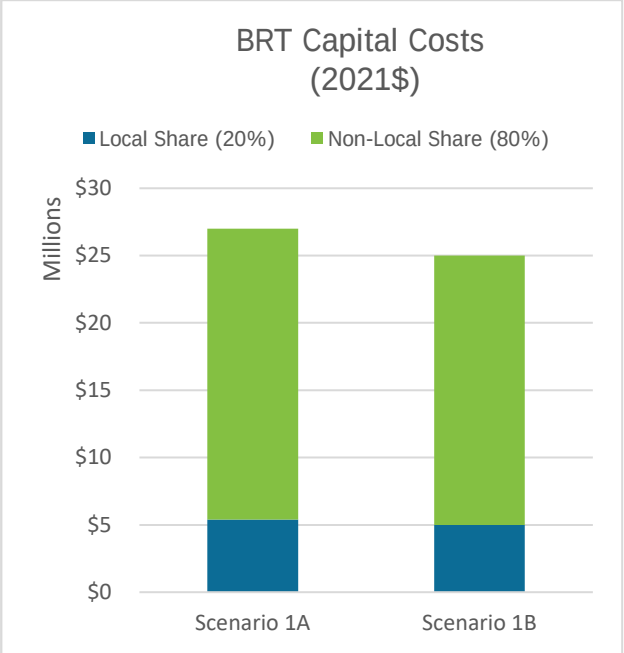
Capital

For each operating scenario, it was assumed that WTS would be responsible for a local share of 20 percent of the total capital costs and the remaining 80 percent of the cost would be provided by other (non-local) funding sources. For fixed-route capital costs, for the purchase of microtransit vehicles and SaaS technology, WTS would be responsible for approximately $86,400 and other funding sources would fund the remaining $345,600 for all three scenarios 1A,1B, and 2. For scenarios 1A and 1B, that include a BRT component, it is assumed that WTS would be responsible for $5.4 or $5.0 million (2021$) whereas the remaining capital investment would be funded by other non-local funding sources.

As an enterprise fund, the City of Waco can transfer funds from the City's General Fund to the WTS Fund to address gaps in funding, as needed. Other non-local funding sources may include Federal Transit Administration (FTA) formula and discretionary funds and Texas Department of Transportation (TxDOT) funds. For additional information regarding non-local funding source opportunities, refer to the **Funding Opportunities** section below.

FIGURE 39: CAPITAL LOCAL AND NON-LOCAL SHARE ASSUMPTIONS

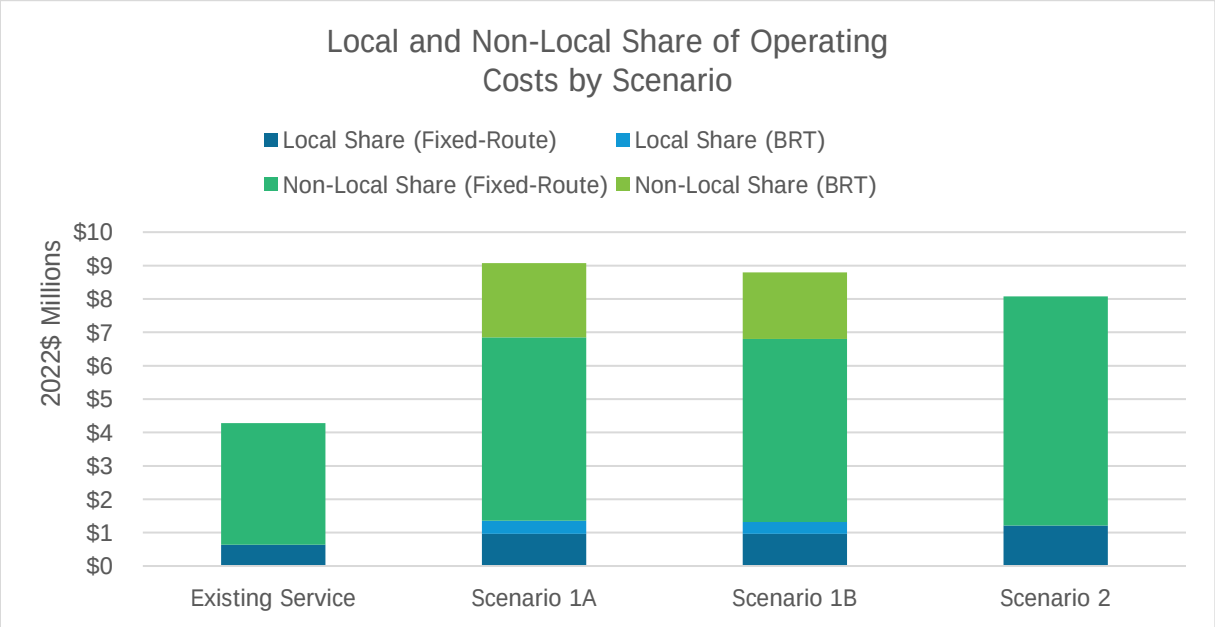




Operating

For each scenario, WTS would be responsible for a local share of 15 percent of the total O&M costs and the remaining 85 percent of the cost would be provided by other funding sources as directed by WTS based on historical data and anticipated revenue. For each scenario, the local and non-local share of operating WTS would more than double existing service operating costs, however, the majority of that cost would be absorbed by non-local funding sources. The overall O&M costs of the existing system are about $4.3 million, and an estimated local share of nearly $650,000. Scenario 1A would cost about $9 million annually in O&M costs with an estimated local share of approximately $1.4 million. Scenario 1B O&M costs are slightly lower at $8.8 million annually in total and a $1.3 million local share. Scenario 2 is expected to have the lowest O&M cost of the three scenarios. The total O&M costs are estimated at approximately $8.1 million, with the local share comprising approximately $1.2 million.

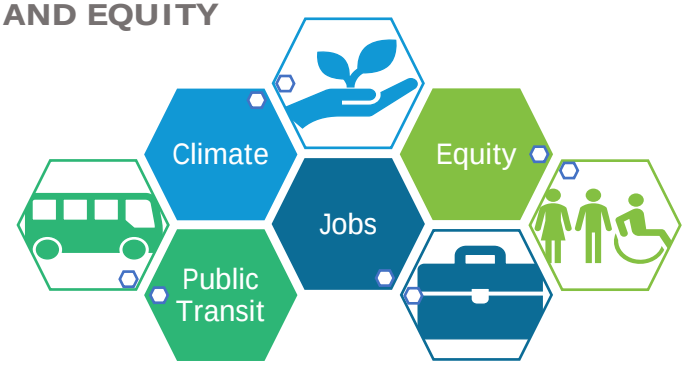
FIGURE 40: LOCAL AND NON-LOCAL SHARE OF OPERATING COSTS



Funding Opportunities

The Bipartisan Infrastructure Law (Infrastructure and Investment Jobs Act (IIJA)) includes around $550 billion in new federal investment in the nation's infrastructure including public transportation. The legislation places a renewed focused on investing in modernizing public transit including taking steps toward tackling the climate crisis by electrifying transit fleets, supporting American jobs and training the transit workforce, and prioritizing equity (Figure 41). Specifically, ensuring that investments go toward addressing historical inequities or proactively advancing equity through the Justice40 Initiative. This Initiative focused on delivering 40 percent of the benefits of Federal investment go toward disadvantaged communities. According to the U.S. Department of Transportation (U.S.DOT) Justice40 mapping tool[8], 46 percent of the Census Tracts in the Waco Metropolitan Area are designated as disadvantaged communities.

FIGURE 41. IIJA FOCUSES INVESTMENTS ON PUBLIC TRANSIT, CLIMATE, JOBS, AND EQUITY



The IIJA also increases the amount of funding available through discretionary (competitive) funding opportunities through the Section 5339(b) Grants for Buses and Bus Facility Program and the Section 5339(c) Low or No Emission Grant Program. Discretionary funding can fill revenue gaps at a local level needed to replace aging fleets, construct bus facilities, improve workforce training programs, and enhance transit

[8]U.S DOT Justice40 Mapping Tool (2022)
https://usdot.maps.arcgis.com/apps/dashboards/d6f90dfcc8b44525b04c7ce748a3674a

infrastructure. The IIJA directs funding to the State of Texas, $3.3 billion in formula funding to improve public transportation over the next five years (FY 2022 – FY 2026). As a recipient of Federal and State funding, the WTS can benefit from increased formula and discretionary funding opportunities and leverage these dollars to fund the selected operating Scenario 2.

As described in the **Fleet Electrification** section, the IIJA offers transit agencies increased funding opportunities to convert their aging diesel fleets to battery-electric buses. If WTS were to pursue discretionary funding opportunities, specifically for the conversion of the fleet, it is recommended to review the FTA's eligibility criteria, requirements under the IIJA, and how to develop a narrative that best positions the agency to receive discretionary funding. Furthermore, WTS should continue to work with the Waco Metropolitan Planning Organization (MPO), the City of Waco, and the TxDOT to identify additional funding opportunities for both capital and operating needs.

Federal Funding Opportunities

Under the IIJA, the expanded Grants for Buses and Bus Facilities Program and the Low or No Emissions Program both offer greater opportunities for public transit agencies to transition their fleets to electric, construct bus-related facilities, and/or purchase related equipment. Following the passing of the IIJA, FTA further streamlined the application process for eligible recipients who plan to apply to one or both grant programs by requiring grant applicants to submit information to one supplemental form. As a fixed-route bus operator, WTS is eligible to apply for funding under each of the following grant programs described in further detail below.

The supplemental form outlines the key details about the project including the description, estimated cost, and schedule. Additionally, the form aligns IIJA criteria for Justice40, workforce development and climate action with the anticipated project. Specific requirements may vary slightly from year to year but are anticipated to remain relatively consistent throughout the life of the IIJA.

Grants for Buses and Bus Facilities Program

The 5339(b) Buses and Bus Facilities Grants Discretionary program is one of two discretionary grant programs included in 5339. For this program, FTA prioritizes projects that demonstrate how they will address significant repair and maintenance needs, improve safety of the system, and deploy connective projects that include advanced technologies.

Eligible projects include:

- Replacement of buses and related equipment
- Rehabilitation of buses, related equipment, and bus-related facilities
- Purchase of buses, related equipment, and bus-related facilities
- Lease of buses and bus-related facilities
- Construction of bus-related facilities

The IIJA requires applicants to describe how the project, in general, generates significant community benefits relating to the environment. A WTS project, for example, may be rated higher if the project is in alignment with a Climate Action Plan or shows that environmental justice populations are benefiting from the reduced emissions. Additionally, WTS should

consider how the project might benefit Justice40 disadvantaged communities, address racial equity, and align with local plans and policies.

If WTS were to apply to this grant program, WTS would be responsible for 20% of the capital costs of the project (*e.g., microtransit buses)* and 80% of the costs would be Federal. However, WTS could request another 5% (total of 85% share) in Federal funds for an eligible project if it included ADA and/or Clean Air Act compliance components. An example project showing various capital components for Scenario 2, is shown in Table 23. As shown in the example, WTS could request a higher Federal share for ADA eligible items at fixed-route bus stops, whereas the other capital improvements would assume the base 80 percent Federal Share.

TABLE 23: EXAMPLE GRANTS FOR BUSES AND BUS FACILITIES PROJECT

Illustrative Example	Unit Quantity	Unit Cost (2022$)	Total Project Cost	Federal Share	WTS Local Share
Microtransit Vehicles for Fixed Route Service	3 Vehicles	$127,300	$381,900	$305,520	$76,380
Bus Stop: Pole and Sign for Fixed Routes 1,2,3	19 Stops	$105	$1,985	$1,588	$397
Bus Stop: ADA Upgrades for Fixed Routes 1,2,3	4 Stops	$2,170	$8,680	$7,378*	$1,302
Total (Rounded)			**$393,000**	**$315,000**	**$78,000**

**Assumes 85% Federal share in alignment with ADA compliance.*

FTA's 5339(b) Bus and Bus Facilities is a discretionary program that can be utilized to fund individual parts of a larger project including buses, bus stop improvements, and maintenance facilities. If WTS decides to advance BRT in the future, Buses and Bus Facilities funding can be used toward dedicated bus lanes or transit signal priority. Funding through this program would be in addition to the federal formula funds received annually. As a result, WTS would not be competing with local projects for funding priorities. However, this also adds uncertainty to a transit agency budgeting as the selection of the projects would be made at the federal level.

Low or No Emissions Vehicle Program

The 5339(c) Buses and Bus Facilities Grants – Low or No Emission (LONO) Vehicle Program is the second discretionary grant program under 5339. It provides funding to finance the purchase or lease of low or no emission vehicles that use advanced technologies, including related equipment or facilities, for transit revenue operations. Projects may include costs incidental to the acquisition of buses or to the construction of facilities, such as the costs of related workforce development and training activities, and project development. Intelligent technology and software for low- or no- emission buses are also included.

Eligible projects include the following:

- Purchasing or leasing low- or no-emission buses
- Constructing or leasing facilities
- Purchasing charging equipment

- Workforce development and training activities

The IIJA requires that applicants for this program must have a Zero-Emission Fleet Transition Plan to be eligible. Additional details regarding this plan are included in the **Fleet Electrification** section. Additionally, applicants should designate 5% of the project budget for workforce development training such as technician training, first-responder training, or vendor-based training. Similar to the Grants for Buses and Bus Facility Program, applicants should continue to demonstrate commitment to Justice40, environmental justice, and racial equity.

An example WTS project for the Low or No Emission Grant is shown in Table 24. The notable difference in this program is that the Federal share for vehicles, assuming they are battery-electric or other low-or no-emission technology, is 85% (compared to 80% for Buses and Bus Facilities projects). Similarly, the Federal share increases to 90% for related equipment such as software or charging equipment for the project. Additionally, workforce development activities are required if applying to this grant program which assumes 0.5% on the total Federal share of the project; noting it is an additive project cost.

TABLE 24: EXAMPLE LOW OR NO EMISSION GRANT PROGRAM

Illustrative Example Project:	Unit Quantity	Unit Cost (2022$)	Total Project Cost	Federal Share	WTS Local Share
Battery-Electric Microtransit Vehicles for Fixed Route Service)*	3 Vehicles	$127,300	$381,900	$324,615	$57,285
Charging Equipment	1 Charger	$150,000	$150,000	$135,000	$15,000
Total	-	-	$531,900	$459,615	$72,285
Workforce Development	0.5%	-	$2,278	$2,298	$460
Total (Rounded)			**$535,000**	**$462,000**	**$73,000**

**Note availability and price is contingent on select vendors who offer BEB cutaways*

FTA's 5339(c) Low or No Emissions discretionary program funding can be utilized for electric buses, charging equipment, and maintenance facility upgrades to accommodate electric vehicles. These funds would be in addition to the federal formula funds received annually. As a result, they would not be competing with local projects for funding priorities. However, this also adds uncertainty to a transit agency's budgeting as the selection of the projects would be made at the federal level, rather than local or regional level.

RAISE Grant Program

The Rebuilding American infrastructure with Sustainability and Equity (RAISE) discretionary grant program administered by the US Department of Transportation (DOT), offers a unique opportunity for the DOT to invest in road, rail, transit and port projects that promise to achieve national objectives. The DOT uses a rigorous merit-based process to select projects with exceptional benefits and make needed improvements to our Nation's infrastructure. In FY22, $1.5 billion was allocated for selected projects. This grant program has gone by many different

names including the Better Utilizing Investments to leverage Development (BUILD) and Transportation Investment Generating Economic Recovery (TIGER) grant program.

Eligible Projects include the following:

- Public transportation projects
- Intermodal projects
- Highway, bridge, or other road projects
- Passenger and freight rail transportation projects
- Port infrastructure investments

The maximum award amount a project can receive is $25M. The minimum award is $5M in urban areas and $1M in rural areas. No more than $250M can be awarded to a single State. No more than 50 percent of funds shall be awarded to urban projects or rural projects. Up to $75M of funds will be awarded to planning grants (i.e., environmental analysis, feasibility studies, and other preconstruction activities for capital projects), including at least $15M to projects that are located in or benefit Areas of Persistent Poverty. The Federal share of project costs may not exceed 80 percent for a project in an urban area. The DOT may increase the Federal share of costs above 80 percent for projects in rural areas and for planning projects located in Areas of Persistent Poverty.

The RAISE Grant program is extremely competitive and annually the DOT receives more than 10,000 applications. In FY2022, more than $185 billion in funding for projects was requested through this program. Applicants are required to complete a cost-benefit analysis and demonstrate how the project advances environmental sustainability, quality of life, mobility and community connectivity, economic competitiveness, partnership and innovation, safety, and a state of good repair.

In FY2022, the DOT awarded projects funding for similar type improvements that WTS will be looking to implement under scenario 2. For example:

- Greenville Transit Authority received $5.8 million for bus stop infrastructure including shelters, push button lighting, and benches at 336 bus stops.
- City of Beaverton, OH received $2 million for new bus stops, signal improvements, wider sidewalks and protected bike lanes.
- ADA County, ID received $5 million for upgrading transit stops and implementing ADA accessible pedestrian ramps.

State Funding Opportunities

The following describes funding opportunities that may be available through coordination with the Texas Department of Transportation and the Waco MPO.

