Killeen-Temple Metropolitan Area

Congestion Management Process

2016 Update

Adopted by the KTMPO Transportation Planning Policy Board on October 19, 2016

Prepared for:

KTMPO KILLEEN-TEMPLE metropolitan planning organization

Prepared by:

ALLIANCE TRANSPORTATION GROUP

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1. Introduction

This document is the 2016 Congestion Management Process (CMP) Update Report for the Killeen Temple Metropolitan Planning Organization (KTMPO) planning area (see Figure 1-2). The report describes the assumptions, methodology, performance measures, and potential congestion mitigation strategies included in the updated CMP.

Congestion Management Process (CMP)

Congestion management is the application of strategies to improve transportation system performance and reliability by reducing the adverse impacts of congestion on the movement of people and goods. A congestion management process (CMP) is a systematic approach for managing congestion that provides accurate, up-to-date information on transportation system performance and assesses alternative strategies for congestion management that meet state and local needs. The CMP is intended to produce transportation system performance measures and congestion management strategies that can be reflected in the regional metropolitan transportation plan (MTP) and transportation improvement program (TIP).

The CMP, as defined in federal regulation, is intended to serve as a systematic process that provides for safe and effective integrated management and operation of the multimodal transportation system. The process includes:

- Development of congestion management objectives;
- Establishment of measures of multimodal transportation system performance;
- Collection of data and system performance monitoring to define the extent and duration of congestion and determine the causes of congestion;
- Identification of congestion management strategies;
- Implementation activities, including identification of an implementation schedule and possible funding sources for each strategy; and
- Evaluation of the effectiveness of implemented strategies.

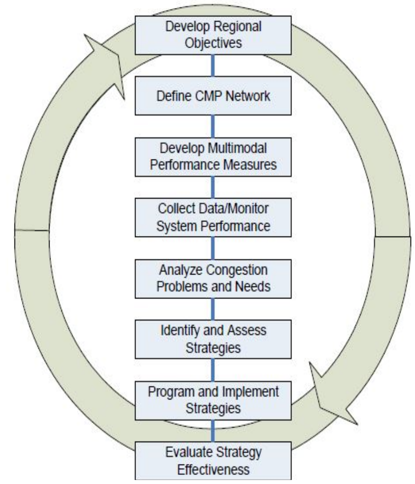
A CMP is required in metropolitan areas with population exceeding 200,000, these areas are known as Transportation Management Areas (TMAs). Federal requirements also state that all CMPs shall be developed and implemented as an integrated part of the metropolitan transportation planning process. The Congestion Management System (CMS) was first introduced by the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and was continued under successive transportation authorization laws, including the current law, Fixing America's Surface Transportation (FAST) Act. The CMP is intended to be an ongoing process, fully integrated into the metropolitan transportation planning process. The CMP is a "living" document, continually evolving to address the performance measure results, concerns of the community, new objectives and goals of the MPO, and up-to-date information on congestion issues.

KTMPO Congestion Management Process

The Killeen Temple Metropolitan Planning Organization (KTMPO) is the metropolitan planning organization (MPO) for the urbanized region surrounding the two cities. The general population of the KTMPO planning area, according to the 2014 US Census American Community Survey estimates, is 355,747. Figure 1-2 shows the KTMPO planning area, which was designated as a TMA in 2012. Within this area, KTMPO has the responsibility of coordinating safe and efficient movement of people and goods on the multi-modal public transportation system. The KTMPO multi-modal transportation system includes faciliites for pedestrians, bicylists, transit users, air transport users, and automobile/truck users.

This KTMPO CMP is modeled after the process suggested in the Federal Highway Administration's *Congestion Management Process: A Guidebook*. Figure 1-1 visualizes the step-by-step process, emphasizing the ongoing nature of the CMP. The eight step process includes the following actions:

Figure 1-1: KTMPO CMP Model Process



Develop Regional Objectives – This step in the process answers the questions: "What is the desired outcome?" and "What do we want to achieve?" It may not be feasible or desirable to try to eliminate all congestion, and so in this step it is important to define the regional objectives for congestion management that are designed to achieve the desired outcome. Some MPOs also define congestion management principles, which shape how congestion is addressed from a policy perspective.

Define Network - This step in the process involves answering the question, "What components of the transportation system are the focus?" and involves defining both the geographic scope and system elements (e.g., freeways, major arterials, transit routes) that will be analyzed in the CMP.

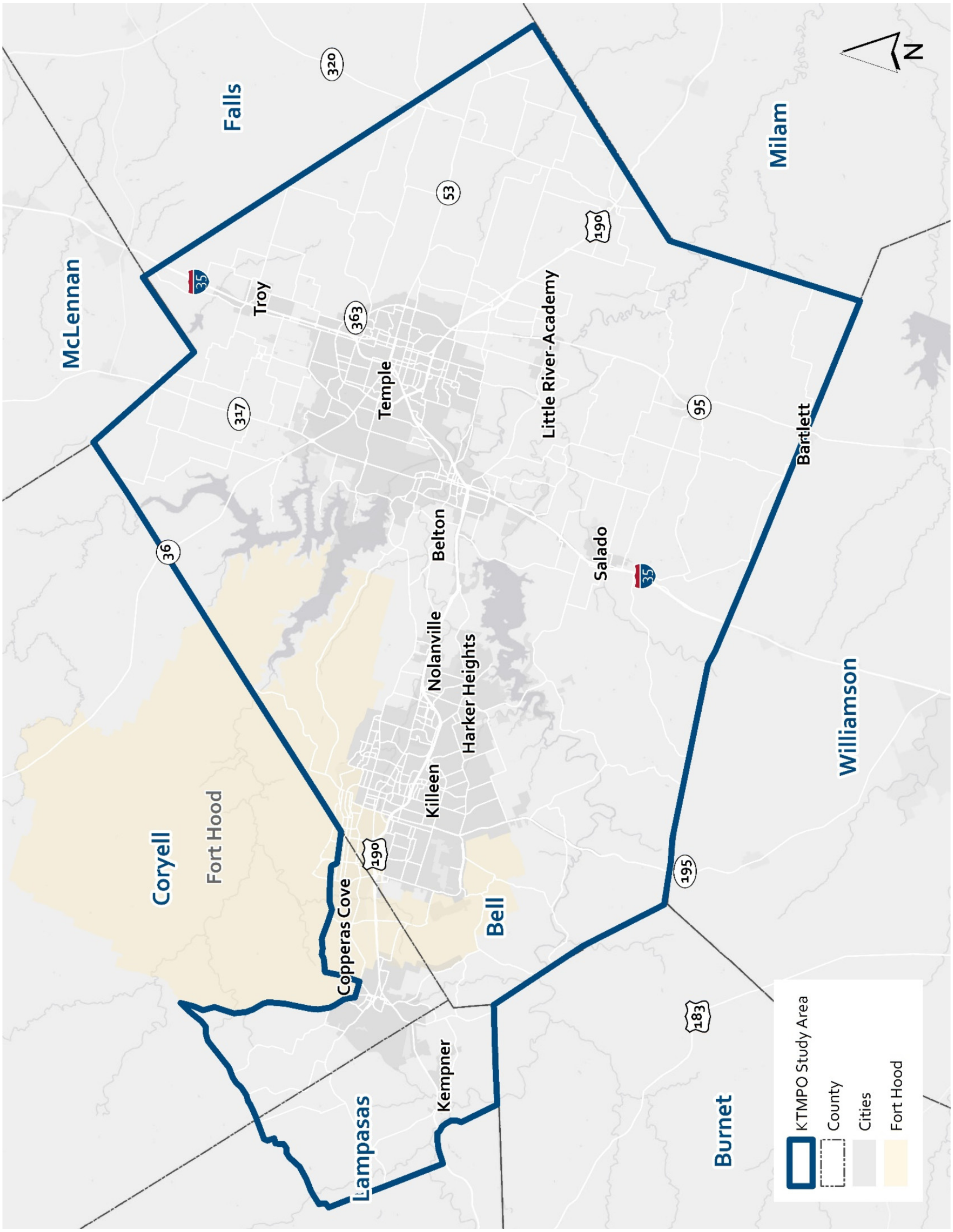
Develop Performance Measures – In this step in the process, the CMP addresses the question, "How do we define and measure congestion?" This step involves developing performance measures to be used to measure congestion on both a regional and local scale. These performance measures should support the regional objectives.

Collect Data/Monitor System Performance - After performance measures are defined, the next step in the process is to collect and analyze data to determine, "How does the transportation system perform?" Data collection may be on-going, and involve a wide range of data sources from various planning partners.

Analyze Congestion Problems and Needs - Using available data and analysis techniques, in the next step in the process the CMP should address the questions, "What congestion problems are present in the region, or are anticipated?" and "What are the sources of unacceptable congestion?"

Identify and Assess Strategies - Working together with the MPO's planning partners, in the next step in the process the CMP should address the question, "What strategies are appropriate to mitigate congestion?" This step involves both identifying and assessing potential strategies, and may include efforts conducted as part of the development of the Metropolitan Transportation Plan (MTP), corridor studies, or project studies.

Figure 1-2: KTMPO Planning Area



Program and Implement Strategies – This step involves answering the question, "How and when will solutions be implemented?" The step typically involves: including strategies in the MTP; determining funding sources; prioritizing strategies; allocating funding in the TIP; and, ultimately, implementing the strategies.

Monitor Strategy Effectiveness – This step should assess, "What have we learned about implemented strategies?" This step will be tied closely to monitoring system performance and is designed to inform future decision making about the effectiveness of transportation strategies. From the lessons learned in this step, the process begins again in a continuous process of monitoring and improving congestion management processes within the region.

Goals and Objectives

KTMPO CMP Vision: "Maintain a safe efficient and convenient transportation system throughout the KTMPO region."

As with any process, it is important to establish the process objectives from the outset. The objectives define what the MPO wants to achieve regarding the congestion management process, and are an essential part of an objectives-driven, performance-based approach to planning for congestion management. These objectives will also serve as one of the primary points of connection and coordination between the CMP and the MTP. The MPO developed goals and objectives for the 2013 CMP based on existing KTMPO planning documents and national best practices. The 2016 CMP Update maintains the same goals and objectives, which guide the actions necessary to maintain a safe efficient and convenient transportation system throughout the KTMPO region. The MPO will continue working to promote projects and policies that support the stated vision, goals, and objectives of this 2016 CMP Update.

Goals and Objectives

Goal: Provide an efficient transportation system

- Promote policies and projects to reduce travel delay
- Promote awareness of alternative transportation modes

Goal: Provide a safe transportation system

- Promote policies and projects to reduce number of crashes and crash severity

Goal: Promote a variety of transportation alternatives

- Promote policies and programs to increase transit ridership on existing services
- Promote awareness of multi-modal facilities
- Promote carpool/shared-ride opportunities

Goal: Encourage programs and developments that promote a healthy environment

- Consider participation in air quality improvement programs
- Encourage community land development plans that balance access to all modes of transportation.

2. Congestion Management Data

Types of Congestion

- Recurring Congestion
  - Peak period
  - Freight
  - Intersection
  - Freeway corridor
  - Non freeway corridor
  - School related
  - Central Business District
  - Bottleneck or hot spot
  - Railroad crossing
  - Parking related
- Non-Recurring Congestion
  - Incident related
  - Special event traffic

Federal regulation 23 CFR 500.109 defines congestion as "the level at which transportation system performance is unacceptable due to excessive travel times and delays." According to the Federal Highway Administration (FHWA), roadway congestion is comprised of three key elements: severity, extent, and duration. However, congestion can have a different meaning depending on the context in which the congestion is experienced. Defining a CMP Network and developing performance measures to analyze congestion along the network are key steps in the CMP. These steps establish the foundation for the process, and are meant to define how congestion is perceived locally.

Congestion Data Sources

Before a CMP Network can be defined or performance measures can be determined, it is important to determine what data is available. The KTMPO CMP employs three main quantitative data sets, whose data coverage is shown in Figure 2-1, and one qualitative data set for analyzing congestion. The CMP also uses additional supplementary data from other sources that helps further the identification and analysis of congestion throughout the region.

National Performance Management Research Data Set (NPMRDS)

The NPMRDS is a vehicle probe-based data set developed by HERE and acquired by the FHWA to support the agency's Freight Performance Measures (FPM) and Urban Congestion Report (UCR) programs. The data set uses crowd-sourced GPS information, typically obtained from mobile phones, vehicles, and portable navigation devices, to provide monthly average travel times (in 5 minute intervals) along the National Highway System (NHS), Strategic Defense Network (STRAHNET), and principal arterials within five miles of a border crossing. The data is also packaged with a location referencing system, which is a network of segments called Traffic Message Channels (TMCs), which can be used in a geographic information system (GIS) to link travel time data to road segments. The data used in this CMP includes monthly data from 2014 for Bell, Coryell, and Lampasas Counties, and was obtained from TxDOT.

Although the NPMRDS separates probe data into passenger vehicle and freight vehicle data, this CMP Update uses the combined data to account for the effects of congestion on the movement of both people and goods throughout the region.

INRIX

The INRIX data set is similar to the NPMRDS in that it is a probe-based data set produced from GPS information taken from personal navigation devices. However, INRIX traffic data is presented in units of speed, instead of average travel time, averaged over 15 minute intervals. The INRIX speed data set used in this CMP is the 2013 version and was obtained from TxDOT, which packages the data with its Road-Highway Inventory Network (RHiNo) for location referencing and travel time calculation.

Regional Travel Demand Model (TDM)

A TDM is a representation of travel behavior throughout a transportation system network. The model uses roadway attributes and socioeconomic data such as population and employment to predict travel behavior. The latest KTMPO TDM uses 2010 and forecasted 2040 demographic inputs to forecast travel demand along the TDM roadway network for different time periods. The TDM does not model travel behavior of modes of travel other than the roadway system. The TDM results provide estimates of vehicle travel times, speed, and traffic volumes along the roadway system of the region.

Google Traffic

Google Traffic is a feature in Google Maps that displays typical traffic conditions along roadways based on travel speed. Google Traffic aggregates crowd-sourced GPS information from smartphones to calculate speeds along roadway segments, which is then used to create an overlay in Google Maps which show traffic conditions on a scale from "fast" to "slow"—with "fast" meaning there is little congestion and "slow" meaning there is heavy congestion for a specific time period. Because the raw data is not publicly available, the CMP utilizes this data source qualitatively. Congestion data from Google

Traffic is collected by reviewing the typical traffic conditions overlay in Google Maps for specific time periods and indicating the severity of congestion for segments consistently displaying congestion. The process involves skimming through several time periods to identify segments with reoccurring congestion, noting the extent and travel direction of the congested roadway segment, and recording the magnitude of congestion.

Supplementary Data Sources

Outside of the four main congestion data sources, KTMPO also designed a survey to gather feedback from the public to determine the location and other characteristics of regional congestion. The survey was hosted online and received 222 unique responses over the one-month period that the survey was open. The survey revealed that many of the respondents perceived daily congestion to be a significant problem in the region, and mostly caused by roadway construction, inadequate road capacity, or ineffective traffic signals. Respondents also identified locations where congestion was the worst (Table 2-1) and provided information about each respondent's commuting patterns and strategies to avoid congestion. A complete summary of the survey results is available in Appendix B.

Table 2-1: Survey Response - Worst Congestion Locations

Intersection	Segment
WS Young @ US 190	W. Adams Ave. (Temple)
FM 2410 @ US 190	WS Young Dr. (Killeen)
Trimmier Rd @ US 190	Trimmier Rd. (Killeen)

Crash data was also incorporated in the CMP as a way to account for non-recurring congestion, since incidents along a network may result in delays and unreliable travel times. Crash data for the region was obtained from TxDOT's Crash Records Information System (CRIS) from 2011 to 2015. The CRIS data provides information about the location of reported crashes (Figure 2-2), as well as different attributes that provide more detail about who was involved and the outcome of each crash (e.g. injury or fatality).

