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CHAPTER 6

SCENARIO ANALYSES

6. SCENARIO ANALYSES

A significant component of developing the MMP was analyzing multiple scenarios of priority, investment, benefit, and application of different modes of transportation to assess reasonable recommendations for the network. Scenario Planning visualizes outcomes across the community vision and spectrum of goals including transportation, economics, and social equity. The scenario analyses used performance measures to evaluate the community return on investment and the trade-offs of alternative transportation improvements, programs, and policies under a variety of possible future conditions or trends. Additional details of the scenario analyses can be found in Appendix C: Scenario Planning Technical Memorandum.

Each mode of transportation evaluated is dynamic and adheres to different internal and external influences. With those elements under consideration, each scenario was tailored to the mode being evaluated within Temple, leading to different analysis processes and measures.

Scenario 1

Traffic Signal and Intersection Optimization

Optimize traffic signals and intersection performance by identifying improvements to intersection with an LOS of D or lower.

Scenario 2

Systemwide Roadway Improvements

Analyze and identify Improvements to roadway segments with an LOS of D or lower.

Scenario 3

Regional Connectors

Add in improvements to major arterial roadways or higher to identify potential improvements to cross-town and regional trips.

Scenario 4

Transit Vision

Review of additional access and transit mode choice improvements to better serve communities. Focus on identifying route alternatives and approximate stop recommendations for underserved and socially vulnerable people.

Scenario 5

Active Transportation Improvements

Analyze how the addition of active transportation facilities and infrastructure benefits the character of the community and the quality of place as well as the health and well-being of the community.

Scenario 6

Emerging Technology & TSMO

Investigate potential impacts (curbside management, parking restrictions/ access, delivery) based on new policy or program recommendations for car sharing, bike sharing or scooter programs.

6.1 Scenario 1-3: Vehicular Transportation

Scenarios 1 – 3 are geared toward understanding impacts to traffic operations and congestion. Scenario 1 focused on poorly performing intersections in the study area. Scenario 2 reviewed deficiently performing roadway segments assuming recommendations from Scenario 1 were "implemented". Scenario 3 built upon Scenario 1 and 2 networks to evaluate the performance of existing and proposed regional connections.

6.1.1 Scenario 1: Systemwide Traffic Signal and Intersection Optimization

The Temple region continues to grow, and that growth will ultimately have an impact on the performance of the roadway system. Scenario 1 optimizes traffic signals and intersection performance by identifying improvements to intersections with a deficient LOS of D or lower. The four phases of analysis demonstrated the perceived benefit to the region:

1. Population and Employment updates: Population and employment estimates were updated to reflect the most recent developments throughout the city and incorporated into the KTMPO model.
2. No-Build: Completed a model run for future 2045 conditions with no additional improvements to identify deficient intersections.
3. Signal Optimization: Completed a model run to optimize the timing and phasing of traffic signals in the study area and identified those still operating deficiently.
4. Standard Intersection Improvements: Implemented intersection improvements (such as approach lanes or turn bays) to the deficient traffic signals within the model and identified those still operating deficiently.

Scenario 1 identifies intersection deficiencies in the 2045 No-Build and attempts to present conceptual solutions via signal optimization and standard intersection improvements. TABLE 10 shows the top five recommended intersection improvements (based on the impact), that were implemented in addition to the signal optimization in order to improve the intersection delay and LOS. TABLE 11 summarizes the performance of intersections within the study area for the No-Build conditions after signal optimization and intersection improvements.

TABLE 10: SCENARIO 1 TOP 5 RECOMMENDED INTERSECTION IMPROVEMENTS AND IMPACT ON LOS

INTERSECTION	RECOMMENDED IMPROVEMENT
Central Ave & 31st St	Add right-turn lane northbound and convert thru to shared thru/right lane eastbound
Charter Oaks Dr & Midway Dr/Kegley Rd	Update northwest bound geometry to show dedicated left turn lane (updated to match current conditions). Add right-turn lane northeast bound and remove stop sign for northwest bound and southbound approaches
IH 35 NB Frontage & Hart Rd	Add traffic signal
IH 35 SB Frontage & Hart Rd	Add traffic signal
Loop 363/Young Ave & FM 438	Add left-turn lane northwest bound, add left-turn lane southbound, and add traffic signal

TABLE 11: SCENARIO 1 2045 INTERSECTION PERFORMANCE IN TEMPLE REGION

LEVEL OF SERVICE	NO-BUILD		SIGNAL OPTIMIZATION		INTERSECTION IMPROVEMENTS	
	AM	PM	AM	PM	AM	PM
Total Deficient	45	55	29	39	14	29
Total Improved as Compared to No-Build	-	-	16	16	31	26
% Improvement as Compared to No-Build	-	-	36%	29%	69%	47%

After the signal optimization, the number of deficient intersections was reduced by 36% in the AM and 29% in the PM. After including the intersection improvements, the number of deficient intersections was reduced by 69% in the AM, and by 49% in the PM. The results demonstrate the benefit of signal optimization and standard intersection improvements to the overall performance of the city's intersections.