Texas Department of Transportation

The associated cost to operate WTS services not covered by fares and contract revenue are provided through grants by the TxDOT. TxDOT receives federal funds for transportation through the US DOT and administers funding to agencies according to the mode of transportation. The General Fund is the primary operating fund for the State of Texas and includes transactions for transportation and other general operations (education, health and

human services, public safety etc.). WTS receives formula funding allocations (e.g., Section 5307 and Section 5310) via TxDOT. Additionally, under Texas State law transit authorities or municipal transit departments are authorized by voters to impose a sales tax dedicated to transit. The City of Waco receives one and one-half percent sales tax on all retail sales, leases and rentals of most goods. Sales tax is budgeted at $46.9 million for FY 2023. The City of Waco can leverage local sales tax funding for a source of revenue for local match.

Unified Transportation Program

TxDOT manages funding for the Unified Transportation Program (UTP). The UTP is fiscally constrained by the planning cash forecast, which means TxDOT can only develop projects that it can afford to execute within potential funding limits. TxDOT's transportation revenues are comprised of a combination of state funds appropriated by the Texas Legislature and Federal Highway Funds appropriated by Congress. In addition, local governments contribute resources to certain projects to help offset project funding needs.

The UTP is organized into 12 funding categories, each UTP addressing a specific type of project or range of eligible activities. Projects are selected by MPOs, TxDOT districts, certain TxDOT divisions, or the Texas Transportation Commission, depending on the category. In addition, categories may be either project-specific or based on allocations. Funding in project-specific categories is awarded to individual projects around the state, while allocation categories are distributed by formula to TxDOT districts or divisions, which subsequently manage the project selection and programming.

WTS may be eligible for funding under the following UTP Categories:

- **UTP Category 9:** Transportation Alternatives Set-Aside Program: funds for this program may be awarded for construction of sidewalks, lighting and other-safety related infrastructure, and transportation projects to achieve compliance with the ADA. For urbanized areas with populations over 200,000 (TMAs), MPOs select projects in consultation with TxDOT. WTS should coordinate with the Waco MPO if interested in pursuing this funding source for additional details and project eligibility.
- **UTP Category 10:** Supplemental Transportation Programs addresses a variety of transportation improvements including ADA projects for the construction or replacement of curb ramps at on-system intersections to make the intersections more accessible to pedestrians with disabilities. Noting that projects are selected statewide based on conditions of curb ramps or locations of intersections without ramps.

Waco Transit System Realignment Study: Existing Conditions Analysis for ADA Paratransit and FTA 5310/5311 Services

Introduction

This memorandum was prepared for Waco Transit System's Realignment Study (also known as "Reimagine Waco Transit"). This analysis evaluates the City of Waco's Demand Response Van Service (ADA paratransit), funded by FTA Section 5307 formula grants for urbanized areas, and other demand-response services operating under FTA Sections 5310 and 5311. This analysis begins with a statistical and spatial analysis to assess the performance of the existing ADA paratransit service, including analysis of origin/destination data to understand common travel patterns of ADA customers. Following this is an assessment of demand-response transportation services funded by FTA Sections 5310 (Enhanced Mobility of Seniors & Individuals with Disabilities) and 5311 (Formula Grants for Rural Areas). This assessment includes the volume and types of trips offered by each transportation provider and funding program. The memorandum concludes with an analysis of the impacts of two fixed-route transit scenarios upon the ADA paratransit and 5310/5311-funded transportation services, including fleet requirements, vehicle-hours, ridership, fares, and budget. A summary of the annual funding allocations for demand-response transportation from each source for FY 2018 is provided in the table below.

Percentage of annual funding for FY2018

Funding Source	Total Allocation	Percentage of Annual Funding
Section 5307	$2,633,035	41%
Section 5310	$348,315	5%
State	$607,223	9%
City of Waco General Fund	$178,448	3%
Fares	$1,342,178	21%
Aux. funds like advertising	$289,212	4%
Concessions (automatic chef)	$8,754	0%
Other trans funds (Medicaid)	$587,961	9%
Misc. funds (silo)	$455,126	7%
Total	**$6,450,252**	

1. Section 5307-Funded Services: Demand Response Van Service (ADA Paratransit) and Evening LINK Service

Summary of Service Parameters

The City of Waco's Demand Response Van Service (ADA paratransit) provides door-to-door service to qualified riders with disabilities who cannot use Waco Transit System's (WTS) fixed-route bus service due to the nature of their mobility challenges. Drivers are trained to provide "minimal" door-to-door assistance, including providing assistance to passengers boarding and alighting the vehicles, escorting passengers to the curb of their destination, and notifying passengers the vehicle has arrived by ringing the doorbell at

their residence.[1] Service hours are from 5:15 AM to 7:15 PM on weekdays and 6:15 AM to 8:15 PM on Saturdays. The service does not operate on Sundays. The Demand Response Van Service operates within ¾ mile of WTS bus stops, in accordance with ADA requirements. Riders must schedule trips between 24 hours and 14 days in advance, by calling the WTS customer service center, which is open 7 days a week between the hours of 8 AM and 5 PM. Fares are $3 for one-way trips scheduled in advance. Same-day service is available on a space-available basis for a premium fare of $4 per one-way trip. WTS also operates the Evening LINK Service, an employment-oriented demand-response service that provides transportation for trips between the Waco Regional Airport and the Waco urbanized area boundary, from 8:30 PM to 11:45 PM Monday through Saturday. This service window is tailored to accommodate the needs of shift workers at the industrial parks near the airport and students at Texas State Technical College (TSTC), who typically take WTS fixed-route service to get to work and use the Evening LINK service for their return trip. The Evening LINK Service is funded by the Job Access and Reverse Commute Program (formerly Section 5316), a funding program consolidated with FTA's Section 5307 in 2018.[2] One-way trips cost $3. Similar to the Demand Response Van Service, trips must be booked at least 24 hours in advance, though same-day service is also offered on a space-available basis.

Fleet Inventory

Section 5307 programs for the Waco urbanized area, including the Demand Response Van Service and the Evening LINK service, have a combined fleet of 56 vehicles, as of January 2022. A summary of the fleets' vehicle make/model, quantity, class, and passenger capacity is shown in the table below.

Summary of Section 5307 (Urban) Fleet Inventory

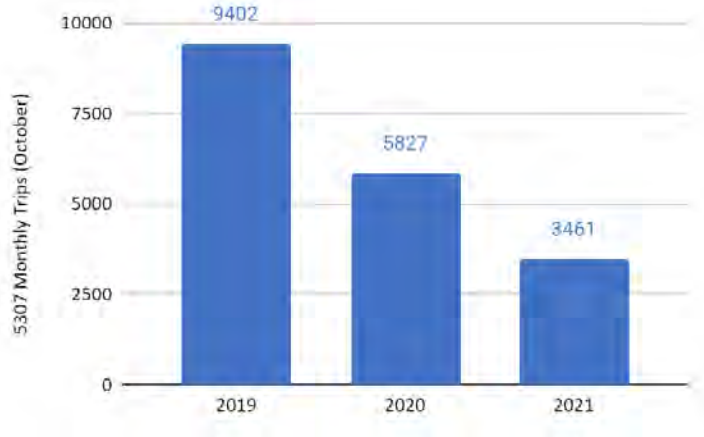
Vehicle Class	Make/Model	Passenger Capacity	Quantity
Automobile	Chevy Impala	4	3
Automobile	Chevy HHR	4	3
Cutaway	Chevy Eldorado	10	14
Cutaway	Ford Transit 350	9	7
Transit Bus	Optima Bus	31	8
Transit Bus	Optima Bus	23	9
Transit Bus	New Flyer Xcelsior	32	8
Trolley Bus	Chance AH-28	25	1
Trolley Bus (spares)	Chance VS-24	25	2
Van	Dodge Van	12	1
Total		**1,025**	**56**

[1] Waco Transit System. 2022. "Demand Response Van Service." https://www.waco-texas.com/transit/demand-van.asp#gsc.tab=0

[2] Federal Transit Administration. 2018, December 4. "Job Access Reverse Commute Program." https://www.transit.dot.gov/funding/grants/grant-programs/job-access-and-reverse-commute-program-5316

Ridership Patterns

Waco's 5307-funded services provide about 3,500 passenger trips per month, as of October 2021, or about 110-120 passenger trips on a typical weekday and about 60-70 passenger trips on a typical Saturday. Monthly ridership on WTS' 5307-funded services, including both the Demand Response Van Service and Evening LINK, has declined significantly due to the COVID-19 pandemic. Total ridership in October 2021 was just 37% of the ridership level observed in October 2019. The Evening Link service alone served 308 monthly passenger trips in October 2021, compared to 3,153 passenger trips on the Demand Response Van Service.

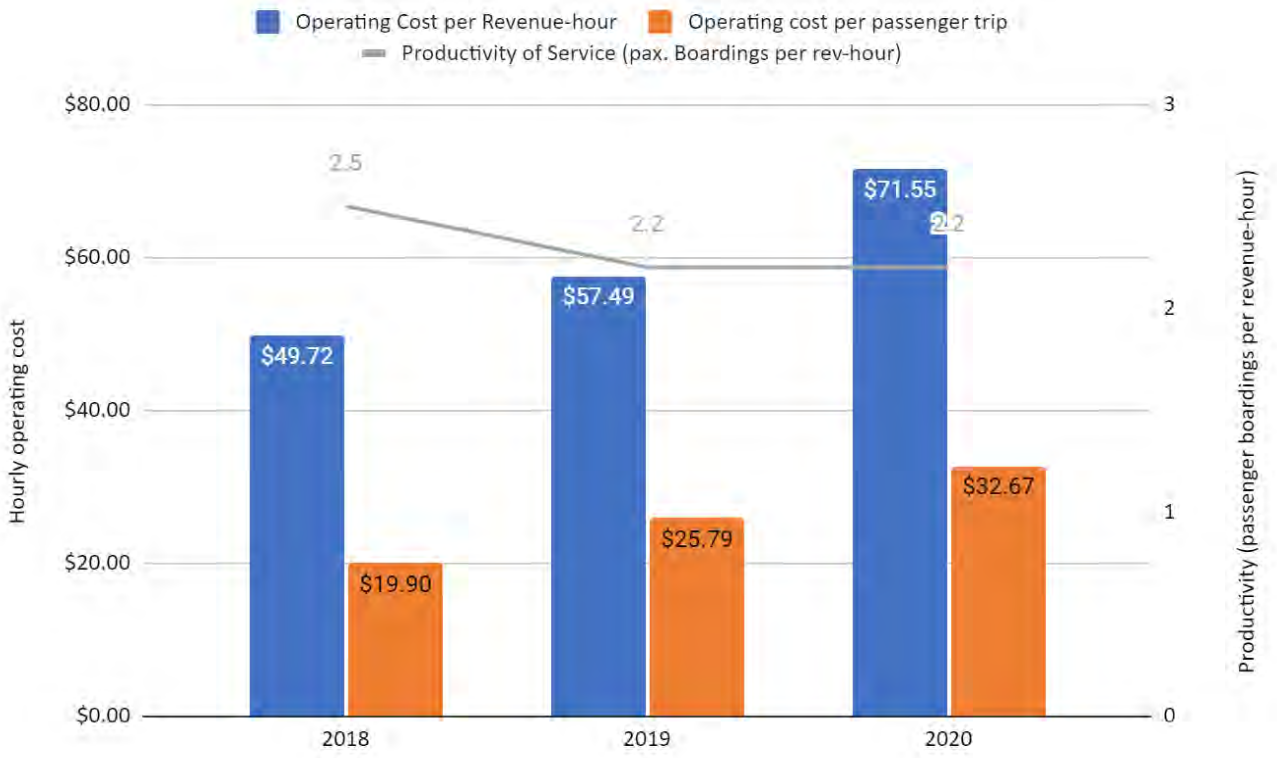


Service KPIs

The Demand Response Van Service faces increasing operating costs and declining productivity of service, which together pose significant challenges for WTS. During the last three fiscal years, from 2018 to 2020, annual operating expenses per revenue-hour have increased from around $50 to around $72.[3] While these hourly expenses are roughly in line with industry benchmarks from other small and mid-sized transit agencies in Texas, the ADA paratransit service's declining ridership (referenced in the previous section) has resulted in rising costs per passenger trip — from about $20 per passenger trip in 2018 to $32 in 2020 — as well as flattening productivity of service. These key indicators are highlighted in the following chart. While these data are not yet available for FY 2021, it is likely that the ongoing decline in ridership shown in October 2021 data above will result in increased operating costs per passenger trip.

[3] FTA National Transit Database. 2018-2020 Agency Profiles for the City of Waco.

FTA Productivity and Cost Performance Indicators — 5307-Funded Paratransit Services



Rider Origin-Destination Patterns

The three maps on the following pages display heatmaps illustrating the relative intensity of rider destinations throughout the Demand Response Van Service zone during the years of 2019, 2020, and 2021. During this three-year period, the most popular origins and destinations remained relatively constant and exhibited little variation. The project team analyzed ADA paratransit trips during the month of October during 2019, and 2020, and 2021.

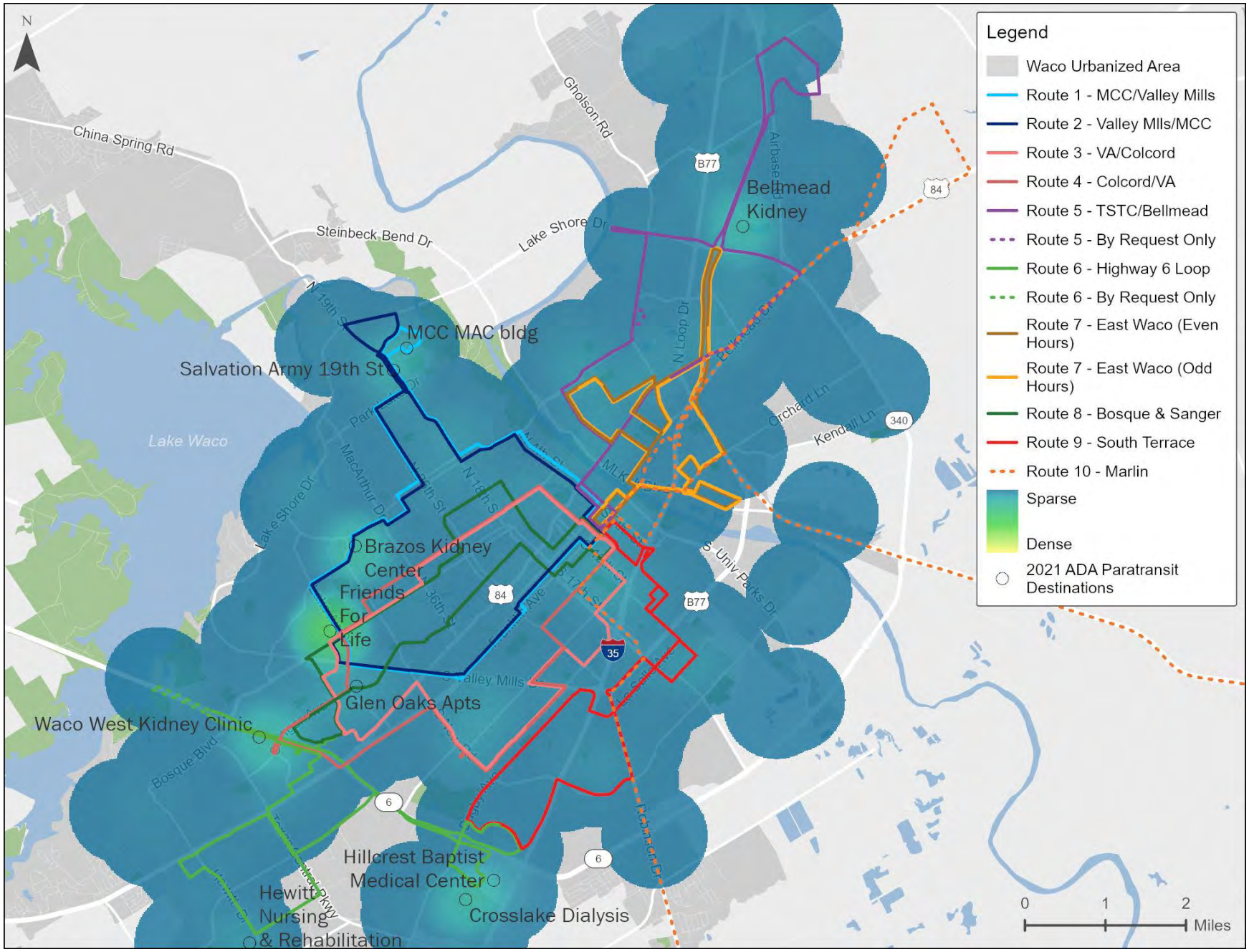
The range of destinations is fairly typical for ADA paratransit programs in smaller and mid-sized American cities, featuring a mix of nonprofit organizations providing services to people with disabilities, food banks, kidney and dialysis clinics, multi-family apartment communities, assisted living facilities for older adults, and McLennan Community College. This mix of destinations is uniquely reflective of the needs of older adults and people with disabilities. It is notable that no single shopping destination (e.g. Central Texas Marketplace, Walmart, etc.) or major employer comprises more than one percent of the monthly pick-ups or drop-offs for the service. On the other hand, Friends for Life, a non-profit organization providing adult day care, independent living support, physical therapy, and job placement services for people with disabilities and older adults, attracts a disproportionate share of pick-ups and drop-offs, between nine and 11 percent, respectively. The most frequently requested 10% of ADA paratransit origins and destinations are shown in the table below and highlighted on the following three maps. Individual origins or destinations in the top decile of ADA paratransit trips feature at least 23 monthly pick-ups or drop-offs.

Among passenger trips on the Evening LINK service, the range of most frequent pick-up and drop-off locations was more dispersed, apart from the Waco Regional Airport and TSTC locations where these trips must begin or end. The top 10 percent most frequently requested pick-up and drop-off locations on the Evening LINK service in October 2021 included Baylor University, Ridgecrest Retirement Center, and the Swann Products warehouse.