Figure 2-1: Quantitative Congestion Data Coverage

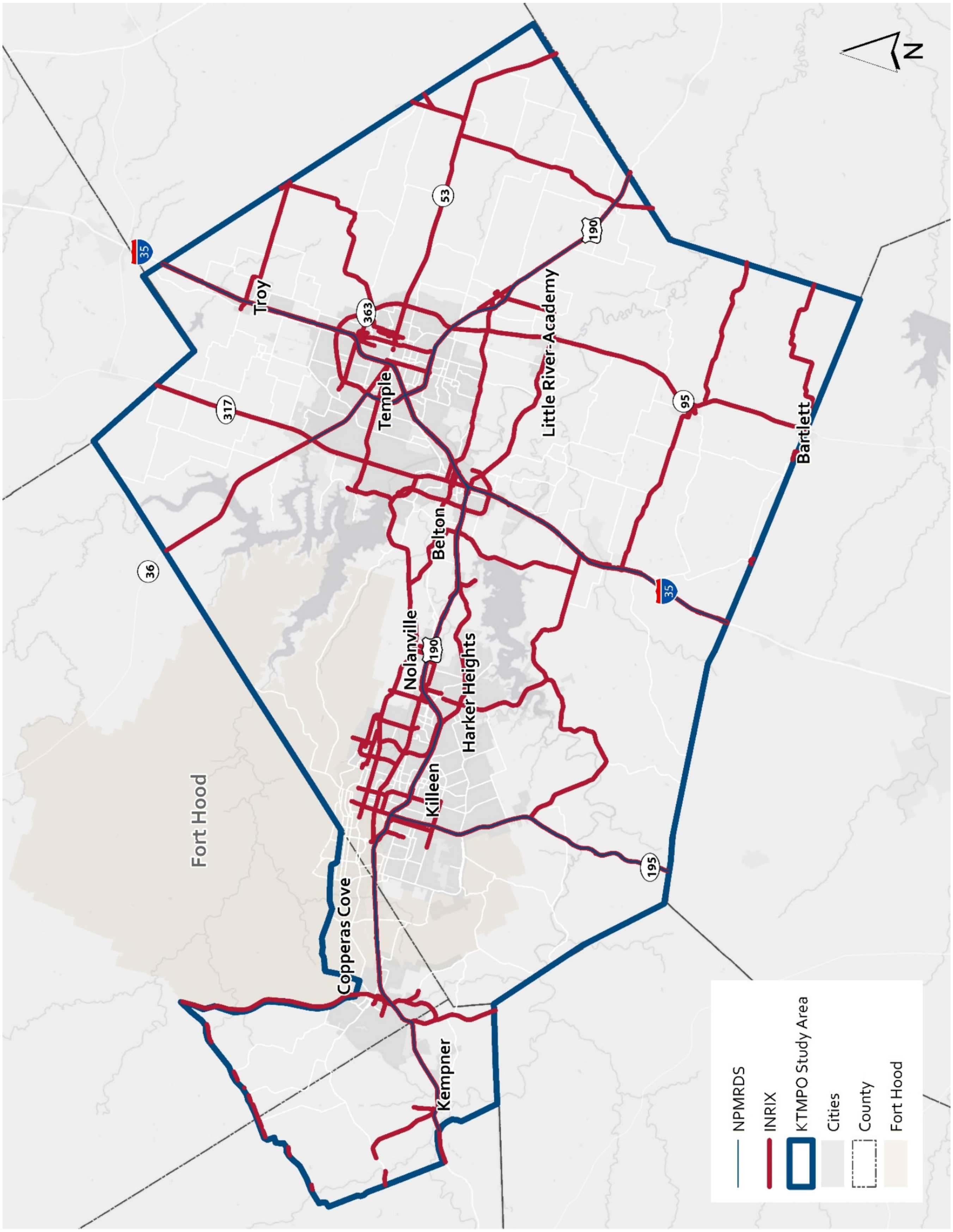
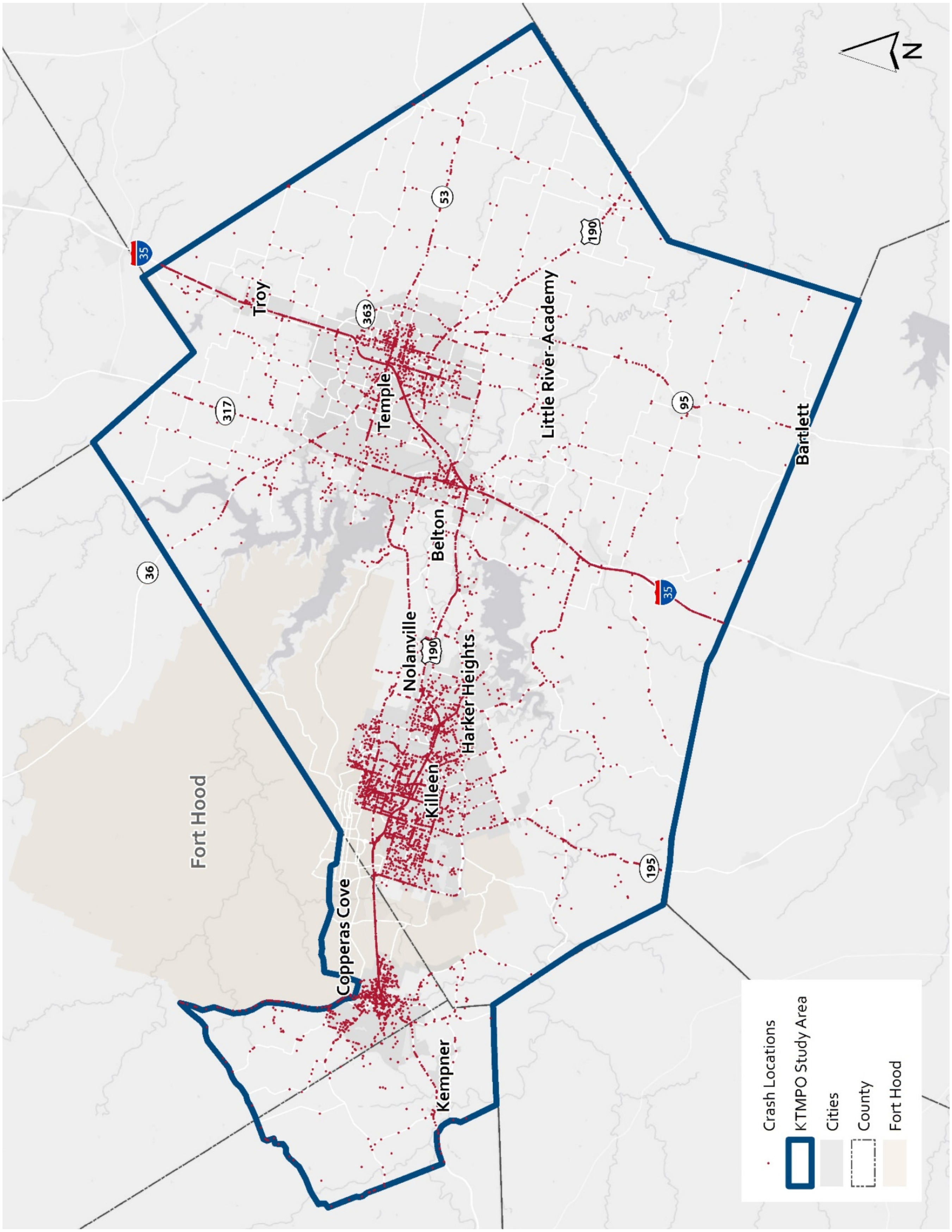


Figure 2-2: CRIS Crash Locations (2011-2015)



CMP Network

Defining a CMP Network involves specifying the geographic boundaries and transportation system components that are the basis of analysis and foundation of the congestion management process. Efforts to improve traffic conditions in the region begin on the CMP Network, and the level of congestion on this network serves as a gauge for overall congestion in the region.

Defining the CMP Network

In May 2013, KTMPO held a series of public workshops to collect input from the community on various transportation topics, including congestion. The public provided feedback about proposed CMP goals and identified congestion locations throughout the area (Figure 2-3). KTMPO staff combined the results from the workshops with congested corridor information provided by the regional public transit provider Hill Country Transit District (HCTD) and Texas Department of Transportation (TxDOT), creating a consolidated list of congested roadways. KTMPO Staff presented this list of roadways to the KTMPO Technical Advisory Committee and Transportation Planning Policy Board where it was approved as the official CMP Network for the region.

The 2013 CMP Network did not take into account quantitative data coverage. However, the 2016 CMP does use quantitative data. As a result of the analysis of this quantitative data, an expanded CMP Network was proposed for the 2016 CMP Update. The updated CMP Network (Figure 2-4) reflects the overlapping data coverage from the four congestion datasets mentioned previously, as well as information gathered from the congestion survey. The network is broken up into segments for analysis purposes, which are detailed in Table 2-2.

Performance Measures

Developing performance measures to identify, assess, and communicate to others about congestion is a critical element of the CMP. A performance measure is a quantifiable measure to assess how well the KTMPO region is meeting the established congestion management goals and objectives. Performance measures serve as indicators to better understand the usage of a transportation facility or the characteristics of travelers using the transportation system. Performance measures can also be assessed over time to indicate whether congestion management strategies are successful in meeting the establish goals and objectives of the CMP.

By monitoring performance and the outcomes from implemented improvement strategies, the quality of decision-making in the planning process can be improved and limited financial resources can be expended more wisely and effectively. The requirement for on-going assessment of the performance measures leads to the need to identify measures that are quantifiable, without placing a heavy burden on time, cost or training on KTMPO staff. This CMP establishes a set of performance measures that can be calculated from real world data on an annual basis and that provide KTMPO with useful information and trends to inform transportation investment decisions.