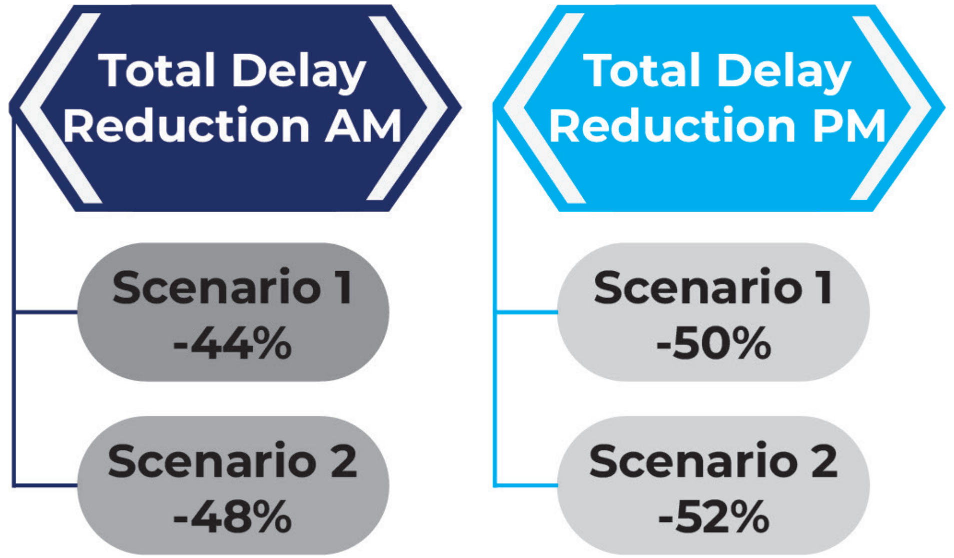
6.1.2 Scenario 2: Systemwide Roadway Improvements

Scenario 2 builds upon the Scenario 1 base network by providing additional recommendations to improve the performance of the remaining deficient intersections identified as part of Scenario 1. These recommendations concentrated on the deficient intersection approaches and roadway segments and sought to improve performance by introducing new turn bays, adding new turn lanes, adding capacity, or modifying lane assignments. TABLE 12 shows the top 5 recommended improvements by the impact that were implemented as part of Scenario 2 to improve the intersection delay and LOS.

TABLE 12: SCENARIO 2 TOP 5 RECOMMENDED INTERSECTION AND SEGMENT IMPROVEMENTS

INTERSECTION	RECOMMENDED IMPROVEMENT
Hilliard Rd, FM 2305 & Old Waco Rd	Add right-turn lane eastbound and southbound
Midway Dr, Charter Oak Dr & Kegley Rd	Extend two-way left-turn lane on Kegley Rd from FM 2305 to Charter Oaks Drive and update functional class to minor arterial. Add traffic signal and change northbound lane assignment to left-turn lane and shared thru/right-turn lane
Old Hwy 95 & FM 93	Widen FM 93 from 2 to 4 lanes from FM 1741 to SH 95
Cearley Rd, SH 53 & Twin Oaks Dr	Northbound lane assignment changed to left-turn lane and shared thru/right-turn lane
3rd St, Industrial Blvd & Young Ave	Add left-turn lane westbound

Delay and Percent Change in Delay for the scenarios compared to No-Build are based on the additional improvements. The total regional delay for Scenario 2 decreases by 4% from Scenario 1 and by 48% from the No-Build in the AM period, while PM reduces 4% beyond the improvement from Scenario 1 to a 52% decrease from the No-Build. As benefits are provided to the analyzed intersections and roadways, it will likely have an impact on other intersections upstream/downstream.



6.1.3 Scenario 3: Regional Connectors

The resulting Scenario 2 network informed Scenario 3, which analyzes major roadways to identify potential improvements to cross-town and regional trips. The regional connectors explored were roadways where additional capacity or connectivity would be beneficial to the performance of the regional transportation network. The following regional connectors were identified from the existing thoroughfare plan and identified gaps were analyzed:

- Highway 36 (Airport Road) - Evaluate the impact of providing additional capacity to a major regional arterial in a region of Temple that is projected to experience high levels of congestion in 2045
- Highway 317 - Evaluate the impact of providing additional capacity to a major regional arterial in a region of Temple that is projected to experience high levels of congestion in 2045
- Highway 95 – Evaluate the impact of providing additional capacity to a major regional arterial in a region of Temple that is projected to experience high levels of congestion in 2045
- Hickory Road – Evaluate the impact of providing an alternative parallel facility to 31st to alleviate congestion in this region
- 1st Street – Evaluate the impact of providing an alternative parallel facility to 31st to alleviate congestion in this region
- Western Outer Loop – Evaluate the impact of completing construction and upgrading the facilities to a 4 lane principal arterial to provide an alternate route to more urban centric roadways (Loop 363 and I-35)
- North Outer Loop – Evaluate the impact of completing construction and upgrading the facilities to a 4 lane principal arterial to provide an alternate route to more urban centric roadways (Loop 363 and I-35)
- Eastern Outer Loop – Evaluate the impact of implementing a new outer loop to support potential future development and to provide an alternative route to more urban centric roadways (Loop 363 and I-35)

In addition to the new regional connectors, interstate and expressway level roadways were reviewed to ensure the improvements planned along I-35, Loop 363 and US 190 were included within the scenario.