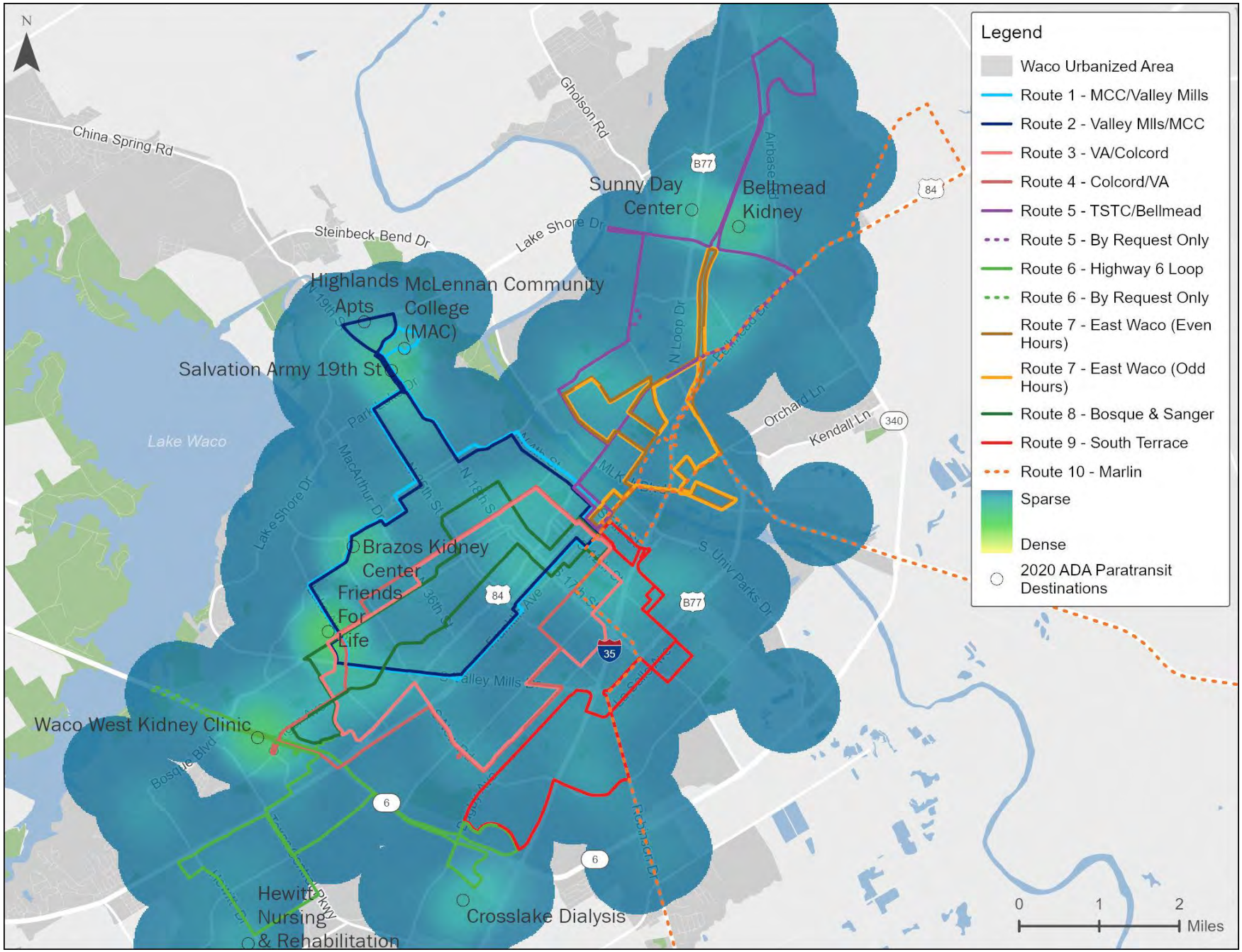
Top 10% of Origins & Destinations of ADA Paratransit (5307) Trips in October 2021

Name	Type	Monthly Pick-ups	Percent of Monthly Pick-ups	Monthly Drop-offs	Percent of Monthly Drop-offs
Friends For Life	Disability Services	291	9.23%	353	11.20%
Bellmead Kidney	Dialysis	149	4.73%	134	4.25%
Waco West Kidney Clinic	Dialysis	113	3.58%	118	3.74%
Crosslake Dialysis	Dialysis	110	3.49%	119	3.77%
Brazos Kidney Center	Dialysis	77	2.44%	71	2.25%
Helping Hands	Food Bank & Disability Services	53	1.68%	44	1.40%
Salvation Army 19th St	Food Bank & Disability Services	40	1.27%	27	0.86%
McLennan Community College (MAC)	Community College	36	1.14%	49	1.55%
Glen Oaks Apartments	Multi-family Housing	33	1.05%	30	0.95%
Senior Care of Hewitt	Assisted Living	33	1.05%	30	0.95%
Hillcrest Hospital	Medical	20	0.63%	24	0.76%

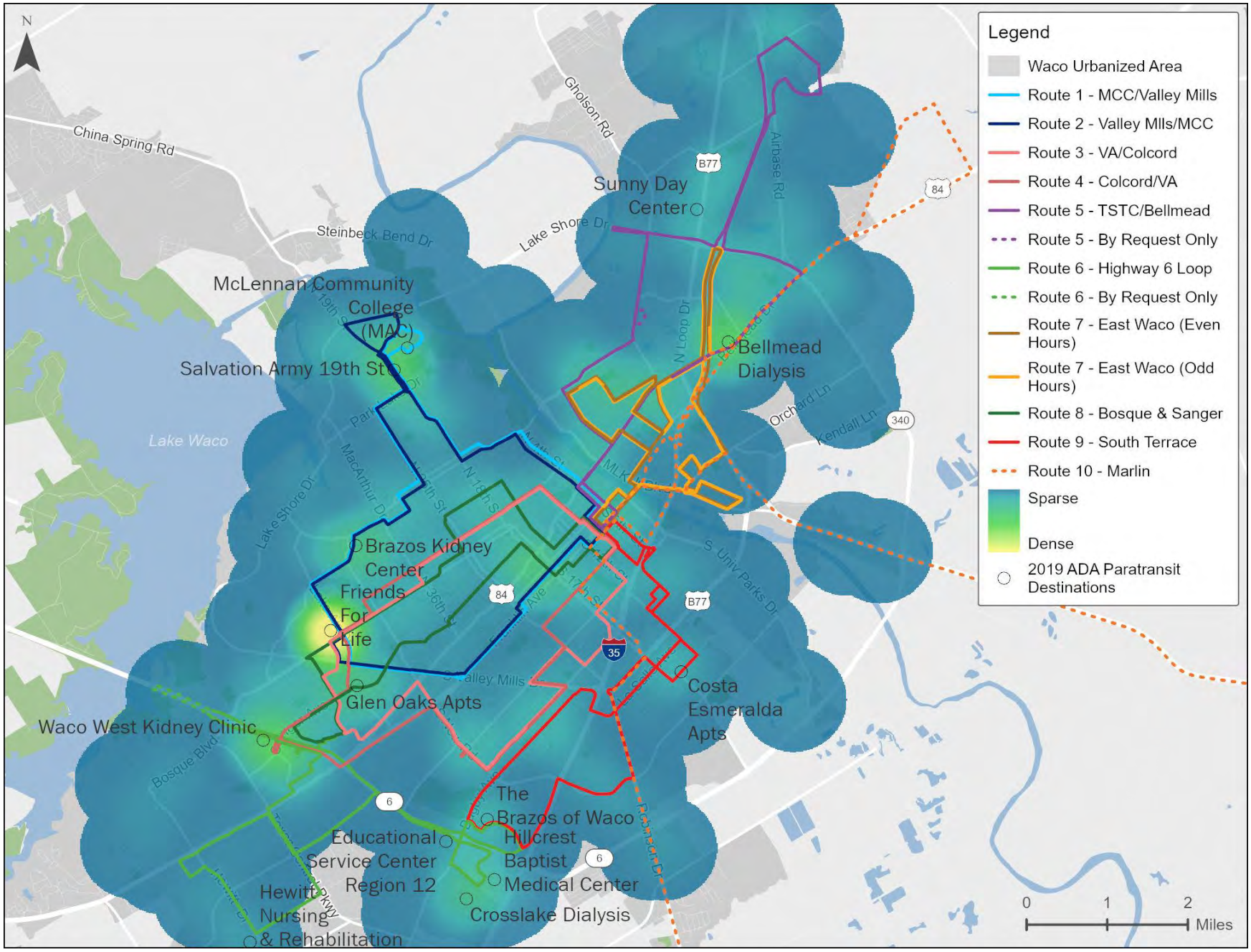
Map of October 2021 ADA Paratransit Destinations



Map of October 2020 ADA Paratransit Destinations



Map of October 2019 ADA Paratransit Destinations

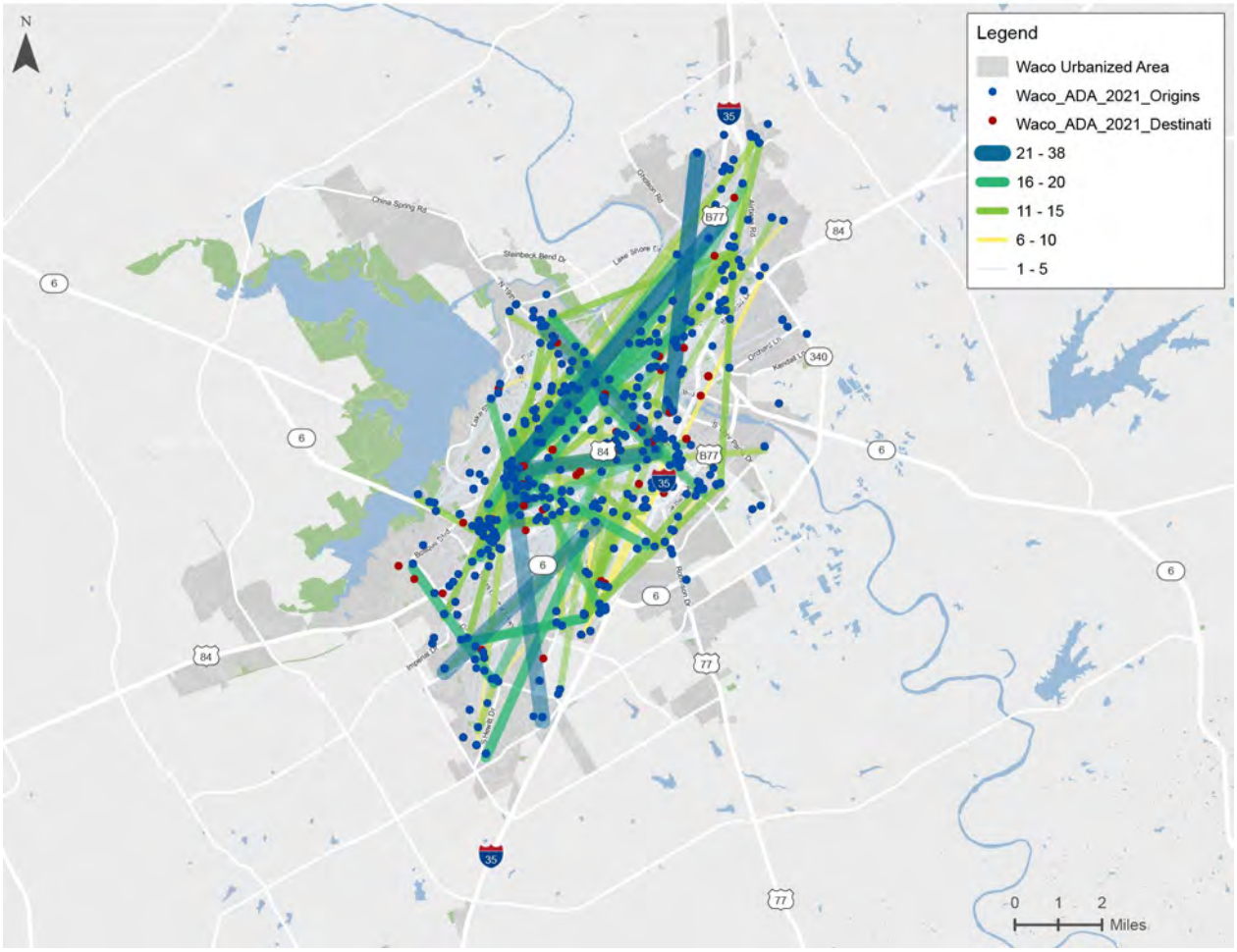


The project team conducted a more granular origin-destination analysis of Demand Response Van Service trips, which involved evaluating the frequency of specific pairs of origins and destinations. The intent of this analysis is to highlight specific passenger journeys that occur most frequently on the service. The map below illustrates that while Key origins & destinations for the most frequent 5307-funded paratransit journeys include apartment communities, disability services organizations, and childcare centers, including:

- Friends for Life
- Brite Start Childcare
- Sandstone Apartments
- Highlander Square Apartments
- Waco Child Development Center
- Klaras Children's Center

The most common origin-destination links are shown in the map below, with the most frequent pairs shown in navy blue and less frequent pairs shown in yellow and green.

Map of Most Frequent Passenger Trip Origin-Destination Links on ADA Paratransit Service, October 2021

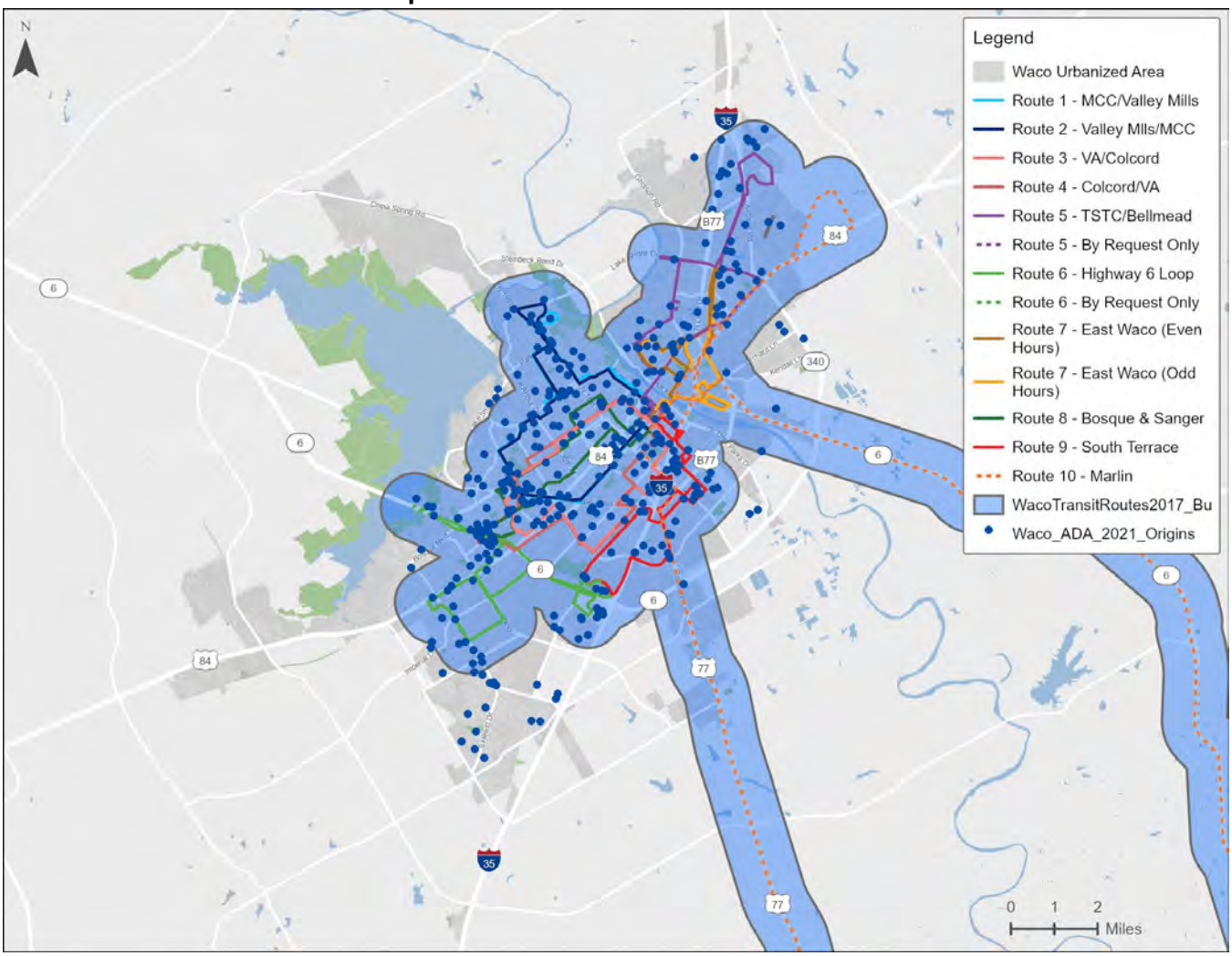


The project team also analyzed rider trip requests with respect to the boundaries of the ADA paratransit coverage area, defined as the statutory ¾-mile buffer from the current WTS fixed-route bus network. Much of the city of Hewitt as well as smaller, but potentially significant portions of Ridgecrest, Lacy-Lakeview, and East Waco are outside of this zone. However, the project team understands that the Demand Response Van Service provides consistently available service to these locations, slightly exceeding the ADA requirement for coverage. A summary of the most frequent origins & destinations located beyond the ¾ mile ADA fixed-route service buffer is provided in the table below. On the following page, a map displays some of these destinations located beyond the coverage zone indicated in blue.