Figure 2-3: Public Defined Areas of Congestion

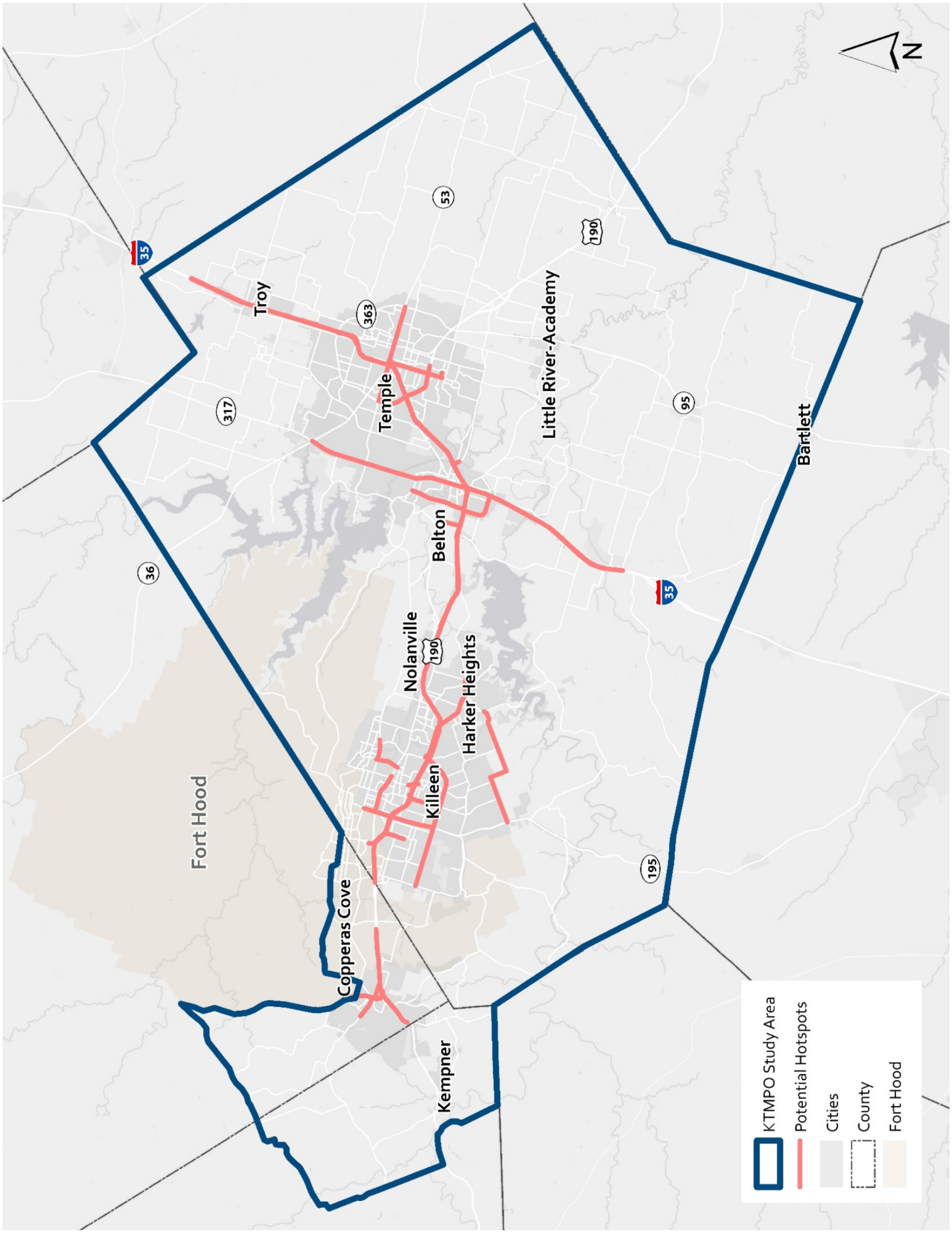


Figure 2-4: Updated CMP Network

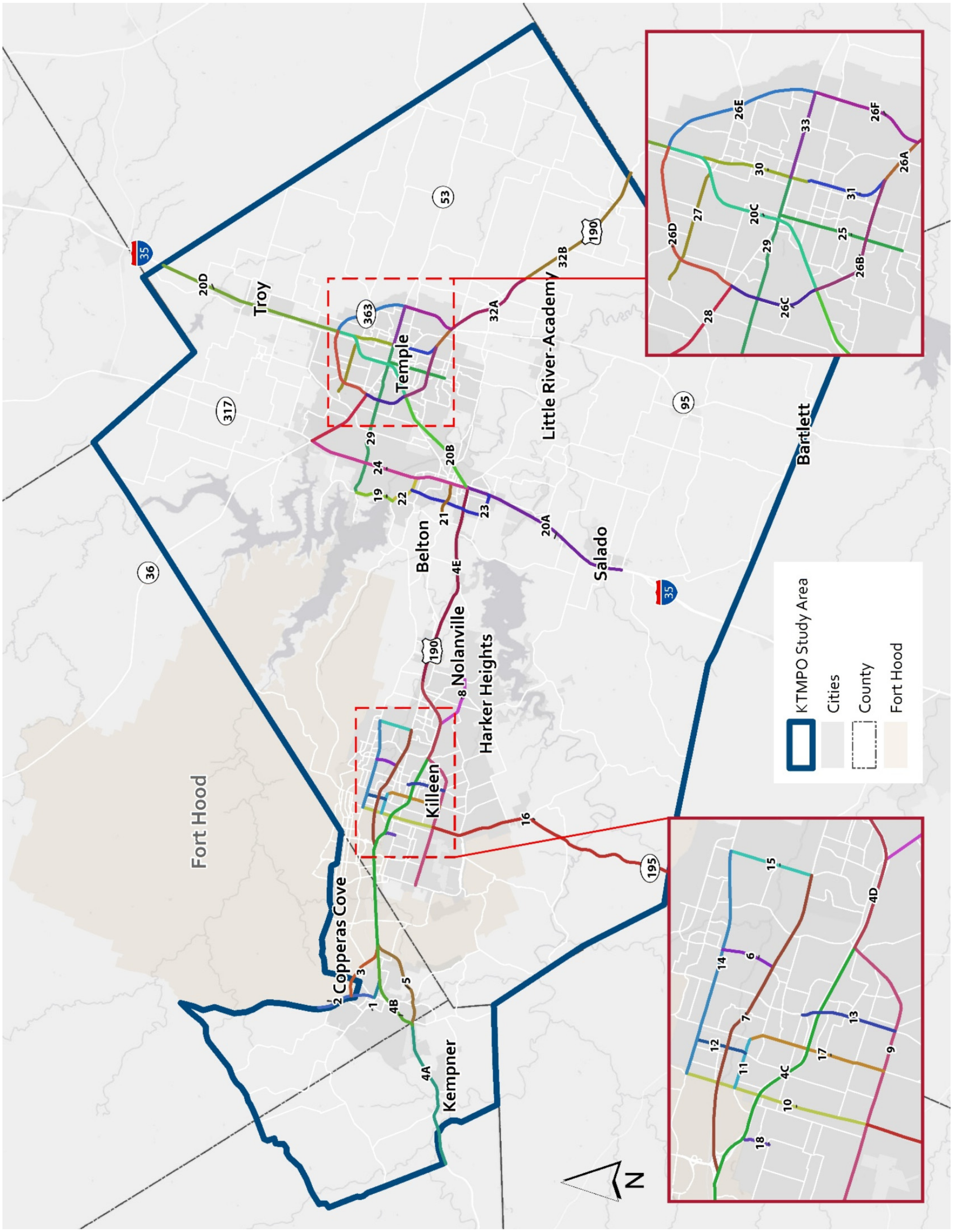


Table 2-2: Updated CMP Network Segments

ID	Roadway	From	To	City
1	AVE D	N 1ST ST	BUSINESS 190	COPPERAS COVE
2	FM 116	AVE D	ELIJAH RD	COPPERAS COVE
3	SH 9[1]	US 190	FM 116	COPPERAS COVE
4A	US 190	FM 1715	BUSINESS 190	COPPERAS COVE
4B	US 190[2]	US 190 BYPASS W	US 190 BYPASS E	COPPERAS COVE
4C	US 190	SH 9	FM 3470/STAN SCHLUETER LOOP	KILLEEN
4D	US 190	FM 3470/STAN SCHLUETER LOOP	BUSINESS 190	KILLEEN
4E	US 190	BUSINESS 190	IH 35	BELTON
5	US 190 BYPASS[1]	US 190 W	US 190 E	COPPERAS COVE
6	38TH ST	BUSINESS 190	RANCIER AVE	KILLEEN
7	BUSINESS 190	US 190	ROY REYNOLDS DR	KILLEEN
8	FM 2410	US 190	WARRIORS PATH	KILLEEN
9	FM 3470/STAN SCHLUETER LOOP	SH 201/CLEAR CREEK RD	US 190	KILLEEN
10	FORT HOOD ST	FM 3470/STAN SCHLUETER LOOP	RANCIER AVE	KILLEEN
11	HALLMARK AVE	FORT HOOD ST	TRIMMIER RD	KILLEEN
12	N 2ND ST	HALLMARK AVE	RANCIER AVE	KILLEEN
13	WS YOUNG DR	ILLINOIS AVE	FM 3470/STAN SCHLUETER LOOP	KILLEEN
14	RANCIER AVE	FORT HOOD ST	ROY REYNOLDS DR	KILLEEN
15	ROY REYNOLDS DR	BUSINESS 190	RANCIER AVE	KILLEEN
16	SH 195	WILLIAMSON COUNTY LINE	FM 3470/STAN SCHLUETER LOOP	KILLEEN
17	TRIMMIER RD	FM 3470/STAN SCHLUETER LOOP	HALLMARK AVE	KILLEEN
18	WILLOW SPRINGS RD	US 190	WATERCREST RD	KILLEEN
19	FM 2271	LAKE RD	FM 2305/W ADAMS AVE	BELTON
20A	IH 35	SALADO (FM 2268)	US 190	BELTON
20B	IH 35	US 190	S LOOP 363	BELTON
20C	IH 35	S LOOP 363	N LOOP 363	TEMPLE
20D	IH 35	N LOOP 363	FALLS COUNTY LINE	TEMPLE
21	FM 93/NOLAN VALLEY RD	WHEAT RD	SH 317	BELTON
22	LAKE RD	FM 2271	SH 317	BELTON
23	LOOP 121	IH 35	LAKE RD	BELTON
24	SH 317	US 190	SH 36	BELTON
25	FM 1741/S 31ST ST	CANYON CREEK DR	SH 53/ADAMS AVE	TEMPLE
26A	LOOP 363	US 190	SPUR 290	TEMPLE
26B	LOOP 363	SPUR 290	IH 35 S	TEMPLE
26C	LOOP 363	IH 35 S	SH 36	TEMPLE
26D	LOOP 363	SH 36	IH 35 N	TEMPLE
26E	LOOP 363	IH 35 N	SH 53	TEMPLE
26F	LOOP 363	SH 53	US 190	TEMPLE
27	INDUSTRIAL BLVD	OLD HOWARD RD	IH 35	TEMPLE
28	SH 36/AIRPORT RD	LOOP 363	SH 317	TEMPLE
29	FM 2305/ADAMS AVE	FM 2271	3RD ST	TEMPLE
30	SPUR 290/3RD ST	AVE E	IH 35	TEMPLE
31	SPUR 290/S 1ST ST	S LOOP 363	AVE E	TEMPLE
32A	US 190 SE	LOOP 363	PRITCHARD RD	TEMPLE
32B	US 190 SE	PRITCHARD RD	MILAM COUNTY LINE	TEMPLE
33	SH 53/ADAMS AVE	3RD ST	E LOOP 363	TEMPLE

[1] Performance measures for this segment were not computed because the segment was not complete at the time data was collected for this CMP Update; future performance reports will likely include this segments as data becomes available.
[2] This segment will likely be referred to as Business 190 in future updates.

Identifying Performance Measures

The Federal CMP requirements do not mandate specific performance measures that must be used during the process. Identifying appropriate congestion performance measures is up to each MPO. Although there are a wide range of performance measures available, it was determined by KTMPO that those selected for this 2016 CMP Update must be understandable, outcome-oriented, and supported by readily available data sources.

The 2013 CMP recommended several performance measures. The 2016 CMP Update evaluated the 213 performance measures to determine whether the old performance measures meet current standards and need for quantifiable measurement. The following questions were considered to assist in identifying appropriate congestion management performance measures:

- Is the measure easily understandable to both the general public and elected officials?
- Does the MPO have the ability and adequate funding to collect the data to track the measure on an on-going basis?
- Does the measure provide the ability to track roadway congestion for the region overall, as well as for individual transportation facilities?
- Do the measures reflect the local definition of congestion?

Table 2-3 highlights the different performance measures previously considered for inclusion in the CMP, and the following sections below explain the measures in more detail.

Table 2-3: Performance Measures

Measure Category	(Sub-measures)	Recommended in: 2013 CMP	Recommended in: 2016 CMP	Data Source
Corridor Level-of-Service		Yes	No	TDM
Volume-to-Capacity Ratios		Yes	**Yes**	TDM
Travel Time	Travel Time	Yes	No	INRIX, NPMRDS, Bluetooth, TDM
	Travel Speed	Yes	No	INRIX, NPMRDS, Bluetooth, TDM
	Average Delay	No	**Yes**	INRIX, NPMRDS, TDM
	Travel Time Index	No	**Yes**	INRIX
Intersection LOS		No	No	TDM
Safety	Number of crashes along a specified corridor	Yes	No	TxDOT CRIS
	Number of crashes at a particular intersection	Yes	No	TxDOT CRIS
	Type of crashes along a specified corridor	No	Yes	TxDOT CRIS
	Type of crashes at a particular intersection	No	No	TxDOT CRIS
	Number of crashes per million vehicle-miles over a section of roadway	No	**Yes**	CRIS/TDM
Transit	Transit ridership	Yes	No	HCTD, NTD
	Transit capacity along congested corridors	No	No	HCTD
	Transit availability	Yes	**Yes**	HCTD
Transportation Options/Availability of Alternative Modes		*Yes*	*No*[3]	*?*

[3] Availability of Alternative Modes was not recommended as a measure in the 2016 CMP Update. As KTMPO continues updating its multi-modal plans and inventory of bicycle and pedestrian facilities, future CMP updates could consider incorporating a measure for transportation options.

Volume-to-Capacity Ratios

In addition to being part of the LOS determination for a roadway, volume-to-capacity (V/C) ratios can be used separately as measure of congestion. V/C ratio is defined as the ratio of demand flow rate to capacity for a traffic facility. Using V/C ratios is popular because data on existing traffic volumes is relatively easy to obtain and the measures (traffic volumes and roadway capacities) can be forecasted by employing the area's TDM.

Travel Time Measures

Travel time measures focus on the time it takes to travel along a selected portion of a highway corridor. Common variations of travel time measures include the following:

- Travel time – the amount of time needed to traverse a corridor segment
- Travel speed – the length of a segment divided by the travel time
- Travel time index – ratio of observed travel speed to free-flow travel speed

These travel time measures can be used for specific roadway segments, intersections, or corridors. The 2016 CMP Update uses the Travel Time Index (TTI) because it allows for direct comparison between different types of roadways in the region.

Delay Measures

Delay measures calculate the additional travel time experienced by drivers due to varying traffic conditions. In other words, delay is the difference between observed travel time and free flow travel time. Delay measures are dependent on how free flow travel time is defined. Free flow travel time could be derived from the posted speed limit or could be defined as the maximum observed travel time. Depending on how free flow travel time is defined, measures of delay can vary.

The 2016 CMP Update proposes using average delay per vehicle as the primary delay measure, supplemented by aggregated delay information where available.

Crash Measures

Crash measures identify high concentrations of crashes at particular locations along a corridor or at a particular turning movement at an intersection or cross street. Crashes certainly impact travel conditions, and can be the cause of nonrecurring congestion along corridors and intersections. Identifying "hot spot" crash locations, and examining the location in the field can assist in identifying potential projects to improve the safety and function of the roadway corridor or intersection. Common improvements could include improving sight distance, adding turn lanes, adding traffic signals, implementing street calming devices, etc. Crash data measures in the KTMPO area could include the following:

- Number of crashes along a specified corridor
- Number of crashes at a particular intersection
- Type of crashes along a specified corridor
- Type of crashes at a particular intersection
- Number of crashes per million vehicle-miles over a section of roadway

There are some constraints to using crash measures to alleviate congestion. For instance, the type of crashes and how they are recorded can make it difficult to measure congestion from reviewing crash data. There may be reporting inconsistencies in the crash data that is documented by local enforcement agencies. Crashes may not be reported or documented, and the exact crash location is not always recorded or accurate. While examining crash data is important in the overall planning process, the inconsistencies within crash data may detract from the suitability of crash measures to identify congested corridors. In the 2016 CMP Update, crash measures are used to supplement the primary congestion hotspot identification measures and prioritize the segments.

Transit Travel Condition Measures

Transit travel condition measures provide information on the conditions experienced by public transit users. Aspects of transit travel conditions include vehicle ridership vs. load capacity and on-time performance reliability. Thus, transit travel condition measures in the KTMPO area could include the following:

- Transit ridership
- Transit capacity along congested corridors
- Transit availability

Transit measures in the 2016 CMP Update are not used to identify congested locations, but are used during the congestion hotspot prioritization process.

Recommended Performance Measures

After considering the ease of access to and characteristics of the available quantitative data, the performance measures recommended for use in the 2016 CMP Update include:

Congestion Measures

- Travel Time Index
  - Average Daily
  - Maximum
- Delay
  - Average Daily
  - Peak Period
  - Annual Hours of Delay
- V/C Ratio (Current and Future)
  - Average Daily
  - Peak Period

Supplemental Measures

- Transit Availability
- Crash Rate
- Rear-end Crash Rate

3. Identification of Congestion Hotspots

Identifying congestion hotspots is part of determining specific congestion problems in the region. Part of the identification process also includes defining what levels of congestion are acceptable or unacceptable in the region. The process of congestion hotspot identification involves using the multiple available data sets to calculate performance measures along the CMP Network, and then aggregating those measures in a way that allows for easy comparison between segments. Finally, segments along the CMP Network are prioritized based on the results of the congestion data analysis, as well as other evaluation criteria, that support the goals and objectives of the CMP and ensure compatibility with other regional planning processes.

Data Analysis

There are many ways to analyze congestion, as reflected in the use of multiple performance measures and data sets throughout this CMP. By using these different measures in conjunction with one another, congestion hotspots can be identified with a relative degree of confidence. Using multiple performance measures and data sets also allows for flexibility in defining and identifying congestion, as certain measures from different sources can be weighted and presented differently to reflect congestion in a way that is specific to the region.

Before calculating congestion performance measures for the 2016 CMP Update, the data sets were first processed so that similar attributes or measures could be easily compared from one data set to the next. Using the three major quantitative congestion data sets (NPMRDS, INRIX, and the KTMPO TDM), performance measures were calculated depending on the data available within each data set. Table 3-1 shows how the quantitative congestion performance measures were calculated. Figures 3-1 through 3-4 show congestion in the region as measured through the Travel Time Index across the three quantitative datasets.

Table 3-1: Quantitative Congestion Performance Measure Descriptions

<table>
<tr><th colspan="3"></th><th>NPMRDS</th><th>INRIX</th><th>TDM</th><th>Units of Measure</th></tr>
<tr><td colspan="2" rowspan="2">Travel Time Index (TTI)</td><td>Average</td><td colspan="3">Average speed along segment/ average freeflow speed</td><td>Ratio</td></tr>
<tr><td>Max</td><td>Minimum speed of any TMC along segment/ average freeflow speed</td><td colspan="2">Minimum speed of any link along segment/ average freeflow speed</td><td>Ratio</td></tr>
<tr><td rowspan="5">Delay</td><td rowspan="3">Current</td><td>Average Daily</td><td>Average seconds of delay (per vehicle)[1] along segment / segment length</td><td>Average seconds of delay per vehicle along segment / segment length</td><td>Total seconds of delay for all links / Volume of all links averaged across segment/ segment length</td><td rowspan="2">Seconds per vehicle per mile</td></tr>
<tr><td>Peak[2]</td><td>Maximum seconds of delay (per vehicle) along segment/ segment length</td><td>Maximum seconds of delay along segment / segment length</td><td></td></tr>
<tr><td>Annual</td><td></td><td>Sum of all observations of delay for all vehicles for entire year</td><td></td><td>Hours</td></tr>
<tr><td rowspan="2">2040</td><td>Average</td><td></td><td></td><td></td><td>Ratio</td></tr>
<tr><td>Increase</td><td></td><td></td><td></td><td>Percentage</td></tr>
<tr><td rowspan="4">VC Ratio</td><td rowspan="2">Current</td><td>Average</td><td></td><td></td><td>Volume/capacity (24-hr)</td><td rowspan="3">Ratio</td></tr>
<tr><td>Peak[2]</td><td></td><td></td><td>Volume/capacity during peaks</td></tr>
<tr><td rowspan="2">2040</td><td>Average</td><td></td><td></td><td>Volume/capacity (24-hr) – 2040 forecast</td></tr>
<tr><td>Increase</td><td></td><td></td><td>% change VC ratio (current to 2040)</td><td>Percentage</td></tr>
</table>

[2] The peak period for KTMPO was defined as: 6AM-9AM for the AM Peak Period, and 4PM-7PM for the PM Peak Period. Peak period figures reflect observations from both the AM and PM peak period.