The impact of the large scale regional arterial connectors captures the benefit to the network at a regionwide level. The scenario explored a series of improvements and new construction of significant regional connectors in the study area. TABLE 13 displays the results of Scenario 3 when compared to the results of the No-Build Scenario to understand how the full set of improvements benefit the study area.

TABLE 13: SCENARIO 3 NO-BUILD AND 2045 LEVEL OF SERVICE

	2045 NO-BUILD CONDITIONS		2045 SCENARIO 3	
	ROADWAY MILES	% OF TOTAL	ROADWAY MILES	% OF TOTAL
LOS A-C	342	67%	396	74%
LOS D-F	172	33%	141	26%
Total	514	100%	536	100%

The following summarizes the improvements seen to the total regional delay (hours) of the Temple study area as reported by the Vehicle Miles Travele (VMT) and Vehicle Hours Traveled (VHT) daily and per person. Annual weekday VHT reduced by 38% from the No-Build condition, while per person delay reduced by 47%.

Figure 29 and Figure 30 provide a high-level snapshot of LOS in the study area from the No-Build to the 2045 Scenario 3 condition.

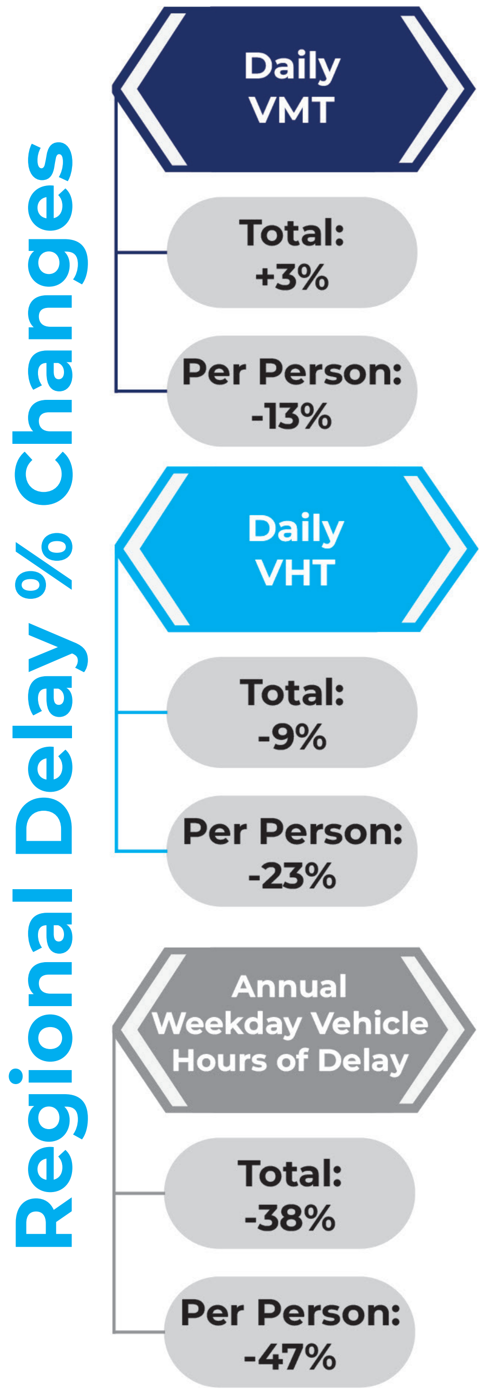


Figure 29: Temple Subarea Level-of-Service – 2045 No-Build Condition

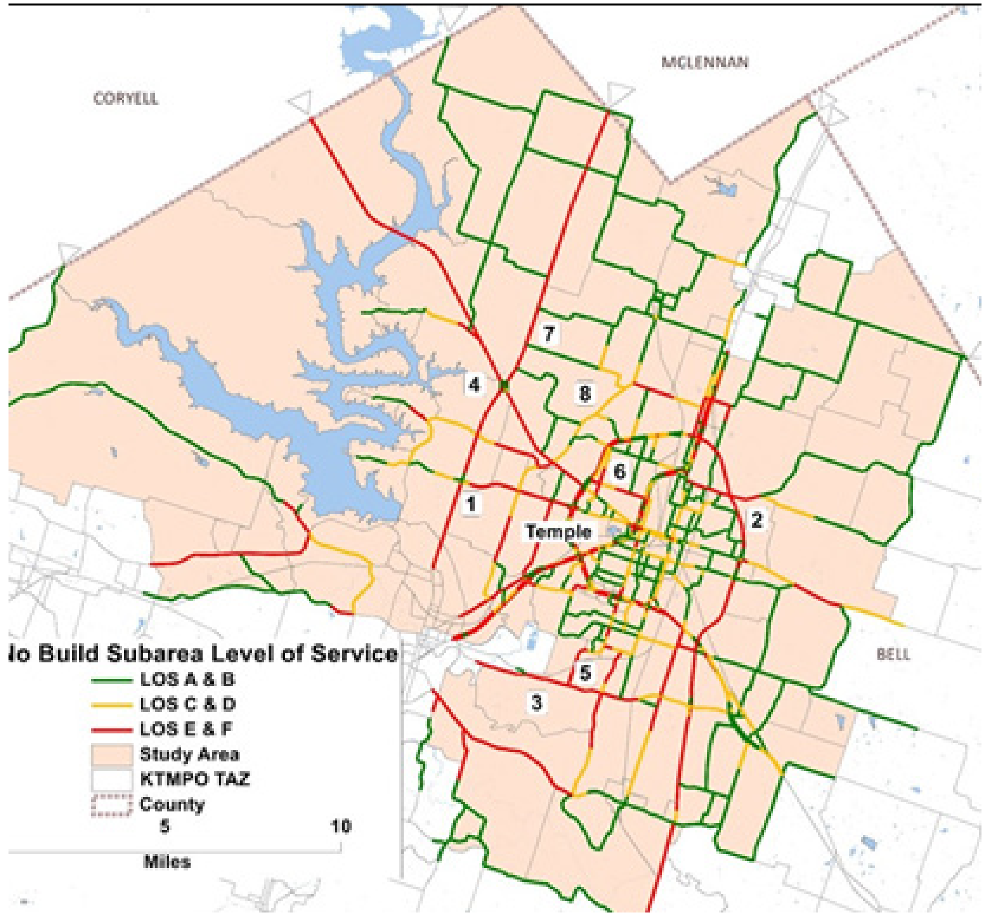
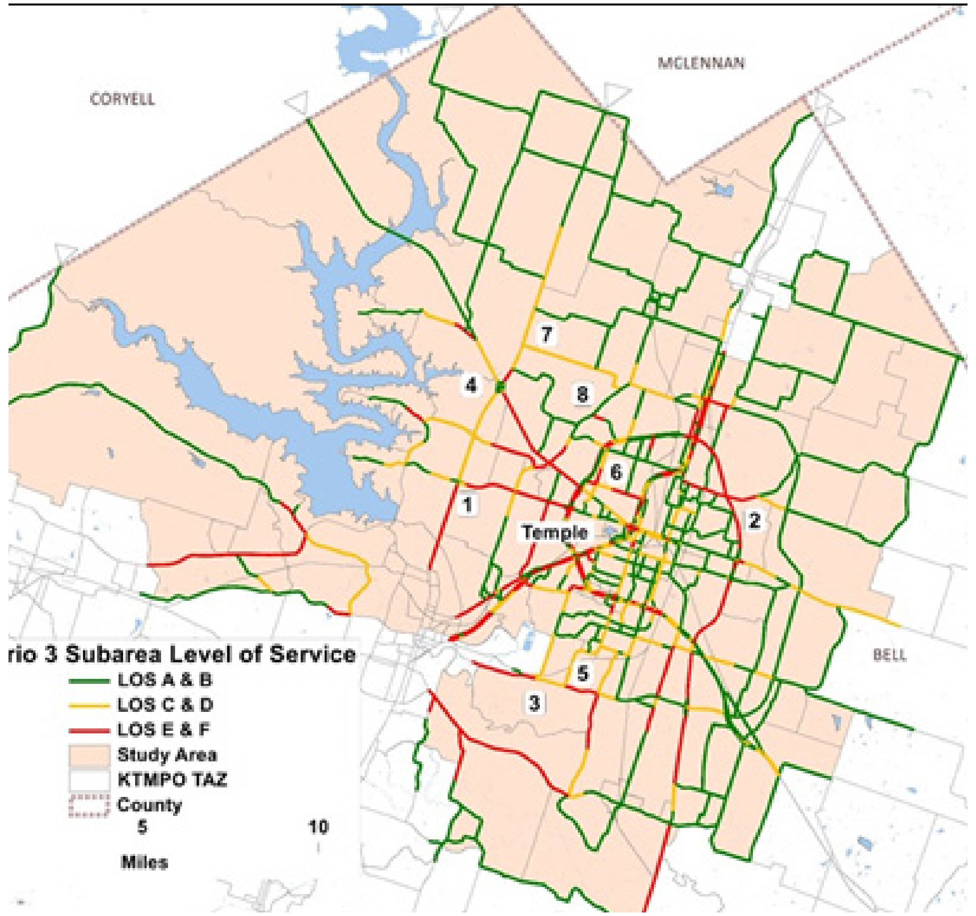


Figure 30: Temple Subarea Level-of-Service – 2045 Scenario 3



6.2 Scenario 4: Transit Vision

From the public feedback received, it is evident the Temple community is interested in more transit options. Scenario 4 looks for additional transit access and transit mode choice improvements. The scenario is intended to inform the recommendations of the Transit Vision Plan that will help decision makers understand the potential outcomes, cost, challenges, future needs, and a roadmap of potential transit options for the City.