Significant Community Destinations Located outside of ADA Paratransit Service Zone

Name	Type	Monthly Pick-ups	Percent of Monthly Pick-ups	Monthly Drop-offs	Percent of Monthly Drop-offs
Walmart on Sun Valley Blvd (Hewitt)	Shopping	1	0.03%	2	0.06%
The Reserve at Dry Creek Apts	Multi-family Housing	3	0.09%	2	0.06%
The Lakes at University Center Apts	Multi-family Housing	2	0.06%	1	0.03%
Luxe at 1300 Apts	Multi-family Housing	1	0.03%	2	0.06%
Lakeshore Estates Retirement Community	Assisted Living Facility	7	0.22%	10	0.32%
Central Texas Helping Hands	Disability Services / Food Bank	53	1.68%	44	1.40%
Cimarron Apartments	Multi-family Housing	21	0.67%	14	0.44%
St. Anthony's Care Center	Medical	0	N/A	1	0.03%

ADA Service Zone for Demand Response Van Service



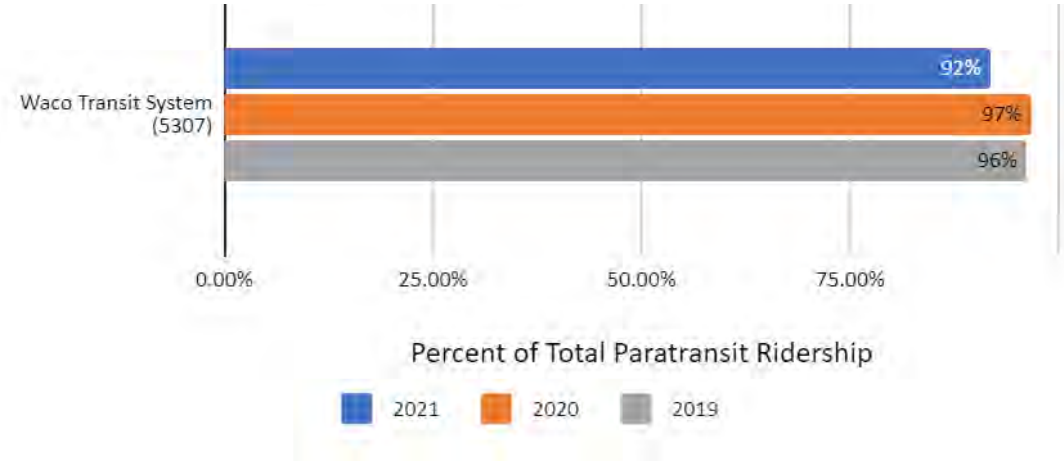
Relative Shares of Demand-Response Transportation Ridership and Fare Revenue

Out of all demand-responsive transportation services operated by WTS — including ADA paratransit, Medicaid-funded non-emergency medical transportation, and rural demand-response transportation in McLennan County - the Demand Response Van Service in Waco is responsible for disproportionate shares of the agency's monthly ridership and fare revenues. Based on the month of October 2021, the Demand Response Van Service accounts for 60% of WTS paratransit ridership and 83% of its fare revenues. Part of the reason for the difference between its shares of ridership and fare revenue is that Medicaid-funded non-emergency medical transportation (NEMT) services, accounting for 23% of paratransit ridership tracked by WTS. Rather, Medicaid-funded services like ModivCare and SafeRide do not charge passengers fares directly, as they are reimbursed by the state of Texas Department of Health and Human Services' Medical Transportation Program. The shares of monthly ridership and fare revenue for October 2021 of the Demand Response Van Service and Evening LINK are shown in the chart below.

Shares of WTS Paratransit Ridership and Fare Revenue

Excluding Medicaid-funded transportation, Section 5307-funded services (Demand Response Van Service and Evening LINK) account for the vast majority of paratransit trips in McLennan County, a share that has ranged from 92 to 97 percent between 2019 and 2021.

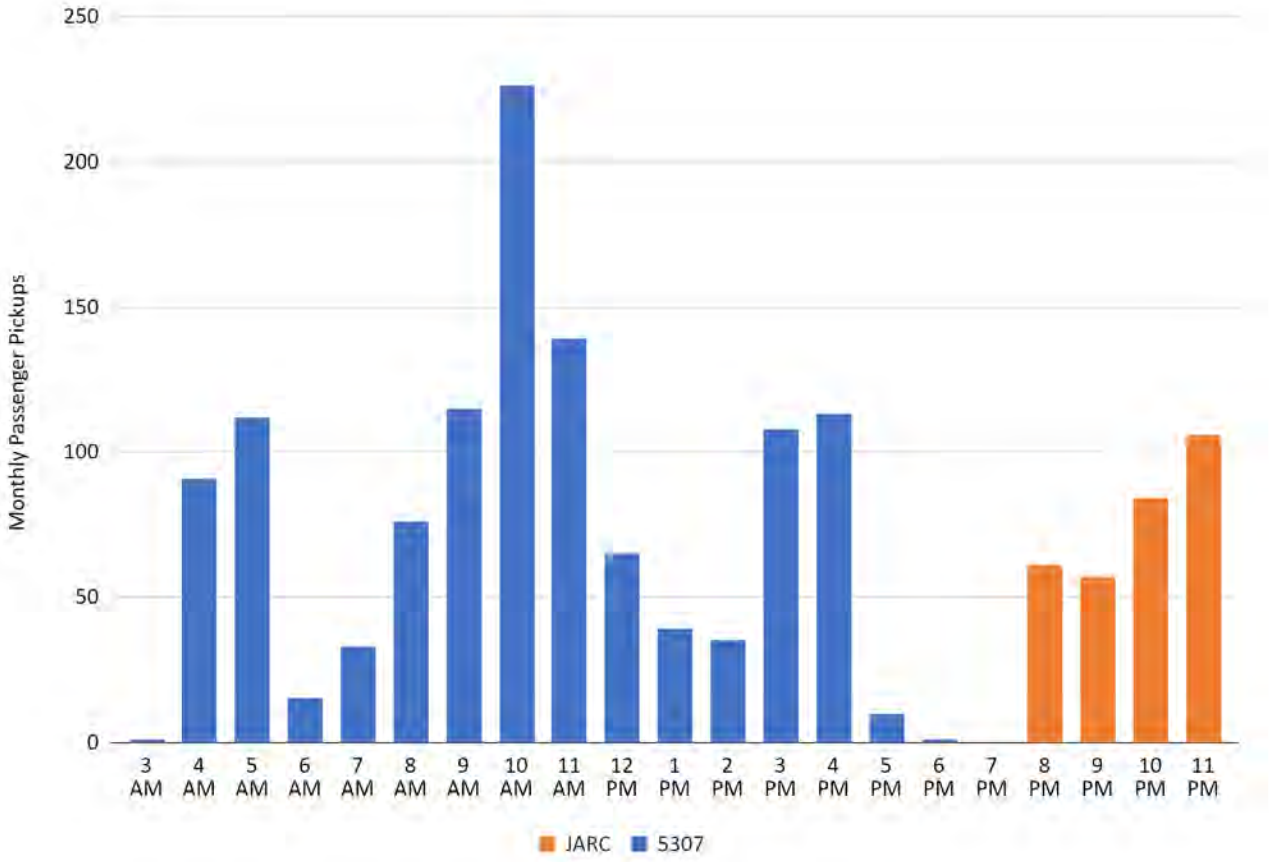
Share of Total WTS-Operated Paratransit Ridership: 5307-Funded Services



Temporal Distribution of Ridership at the Time of Pickup

The Demand Response Van Service shows three distinct peaks, based on the travel dataset reviewed from October 2021. From 4 AM to 6 AM is the first peak, a cohort likely composed of riders making commute trips, as few other non-residential destinations are publicly accessible during these hours. That there are scheduled pickups between 4 AM and 5 AM, an hour before the scheduled start of Demand Response Van Service, indicates the flexibility that WTS dispatchers have in sequencing rider pickups according to vehicle and seat availability. The second peak, between 9 AM and 12 PM, is the service's most popular travel period, and likely features a broader range of trip purposes than the cohort of riders traveling during the early morning hours. A third, but smaller, cohort of riders makes up the third peak occurring between 3 PM and 5 PM. Very few pickups occur between 5 PM and 7 PM, during the service's scheduled hours of operation, indicating that dispatchers typically shift passenger pickups to earlier in the day to ensure that all vehicles can complete their drop-offs and return to the maintenance facility by the end of the scheduled service day. Not surprisingly, the 5307-funded Evening LINK service comprises all of the passenger pickups between 8 PM and midnight, as the service is intended to transport shift workers and students at TSTC after the end of WTS fixed-route and ADA paratransit service. The temporal distribution of rider pickups is shown in the following chart.

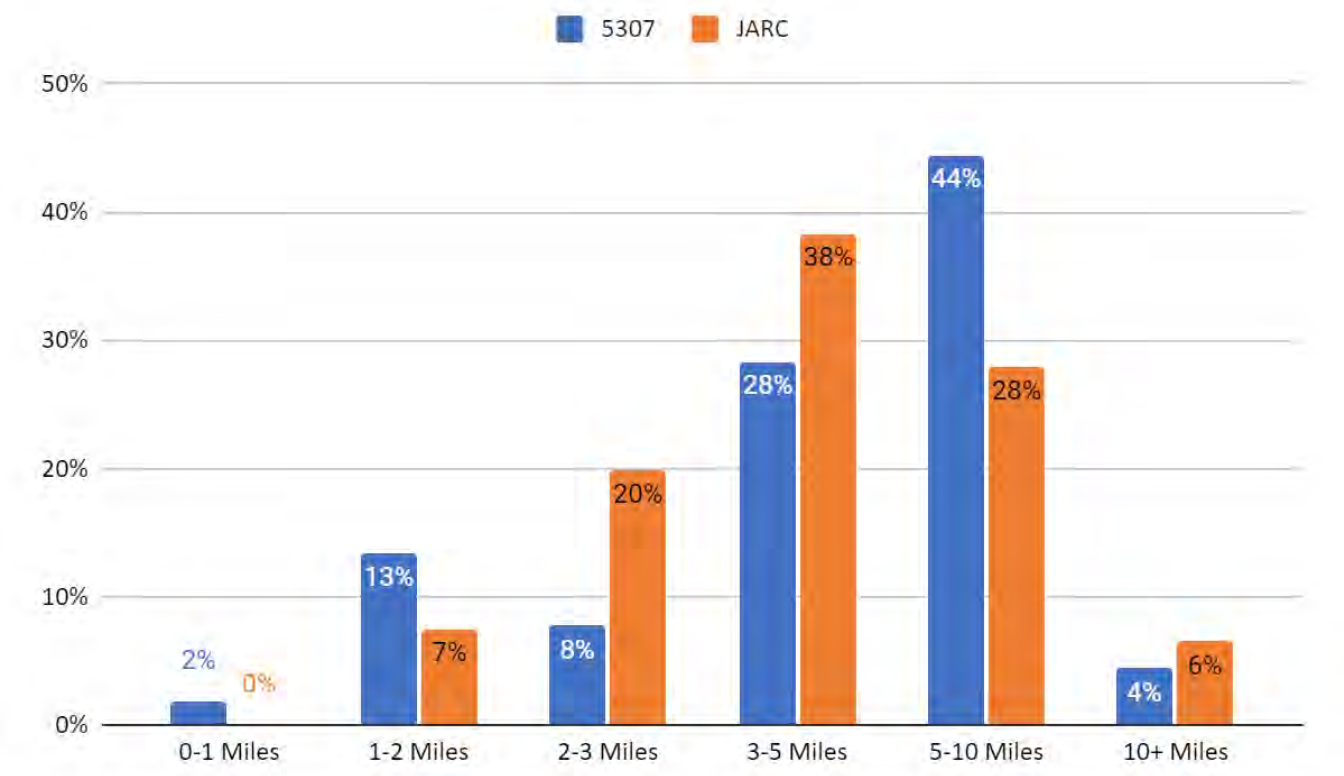
Temporal Distribution of 5307-Funded Paratransit Ridership, October 2021



Distance Distribution of 5307-Funded Paratransit Ridership

Section 5307-funded paratransit trips serve relatively short distances compared to the Section 5310/5311-funed rural demand-response trips. The Demand Response Van Service (ADA paratransit) has an average trip distance of 5.2 miles, while the JARC-funded Evening LINK service features average trip distances of 4.8 miles. The ADA service features a larger share of trips in the 5-10 mile range compared to the JARC-funded service, 44% compared to 28%, respectively. The distance distribution of ridership for both services is shown in the chart below.

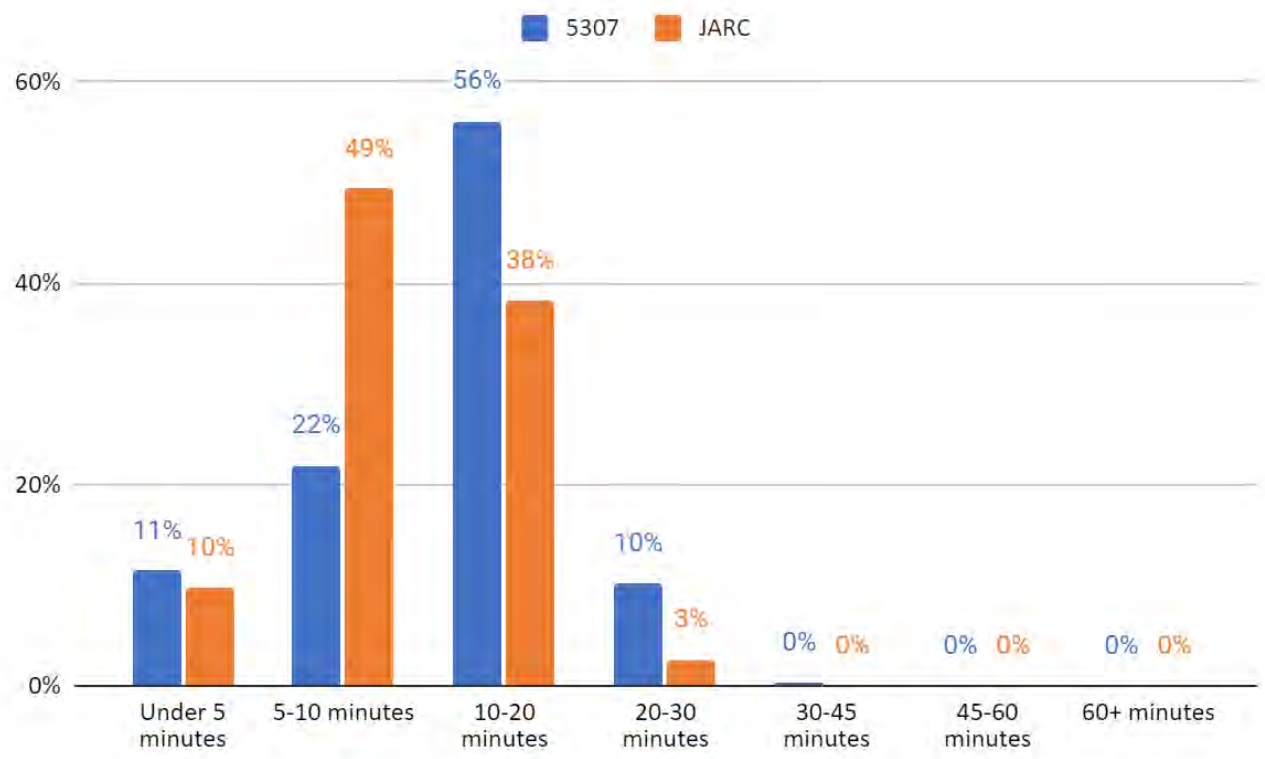
Distance Distribution of 5307-Funded Paratransit Ridership, October 2021



Duration Distribution of 5307-Funded Paratransit Ridership

The vast majority of Section 5307-funded paratransit trips — 89% of Demand Response Van Service and 97% of Evening LINK — are less than 20 minutes in duration. The Demand Response Van Service (ADA paratransit) has an average trip duration of 13 minutes, while the JARC-funded Evening LINK service features average trip duration of 10 minutes. The ADA service features a larger share of trips in the 20-30 minute range compared to the JARC-funded service, 10% compared to 3%, respectively. The Evening LINK service's requirement that trips must begin or end at the TSTC/Waco Regional Airport area likely has some influence in limiting trip durations. The duration distribution of ridership for both services is shown in the chart below.