Figure 3-1: NPMRDS Travel Time Index

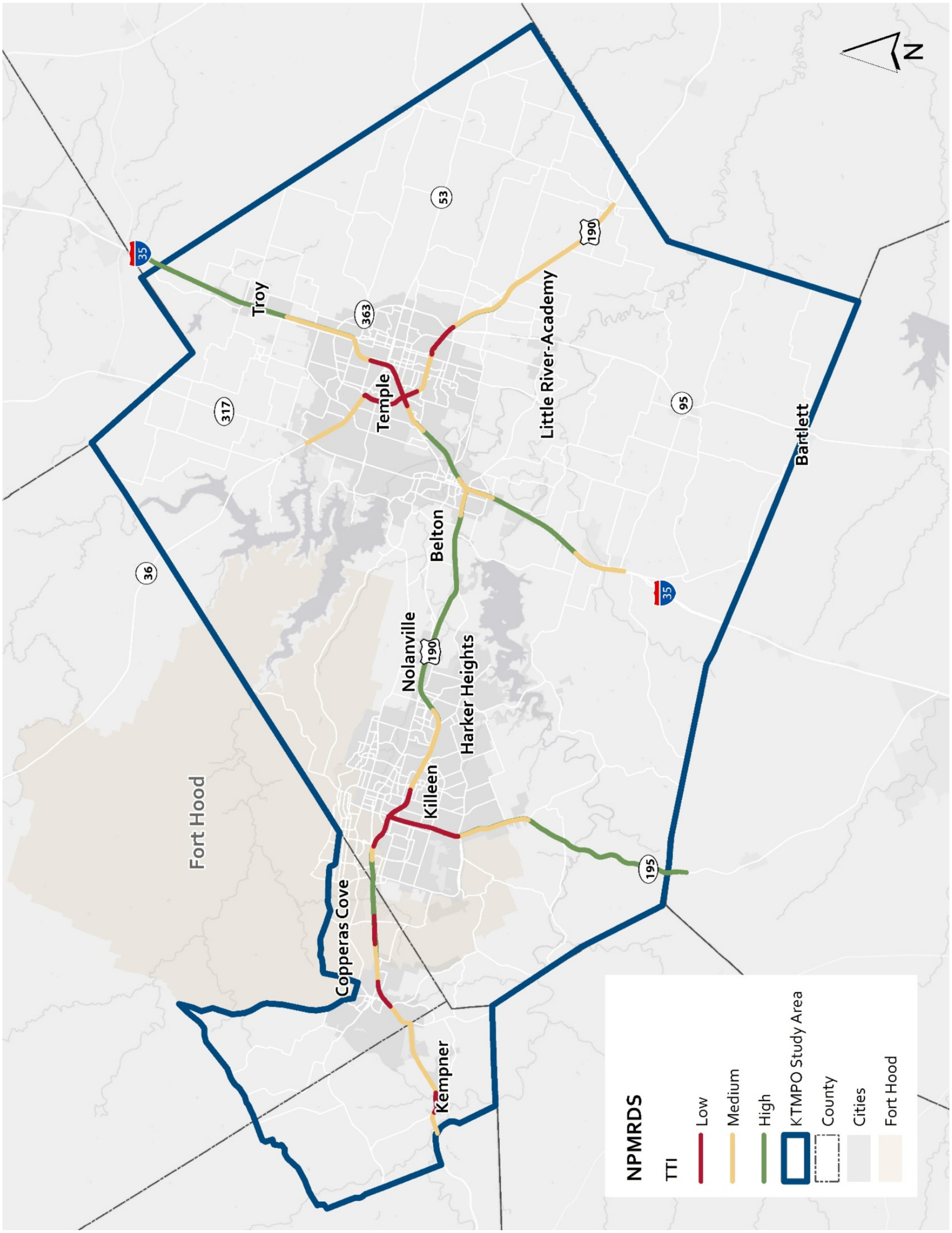


Figure 3-2: INRIX Travel Time Index

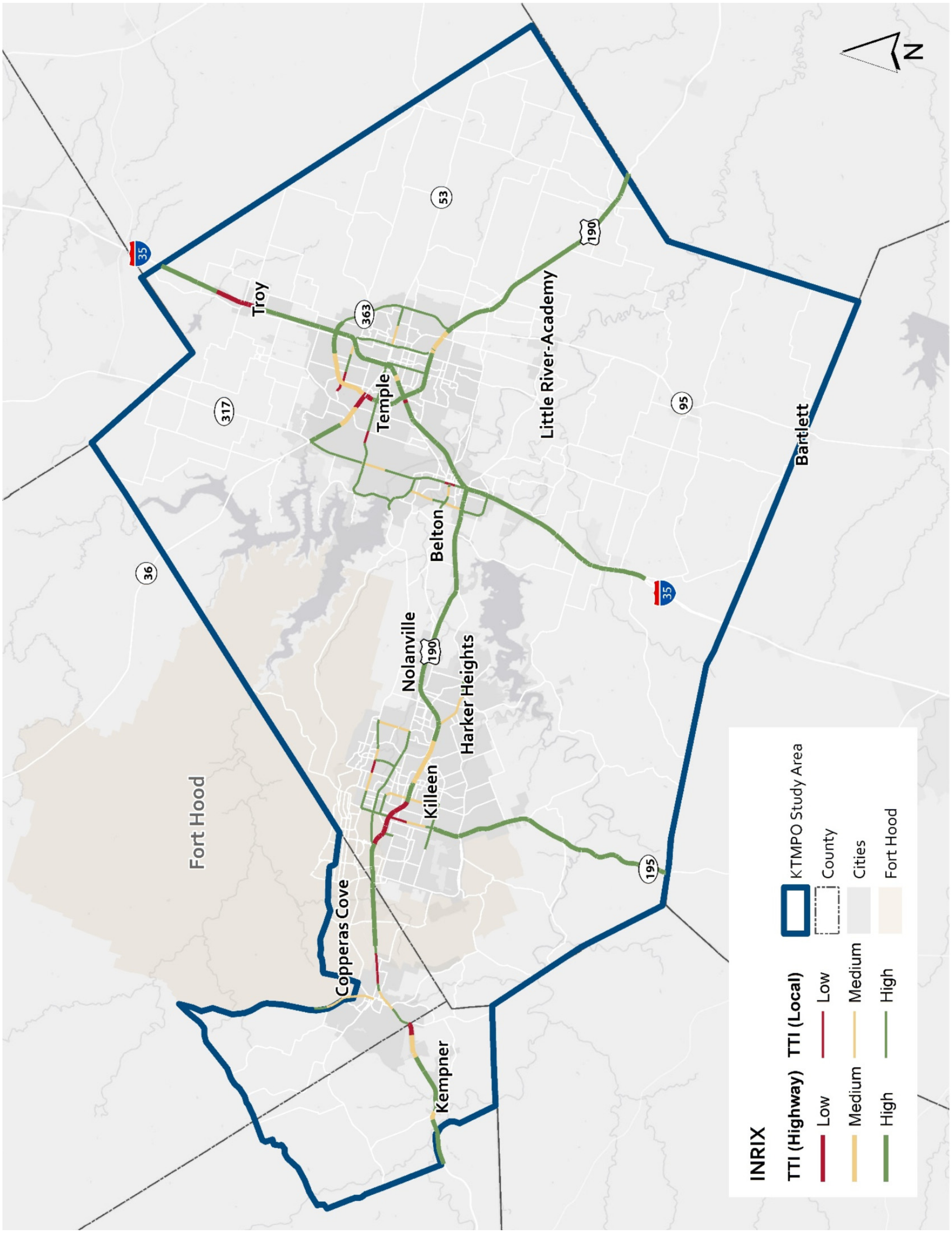


Figure 3-3: 2010 TDM Travel Time Index

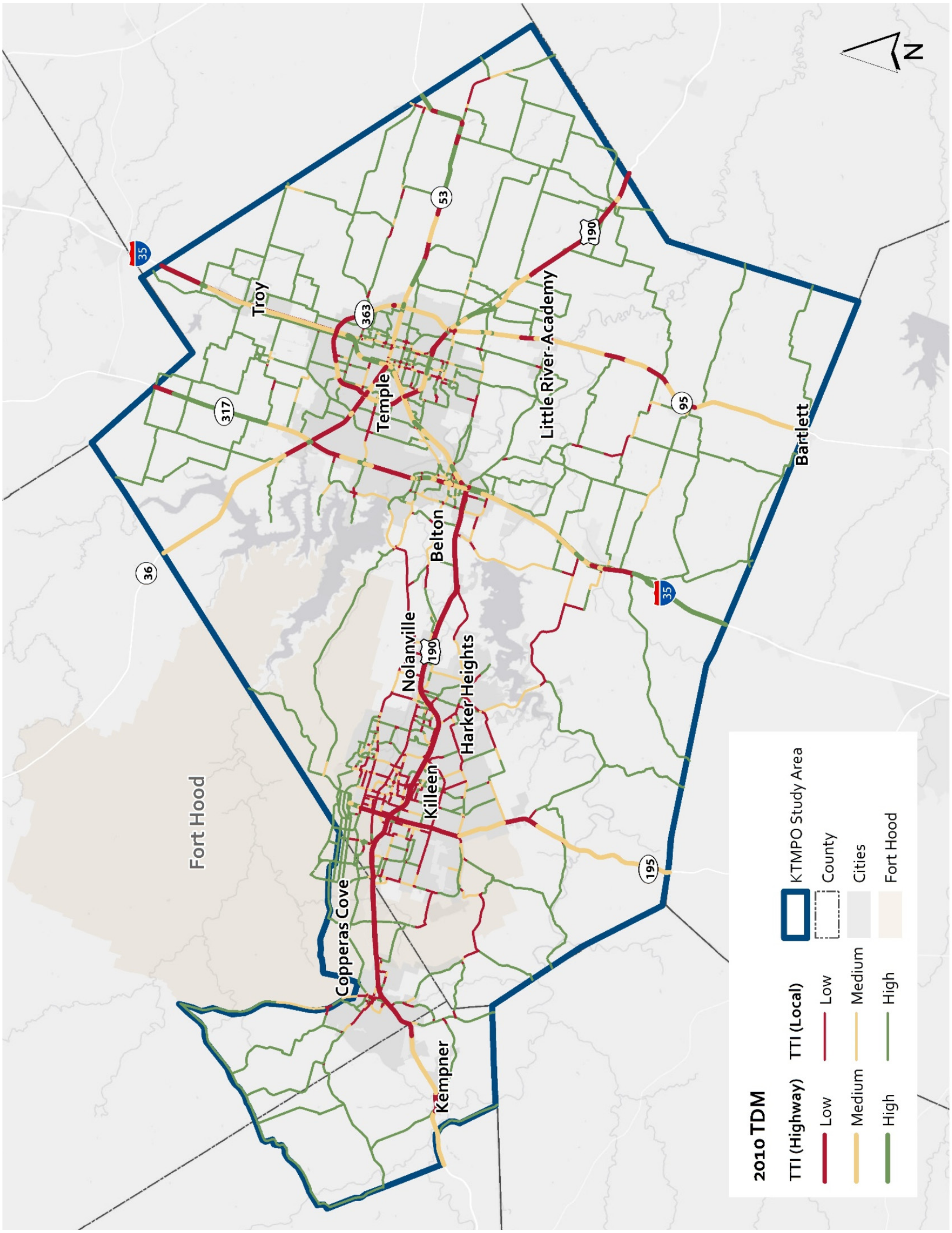
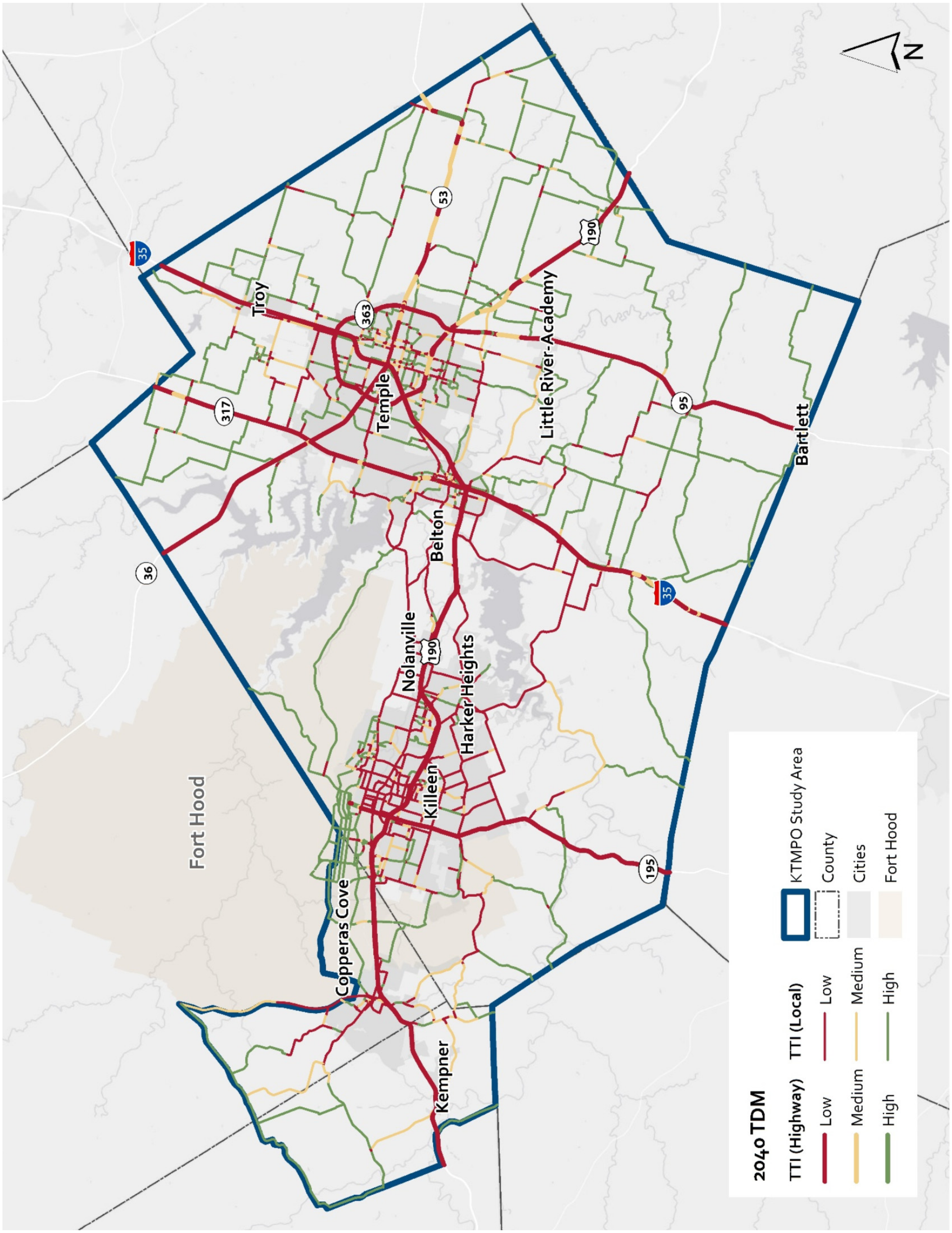


Figure 3-4: 2040 TDM Travel Time Index



Data Conflation

Data conflation is the process of combining the different quantitative congestion data sets that have dissimilar geographic extents. Because the geographic information included with each dataset originated from different sources, it was necessary to aggregate the data into one geographic layer to ensure the results for each segment of the CMP were directly comparable.