A common theme from the public's feedback was the need for a flexible transit option that meets their time and location needs. The introduction of Microtransit was a key element of this scenario analysis. Microtransit, or on-demand transit, is like a fixed route bus because passengers are asked to walk to meet a vehicle at a 'virtual bus stop' that may be up to ¼ or ½ of a mile from their requested location. However, it is different from a fixed route bus since there are no schedules or fixed routes. Instead, trips must start and end within specified zones that fill gaps in the bus network.

6.2.1 Alternatives Analysis

Three alternatives were explored in Scenario 4. Each provides the introduction of a bi-directional service, Microtransit through mobility zones, and includes differences between the candidate alternatives and the existing Temple transit service provided by routes 510 and 530. These alternatives were structured to determine the preferred combination of route and service concepts that will have the support of the community, City leadership, project partners, and City staff.

Alternative A modifies and expands the existing fixed routes 510 and 530. The alternative includes 1) replacing current loop routes with bi-directional service, 2) modifications to the existing routes for more streamlined and easier to use service, 3) more direct services to Temple College and the VA Hospital by the addition of route 520, and 4) service to the Industrial Park through a new 560 Industrial route. The alternative provides coverage similar to existing service with the expectation that those jobs that fall just outside of the stop locations would still be within a reasonable walking distance and would still use the service. Figure 24 displays the proposed fixed route network of alternative A.

Alternative B uses the proposed fixed route services from Alternative A, minus Route 560. The alternative adds Mobility Zones in West Temple and North Temple to provide Microtransit services to these locations that adds potential for 12% additional coverage. Figure 25 displays the proposed route and mobility zones for Alternative B.

Alternative C also uses the proposed fixed route services from Alternative A, minus Route 560. However, the alternative includes the entire city as a mobility zone that adds potential for 100% coverage based on the on-demand service. Figure 26 displays the proposed route and mobility zones for Alternative B.