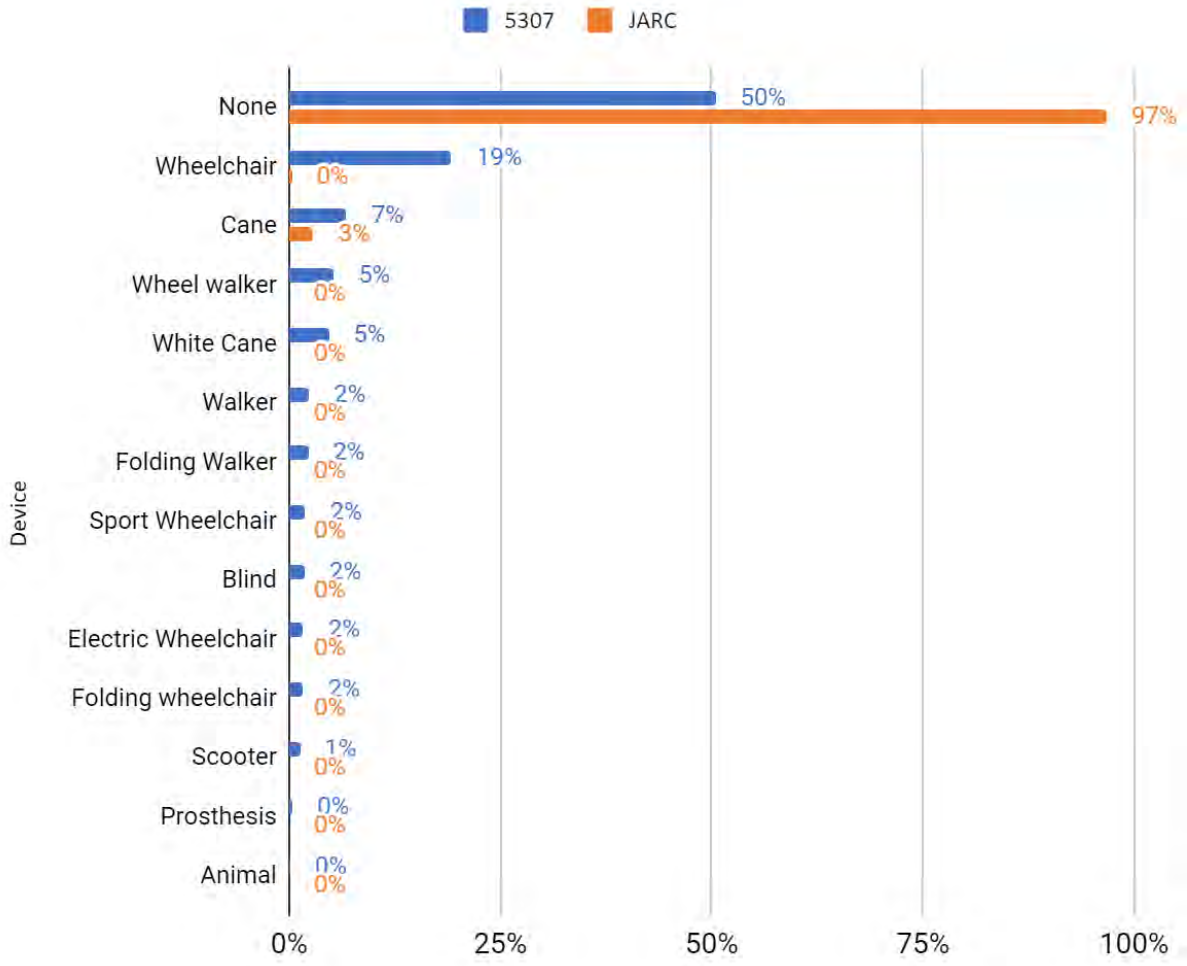
Duration Distribution of 5307-Funded Paratransit Ridership, October 2021



Usage of Mobility Aids

WTS' two 5307-funded services differ significantly in the proportion of riders who use a mobility aid. This is an important consideration in these services' operations, as riders who use mobility aids — or otherwise have ambulatory difficulties — are likely to require longer boarding and alighting times at pick-up and drop-off. Half (50%) of the Demand Response Van Service's ridership used a mobility aid in October 2021, compared to just three percent of Evening LINK ridership. The breakdown of the usage of each type of mobility aid and its prevalence in both services is shown in the chart below.

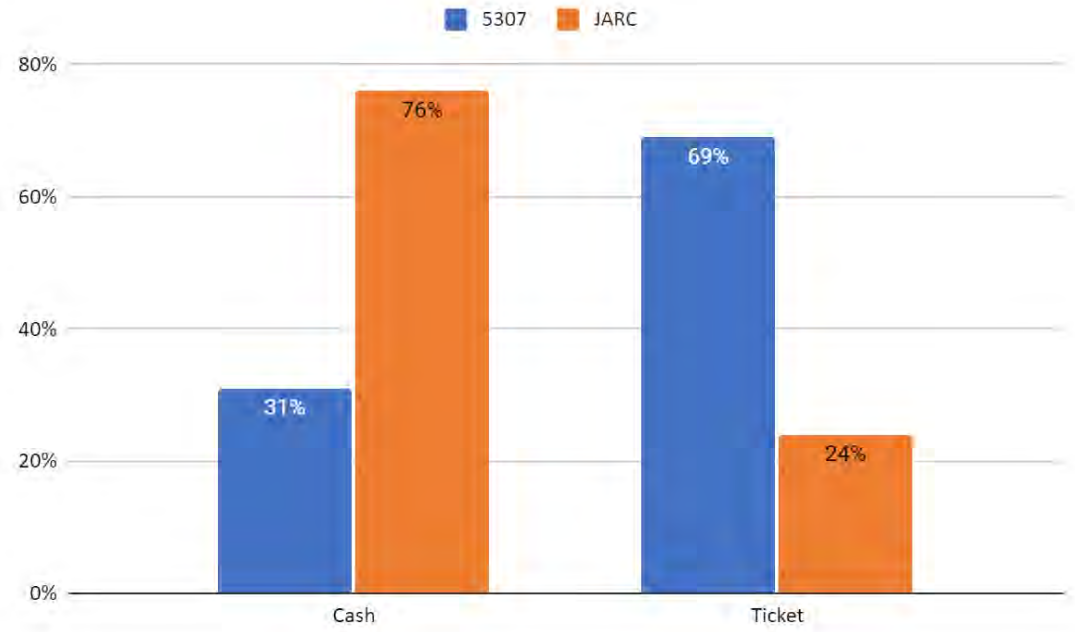
Usage of Mobility Aids in 5307-Funded Paratransit Services



Fare Payment Method

WTS accepts two forms of fare payment for its Demand Response Van Service and Evening LINK: cash (exact change required) or tickets, which can be purchased in booklets of 10 tickets for $30. Evening LINK riders are much more likely to pay their fares in cash, as cash transactions make up 76% of October 2021 on the service, compared to 31% of ADA paratransit trips. Likewise, ADA riders are more likely to purchase tickets to pay for their trips, an indication that they ride more frequently than Evening LINK riders, given the higher sunk cost of purchasing a ticket booklet. Unlike ADA service, the Evening LINK service does not offer passengers the ability to purchase subscription trips, which may encourage more repeat ridership and discourage cash fare payment.

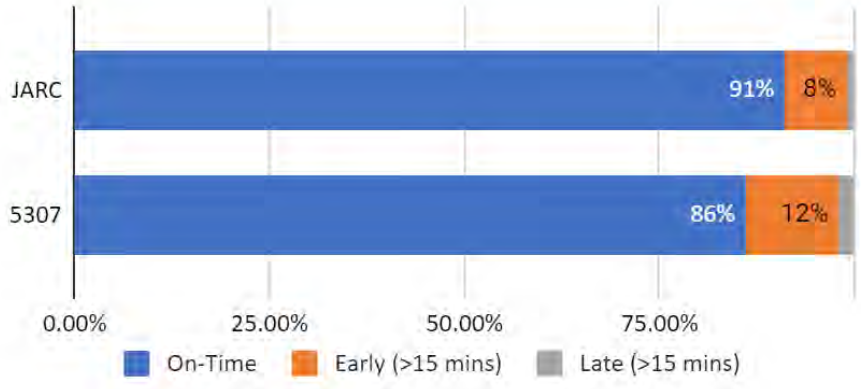
Fare Payment Method — 5307-Funded Services



On-Time Performance at Time of Pickup

Neither of the 5307-funded paratransit services feature significant on-time performance issues, based on a review of trip data from October 2021. Both services feature on-time performance of better than 85%, a traditional transit industry benchmark. On-time performance is measured in relation to the +/- 15-minute pickup windows that are communicated to riders during their trip reservation requests. A trip is considered late if the vehicle arrives more than 15 minutes after the scheduled pick-up time, and it is considered early if it arrives more than 15 minutes before the scheduled pick-up time. Early trips are more common in both services — 8% in the Evening LINK service and 12% in the ADA paratransit service — while late trips are comparatively rare.

On-Time Performance at Time of Pickup — 5307-Funded Services



2. Section 5310- and 5311-funded Transportation Services

Summary of Service Parameters

The McLennan County Rural Transportation District (MCRTD) manages curb-to-curb, demand-response Rural Transportation service available to the general public, which is operated by Waco Transit System. There is no eligibility process; however, riders must live outside of the Waco urbanized area otherwise served by the WTS Demand Response Service Van (ADA paratransit). Service hours are the same as the Demand Response Van Service, from 5:15 AM to 7:15 PM on weekdays and 6:15 AM to 8:15 PM on Saturdays. The service does not operate on Sundays. As with the Demand Response Van Service, riders must schedule trips between 24 hours and 14 days in advance, by calling the WTS customer service center. Fares are $3 for one-way trips scheduled in advance, and trips to adjacent counties cost $5 per one-way trip. Same-day service is available on a space-available basis for a premium fare of $5 per one-way trip. The WTS Rural Transportation service is funded by FTA Sections 5310 and 5311.

Fleet Inventory

The MCRTD Rural Transportation service operated by WTS has a combined fleet of 29 vehicles, as of January 2022. A summary of the fleets' vehicle make/model, quantity, class, and passenger capacity is shown in the table below.

Summary of Section 5310/5311 (Rural) Fleet Inventory

Vehicle Class	Make/Model	Passenger Capacity	Quantity
Automobile	Chevy Impala	5	1
Cutaway	Chevy Eldorado	10	7
Cutaway	Chevy Goshen	10	2
Cutaway	Ford Transit 350	9	8
Minivan	AMG MV1	3	7
Van	Ford E-350 Van	10	3
Non-Revenue/Service Vehicle	Chevy Impala	5	1
Total		**223**	**29**

Ridership Patterns

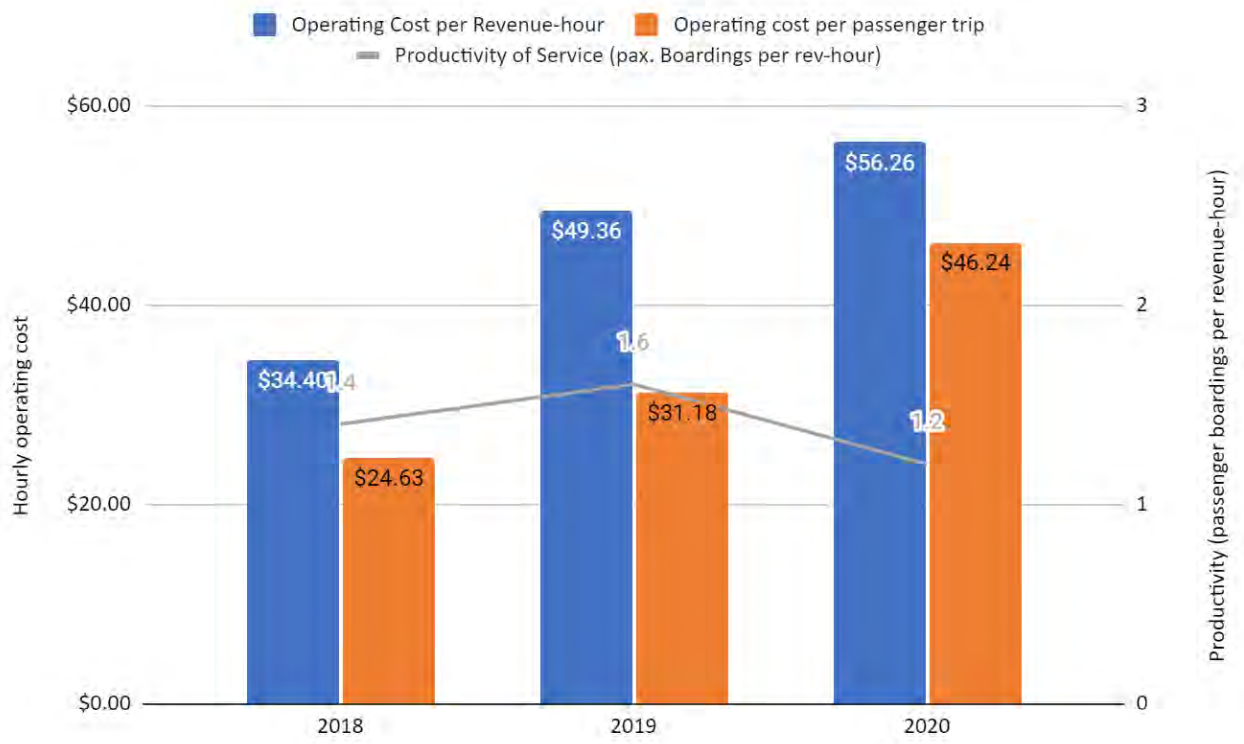
Waco's 5310/5311-funded Rural Transportation service provides about 1,900 passenger trips per month, as of October 2021, or about 60-70 passenger trips on a typical weekday and about 30-40 passenger trips on a typical Saturday. Annual ridership on the Rural Transportation service declined significantly between 2018 and 2020. While part of this decline is certainly attributable to the COVID-19 pandemic, which began near the end of the 2020 fiscal year, the decline was well underway starting in the 2019

fiscal year. Annual ridership declined from 42,006 passenger trips during the 2018 fiscal year to 24,933 passenger trips during the 2020 fiscal year, a decline of 41%.[4]

Service KPIs

As with Waco's 5307-funded services, the Rural Transportation services faces increasing operating costs (though lower than the urban ADA paratransit and Evening LINK services) and declining productivity of service, each of which together pose significant challenges for WTS. During the last three fiscal years, from 2018 to 2020, annual operating expenses per revenue-hour have increased from $34.40 to 56.26.[5] However, these hourly costs are somewhat lower than industry benchmarks from other small and mid-sized transit agencies in Texas. The Rural Transportation service operated considerably fewer revenue-hours in 2019 and 2020 compared to 2018; during this period, annual revenue-hours declined from 30,071 to 20,489 (32 percent decline). However, ridership fell to an even greater extent during the same period (by 41%), resulting in a rising cost per passenger trip, from $24.63 to $46.24, an 88% increase. These key indicators are highlighted in the following chart.

FTA Productivity and Cost Performance Indicators — 5310/5311-Funded Paratransit Services



Rider Origin-Destination Patterns

The most popular, non-residential origins and destinations of riders on the Rural Transportation service feature many of the same locations frequently requested by ADA paratransit riders, though with kidney and dialysis clinics more predominant among the mix, accounting for six of the service's ten most popular

[4] FTA National Transit Database. 2018-2020 Agency Profiles for the McLennan County Rural Transportation District.
[5] Ibid.

pick-up locations. This may be reflective of the relative absence of healthcare facilities in rural portions of McLennan County, which may encourage riders to travel to urbanized areas of Waco for these services. The most frequently requested 20% of ADA paratransit origins and destinations are shown in the table below. Individual origins or destinations in the top quintile of frequency feature at least 7 monthly pick-ups or drop-offs. We use quintiles here rather than deciles, as in the ADA paratransit analysis, due to lower overall frequency of requests throughout the month for any specific location. Likewise, due to lower overall volumes of trips throughout the region and the lack of meaningful clusters, it was not practical to create heatmaps showing intensity of origins or destinations for the Rural Transportation Service.

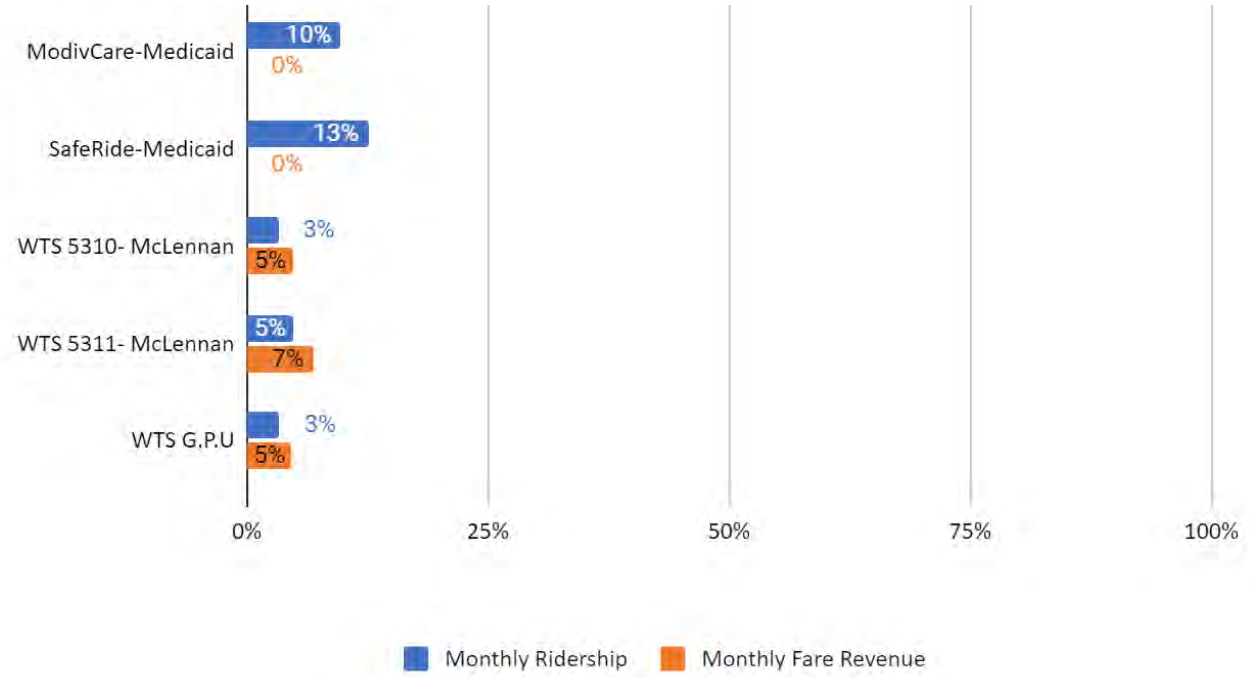
Top 20% of Origins & Destinations of MCRTD Rural Transportation Service (5310/5311) Trips in October 2021

Name	Type	Monthly Pick-ups	Percent of Monthly Pick-ups	Monthly Drop-offs	Percent of Monthly Drop-offs
Friends For Life	Disability Services	66	10.87%	34	5.60%
Bellmead Kidney	Dialysis	22	3.62%	25	4.12%
Crosslake Dialysis	Dialysis	19	3.13%	15	2.47%
Helping Hands	Food Bank & Disability Services	16	2.64%	19	3.13%
West Waco Kidney Clinic	Dialysis	15	2.47%	5	0.82%
Goodwill Store	Food Bank & Shopping	8	1.32%	7	1.15%
Hillsboro Dialysis	Dialysis	8	1.32%	2	0.33%
Texas Concrete	Employment	7	1.15%	12	1.98%
Fresenius Medical Care	Dialysis	7	1.15%	N/A	N/A
Brazos Kidney Center	Dialysis	6	0.99%	44	1.40%

Relative Shares of Demand-Response Transportation Ridership and Fare Revenue

The MCRTD Rural Transportation service is responsible for small shares of the WTS' monthly ridership and fare revenues, compared to the 5307-funded services. Based on the month of October 2021, the Rural Transportation service accounts for 11% of WTS paratransit ridership and 17% of its fare revenues. The shares of monthly ridership and fare revenue for October 2021 of each 5310/5311-funded demand-response service operated by WTS are shown in the chart below. "WTS G.P.U." refers to the portion of the Rural Transportation service funded by the City of Waco.