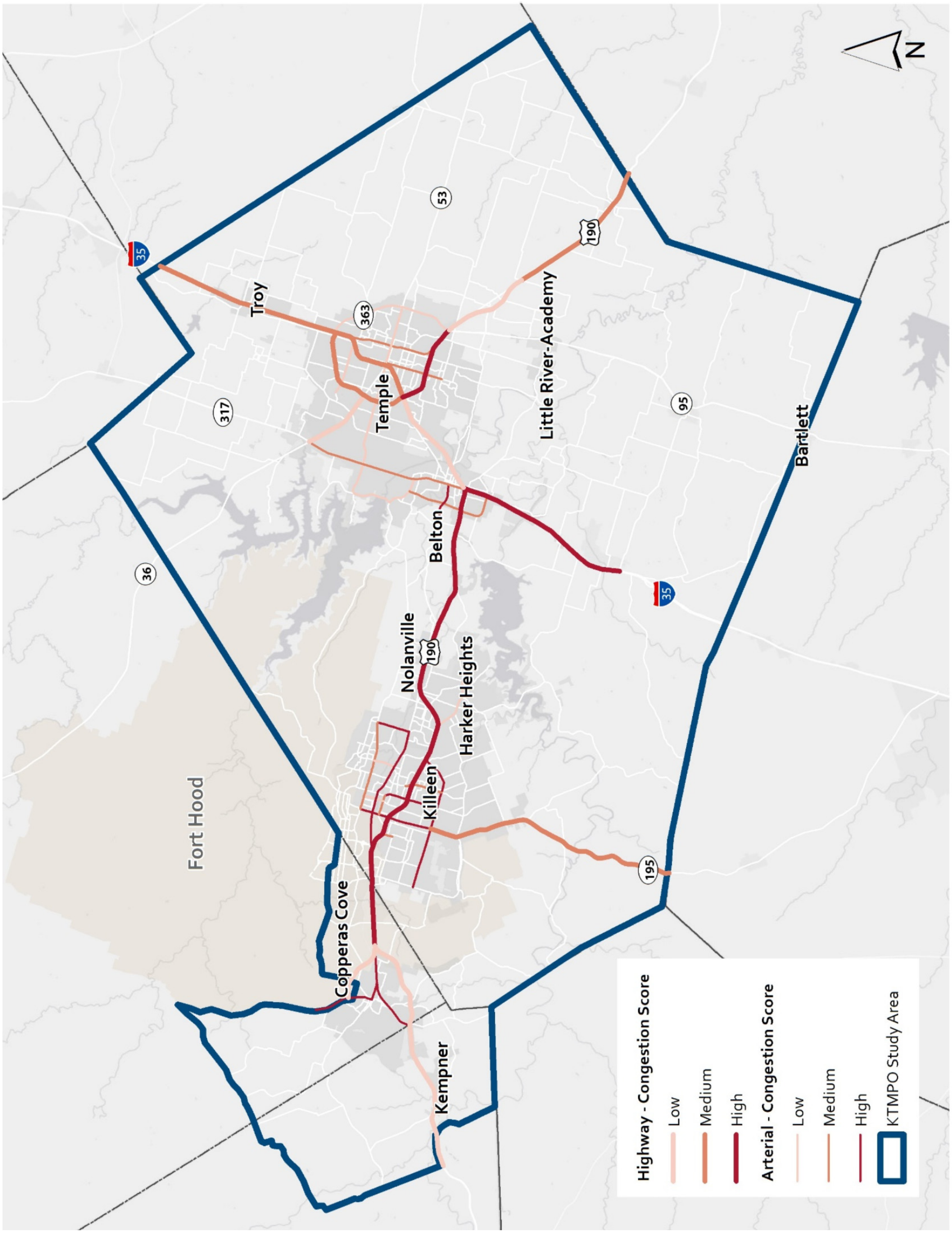
The conflation process involved generating a buffer region around each segment of the CMP Network, then using GIS geoprocessing tools to use the buffer as a "catchment area" to collect the segments from each data source. Once the quantitative data was collected on one layer, the previously computed performance measures from Table 3-1 were compared for each data source. The complete inventory of performance measures for each CMP segment can be found in Appendix B.

The final step in the conflation process was to apply weights to the quantitative congestion performance measures and qualitative congestion data (from Google Traffic) to create a composite congestion score. The weights assigned to the congestion data are shown in Table 3-2. This score represents a weighted measure of congestion generated from the various different data sets, both quantitative and qualitative, that identifies congestion hotspots within the region. Figure 3-5 displays congestion hotspots determined by the number of data sources which indicate there is congestion for a particular segment.

Table 3-2: Congestion Score Data Weighting

	Number of Sources	NPMRDS	INRIX	TDM	Google	Total
All Sources	5%	20%	50%	20%	5%	100%
TDM + INRIX	5%		60%	30%	5%	100%
TDM + NPMRDS	5%	50%		40%	5%	100%
TDM Only	25%			70%	5%	100%

Figure 3-5: KTMPO Congestion Hotspots (All Sources)



Prioritization Process

The data conflation process results in a combined measure of congestion that can be used to rank the segments of the CMP Network to determine the "worst" performing segments in terms of vehicle travel speed. However, the goals and objectives of the KTMPO CMP do not focus solely on speed data as the only means to target congestion mitigation strategies. For that reason, this 2016 CMP Update introduces a more robust congestion hotspot prioritization process that considers other elements of the transportation system as evaluation criteria to determine which congested hotspots should be the primary focus of congestion mitigation strategies in the region. The following section describes the elements of the prioritization process.

Congestion Score

As described in the section about data conflation, each segment of the CMP Network was given a congestion score that represents a weighted measure of congestion as determined through the quantitative and qualitative congestion data collected for the network. The congestion score was the most heavily weighted evaluation criteria used in the prioritization process.

Other Evaluation Criteria

The CMP uses the other evaluation criteria described in the following section to prioritize congestion hotspots in the region. The full results of the prioritization process, including tables detailing the values assigned for the evaluation criteria for each segment, can be found in Appendix B.

Traffic Volume

Using traffic volumes in the prioritization process allows the CMP to consider not only the severity of congestion on each segment, but also the magnitude of the congestion (i.e. how many people are affected by congestion). The volume data used in the prioritization process was taken from the Travel Demand Model, and represents the average flow along all TDM links within a segment.

Safety

One of the primary goals of the CMP is to facilitate the movement of people and goods in a safe manner. Therefore, safety was a major consideration in the prioritization process for the 2016 CMP Update. There were two evaluation criteria related to safety that were used to rank the congested hotspots:

- **Crash Rate** – The prioritization process uses the number of crashes normalized by the volume of traffic along each roadway in the CMP Network to prioritize congestion hotspots. The goal of including the crash rate is that segments with higher occurrences of crashes will receive higher priority so that future projects aimed at addressing congestion on that segment may also reduce crash rates.
- **Rear End Crash Rate** – In addition to considering the overall crash rate, the prioritization process also considers the percentage of crashes that are rear-end collisions. Rear end crashes could correspond to a higher prevalence of congestion where motorists may unexpectedly encounter congestion-related queues.

School Locations

The location of schools along the CMP Network may influence congestion due to the concentrated nature of school-related trips. The inclusion of school location in the prioritization process ensures that congestion hotspots that may either be affected by the presence of schools, or that may affect safety or access to schools in the region can be prioritized.

Transit Routes

Congestion along the CMP Network affects fixed-route buses in the Killeen-Temple area as much as it affects automobiles. Because the speed and travel time data available does not make any accommodation for the adverse impacts of congestion on public transportation, the prioritization process uses the presence of transit routes on CMP Network segments to ensure that congestion hotspots that affect transit vehicles are considered a higher priority for regional congestion reduction goals.

Public Need Identification

Finally, the prioritization process makes use of the public congestion survey that KTMPO produced at the beginning of the 2016 CMP Update process. Segments which survey respondents listed as congested with the highest frequency will receive greater priority in the final list of ranked congestion hotspots. Including the survey results in the process also ensures that KTMPO strongly considers public input when identifying congested locations in the region.

Evaluation Criteria Weighting

The process of determining weights for the evaluation criteria used to prioritize congestion hotspots was accomplished collaboratively with the project team, KTMPO staff, and members of the KTMPO Technical Advisory Committee (TAC). The TAC was presented with an initial list of recommended weights determined by the team in consultation with staff, and were given the opportunity to provide direct feedback on the criteria and initial weights at their July 6, 2016 meeting. The team also delivered an interactive spreadsheet tool that was distributed to both KTMPO staff and TAC members that allowed those surveyed to manually adjust the weights for each criteria and compare the shift in rank of each CMP Network segment that resulted with each change to the criteria weights.

After gathering feedback from the TAC, the project team revised the initial weights, and presented the revised weighting mix and resulting prioritized hotspot list back to the TAC at a meeting on August 3, 2016. After a final round of discussion and weighting adjustment, the TAC recommended that the Policy Board adopt the weighting mix shown in Table 3-3. The Policy Board approved the final evaluation criteria weights and resulting hotspot rankings on August 17, 2016. The complete prioritization matrix showing scores for each criteria on all segments of the CMP Network can be found in Appendix B.

Table 3-3: Final Evaluation Criteria Weighting

Criteria		Weight
Congestion Rank		30%
Volume		20%
Safety	Crashes	15%
	Rear-End Crashes	10%
Transit		15%
School		5%
Public Input		5%
Total		***100%***

Prioritized Hotspot List

Table 3-4 and Table 3-5 show the congested segments of the CMP Network, ranked based on the results of the prioritization process. The list is separated into highway and arterial elements of the CMP Network. The list represents a snapshot of the highest priority congestion hotspots along the transportation network in Killeen-Temple based on the data available during the 2016 CMP Update. As KTMPO continues to acquire data and update other regional planning documents, the evaluation criteria and weights used to sort this list should be revisited to ensure that the CMP continues to reinforce current planning efforts in the region.

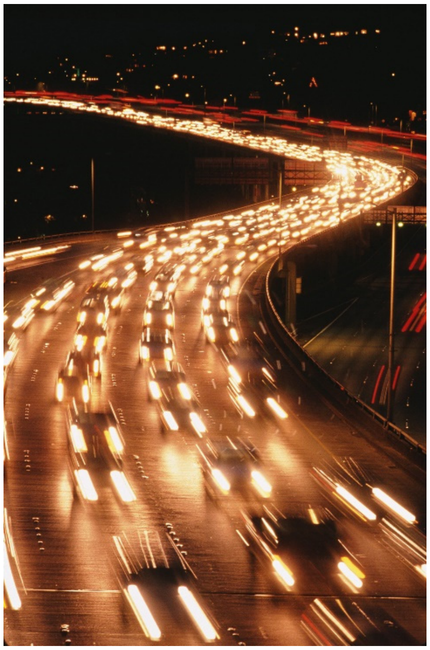
Table 3-4: Final Prioritized List of Congestion Hotspots – Highways

Segment ID	Description	Priority Rank
4C	US 190 - SH 9 TO FM 3470/STAN SCHLUETER LOOP	1
4D	US 190 - FM 3470/STAN SCHLUETER LOOP TO BUSINESS 190	2
4E	US 190 - BUSINESS 190 TO IH 35	3
20A	IH 35 - SALADO (FM 2268) TO US 190	4
20C	IH 35 - S LOOP 363 TO N LOOP 363	5
26B	LOOP 363 - SPUR 290 TO IH 35 S	6
20B	IH 35 - US 190 TO S LOOP 363	7
20D	IH 35 - N LOOP 363 TO FALLS COUNTY LINE	8
26C	LOOP 363 - IH 35 S TO SH 36	9
26A	LOOP 363 - US 190 TO SPUR 290	10
16	SH 195 - WILLIAMSON COUNTY LINE TO FM 3470/STAN SCHLUETER LOOP	11
32B	US 190 SE - PRITCHARD RD TO MILAM COUNTY LINE	12
4A	US 190 - FM 1715 TO BUSINESS 190	13
28	SH 36/AIRPORT RD - LOOP 363 TO SH 317	14
32A	US 190 SE - LOOP 363 TO PRITCHARD RD	15
26E	LOOP 363 - IH 35 N TO SH 53	16
26D	LOOP 363 - SH 36 TO IH 35 N	17
26F	LOOP 363 - SH 53 TO US 190	18

Table 3-5: Final Prioritized List of Congestion Hotspots – Arterials

Segment ID	Description	Priority Rank
17	TRIMMIER RD - FM 3470/STAN SCHLUETER LOOP TO HALLMARK AVE	1
9	FM 3470/STAN SCHLUETER LOOP - SH 201/CLEAR CREEK RD TO US 190	2
4B	US 190 - US 190 BYPASS W TO US 190 BYPASS E	3
14	RANCIER AVE - FORT HOOD ST TO ROY REYNOLDS DR	4
10	FORT HOOD ST - FM 3470/STAN SCHLUETER LOOP TO RANCIER AVE	5
24	SH 317 - US 190 TO SH 36	6
7	BUSINESS 190 - US 190 TO ROY REYNOLDS DR	7
23	LOOP 121 - IH 35 TO LAKE RD	8
10	FORT HOOD ST - FM 3470/STAN SCHLUETER LOOP TO RANCIER AVE	5
13	WS YOUNG DR - ILLINOIS AVE TO FM 3470/STAN SCHLUETER LOOP	9
1	AVE D - N 1ST ST TO BUSINESS 190	10
29	FM 2305/ADAMS AVE - FM 2271 TO 3RD ST	11
8	FM 2410 - US 190 TO WARRIORS PATH	12
25	FM 1741/S 31ST ST - CANYON CREEK DR TO SH 53/ADAMS AVE	13
18	WILLOW SPRINGS RD - US 190 TO WATERCREST RD	14
2	FM 116 - AVE D TO ELIJAH RD	15
22	LAKE RD - FM 2271 TO SH 317	16
31	SPUR 290/S 1ST ST - S LOOP 363 TO AVE E	17
21	FM 93/NOLAN VALLEY RD - WHEAT RD TO SH 317	18
30	SPUR 290/3RD ST - AVE E TO IH 35	19
11	HALLMARK AVE - FORT HOOD ST TO TRIMMIER RD	20
6	38TH ST - BUSINESS 190 TO RANCIER AVE	21
12	N 2ND ST - HALLMARK AVE TO RANCIER AVE	22
27	INDUSTRIAL BLVD - OLD HOWARD RD TO IH 35	23
15	ROY REYNOLDS DR - BUSINESS 190 TO RANCIER AVE	24
33	SH 53/ADAMS AVE - 3RD ST TO E LOOP 363	25
19	FM 2271 - LAKE RD TO FM 2305/W ADAMS AVE	26

4. Congestion Mitigation Strategies



The CMP is a tool to be utilized in the KTMPO region to address persistent congestion problems and prioritize transportation investments. There are many congestion management strategies and these strategies differ in terms of effectiveness, cost, complexity, and difficulty of implementation. Congestion management strategies are not one size fits all. Congested roadways and intersections need to be properly examined to evaluate which congestion mitigation strategy will effectively improve the congestion related problems. The CMP framework identifies numerous congestion mitigation strategies that can individually or collectively improve the operational efficiency of the KTMPO transportation system. When suitable strategies are implemented, the improvements impact auto, transit, pedestrian, and bicycle usage. The following sections identify several proven congestion management strategies that can be used to mitigate congestion in the KTMPO region.

Identifying Strategies

The mitigation strategies presented in the following section were selected based on their appropriateness for the KTMPO region and address congestion from a variety of angles. New infrastructure, infrastructure optimization, technological efficiency improvement, non-motorized improvement, and non-infrastructure program strategies have been considered for this plan. These strategies confront congestion at multiple scales so as to address deficiencies at specific locations as well as region-wide. Some strategies are more appropriate for highway projects, while others are more appropriate for arterial road projects.

How well each strategy can effectively mitigate operational, intersection, and capacity deficiencies depends on the specifics of each situation. There is no single best strategy for mitigating congestion. Instead, areas prone to congestion need to be reviewed on a case-by-case basis, and the most appropriate strategies for each situation need to be selected. This plan provides a toolbox of strategies that are already being used in the KTMPO area, as well as additional strategies that are being implemented in similar areas.

New Infrastructure

New infrastructure strategies, such as building new roadways, are typically used to significantly increase capacity in areas with high congestion. New infrastructure strategies typically do not aid in relieving non-recurring congestion, which accounts for about half of all congestion (FHWA, 2015). Non-recurring congestion, such as construction work, weather, and special events should be addressed by other means. Building new infrastructure can also be much more cost-intensive than improving existing infrastructure or operations, especially if new right-of-way must be procured.

Constructing Park-and-Ride Facilities

Park-and-ride facilities allow easy integration of multiple transportation modes and help facilitate the use of alternative transportation to and from areas with high traffic volumes. Motorists can leave their cars at the facility, then use transit to complete their journey. This relieves the motorists from the burden of finding parking at the final destination and can provide a more pleasant commute experience compared to driving in congested traffic.

Passenger Rail

Passenger rail can more efficiently move greater numbers of travelers further distances and relieve congestion between major destinations. Passenger rail is not likely to be an appropriate short-term strategy for the KTMPO region, but may become feasible as the region continues to grow and if KTMPO's transportation planning processes identify rail transportation as a regional preference.

New SOV Lanes

Additional single occupancy vehicle (SOV) lanes can be added to existing roadways and create additional capacity when necessary. While additional SOV lanes may address capacity deficiencies and relieve congestion in the short-term, studies have shown that they may also incentivize automobile trips to the point that the additional capacity is quickly occupied and congestion recurs shortly after expansion is complete (a phenomenon known as "induced demand.")

New Location Roadways

New location roadways create connections between popular destinations and relieve congestion in other areas. Particular attention should be paid to right-of-way preservation for identified new-location roadways as the area develops.