Figure 24: Transit Alternative A

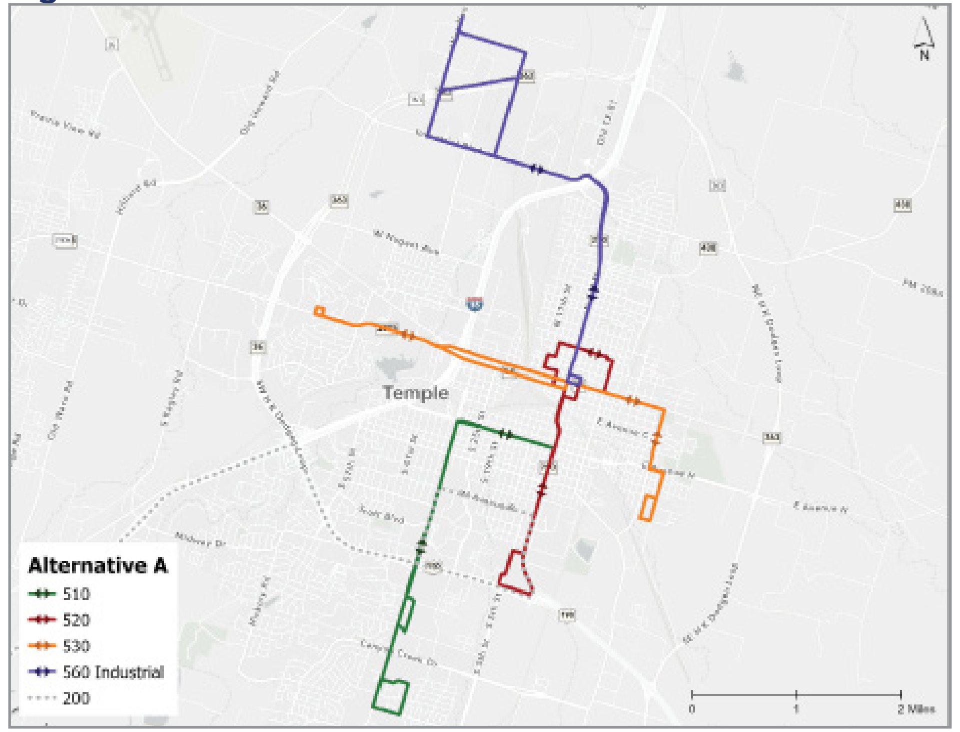


Figure 25: Transit Alternative B

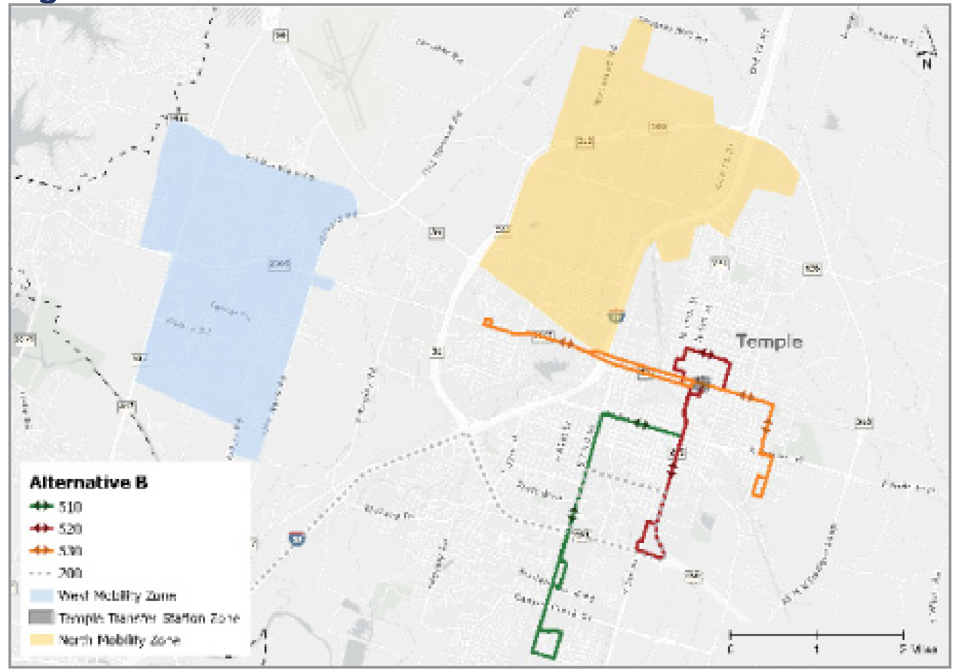
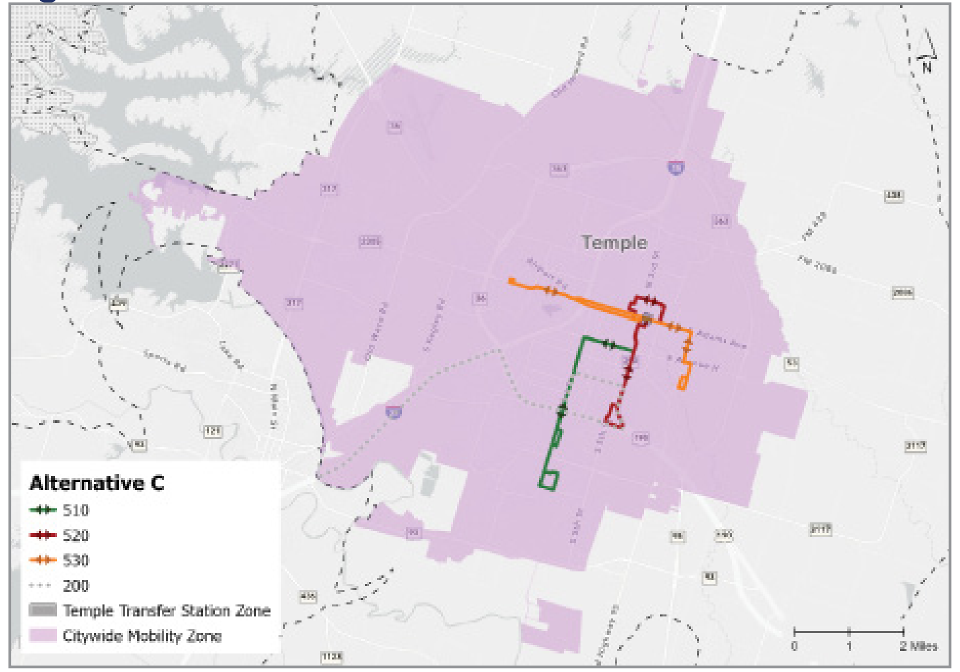


Figure 26: Transit Alternative C



Upfront capital costs for Alternative A are highest of the three alternatives, since fixed-route vehicles are more expensive than Microtransit vehicles. However, because Alternative A requires the fewest vehicles overall, its yearly operating costs are lowest of the three alternatives. Conversely, Alternative C requires the most vehicles and operators, which would make it the most expensive to operate.