Shares of Paratransit Ridership and Fare Revenue



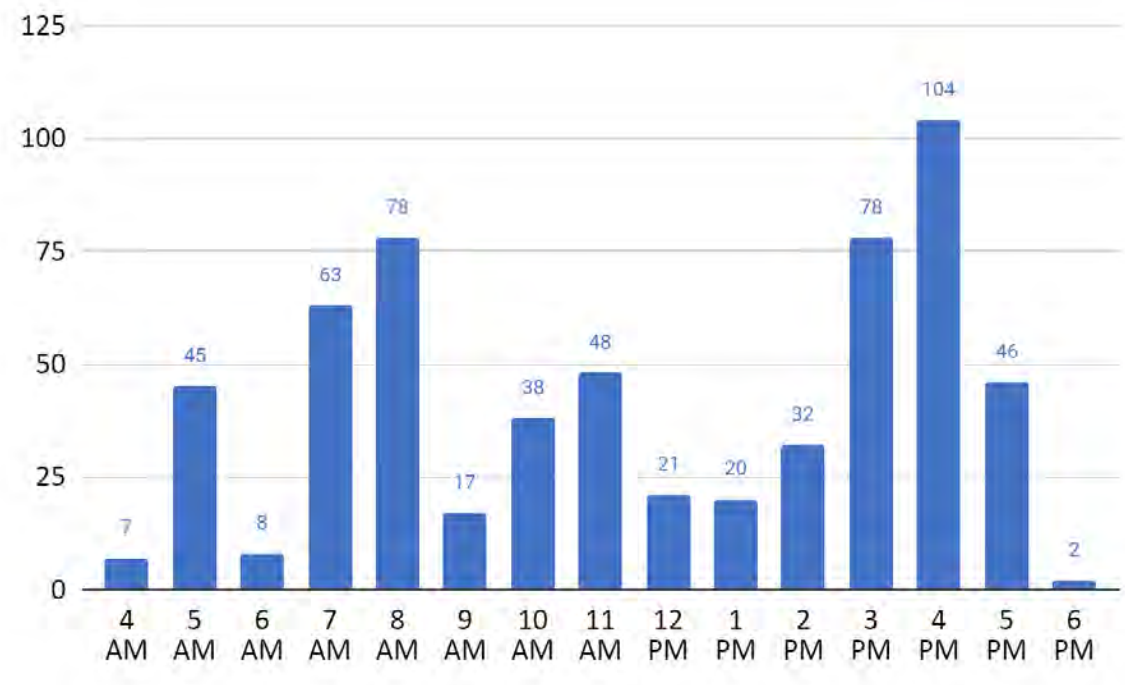
Excluding Medicaid-funded transportation, the Rural Transportation service accounts for a small share of paratransit trips in McLennan County, ranging from three to eight percent of ridership between 2019 and 2021.

Share of Total WTS-Operated Paratransit Ridership: 5310/5311-Funded Services

Temporal Distribution of Ridership at the Time of Pickup

The Rural Transportation service shows two distinct peaks, based on the travel dataset reviewed from October 2021. The first peak occurs between 7 AM and 9 AM, while the second occurs from 3 PM to 6 PM. Very few pickups occur after 6 PM. While the 6 PM hour is within the service's scheduled hours of operation, it is likely that dispatchers typically shift passenger pickups to earlier in the day to ensure that all vehicles can complete their drop-offs and return to the maintenance facility by the end of the scheduled service day.

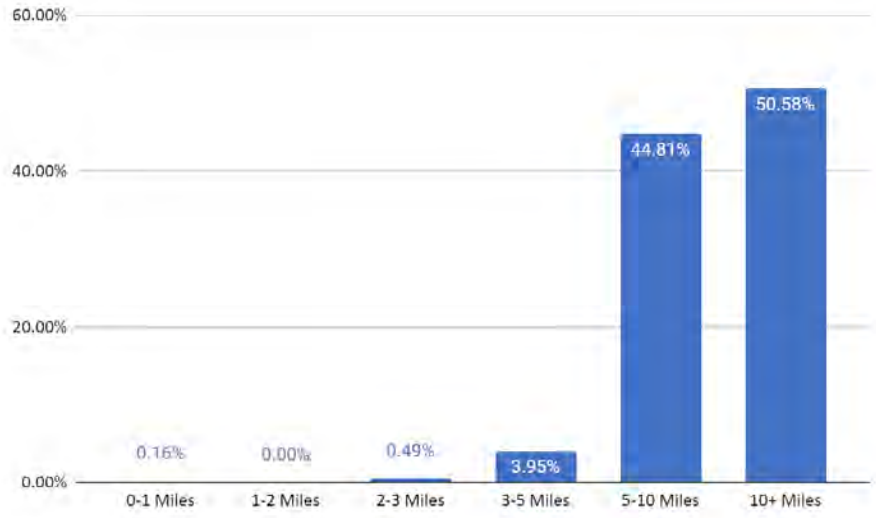
Temporal Distribution of MCRTD Rural Transportation Service Ridership at the Time of Pickup



Distance Distribution of MCRTD Rural Transportation Service Ridership

Section 5310/5311-funded paratransit trips service longer-distance trips compared to the Demand Response Van Service or Evening LINK service. The Rural Transportation service has an average trip distance of 13 miles outside of the Waco urbanized area, while Rural Transportation service trips funded by the City of Waco feature average trip distances of 8 miles. Due to the longer travel distances between destinations and lower population density of rural areas, a majority (51%) of trips involve distances of more than 10 miles, while 95% involve trips of at least five miles. The distance distribution of ridership for the Rural Transportation service is shown in the chart below.

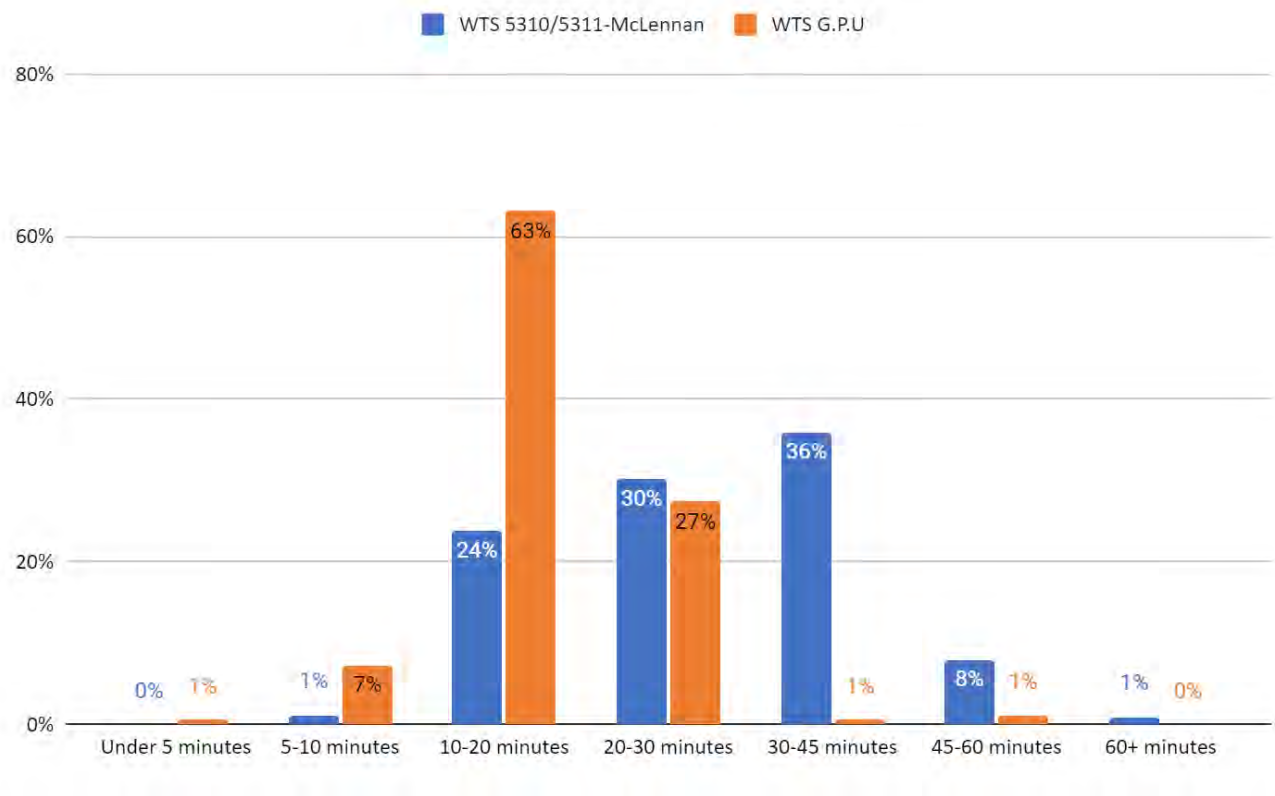
Distance Distribution of 5307-Funded Paratransit Ridership, October 2021



Duration Distribution of MCRTD Rural Transportation Ridership

The Rural Transportation service features longer-duration trips compared to the 5307-funded paratransit services. Among MCRTD Rural Transportation trips funded by Sections 5310/53111, the average duration was 28 minutes, compared to 17 minutes for the portion of the service funded by the City of Waco. About two thirds (66%) of the 5310/5311-funded service features trip durations of between 20 and 45 minutes, compared to 10% of ADA paratransit trips and 3% of Evening LINK trips falling in this range. Less than one percent of 5310/5311-funded trips are shorter than 10 minutes or longer than 60 minutes, respectively. The duration distribution of ridership for both services is shown in the chart below.

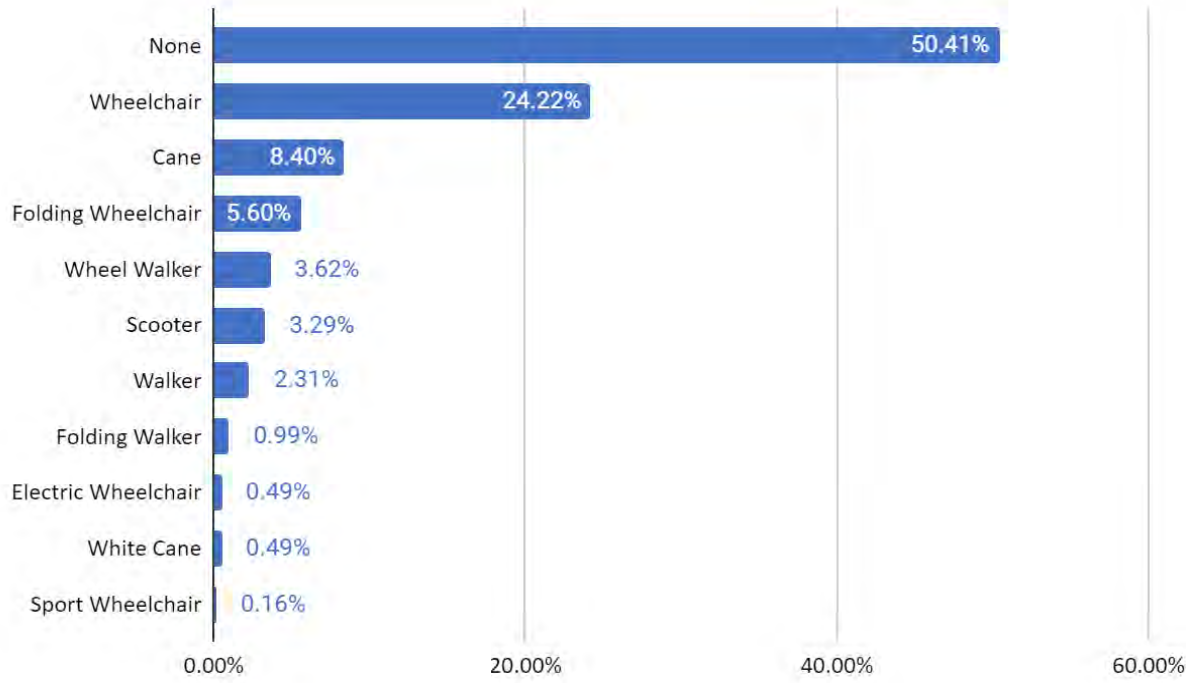
Duration Distribution of MCRTD Rural Transportation Ridership, October 2021



Usage of Mobility Aids

About half of Rural Transportation service riders (51%) use some form of mobility aid, a similar proportion to riders of the Demand Response Van Service. The breakdown of the usage of each type of mobility aid and its prevalence in both services is shown in the chart below.

Usage of Mobility Aids in MCRTD Rural Transportation Service



Fare Payment Method

As with its 5307-funded paratransit service, WTS accepts two forms of fare payment for its Rural Transportation service: cash (exact change required) or tickets, which can be purchased in booklets of 10 tickets for $30. A majority (63%) of Rural Transportation riders pay for their trips using tickets, while the remainder (37%) use cash.

On-Time Performance at Time of Pickup

The MCRTD Rural Transportation does not feature significant on-time performance issues based on a review of its October 2021 trip data. On-time performance is measured in relation to the +/- 15-minute pickup windows that are communicated to riders during their trip reservation requests. A trip is considered late if the vehicle arrives more than 15 minutes after the scheduled pick-up time, and it is considered early if it arrives more than 15 minutes before the scheduled pick-up time. The Rural Transportation service features an on-time performance of 90%, with 6% of trips arriving early and 4% arriving late.

3. Impacts of Implementing WTS Realignment Scenarios A and C

Fixed-Route Impacts on ADA Paratransit

The project team estimated the demographics and key destinations of paratransit service zones resulting from the generation of ¾-mile buffers around planned fixed-route stop locations in Realignment Scenarios A and C and compared them to existing conditions. This analysis leveraged Remix Transit software, which calculates the population, employment, and demographics within ¾-mile buffers of the fixed-route service alternatives sourced from US Census data. While neither Scenario A or C would result in a change in the population demographics within their respective service zones, these scenarios would result in somewhat smaller bases of underlying population and jobs. Scenarios A or C would each cause the number of residents living within the ADA paratransit buffer to decline by about six percent. Scenario A would cause

the number of jobs in the paratransit zone to decline by about 14 percent, compared to a loss of about six percent under Scenario C. These findings are summarized in the table below.

Population, Jobs, and Demographic Coverage Statistics within ¾ Mile Buffer Zones of Realignment Scenarios

	Existing Network	Scenario A	Scenario C
Population	133,900	125,300	125,600
Jobs	80,000	69,100	75,300
Percent of people in poverty	28%	29%	29%
Percent of people within 200% of poverty threshold	56%	57%	57%
Percent of people who are non-White or of Hispanic/Latino origin	62%	64%	64%
Percent of people living with a disability	13%	13%	13%
Percent of car-free households	10%	10%	9%
Percent of people who are 65+	12%	12%	12%
Percent of people who speak English less than "very well"	16%	17%	16%
Pharmacies	31	29	25
Nursing homes	23	17	17
Hospitals	4	4	4

Microtransit Impacts on ADA Paratransit

Some microtransit services are able to significantly offset their operating costs by absorbing a substantial share of ADA paratransit customer trips, enabling transit agencies to conserve operating resources. The cost savings stems from the fact that well-designed microtransit typically features both higher productivity of service and lower operating cost per passenger trip, compared to ADA paratransit services. This is due to a variety of factors, including the smaller vehicles, lower labor costs, and more efficient vehicle routing parameters often found in microtransit (e.g. picking up and dropping off non-ADA-eligible passengers at the nearest corner instead of adhering to the ADA-required curb-to-curb stops model of paratransit service). **While the cost savings for WTS are likely to be minimal due to the small volume of ADA customer trips that begin and end within the proposed microtransit zones, ADA customers in the zones would nonetheless benefit from the ability to book same-day, on-demand trips offered via microtransit.**

The modal shift of riders from ADA paratransit to microtransit can follow an agency's official policy of commingling, with multiple passenger types (ADA and general public) served in wheelchair-accessible vehicles allocated to the microtransit service. In addition, some ADA paratransit customers may, of their own volition, use the microtransit service for same-day travel, an option not currently offered by the Demand Response Van service or most other ADA paratransit programs. The shift of riders from ADA paratransit to microtransit, whether by formal commingling of passengers or through less formal

multimodal travel patterns, is only possible if a rider's trip begins and ends within the microtransit service zone.