HOV Lanes

Incentivized capacity increases can reduce the number of SOVs on the roadway and reduce congestion. Only vehicles with multiple passengers may use HOV lanes, which are typically less crowded than other travel lanes. The possibility of a faster commute may encourage more people to carpool, reducing the number of cars on the road and, subsequently, congestion.

Infrastructure Operations

Strategies to improve infrastructure operations can significantly enhance the efficiency of the transportation system. These strategies are designed to allow more effective management of the supply and use of existing roadway facilities. Infrastructure operations strategies can effectively increase capacity without construction of additional general purpose lanes. These strategies typically have a lower cost, can be implemented faster, and require less right-of-way compared to new infrastructure mitigation strategies.

Access and Driveway Spacing

Steady traffic flows are more easily maintained when access points and intersections are spaced further apart. This strategy can also reduce conflict points with pedestrians and other roadway users. Similarly, wider driveway spacing can improve traffic flow and reduce the number of merging conflict points along roadways.

Median Treatments

Non-traversable and raised medians, as well as two-way left-turn lanes (TWLTL), can regulate access to a roadway and reduce the number of crashes.

Right-of-Way Management

Maintaining and preserving existing right-of-way makes it easier to make future roadway improvements, as the region grows and roadway enhancements become more necessary.

Highway Geometric Improvements

Improvements to highway geometry can reduce crashes and improved traffic flows.

Wayfinding and Signage Improvements

Clearly marked streets and wayfinding can help maintain steady traffic flows and direct vehicles down the most appropriate routes.

Transit Fixed Route Operations

Fixed route transit services, such as additional bus routes, can provide a more predictable and reliable service to transit users and encourage others to begin using this service instead of driving. The presence of transit service has the effect of increasing total capacity of a roadway due to the more efficient utilization of space needed to move several people by a bus or transit vehicle compared to several single-occupant automobiles.

Intersection Turn Lanes

By separating turning traffic from through traffic, movement can be maintained and the number of vehicle conflicts can be reduced.

Grade Separated Railroad Crossings

Grade separation can improve safety and reduce the amount of queued traffic caused by long trains.

Roundabout Intersections

Roundabouts can help facilitate a continuous flow of traffic and reduce the number of conflicts in an intersection. By reducing the amount of stop and go traffic, roundabouts can also improve air quality and reduce noise.

Acceleration/Deceleration Lanes

Additional lanes for accelerating or decelerating allow for vehicles to safely match speeds with other vehicles before merging.

Hill-Climbing Lanes

Hill-climbing lanes allow for safe passing of slower vehicles while ascending hills.

Grade-Separated Intersection

The separation of grades at intersections can reduce vehicle conflicts where crashes are more likely to occur.

Designated Truck Routes

Diverting commercial and truck traffic to designated roads can limit congestion, air pollution, and noise along those roads, while potentially relieving congestion on other roads.

Bus on Shoulder System (BOSS)

A bus on shoulder system allows for buses to operate on shoulders to bypass traffic. This frees up space on the roadway for other vehicles but also provides a higher level of service to transit users.

Bus Pullouts

Bus pullouts allow for buses to move off of the street when picking up or dropping off passengers, which prevents the disruption of traffic flow for automobile users on a roadway. Care should be taken when implementing bus pullouts that the transit vehicle is able to re-enter the flow of traffic in a reasonable way, which is typically accomplished through some sort of transit signal that stops automobile traffic once the transit vehicle is ready to leave the pullout.

Bottleneck Removal

By correcting and removing physical limitations that form capacity constraints, traffic can flow more freely without backing up.

Technological Efficiency Improvement

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.

Ramp Metering

Ramp metering maintains incoming and outgoing traffic flows to and from highways and can help manage high-traffic areas efficiently.

Traveler Information and Rerouting Systems

Through a system of communication means, such as electronic signs, traffic can be directed along alternative corridors when other corridors become congested.

Electronic Commercial Vehicle Clearance and Tolls

These tolls regulate the flow of commercial vehicles so as to reduce the freight demand on certain roadways during periods of high demand.

Bluetooth-Based Travel Time Measurement

Accurate travel-time estimates can help motorists make decisions on which routes to take and when to take them.

Route Information

By informing people about current travel conditions and recommended routes/detours, congestion can be avoided.

Traffic Signal Optimization

Optimizing timings and sensors for location specific needs can help maintain traffic flows.

Transit Signal Priority

By giving transit services priority at traffic signals, transit services can be improved and incentivized as a viable mode of transportation.

Demand-Responsive Signal System

Traffic signals modify timings based on traffic demand and help to maintain traffic flows when the transportation system is under heavy load.

Transit Vehicle Tracking

Tracking the exact locations and arrival times of transit vehicles can improve the user experience and incentivize transit use.

Non-Motorized Improvements

Non-motorized improvement strategies typically involve improving or creating new infrastructure that more effectively facilitates the use of active transportation. Active transportation includes modes such as walking or biking. Encouraging and facilitating active transportation can help reduce the number of trips made by single occupancy vehicles, thus reducing congestion on roadways. According to the National Travel Household Survey (2009), about half of all trips in metropolitan areas are three miles or less and about 28% of all trips are one mile or less. These distances can easily be made by bicycle or on foot, but 65% of trips one mile or less are made by automobile. Capacity improvements for non-motorized transportation often have no effect on motorized transportation capacity but can decrease the demand for motorized transportation. Non-motorized improvements can also improve safety conditions and reduce conflicts for people who currently already use active transportation.

Bicycle Paths/Lanes

Additional bicycle lanes/paths can improve safety for those who travel by bicycle and help to facilitate the use of bicycles to replace shorter trips usually taken by cars.

Sidewalks

Sidewalks along roadways can improve the safety conditions for pedestrians and help reduce conflicts between pedestrians and motorists.

Pedestrian Signals

Pedestrian signals can help to improve pedestrian safety as well as reduce conflicts at intersections.

Bicycle Racks

Secure, safe, and convenient bicycle parking options can encourage more cycling and reduce trips taken by car.

Safe Routes to School Program

This federally funded program helps to invest in and improve pedestrian and bicycle infrastructure near schools, allowing children and parents to use alternative modes of transportation to get to and from school.

Bike Sharing System

A network of bicycle rental stations allows for people to make short trips by bicycle. Bike sharing systems are good for resolving the "last mile problem," which refers to either the first or last leg of a transit trip that is often too far to walk. Bike sharing already exists in many cities across Texas and is seen as a good way to replace shorter car trips with bicycle trips.

Non-Infrastructure Improvement

These strategies often involve incentivized programs to help manage demand without the need to improve existing infrastructure or construct expensive new infrastructure. Some strategies can be directly implemented by a municipality or government, while others would be implemented by employers and incentivized through tax benefits. These strategies are often implemented region-wide to mitigate congestion rather than at specific locations and can be very low-cost.

Motorist Assistance Patrols

Special patrols can access accidents and stranded vehicles more quickly and get traffic moving again. An example of this is the HERO (Highway Emergency Response Operator) program, which operates in the Austin metropolitan area.

Strategies to Improve Accident Response and Clearance Time

Improved accident response and clearance times mean that accidents can be addressed sooner and normal traffic conditions can be restored more quickly.

Initiating and Managing a Rideshare Program

Ridesharing programs, which match employees that leave near one another to facilitate carpooling, can result in fewer cars on roads and less congestion, while also encouraging travelers to utilize an alternative mode of transportation.

Flexible Work Hours

Flexible work hours relieve stress on the transportation network during peak travel times by allowing people to commute to and from work at off-peak travel times.

Telecommuting

Telecommuting allows for people to work from home and reduces the number of trips between work and home during peak travel times.

Satellite Offices

Satellite offices can disperse jobs throughout a larger area, rather than in one office. This prevents concentrated congestion in one area.

Land Use Management

Controlling and regulating land uses can help control which types and how many trips are being made in specific areas. Managing growth and development can directly impact the transportation system as well as influence how commuters select their travel mode. Implementing land uses that contain a mix of residential, retail, and employment can improve the feasibility of conducting trips by walking or biking, therefore reducing automobile demand on congested corridors.

Commuter Choice Tax Benefits

Employers can provide incentives and discounted transit passes to encourage transit use in exchange for tax benefits.

HOV Toll Savings

Preferential pricing for multi-occupant vehicles on toll roads incentivizes ridesharing, which can again reduce the number of cars on the road at a particular time.

Parking Management

Preferential parking for vehicles that carry more than a single occupant can encourage ridesharing.

Driver Education

Driver education programs can inform drivers about choices that are available to avoid and reduce congestion.

CMP Strategy Toolbox

Table 4-1 displays the "toolbox" of strategies for the KTMPO region to consider when managing congestion. The toolbox includes several attributes for each strategy to help local policy-makers and transportation planners assess the applicability of each strategy to particular types of deficiencies/congestion in the region (columns 2 through 4). Columns 5 through 10 provide information about each strategy in terms of implementation period, inclusion in the 2013 CMP, and appropriate facility type for implementation: highway, arterial, or strategies that are not dependent on any particular location but are instead regional in extent (typically strategies that address demand management).

Table 4-1: CMP Strategy Toolbox

Strategies	Operational Deficiency	Intersection Deficiency	Capacity Deficiency	Short Term Strategy	Long Term Strategy	Included in 2013 Plan	Highway Strategies	Arterial Strategies	Regional Strategies	Cost
NEW INFRASTRUCTURE										
Constructing Park-and-Ride Facilities	X				X	X			X	$$
New SOV Lanes			X	X		X	X	X		$$$
New Location Roadways			X	X		X	X	X		$$$$
Passenger Rail			X		X	X			X	$$$$
HOV Lanes			X		X	X	X			$$$
INFRASTRUCTURE OPTIMIZATION										
Access Spacing	X			X		X	*	X		$
Driveway Spacing	X				X	X		X		$
Median Treatments	X			X		X		X		$
Right of Way Management	X		X		X	X	X	X		$
Highway Geometric Improvements	X				X	X	X	X		$$
Way Finding and Signage Improvements	X			X		X			X	$
Transit Fixed Route Operations			X		X		*	X	X	$$
Bus on Shoulder System (BOSS)	X		X	X			X	*		$
Bus Pullouts	X			X			*	X		$$
Intersection Turn Lanes	X	X			X	X		X		$$
Grade Separated Railroad Crossings	X				X	X	X	X		$$$
Roundabout Intersections		X			X	X		X		$$
Acceleration/Deceleration Lanes	X				X	X	X	X		$$
Grade-Separated Intersection		X			X	X	X	X		$$$
Designated Truck Routes	X				X				X	$
Bottleneck Removal	X				X		X	X		$$$
Hill-Climbing Lanes	X				X	X	X	X		$$
TECHNOLOGICAL EFFICIENCY IMPROVEMENTS										
Demand-Responsive Signal System	X	X		X				X		$$
Traveler Information and Rerouting Systems	X				X	X			X	$$
Traffic Signal Optimization	X	X		X				X		$$
Bluetooth-Based Travel Time Measurement	X			X		X			X	$
Route Information	X				X				X	$
Electronic Commercial Vehicle Clearance and Tolls	X				X	X	X	X		$$
Ramp Metering	X				X	X	X			$$
Transit Signal Priority	X	X			X			X		$$
Transit Vehicle Tracking	X			X					X	$$
NON-MOTORIZED IMPROVEMENTS										
Bicycle Paths/Lanes	X		X	X		X	X	X	X	$/$$
Bicycle Racks	X			X		X			X	$
Bikeshare System	X		X		X				X	$$$
Sidewalks	X		X	X		X		X	X	$/$$
Pedestrian Signals		X			X	X		X	X	$
Safe Routes to School Program	X			X					X	$
NON-INFRASTRUCTURE STRATEGIES										
Flexible Work Hours				X		X			X	$
Motorist Assistance Patrols					X	X			X	$$
Strategies to Improve Response Time				X		X			X	$
Strategies to Reduce Clearance Times					X	X			X	$
Initiating and Managing a Rideshare Program					X	X			X	$$
Parking Management				X				X	X	$$
Telecommuting				X		X			X	$
Satellite Offices					X	X			X	$$
Land Use Management					X	X			X	$
Commuter Choice Tax Benefits				X					X	$$
HOV Toll Savings					X		X		X	$$
Driver Education					X				X	$

Evaluating Strategy Effectiveness

The 2016 CMP update provides KTMPO with a prioritized list of congested roadway segments in the region, as well as a list of strategies that can be considered in future planning studies that may address congestion in those hotspot locations. This update also takes the initial step of assessing the effectiveness of each of these strategies towards addressing the particular congestion problems identified during data analysis. The matrices in Tables 4-2 through Table 4-4 show whether a highway or arterial congestion mitigation strategy is likely to be effective, marginally effective, or not applicable to each segment of the CMP Network. As the priorities and travel patterns in the region continue to change, new projects are implemented, and new mitigation strategies are identified, these matrices will be updated to reflect the most up-to-date assessment of how the region can best address its congestion needs. It should also be noted that these recommendations are no substitute for detailed corridor-level analyses, which will be necessary to conduct before any specific projects can be advanced through the region's Metropolitan Transportation Plan (MTP) and Transportation Improvement Plan (TIP) planning and implementation processes.

Table 4-2: CMP Strategy Effectiveness (Highways)

Segment ID	Description	Priority Rank	Operational Deficiency	Intersection Deficiency	Capacity Deficiency	Current Project	New SOV Lanes	New Location Roadways	HOV Lanes	Access Spacing	Right of Way Management	Highway Geometric Improvements	Transit Fixed Route Operations	Bus on Shoulder System (BOSS)	Bus Pullouts	Acceleration/Deceleration Lanes	Grade-Separated Intersection	Bottleneck Removal	Hill-Climbing Lanes	Electronic Commercial Vehicle Clearance & Tolls	Ramp Metering	Bicycle Paths/Lanes
4C	US 190 - SH 9 TO FM 3470/STAN SCHLUETER LOOP	1	-	-	X	✓	*	○	◐	○	●	◐	◐	●	○	●	○	●	◐	●	●	◐
4D	US 190 - FM 3470/STAN SCHLUETER LOOP TO BUSINESS 190	2	-	-	X	✓	*	○	◐	○	●	◐	◐	●	○	●	○	●	◐	●	●	◐
4E	US 190 - BUSINESS 190 TO IH 35	3	X	-	-	F	*	○	◐	○	●	◐	◐	●	○	●	○	●	◐	●	●	◐
20A	IH 35 - SALADO (FM 2268) TO US 190	4	-	-	X	✓	*	○	◐	○	●	◐	◐	●	○	●	○	●	◐	●	◐	◐
20C	IH 35 - S LOOP 363 TO N LOOP 363	5	-	-	X	✓	*	○	◐	○	●	◐	◐	●	○	●	○	●	◐	●	◐	◐
26B	LOOP 363 - SPUR 290 TO IH 35 S	6	X	-	!	-	◐	○	◐	○	●	●	◐	●	○	●	○	●	○	●	◐	◐
20B	IH 35 - US 190 TO S LOOP 363	7	-	-	X	✓	*	○	◐	○	●	◐	◐	●	○	●	○	●	◐	●	◐	◐
20D	IH 35 - N LOOP 363 TO FALLS COUNTY LINE	8	-	-	X	✓	*	○	◐	○	●	◐	◐	●	○	●	○	●	◐	●	◐	◐
26C	LOOP 363 - IH 35 S TO SH 36	9	X	-	-	-	◐	○	○	○	●	●	◐	●	○	●	○	●	○	●	◐	◐
26A	LOOP 363 - US 190 TO SPUR 290	10	X	X	-	F	◐	○	○	○	●	●	◐	●	○	●	●	●	○	●	◐	◐
16	SH 195 - WILLIAMSON COUNTY LINE TO FM 3470/STAN SCHLUETER LOOP	11	-	X	-	-	◐	○	○	◐	●	●	○	○	○	●	●	●	●	◐	○	◐
32B	US 190 SE - PRITCHARD RD TO MILAM COUNTY LINE	12	X	X	-	-	◐	◐	○	●	●	◐	○	○	○	●	●	●	○	◐	○	◐
4A	US 190 - FM 1715 TO BUSINESS 190	13	-	X	-	-	◐	◐	○	◐	●	●	○	○	○	●	●	●	◐	◐	○	◐
28	SH 36 - LOOP 363 TO SH 317	14	X	-	-	-	◐	○	○	●	●	◐	◐	◐	◐	●	◐	●	◐	◐	○	●
32A	US 190 SE - LOOP 363 TO PRITCHARD RD	15	X	X	-	-	◐	○	○	●	●	◐	○	○	○	●	●	●	○	◐	○	◐
26E	LOOP 363 - IH 35 N TO SH 53	16	-	-	!	-	◐	○	○	◐	●	●	◐	◐	○	●	◐	●	○	●	◐	◐
26D	LOOP 363 - SH 36 TO IH 35 N	17	-	-	!	-	◐	○	○	◐	●	●	◐	◐	○	●	◐	●	○	●	◐	◐
26F	LOOP 363 - SH 53 TO US 190	18	-	-	!	-	◐	○	○	◐	●	●	◐	◐	○	●	○	●	○	●	◐	◐