These draft alternatives are a culmination of the project team's effort to develop a customized vision for transit that reflects the Temple community and is informed by both the technical analysis and the public input process. The alternatives and recommendations represent the mobility needs and wants of residents throughout the study area. Expanding the travel options for residents in Temple is an expansion of quality of life, which is imperative to any city that is experiencing growth.

Based on the scenario analysis the following recommendations are key to the development of the Transit Vision Plan.

- **Increased Frequency –** Through the addition of a new fixed route (Route 520) and modifications to the existing routes (to create more intuitive and bi-directional service), the City can be more strategic with transit resources and provide a route that operates every thirty minutes between the DT Transfer Station and Temple College (one of the most productive stops in the existing system).
- **Intuitive Transit Design –** Streamlined bi-directional service minimizes out-of-direction travel, reduces travel time, and fosters easy-to-use and easy-to-understand transit service.
- **The Addition of Microtransit Service –** The addition of Microtransit service expands and improves coverage across the entire network, giving riders from areas of the city that don't currently have service the ability to commute into downtown more easily via the Temple Transfer Station Mobility Island.
- **Microtransit 'Mobility Island' for Fixed Route Network Connectivity –** A mobility island serves as a way to connect Microtransit zones to the fixed route network. The Microtransit alternatives add a Mobility Island at the Temple Transfer Station.

6.3 Scenario 5: Active Transportation Improvements

Scenario 5 analyzes how the addition of active transportation facilities or infrastructure benefit the character of the community and the quality of place. The recommended improvements within the context examples aim to address challenges and opportunities presented by active transportation demand, level of stress, and the concerns and suggestions received through public input. The context level examples in this scenario provide a bank of recommendations for the City to reference a range and combination of available strategies. It also provides a guide to help identify opportunities to apply similar strategies in locations throughout the City. In this way, each context example provides a template for developing recommendations for the Active Transportation Plan.

Two locations, each with a different community context, were selected to provide examples of how a community could benefit from active transportation improvements. Context A prioritizes the connection of neighborhoods to important daily needs such as schools, public amenities, transit stations, parks, and major retail and employment areas. Context B focuses on example corridor improvements that provide connectivity across the City and integrate improvements to the on-street active transportation system with the use of off-street trails. This option also focuses on reducing significant barriers to crossing busy and wide streets by improving the design and frequency of crossing locations.

6.3.1 Context A: Connecting People to Places – Meredith Dunbar Early Childhood School Example

Context A focuses on connecting the community to places they visit most often. While many people use personal vehicles to travel to and from their destinations, others may prefer, need, or desire to use other methods. The analysis provides a case study for connecting an activity center to its surrounding area by investing in new infrastructure or improving upon existing facilities near and around the location. The infrastructure analysis considered walk zones as ¼ mile from the activity center, while bike zones were considered as one mile from the activity center. Meredith Dunbar School was selected for this context review.

Within these boundaries, this example analyzes connections from the school to the surrounding neighborhoods and nearby amenities, employment, services, shopping, and recreational areas. Information gathered from the CSA, neighborhood plans, a stakeholder engagement meeting with the principal of the school, and public feedback were all considered when developing potential recommendations. Figure 27 presents a snapshot of preliminary recommendations and their impact on the system.

Figure 27: Context A Example - Meredith Dunbar School

6.3.2 Context B: Key Corridors and Off-Street Connectivity – S. 25th Street Example

Efficient modes of transportation are built on a network with a strong backbone that provides quick, efficient, and convenient connections. For example, vehicular traffic could use an arterial as core east/west and north/south connectors. These types of streets are wide, have turning lanes in most locations, and prioritize travel along the corridor above the streets that intersect them. A transit system should have core routes that run at a higher frequency and provide convenient service in the highest demand locations. Similarly, the pedestrian and bicycle network should have key routes that supply comfortable, safe, and convenient connections without gaps or barriers where they are prioritized. Like Context A, this option analyzed infrastructure for walk zones at a ¼ mile from the corridor and bike zones at one mile from the corridor. South 25th Street in West Temple was selected as the example location for this context application of active transportation solutions.

The analysis of S. 25th Street focuses on closing gaps and identifying bicycle and pedestrian improvements that lead to seamless active travel along the corridor. Like context A, information gained from the CSA, neighborhood plans, stakeholder engagement and public feedback were all considered when developing potential recommendations. Figure 28 provides a snapshot of preliminary recommendations and their impact on the system.

The City has a variety of options to improve active transportation movement through several different contexts. The context reviews provided in this scenario showcase examples of potential projects the City can analyze for application at similar locations to close key gaps in the active transportation network. Relatively minor improvements such as new sidewalks, striping for crosswalks and bike lanes, and signage can have an impact on the network comparable to the impact of larger improvements such as intersection design enhancements, new hike and bike trails, and protected bike lanes. The analysis process and bank of recommendations from this scenario review will be carried into the development of the Active Transportation Plan.