Scenario A features three microtransit zones, while Scenario C features two microtransit zones. In both scenarios, microtransit is designed to serve the more peripheral neighborhoods covered by Waco Transit System, which are historically more difficult to serve with fixed-route buses. Zones range from four to 15 square miles in area and are designed to be operated with two vehicles each to ensure a reliable quality of service.

Microtransit zones described below are intended to fulfill the following objectives:

- Improve access to jobs, shopping, education, healthcare, and other essential services
- Facilitate first-mile/last-mile connections to WTS fixed-route bus service, such as the proposed BRT corridor of Scenario A.
- Enhance point-to-point mobility in lower-density areas with insufficient demand to justify fixed-route bus service.

In Scenario A, the microtransit zones include:

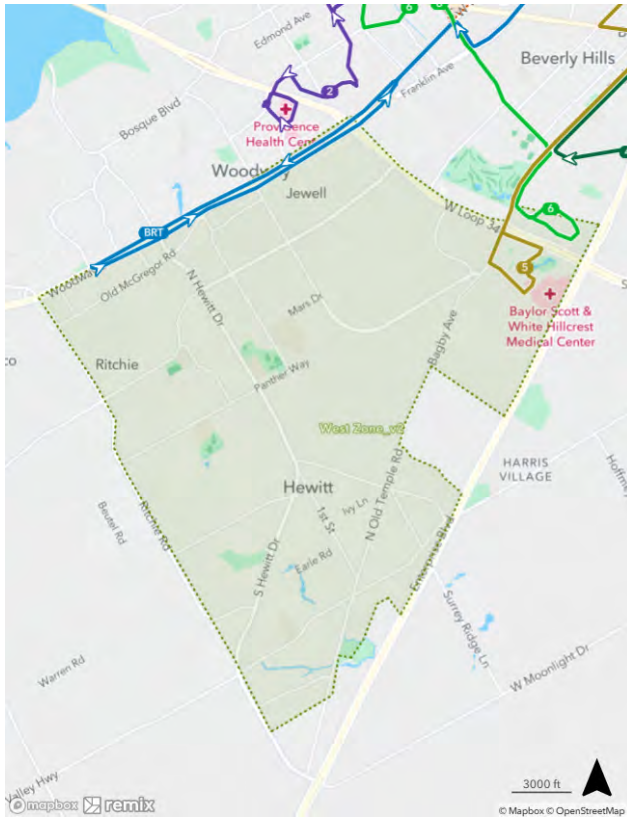
- **West Zone:** including the industrial parks of Jewell, Baylor Scott & White Medical Center, Central Texas Marketplace, and the the communities of Ritchie and Hewitt, which have not been served by WTS fixed-route buses in the past.
- **North Zone:** including the Hillcrest Estate Magnolia area, between roughly Lake Air Drive and North 36th Street.
- **East Zone:** including the areas of Bellmead, Lacy-Lakeview, Ocaw, and Texas State Technical College (TSTC).

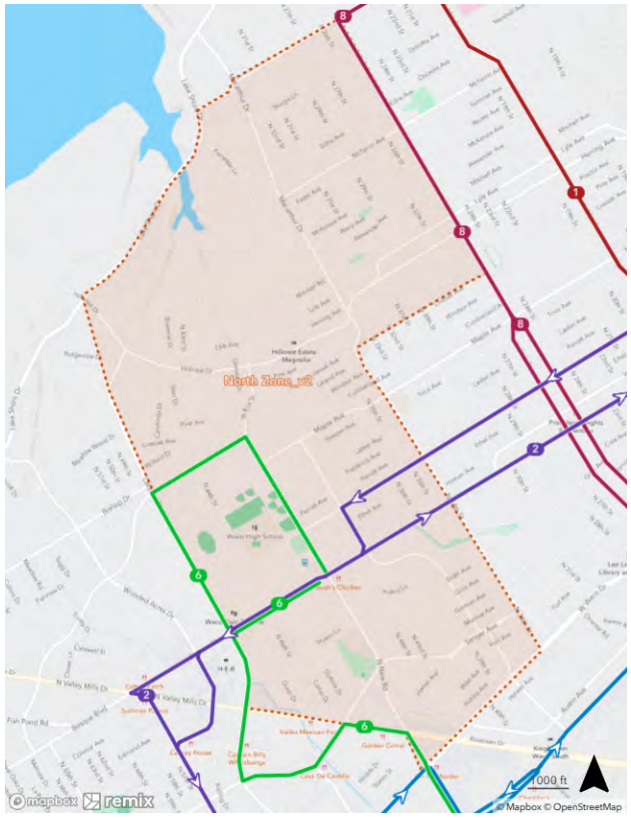
In Scenario C, the microtransit zones include:

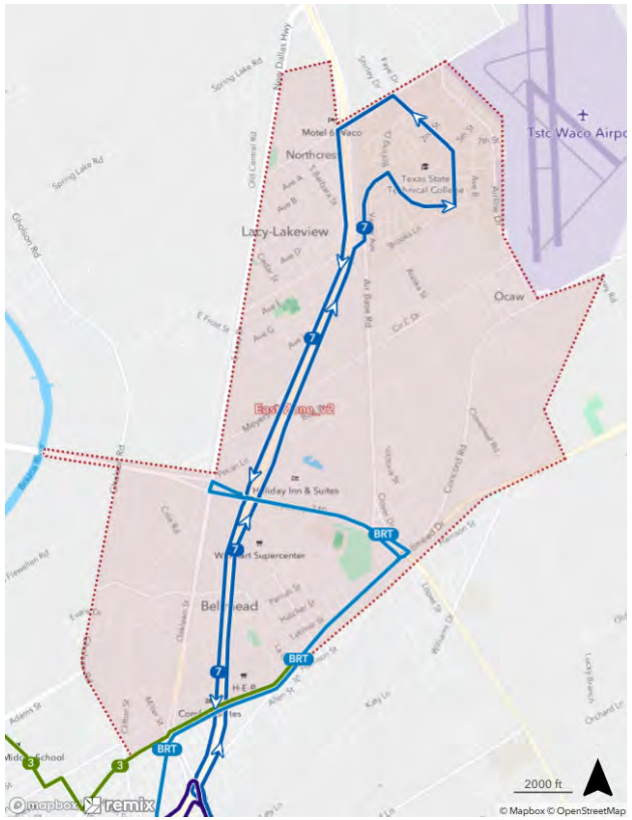
- **West Zone:** this zone is the same as the West Zone described above.
- **East Zone:** includes communities of East Waco and Bellmead.

Maps of each of these zones are shown on the following two pages.

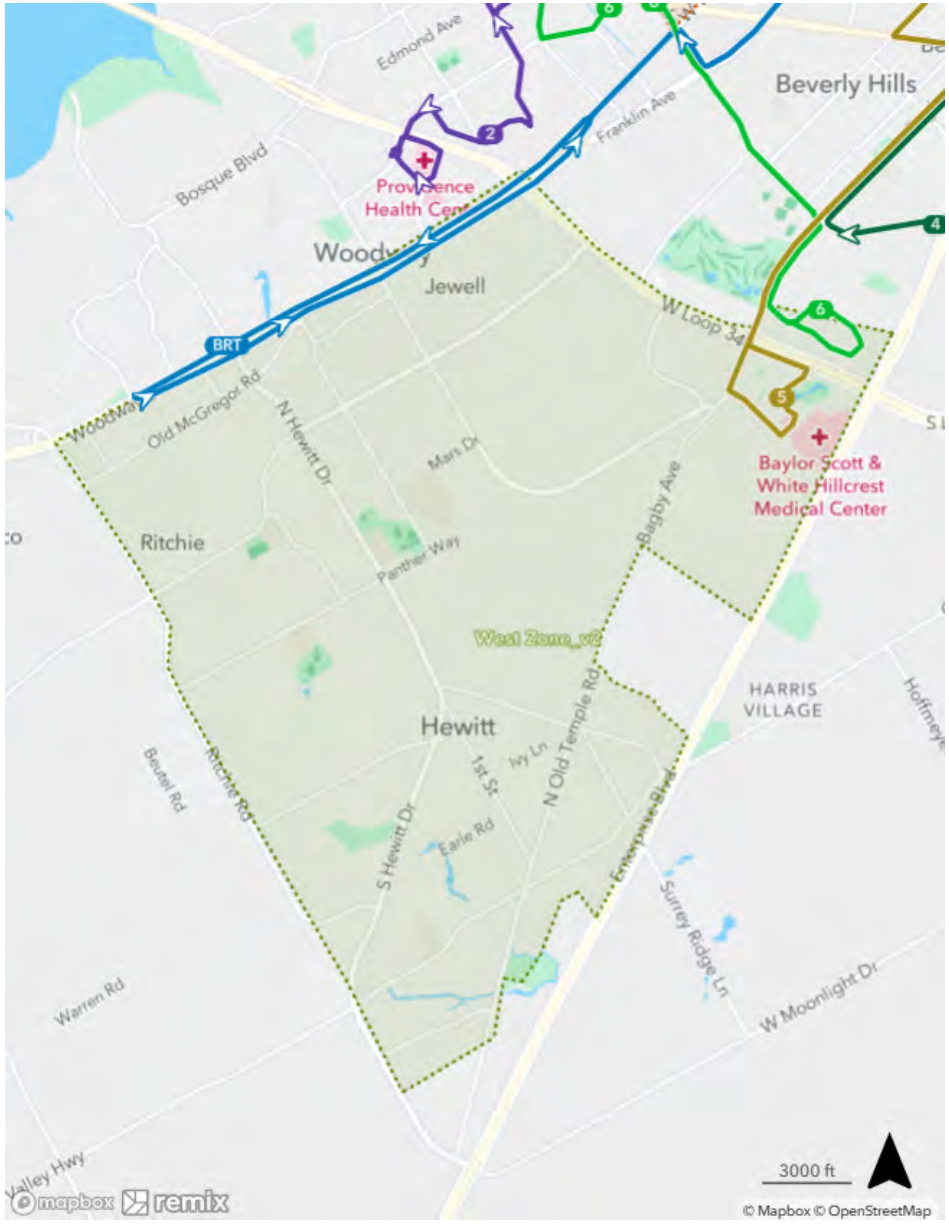
Maps of Scenario A Microtransit Zones

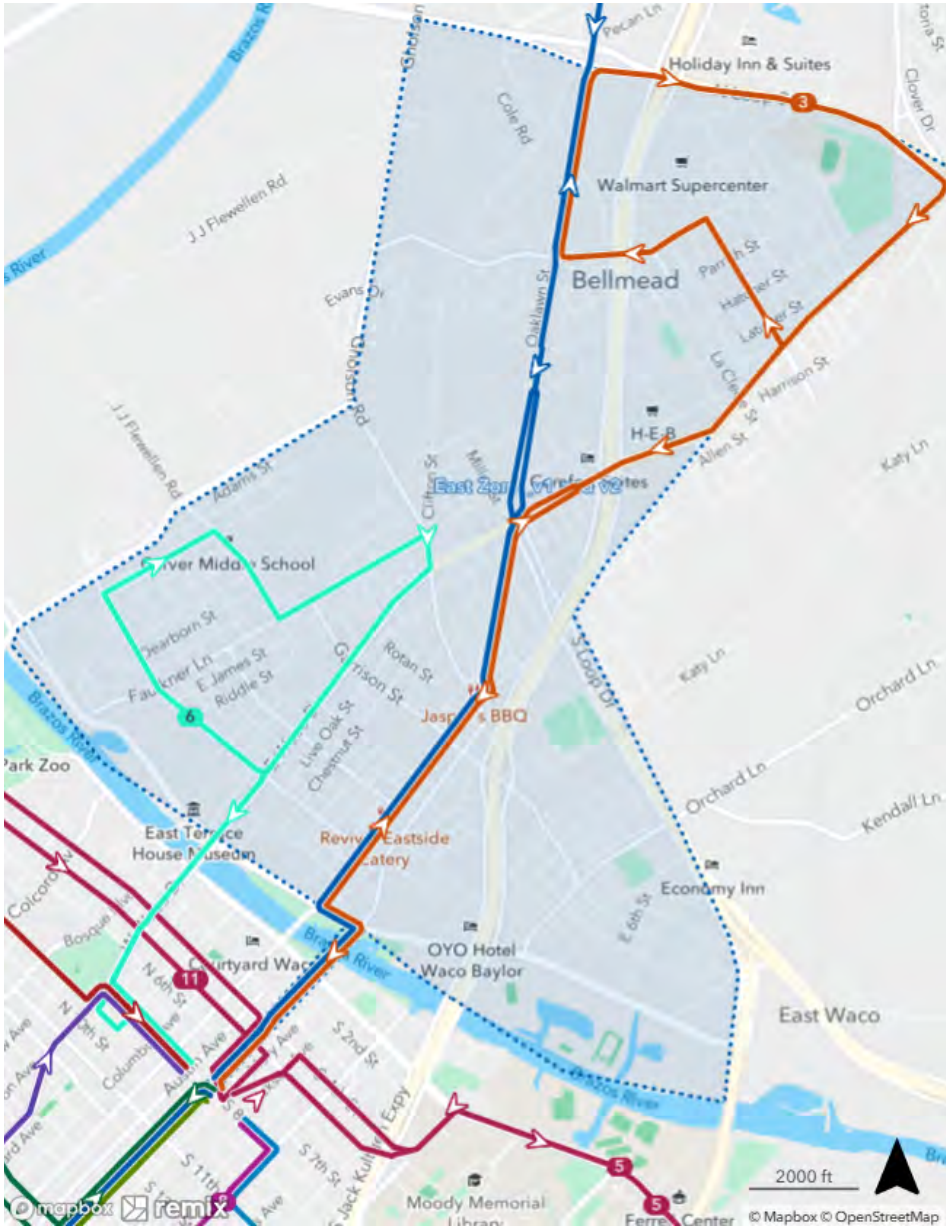






Maps of Scenario C Microtransit Zones





The project team evaluated the proposed microtransit service zones in Scenarios A and C, shown above, with respect to their anticipated impacts upon the Demand Response Van Service (ADA paratransit) ridership. This analysis finds that microtransit is likely to have only a marginal impact on ADA paratransit ridership in Waco, due to the relatively low volume of ADA trips that can be reasonably replaced by these microtransit zones as well as the relatively small difference between microtransit and the ADA service in terms of operating cost per passenger trip. In comparing costs of microtransit and the Demand Response Van Service, we employed the following assumptions:

1. Ridership on the Demand Response Van Service was analyzed using the October 2021 dataset referenced previously and provided by the City of Waco.
2. The percentage of ADA paratransit customer trips likely to shift to microtransit service (for trips beginning *and* ending in the microtransit zone) ranges between 20% and 40%, depending on the level of demand for the microtransit service. This range is consistent with findings from Via's Arlington (TX) On Demand service and other peer-reviewed studies.[6]
3. The cost per passenger trip of ADA paratransit service is assumed to be $32.67, the figure reported to the FTA National Transit Database (NTD) in 2020.
4. Total microtransit ridership is assumed to range from 143 - 287 boardings per weekday in Scenario A's three zones combined, while in Scenario C's two zones the weekday ridership range is expected to be between 98 and 197 daily boardings. These ranges draw upon observed microtransit ridership patterns found in other, similar microtransit services in Texas and are scaled to underlying population and employment totals of the proposed zones in Waco. Ranges are provided to express the uncertainty of demand for microtransit service, with the low end of the range representing a service that performs worse than other peer services and the high end of the range representing a service performing better than its peers.
5. Service hours for microtransit are assumed to match those of the Demand Response Van Service, with 14-hour service spans on weekdays and Saturdays.

Geospatial analysis of ADA customer trips shown in Rider Origin-Destination Patterns was used to indicate the volume of trips that could potentially be served by microtransit. The three microtransit zones of Scenario A contain 273 monthly ADA paratransit trips whose origin and destination is within these zones. In the two microtransit zones of Scenario C, 154 monthly ADA paratransit trips were identified whose origin and destination is within these zones. These totals reflect nine and four percent of monthly ADA paratransit ridership beginning and ending entirely within the microtransit zones of Scenarios A and C, respectively.

The next step of this analysis estimates the cost of service for the ADA customer trips beginning and ending within the microtransit zones under the assumption that between 20% and 40% of eligible ADA customer trips shift to microtransit. These figures represent the ceiling of maximum possible cost savings, i.e. if the microtransit were to serve these affected trips at zero cost. These totals assume a cost per passenger trip of $32.67, per NTD reporting from the City of Waco and are shown in the table below.

[6] Khan, et al. 2021. "Travel Behaviors of the Transportation-Disabled Population and Impacts of Alternate Transit Choices: A Trip Data Analysis of The Handitran Paratransit Service in Arlington, TX." International Conference on Transportation and Development. https://doi.org/10.1061/9780784483534.043.