! - Potential Future Deficiency F - Future Planned Project * - Strategy Being Implemented by Current or Future Project

○ - N/A ◐ - Marginally Effective ● - Effective

Table 4-3: CMP Strategy Effectiveness (Arterials)

Segment ID	Description	Priority Rank	Operational Deficiency	Instersection Deficiency	Capacity Deficiency	Current Project	New SOV Lanes	New Location Roadways	Access Spacing	Driveway Spacing	Median Treatments	Right of Way Management	Highway Geometric Improvements	Transit Fixed Route Operations	Bus on Shoulder System (BOSS)	Bus Pullouts	Intersection Turn Lanes	Grade Separated Railroad Crossings	Roundabout Intersections	Acceleration/Deceleration Lanes	Grade-Separated Intersection	Bottleneck Removal	Hill-Climbing Lanes	Demand-Responsive Signal System	Traffic Signal Optimization	Electronic Commercial Vehicle Clearance and Tolls	Transit Signal Priority	Bicycle Paths/Lanes	Sidewalks	Pedestrian Signals
17	TRIMMIER RD - FM 3470/STAN SCHLUETER LOOP TO HALLMARK AVE	1	X	X	X	F	○	●	◐	◐	●	◐	○	●	○	◐	●	○	○	○	○	●	○	●	●	○	●	●	●	●
9	FM 3470/STAN SCHLUETER LOOP - SH 201/ CLEAR CREEK RD TO US 190	2	X	X	X	-	◐	●	◐	○	●	●	◐	●	◐	●	●	○	◐	◐	◐	●	○	●	●	◐	●	◐	●	●
4B	US 190 - US 190 BYPASS W TO US 190 BYPASS E	3	X	-	X	-	○	*	○	○	●	●	○	●	◐	●	●	○	◐	○	○	●	○	●	●	◐	●	◐	●	●
14	RANCIER AVE - FORT HOOD ST TO ROY REYNOLDS DR	4	X	-	-	-	○	●	○	○	●	◐	○	●	○	●	●	○	●	○	○	●	○	●	●	○	●	●	●	●
10	FORT HOOD ST - FM 3470/STAN SCHLUETER LOOP TO RANCIER AVE	5	X	-	X	-	◐	●	◐	○	●	●	○	●	○	●	●	●	◐	◐	◐	●	○	●	●	◐	●	◐	●	●
24	SH 317 - US 190 TO SH 36	6	X	-	-	✓	◐	●	◐	◐	◐	●	◐	●	◐	●	◐	○	●	◐	◐	●	○	●	●	◐	◐	◐	●	●
7	BUSINESS 190 - US 190 TO ROY REYNOLDS DR	7	X	-	X	-	◐	●	○	○	●	●	◐	●	◐	●	◐	○	◐	◐	◐	●	○	●	●	○	●	●	●	●
23	LOOP 121 - IH 35 TO LAKE RD	8	-	X	-	-	●	●	◐	◐	◐	●	◐	●	○	●	●	○	●	○	○	●	○	●	●	○	◐	●	●	●
13	WS YOUNG DR - ILLINOIS AVE TO FM 3470/STAN SCHLUETER LOOP	9	X	X	-	-	○	●	◐	◐	●	◐	○	●	○	◐	◐	○	●	○	○	●	○	●	●	○	●	●	●	●
1	AVE D - N 1ST ST TO BUSINESS 190	10	-	-	X	-	◐	●	◐	◐	◐	◐	○	●	○	◐	●	○	●	○	○	●	○	●	●	○	◐	●	●	●
29	FM 2305/ADAMS AVE - FM 2271 TO 3RD ST	11	X	-	-	-	◐	●	◐	◐	●	●	◐	●	◐	●	◐	○	◐	◐	◐	●	○	●	●	◐	●	●	●	●
8	FM 2410 - US 190 TO WARRIORS PATH	12	X	X	-	-	◐	●	◐	◐	◐	●	◐	●	○	◐	●	○	◐	○	○	●	◐	●	●	○	◐	●	●	●
25	FM 1741/S 31ST ST - CANYON CREEK DR TO SH 53/ADAMS AVE	13	-	X	-	-	◐	◐	○	○	◐	●	●	●	○	●	◐	○	◐	○	○	●	○	●	●	○	●	●	●	●

Table 4-4: CMP Strategy Effectiveness Continued (Arterials)

Segment ID	Description	Priority Rank	Operational Deficiency	Instersection Deficiency	Capacity Deficiency	Current Project	New SOV Lanes	New Location Roadways	Access Spacing	Driveway Spacing	Median Treatments	Right of Way Management	Highway Geometric Improvements	Transit Fixed Route Operations	Bus on Shoulder System (BOSS)	Bus Pullouts	Intersection Turn Lanes	Grade Separated Railroad Crossings	Roundabout Intersections	Acceleration/Deceleration Lanes	Grade-Separated Intersection	Bottleneck Removal	Hill-Climbing Lanes	Demand-Responsive Signal System	Traffic Signal Optimization	Electronic Commercial Vehicle Clearance and Tolls	Transit Signal Priority	Bicycle Paths/Lanes	Sidewalks	Pedestrian Signals
18	WILLOW SPRINGS RD - US 190 TO WATERCREST RD	14	-	-	X	-	○	○	◐	◐	○	◐	◐	●	○	◐	◐	○	◐	○	○	●	○	●	●	○	●	●	●	●
2	FM 116 - AVE D TO ELIJAH RD	15	-	-	X	-	●	◐	●	●	◐	●	●	◐	○	◐	●	◐	◐	◐	◐	●	◐	●	●	◐	◐	◐	●	●
22	LAKE RD - FM 2271 TO SH 317	16	X	-	-	-	◐	◐	◐	◐	◐	●	●	◐	○	◐	◐	○	●	○	○	●	○	●	●	○	◐	●	●	●
31	SPUR 290/S 1ST ST - S LOOP 363 TO AVE E	17	X	-	-	-	○	○	●	●	○	◐	◐	●	○	●	●	○	●	○	○	●	○	●	●	○	●	●	●	●
21	FM 93/NOLAN VALLEY RD - WHEAT RD TO SH 317	18	-	X	-	-	●	◐	◐	◐	◐	●	●	◐	○	◐	●	○	●	○	○	●	○	●	●	○	◐	●	●	●
30	SPUR 290/3RD ST - AVE E TO IH 35	19	X	-	-	-	○	○	◐	◐	◐	◐	◐	●	○	●	◐	○	●	○	○	●	○	●	●	○	●	●	●	●
11	HALLMARK AVE - FORT HOOD ST TO TRIMMIER RD	20	-	-	X	-	○	○	●	●	○	◐	◐	●	○	◐	●	○	●	○	○	●	○	●	●	○	●	●	●	●
6	38TH ST - BUSINESS 190 TO RANCIER AVE	21	X	-	-	-	◐	○	◐	◐	◐	◐	○	●	○	◐	◐	○	◐	○	○	●	○	●	●	○	●	●	●	●
12	N 2ND ST - HALLMARK AVE TO RANCIER AVE	22	-	X	-	-	○	○	●	●	○	◐	○	●	○	◐	●	◐	●	○	○	●	○	●	●	○	●	●	●	●
27	INDUSTRIAL BLVD - OLD HOWARD RD TO IH 35	23	X	-	-	-	◐	◐	◐	◐	◐	◐	◐	●	○	◐	◐	◐	◐	○	○	●	○	●	●	◐	●	●	●	●
15	ROY REYNOLDS DR - BUSINESS 190 TO RANCIER AVE	24	-	-	!	-	◐	○	◐	◐	◐	◐	○	●	○	◐	◐	●	●	○	○	●	○	●	●	○	●	●	●	●
33	SH 53/ADAMS AVE - 3RD ST TO E LOOP 363	25	!	-	-	-	◐	○	◐	◐	◐	●	○	●	○	●	◐	○	●	○	○	●	◐	●	●	◐	●	●	●	●
19	FM 2271 - LAKE RD TO FM 2305/W ADAMS AVE	26	-	-	!	-	◐	○	◐	◐	○	●	◐	◐	○	◐	◐	○	●	○	○	●	○	●	●	○	◐	◐	●	●

5. Plan Monitoring and Performance Tracking

"...the most important element of the CMP is the Monitoring Plan..."

The Congestion Management Process is intended to be a dynamic guidebook for tracking progress towards the region's congestion management goals. As such, the most important element of the CMP is the Monitoring Plan, which guides the MPO through the process of tracking and reporting performance on the CMP Network and assessing progress made towards congestion reduction.

The general steps required to carry out an effective monitoring program for congestion management are:

1. Maintain and update the designated CMP network
    a. Evaluate available data sources to determine any expansion in coverage
2. Identify locations where CMP projects have been implemented and document these segments in the appropriate GIS layer
    a. Identify the strategy within the strategy matrix that each project implements
3. Obtain selected monitoring datasets from TxDOT or other available sources
4. Use the performance monitoring datasets to evaluate the CMP network performance
5. Document outcomes, particularly at locations where transportation investments have been made, to determine performance improvements or identify challenges remaining to be addressed

The first two steps in the monitoring plan are straightforward and are not expanded upon in this chapter. The following sections describe the data sources, processing, and outcome documentation that KTMPO should implement to monitor system performance.

Step 3: Obtain Performance Data

As discussed in Chapter 2, thanks in large part to the proliferation of smartphone data, there are now a number of travel time data sources available to KTMPO through its planning partners. In monitoring system performance, KTMPO should seek to acquire the following data sources:

- **National Performance Management Research Data Set (NPMRDS)** – The NPMRDS is readily available through TxDOT and delivered in a manner that is fairly user-friendly. As the official data source used by FHWA to calculate Federal performance measures, the NPMRDS also provides KTMPO with technical support from FHWA. Unfortunately, data coverage is limited to roadways on the National Highway System. At the time of the 2016 CMP Update, FHWA was in the process of re-procuring the NPMRDS, so in upcoming years there may be changes to the format of the data.
- **INRIX –** INRIX is a private travel data company that collects data and sells it to interested parties. In this case, TxDOT has partnered with the Texas A&M Transportation Institute (TTI) to purchase data from INRIX and have TTI process the data to produce the annual list of the top 100 congested roadway segments

in the state. TxDOT makes the processed data available to MPOs, and the coverage of the data in KTMPO includes most of the roadways on the CMP Network.

- KTMPO Regional Travel Demand Model – KTMPO may seek to supplement the observed travel time datasets with forecast travel information produced by the regional Travel Demand Model. The TDM is typically updated every four to five years when the MPO prepares updates to the Metropolitan Transportation Plan. The TDM should be used to supplement information from primary sources, but not to replace them because it does not contain observed data, only forecasts of possible future transportation scenarios.
- Google Traffic – The MPO may also supplement the quantitative data with observations from the typical traffic layer available in Google Maps. KTMPO can collect the data qualitatively from the web in a process described in the following section or may contact Google directly to inquire about data availability for public sector users and transportation planning purposes.
- Bluetooth – Bluetooth detectors are currently operational only along IH 35 through the KTMPO region. However, as Bluetooth technology increases in breadth and accuracy, KTMPO may partner with local jurisdictions and TxDOT to acquire and install Bluetooth detectors along key routes in the CMP Network that may not be covered by the other available quantitative data sources.

Source: Michael Miller; FME News Service

Step 4: Evaluate CMP Network Performance

This section briefly describes the process for taking data from the most readily available datasets and converting it into a format where performance measures can easily be recorded. Data processing for any other dataset that the MPO may obtain should be a key consideration in determining whether the MPO should pursue additional data.

NPMRDS

Data processing for the NPMRDS is relatively straightforward given the partnership between the data collection company (HERE) and FHWA. The data file given to KTMPO by TxDOT includes several PDF guides to help the MPO process the data and connect it to the regional roadway system in GIS. The major steps in the process are as follows:

- *Process Raw Travel Time Data* – the travel time data is delivered for reporting segments – known as Traffic Messaging Channels (TMCs) – for every 30 second period throughout the reporting period (typically data files are delivered monthly). This raw data travel time data can be aggregated into 15-minute average speeds for file size management, and during the aggregation process, outliers can be removed.
- *Compute free-flow travel speed* – with the raw data, the user can also compute the 85^{th} percentile travel speed, which is used as the freeflow travel speed for each TMC.
- *Compute performance measures* – once the 15 minute averages and freeflow speeds are determined, the TTI and Delay measures can be computed. Refer to the table in Chapter 3 for the calculation methods for each performance measure.

- *Connect performance measure calculations to geographic data* – the process for joining the performance data to the shapefile is explained in detail by the guidebook provided by FHWA that accompanies the data.

INRIX

In the file format that TxDOT provides INRIX data to its planning partners, most of the data processing has already been accomplished. The data deliverable contains a spreadsheet that has 15-minute average travel speeds and freeflow travel speeds already computed for each RHiNo segment, and a shapefile with the RHiNo segments for all roadways in the region. The MPO can use the 15-minute and freeflow speed data to compute the TTI and Delay performance measures. Additional delay measures outlined in Chapter 3 are available in another spreadsheet, which contains the performance measures calculated by TTI for the Texas 100 Most Congested Roadways. Note that the Texas 100 roadway network may not contain performance data for as many roadways as may be available through the 15-minute spreadsheet. The data deliverable also contains a guidebook that the MPO may use to join the calculated performance data to the provided shapefiles, although some care is advised to ensure that the directionality of the speed data aligns with the directionality of the shapefile.

Google Traffic

The first step to collect congestion data from Google Traffic is to identify a reference network (e.g. CMP Network) to determine which roads to evaluate. The network as a whole is split into manageable sections or cells that should roughly reflect the scale to which Google Maps is being viewed during the data collection. The scale in Google Maps should be defined so that all roads are easily identified—that is, roads do not overlap others to the point that the level of congestion cannot be deciphered—but it should not be zoomed in so far that the traffic overlay shows data for small local roads not a part of the analysis. A half-mile to one-mile scale in Google Maps should be sufficient.

The next step is to set up a data log which records a unique ID, street name, direction, and extent identified by closest cross street. Extent of each segment is different and does not necessarily have to be from one major road to another. The log should also include the specified time periods and days for which data is being collected. Once the congestion log is set up, the next step is to work cell-by-cell screening for congested segments. This process involves observing the Google Traffic overlay for each specified time period and day, taking note of where there is reoccurring congestion. Then, focusing in on one of the identified congested segments, record the segment description information in the data log and work through the different time periods recording the magnitude of congestion, based on the scale provided in Google Traffic. Once this process is completed for a segment, the process is repeated for other segments along the reference network in that cell. Before moving on to the next cell, screenshots of the full extent of the cell in Google Maps should be taken as a QC measure.

After all congested segments have been identified for the reference network, the collected congestion information is aggregated and brought into GIS. This is done by either creating a new shapefile and manually drawing in the congested segments based on Google base maps and the descriptions provided in the data log or by using the data log to approximately match the congestion data to a current network. The final product should include congested segments with associated attributes that describe the magnitude and/or duration of congestion as specified by a given scale relative to the Google Traffic scale. The congested segments can then be compared with segments on the CMP Network to determine to what extent the CMP Network segments are congested.