Figure 28: Context B Example - W. 25th Street

6.4 Scenario 6: Emerging Technology & TSMO

Scenario 6 considers the potential impacts on the transportation network, the City, and the region based on new emerging technologies and Transportation System Management and Operations (TSMO) policy or programs. As Temple and the surrounding area continue to grow, balancing the enhancement of safety and efficiently maintaining mobility will become more complex. With growth comes higher traffic volumes, a more complex mix of modes on the transportation system, more points of conflict, and a need for more sophisticated methods of evaluating and managing transportation needs.

Rapid development of a broad range of technologies in vehicle guidance, monitoring systems, automated data collection systems, artificial intelligence, traffic management software, communication systems, micro mobility services (car, bike or scooter sharing programs) and data management tools is creating new and exciting opportunities for how transportation services are supplied and managed. By examining the emerging technologies and advanced data collection and management methods that are on the horizon, the city can make decisions now that can help maximize the value of these technologies as they become available.

6.4.1 Existing Policy

This scenario identifies existing policies and other available programs regarding emerging technologies or TSMO strategies in place at the city or MPO level.

Interest in Emerging Technologies and TSMO was expressed in the City of Temple's Comprehensive Plan 2020. Two of the stated principles of the Plan were to 1) Evaluate opportunities to invest in transportation demand management and smart city technologies to improve transportation efficiency, and 2) Proactively monitor predicted changes to the transportation system stemming from the onset of autonomous vehicle technologies.

Temple also recently implemented new initiatives to help with congestion, mobility and safety in the City. The first was the creation of a parking garage policy and the second was an initiative to look at additional midblock crossings that will provide a reduced walking distance for pedestrians when crossing busy roadways improving safety and mobility.

Consideration of Emerging Technologies and TSMO by KTMPO was evident in their Congestion Management Process (CMP) that states:

Technological efficiency improvement strategies utilize modern technology and computing capabilities to improve efficiency and operations in the existing transportation system. These strategies typically involve using sensors to collect and process data about traffic conditions. Information about traffic conditions can be directly presented to commuters in the form of electronic signage so that they can make travel decisions based on current conditions. The information can also be used to manipulate traffic operations based on current demands. Technological efficiency improvement strategies can effectively increase a transportation system's capacity without requiring costly and time-consuming construction.

KTMPO's CMP identifies a set of strategies that can be part of a toolbox for management of congestion including the following:

- Ramp Metering
- Traveler Information and Rerouting Systems:
- Electronic Commercial Vehicle Clearance and Tolls
- Automated Travel Time Measurement
- Route Information
- Traffic Signal Optimization
- Transit Signal Priority
- Demand-Responsive Signal System
- Transit Vehicle Tracking
- Motorist Assistance Patrols
- Strategies to Improve Accident Response and Clearance Time
- Parking Management
- Pedestrian Signals
- Bike Sharing System

6.4.2 Industry Best Practices

New technologies emerge quickly and can have a major impact of the transportation network. Although the City can't plan specifically for new technologies that have yet to be developed or infiltrate the network, they can plan for the space they will potentially inhabit. TABLE 14 is list of emerging technologies, mobility solutions and advanced data management methods that the City should monitor and consider for future application.

TABLE 14: BEST PRACTICES TOOLS FOR EMERGING TECHNOLOGIES, MOBILITY SOLUTIONS, AND DATA MANAGEMENT

INTERSECTION	RECOMMENDED IMPROVEMENT
Sensors, Communications and Warnings	Weather and Flood Warning Systems
	End-of-Queue Warning System
	Speed Warning System
	Pedestrian and Bicyclist Detection, Notification, and Warnings
Coordinated Traffic Management and Adaptive Signal Control	Expanded Regional Traffic Management Center (TMC)
	Adaptive Signal Timing
Vehicle Technologies	Signal Infrastructure-to-Vehicle Communications
	Roadway Design, Infrastructure, and Maintenance to Support Safe Automated and Autonomous Vehicle Operations
	Autonomous Shuttles
Mobility Innovations	Ridesharing and Carpooling
	Shared Micromobility
	Curbside Management and ADA Accessibility
Advanced Data Collection and Data Management Methods	Use of "Big Data"
	Real-time Traffic Data Capture by Signal System Equipment
	Advanced Video-based Data Collection
	Automated Traffic Signal Performance Monitoring (ATSPM)
	Asset Management and ITS Performance Monitoring Systems
	Unmanned Aerial Vehicles (Drones) for Data Collection

The analysis of emerging technologies and TSMO strategies in Temple and the surrounding area demonstrated that there is significant potential for these options. Discussion of the regional safety and mobility needs with key stakeholders from the study area revealed that there is strong support for cost-effective strategies that can help optimize system performance through increased system management and operations. The discussion with key stakeholders also revealed an openness to consideration of innovative emerging technologies and methods as well as to greater collaboration among area agencies in the management and operations of the area's transportation system. These findings and the appetite for inclusion of emerging technologies will be considered in the development of mobility recommendations for the study area.