Demand Response Van Service Operating Costs for ADA Customer Trips within Microtransit Zones

	Scenario A	Percent of Section 5307 Funding (2018)	Scenario C	Percent of Section 5307 Funding (2018)
Low Modal Shift: 20%	$21,405	0.81%	$12,075	0.46%
Medium Modal Shift: 30%	$32,108	1.22%	$18,112	0.69%
High Modal Shift: 40%	$42,811	1.63%	$24,150	0.92%

Because the ADA paratransit trips that begin and end within proposed microtransit zones represent a small proportion of total ADA ridership, the cost savings from serving these trips with microtransit are relatively small compared to the total annual operating costs for the service. These costs account for between one and two percent of total 5307 funding (FY 2018) under Scenario A microtransit zones and less than one percent under Scenario C microtransit zones.

The next step of this analysis estimates the cost of serving the affected ADA paratransit trips (whose origin and destination is within the proposed microtransit zones) with microtransit. The project team assumes that each of the microtransit zones require two vehicles, resulting in a total fleet of six vehicles in Scenario A and four vehicles in Scenario C.[7] Given a 14-hour span of service, we estimate that Scenario A's microtransit zones will require 21,920 vehicle-hours, while Scenario C's microtransit zones will require 14,613 vehicle-hours.

The two most common partnership models for microtransit operations are agency-operated service, operated using WTS drivers and vehicles and acquires a microtransit software technology license, and purchased transportation service, in which a third-party vendor provides vehicles, drivers, technology, and operations support. For agency-operated microtransit service, we assume that current hourly operating costs for WTS' paratransit service continue to apply ($71.55 in 2020, according to the NTD), plus monthly software license and one-time installation fees. Under the purchased transportation model, microtransit costs are typically expressed as "fully-loaded" hourly costs inclusive of vehicles, software, labor, maintenance and fuel, and customer support. In Texas, hourly costs for microtransit vendors' purchased transportation services typically range from $50 - 80 per vehicle-hour. This analysis assumes the mid-point of this range, at $65 per vehicle-hour.

The annual costs as well as the cost per passenger trip of microtransit service for the affected ADA customer trips described above are shown in the table below. The annual operating cost under the purchased transportation model reflects $65/vehicle-hour pricing. Cost per passenger trip assumptions reflect a medium-demand scenario, in which microtransit attracts ridership at similar rates to peer services.

[7] Further analysis of microtransit service, using agent-based simulation software, can confirm the validity of this assumption by evaluating the precise quality of service riders will likely experience in each zone given a two-vehicle fleet.

Microtransit Service Costs for Affected ADA Paratransit Trips Served by Scenario A

	Agency-operated microtransit service	Purchased transportation (i.e. third-party microtransit vendor)
Annual operating cost	$26,831	$23,167
Cost per passenger trip (medium-demand scenario)	$27.30	$23.57

The corresponding costs for microtransit zones in Scenario C are shown in the table below.

Microtransit Service Costs for Affected ADA Paratransit Trips Served by Scenario C

	Agency-operated microtransit service	Purchased transportation (i.e. third-party microtransit vendor)
Annual operating cost	$14,861	$12,697
Cost per passenger trip	$26.81	$22.90

This analysis concludes by subtracting the cost of microtransit operations from the cost of providing the affected ADA paratransit trips described above. These cost savings impacts reflect both microtransit partnership models and are expressed in three scenarios: low modal shift (20% of affected ADA paratransit customer trips switch to microtransit), medium modal shift (30% make the shift), or high modal shift (40% make this shift).

Net Cost Savings of Modal Shift from ADA Paratransit to Microtransit Service for Eligible Trips in Scenario A

	Agency-operated microtransit service	Purchased transportation (i.e. third-party microtransit vendor)
Low Modal Shift (20%)	$3,518	$5,961
Medium Modal Shift (30%)	$5,277	$8,941
High Modal Shift (40%)	$7,035	$11,922

The corresponding table for Scenario C is provided below.

Net Cost Savings of Modal Shift from ADA Paratransit to Microtransit Service for Eligible Trips in Scenario C

	Agency-operated microtransit service	Purchased transportation (i.e. third-party microtransit vendor)
Low Modal Shift (20%)	$2,168	$3,610
Medium Modal Shift (30%)	$3,251	$5,416
High Modal Shift (40%)	$4,335	$7,221

These findings indicate that cost savings are likely to be greater under the purchased transportation partnership model for microtransit in both Scenario A and C. However, these savings are marginal relative to the City of Waco's overall Section 5307 funding, less than one-half of a percentage point of the $2.6 million total indicated in Summary of Service Parameters.

SILO DISTRICT TROLLEY

The Silo District Trolley was run by the City of Waco from 2016 – 2020 as a free tourist shuttle and downtown circulator. The Waco Transit System may seek to reinstate the trolley service as and when funding becomes available. The following provides a brief history on the service with route recommendations based on current and future development.

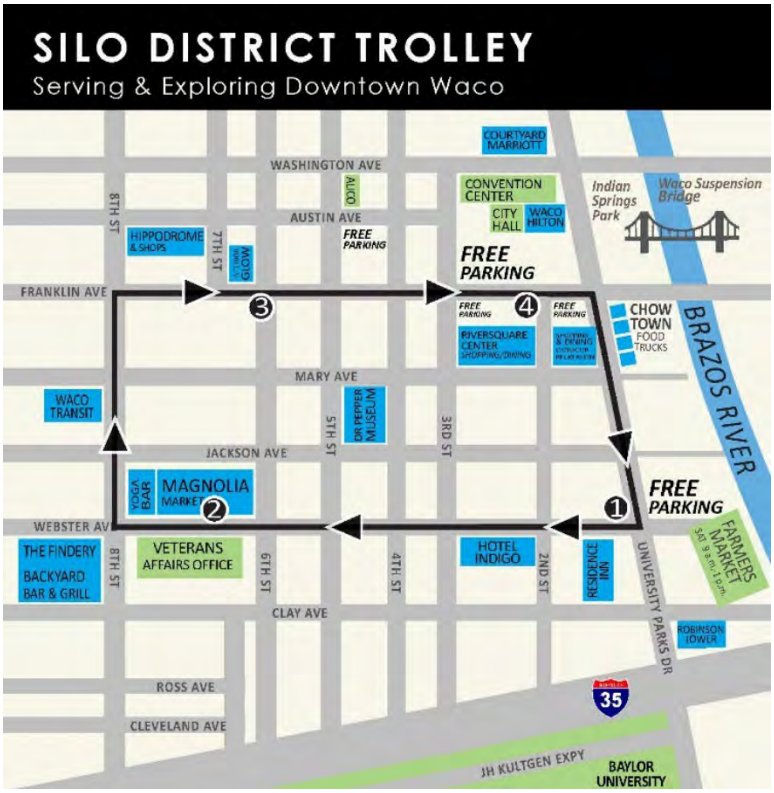
Background

2016 Start

In 2016, the City of Waco introduced the Silo District Trolley to curb traffic congestion and address parking issues in downtown Waco. Service ran about every 8-10 minutes Monday through Saturday from 9:00 AM to 6:30 PM. The original route ran a loop on Webster Avenue, 8th Street, Franklin Avenue, and University Parks Drive with four stops near free parking lots, local businesses, and other attractions.

1. University Parks Dr. & Webster Ave.
2. 6th St. & Webster Ave.
3. 6th St. & Franklin Ave.
4. 2nd St. & Franklin Ave.

FIGURE 1: 2016 SILO DISTRICT TROLLEY MAP



2017 Changes

In 2017, the route was extended three blocks along Webster Avenue to 11th Street then continued one block further to Austin Avenue, where it ran for five blocks before returning to Franklin Avenue at 6th Street and completing the loop as before. This expanded route ran approximately every 15-20 minutes with five stops.

1. 6th St. & Webster Ave.
2. 11th St. @ Balcones Distillery
3. Austin Ave. Shops
4. 6th St. and Franklin Ave.
5. 2nd St. & Franklin Ave.

FIGURE 2: 2016 SILO DISTRICT TROLLEY MAP

2019 – 2020 Ridership

From February 2019 to February 2020, the Silo District Trolley's ridership was 104,545 with an average of 313 boardings per day. The trolley averaged higher ridership on Saturdays with an average of 464 boardings per day.

TABLE 1: SILO DISTRICT TROLLEY RIDERSHIP, FEB. 2019 – FEB. 2020

Days	Ridership	Average Boardings per Day
Weekdays	78,090	282
Saturdays	26,455	464
Monday – Saturday	104,545	313

Recommendations

The Silo District Trolley service was paused in 2020 due to the COVID-19 pandemic and associated government shutdown. Should the demand and funding arise, a reinstated Silo District Trolley can serve not only as a shuttle for tourists to explore attractions from downtown hotels, but it can also act as a downtown circulator for residents to reach their favorite local businesses or places of employment. One tourist destination or favorite restaurant is also a service industry job, and service connecting both may battle traffic congestion and parking availability downtown. Moreover, downtown circulator route can help alleviate these issues.

Circulator Bus Transit Best Practices

A circulator route is best suited for areas with sufficient employees, tourists, and shoppers or otherwise closely located attractions, and downtown Waco fits that description. A dedicated source of funding and ridership is key, and the following strategies help to succeed with both:

- Frequent service (10–15-minute headways)
- Unique branding
- Fare-free or nominal fare flexibility

It can also be helpful to reanalyze the service, its ridership, and local marketing efforts annually. This may involve putting out surveys to better cater scheduling, route alignment, or stops to the needs of the route's users or potential users. Other transportation strategies that can help or hinder the route's success include parking management, pedestrian infrastructure, complementary bike share systems, and the route's fit within the wider transit network. Long-term land use planning that supports the service can also be key to success in the future.[1]

Recommended Service Plan

The recommended service plan seeks to mimic previous Silo District Trolley service while tailoring the service to the changing needs of Waco, namely crossing the Brazos River to make a connection to new development along M.L.K., Jr. Boulevard. The key to a circulator route's success is maintaining 15-minute headways to provide frequent, reliable service. The route is likely to cater to two primary types of users. The first is a visitor who may not be familiar with the transit system and seeks a service they can rely on without having to know the schedule or look up a live tracking app. The second type of user this service should seek to gain is a local who works downtown and either rides another route bus route from an outlying neighborhood where they live or drives and parks in a free parking lot downtown. Both types of riders require fast, frequent service to be consistent users of this proposed downtown circulator.

[1] Texas A&M Transportation Institute, Transportation Policy Research, *Circulator Bus Transit*, https://policy.tti.tamu.edu/strategy/circulator-bus-transit/.

This recommended service plan attempts to maintain a comparable route length and number of stops to previous iterations. The proposed route travels on University Parks Drive and Webster Avenue as previous trolley routes but extends to Washington Avenue, which it uses to cross the river and serve as a connection to the new development there. The transformation of Washington Avenue back to a two-way street makes this possible. By crossing the river on Washington Avenue, the route can make a quick loop north of the river with two right turns and a single stop to keep the overall route length and headways relatively short. The stop north of the river is proposed at the base of the Waco Suspension Bridge where a new, signalized crosswalk connects the riverside park to the new developments across M.L.K. Jr. Blvd. The route returns to downtown Waco on the Franklin Avenue bridge to complete its loop.

TABLE 2: SILO DISTRICT TROLLEY HISTORICAL ROUTE COMPARISON

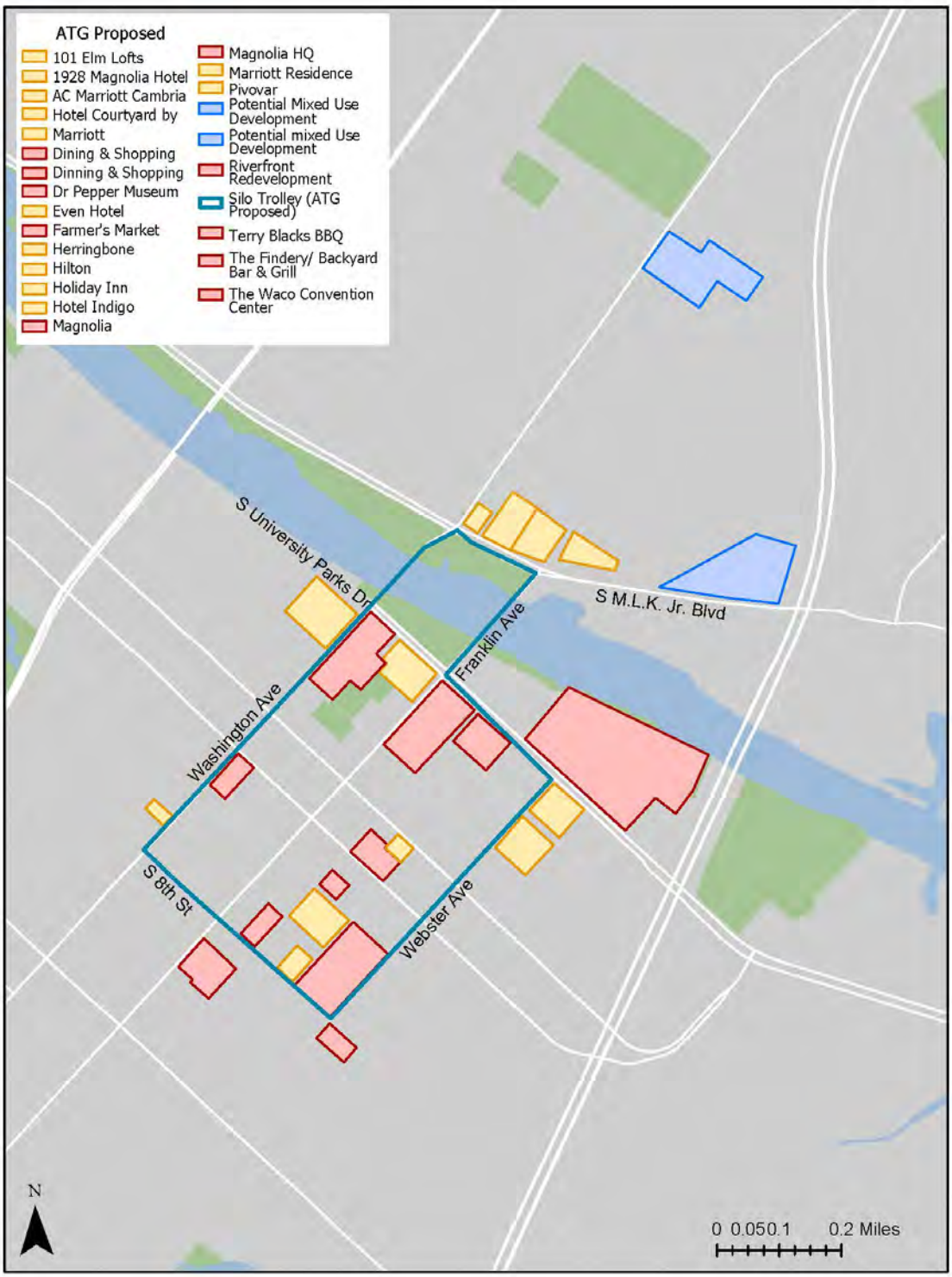
Trolley Service	Route Length (miles)	# of Stops	Average Distance Between Stops (Miles)	Headways (Minutes)
2016	1.5	4	0.38	8-10
2017-2020	2.2	5	0.44	15-20
Proposed	**2.3**	**6**	**0.38**	**15-20**

Pending availability of funds, it's worth considering extending the hours from the old service, which only ran from 9:00 AM to 6:30 PM. Extending the service from 9:00 AM to 9:00 PM, for example, would allow it to capture some of the after-dinner traffic to transport people back to their hotels or cars in the free parking lots around downtown while maintain a simple, 12-hour schedule easy for potential riders to remember.

Stops

1. S. University Parks Dr. & Franklin Ave.
2. Webster Ave. & S. University Parks Dr.
3. 6th St. & Webster Ave.
4. 8th St. & Austin Ave.
5. Washington Ave. @ Convention Center
6. S. M.L.K. Jr. Blvd. at Waco Suspension Bridge

FIGURE 3: PROPOSED SILO ROUTE



Potential New Development Extension

Two potential new developments north of the river have been identified by the City of Waco. The trolley route could be extended in the future to serve either or both those areas, but extending the route length and number of stops without increasing the number of vehicles that serve the route would mean the headways also increase. Based on the previous trolley service and estimates for the proposed route, extending this service to the potential new developments could extend the headways to 20-30 minutes.

Stops

1. Webster Ave. & S. University Parks Dr.
2. 6th St. & Webster Ave.
3. 8th St. & Austin Ave.
4. 3rd St. & Austin Ave.
5. Elm Ave. & S. M.L.K. Jr. Blvd.
6. Potential new development at Elm Ave. & Spring St.
7. Potential new development at I-35 & S. M.L.K. Jr. Blvd.
8. S. M.L.K. Jr. Blvd. & E. Bridge St.
9. S. University Parks Dr. & Franklin Ave.

TABLE 3: SILO DISTRICT TROLLEY HISTORICAL ROUTE COMPARISON

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2017-2020	2.2	5	0.44	15-20
Proposed	2.3	6	0.38	15-20
Proposed (Extension)	**4.2**	**9**	**0.43**	**20-30**

Extending the route to potential new developments north of the river significantly extends the route length, time, and number of stops, which could impact the headways significantly without additional vehicle assets. For a downtown circulator route, it is key to maintain low headways, or it loses its convenience and thus, ridership. Should the potential new developments warrant a future extension of trolley service, a downtown circulator that remains south of the river with a loop route north of the river that crosses the river to connect to downtown may be the best way to keep headways low.

FIGURE 4: PROPOSED SILO ROUTE EXPANSION