TDM

Travel speed information is included in the outputs from the TDM. The TDM outputs also contain information about volume on the roadway network (referred to as "flow" in the TDM) that is used during the hotspot prioritization process.

Prioritization Data

In order to supplement the congestion data and calculate evaluation measures used during the prioritization process, the MPO should also collect data from the following sources:

- *TxDOT Crash Recording Information System (CRIS)* – This dataset provides crash location information in a format that is easily convertible to a shapefile that can be used to calculate the crash rates and rear-end crash rates along CMP Network segments.
- *Transit Availability* – The MPO may partner with Hill Country Transit District (HCTD) to obtain shapefiles containing current and/or future transit routes. If HCTD installs Automatic Passenger Counters in the future, it may also be possible to incorporate route- or stop-specific transit ridership data into the prioritization matrix.
- *School Location* – School location shapefiles are readily available through GIS providers such as ESRI, or through the State. The MPO may also partner with local school districts to obtain or create a school location shapefile for the region.
- *Public Input* – KTMPO may conduct a Congestion Survey at any time and use the responses to calculate the most frequently identified congested locations along the CMP Network.

Performance Measures

As listed in Chapter 2, the performance measures recommended for use in monitoring system performance are:

- Travel Time Index
  - Average Daily
  - Maximum
- Delay
  - Average Daily
  - Peak Period
  - Annual Hours of Delay
- V/C Ratio (Current and Future)
  - Average Daily
  - Peak Period
- Transit Availability
- Crash Rate
- Rear-end Crash Rate

Step 5: Documenting Performance Outcomes

Once performance measures have been calculated from the appropriate datasets, KTMPO should note year-over-year changes in each metric for each reporting segment of the CMP Network. This should result in a re-prioritization of the segments to determine what changes (if any) have occurred to the list of highest priority congested roadway segments. The MPO may choose to expand upon or re-weight the evaluation criteria used in the prioritization process to best align the process with current metropolitan planning goals and objectives.

While documenting performance changes, KTMPO should note which segments of the CMP Network had congestion mitigation projects implemented during the time since the last performance update (this should have been accomplished in Step 2 of the monitoring plan). Noting correlations between the types of strategies that are implemented and the changes in congestion performance will allow the MPO to develop metrics that predict the expected performance impacts for strategies in the CMP Toolbox.

For example, if one of the region's municipalities implements a signal re-timing project along several roadway corridors on the CMP Network, the MPO can record the changes in the TTI and delay on those corridors before and after the signal re-timing and develop an average improvement value that can be expected on similar corridors for which signal re-timing is an appropriate congestion mitigation strategy. Once specific projects are implemented, performance improvement metrics can be directly compared to project costs to identify the most cost-effective congestion mitigation strategies that are tailored to conditions in the region.

Conclusion

An ongoing monitoring program is one of the key steps in implementing the FAST Act performance management strategy. It not only allows KTMPO to identify emerging problems on the transportation system, but it also allows the MPO to measure the outcomes of transportation investment decisions to determine if the planning process is being effective in addressing local transportation challenges. Learning what works and doesn't work provides a basis for continuous improvement in the outcomes of the metropolitan planning process.

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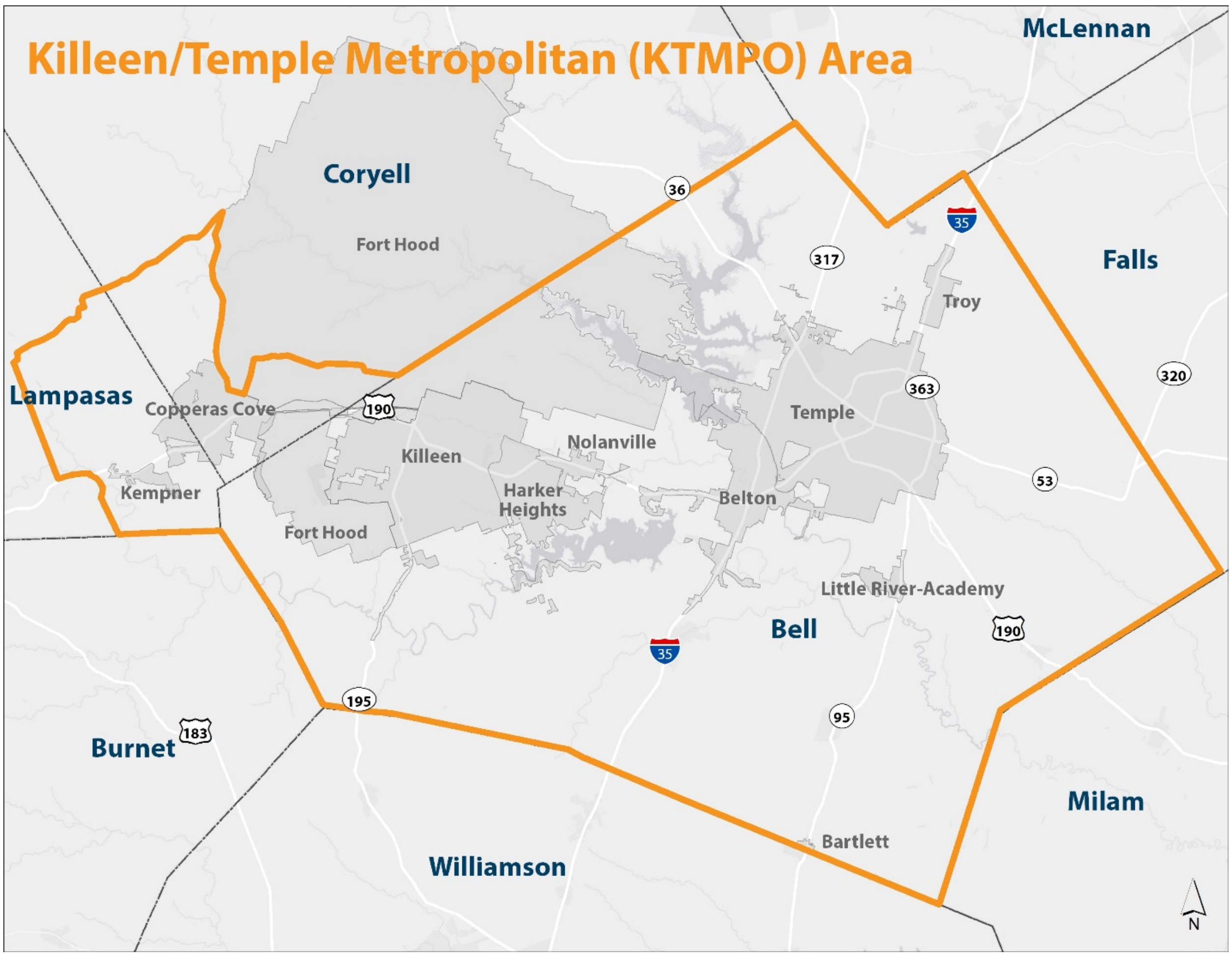
Appendix A

Congestion Survey Results Memo

KTMPO Congestion Management Process (CMP) | Survey Results

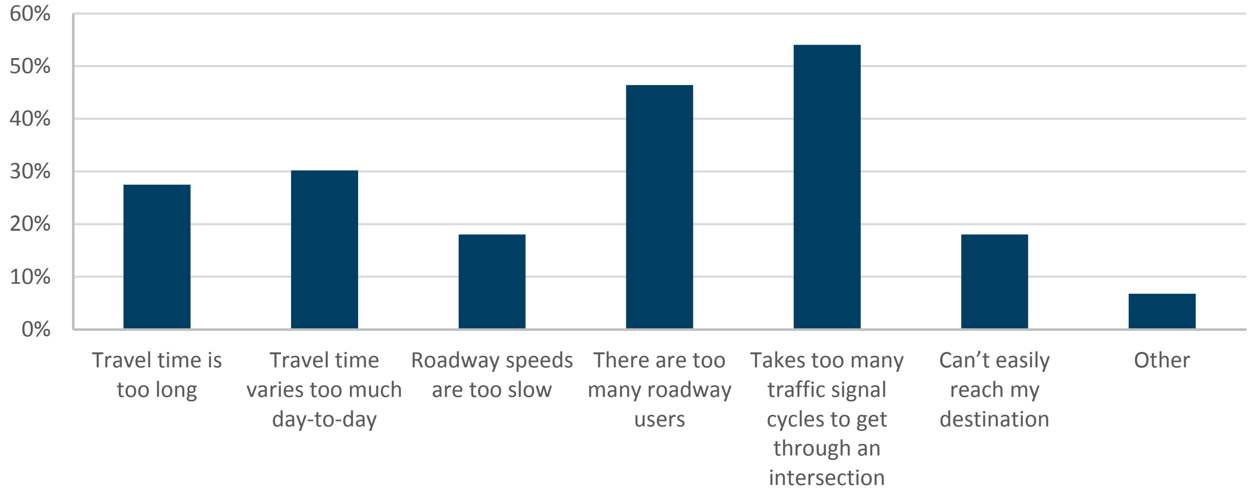
The congestion survey was designed to gather feedback on how travelers define and where they experience congestion in the Killeen/Temple metropolitan area (Fig. 1). This feedback was meant to supplement other quantitative/qualitative data sources in the process of identifying congested roadway segments and prioritizing which segments to focus congestion management efforts. The survey was open to the public from Feb. 29, 2016 to March 31, 2016 and received 222 responses. The following briefly summarizes and presents the results from the congestion survey.

Fig. 1: Killeen/Temple Metropolitan Area



In regards to overall congestion (i.e. Question 1 of the survey), 90% (200) of the respondents who answered the question agreed that traffic congestion was a significant problem in the Killeen/Temple metropolitan area. Since the definition of what is considered to be congestion changes from place to place, it was important to identify how Killeen/Temple travelers locally defined congestion. Fig. 2 illustrates the survey responses that helped to answer this question.

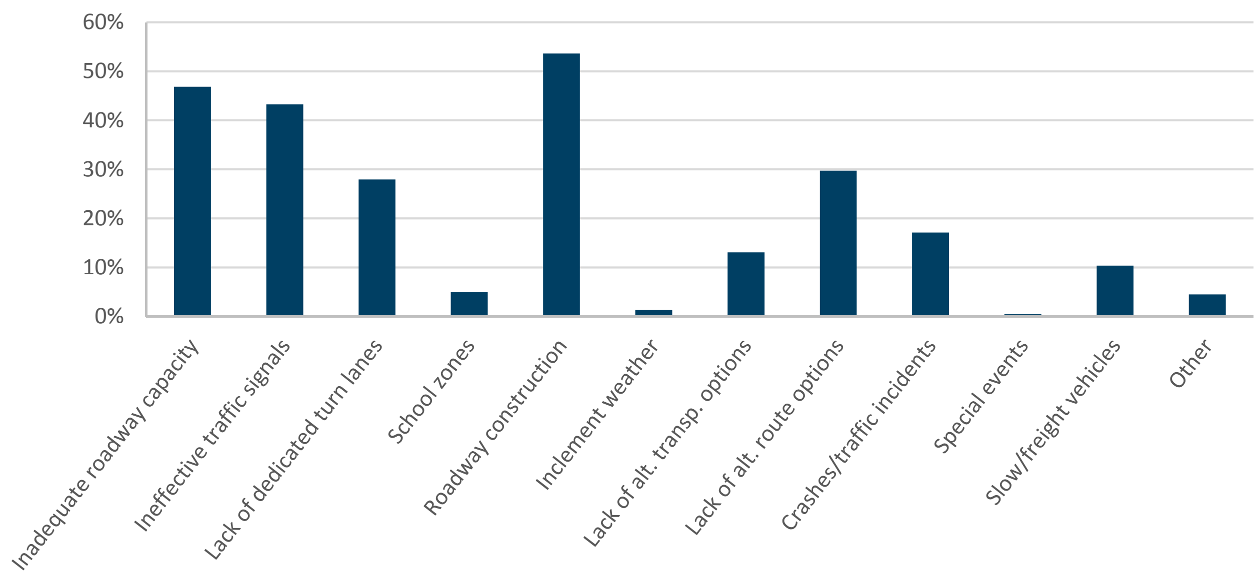
Fig. 2: Responses to survey Question 2 - Which of the following best fits your definition of traffic congestion?



Respondents to this question were given the option to select multiple answers, and 54% included "Takes too many traffic signal cycles to get through an intersection" in their definition of traffic congestion. This definition of congestion was agreed upon the most, while 46% believed traffic congestion in the area was defined as there being "…too many roadway users".

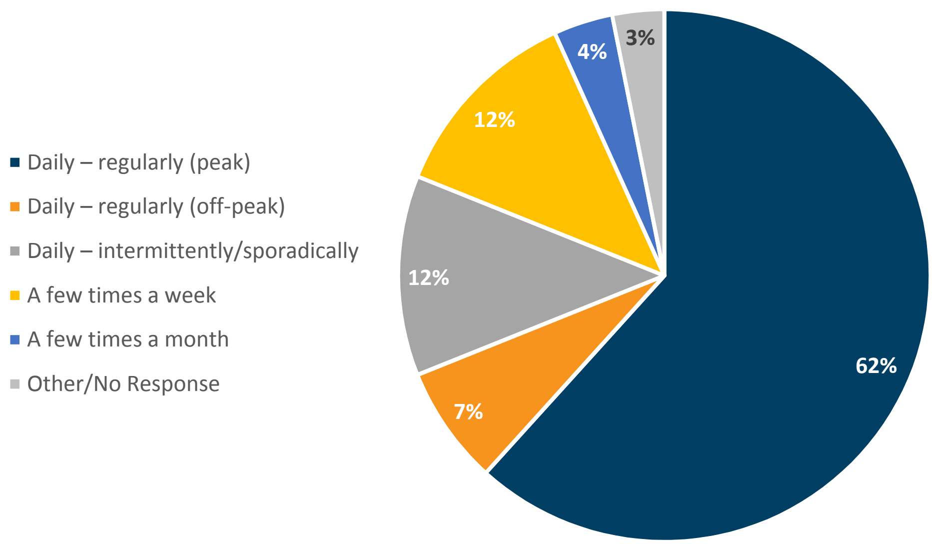
Additionally, survey respondents identified the causes of this type of traffic congestion. The biggest culprit for traffic congestion in the area, as pointed out by 54% of the respondents, was roadway construction—with inadequate roadway capacity (47%) and ineffective/poorly timed traffic signals (43%) being the next most identified causes of congestion. Fig. 3 presents the full results for the question linked to these answers; respondents were allowed choose multiple answers.

Fig. 3: Responses to survey Question 3 - What do you perceive are the biggest causes of traffic congestion in the Killeen/Temple metro area?



Looking at the frequency to which travelers experienced congestion in the area, 62% claimed to experience congestion daily during peak travel periods (7AM-9AM and 4PM-6PM). Fig. 4 provides the full results for determining the frequency in which respondents experienced congestion.

Fig. 4: Responses to survey Question 4 - How often do you experience traffic congestion in the Killeen/Temple metro area?



In terms of identifying where on the roadway network travelers were experiencing the most congestion (i.e. survey Question 5), the following table shows the top three most mentioned intersections and road segments.

Table 1: Responses to survey Question 5 - Worst Congestion Locations (Current)

Intersection	Mentions	Segment	Mentions
WS Young @ US 190	19	W. Adams Ave. (Temple)	19
FM 2410 @ US 190	15	WS Young Dr. (Killeen)	10
Trimmier Rd @ US 190	11	Trimmier Rd. (Killeen)	9

IH-35, in general, was also mentioned frequently by the respondents as being most heavily congested.

While it was crucial to understand how the community defines and where/how they experience congestion, it was also beneficial to understand more about the respondent's travel behavior. For instance, in response to Question 7 of the survey, 98% of the respondents reported that they travel in a personal car most often. Only one person of the 218 who answered the question reported taking an alternative mode of transportation (i.e. carpool). Looking at travel patterns, Figures 5 and 6 show which zip codes respondents travel from (i.e. where they live) and which they travel to most frequently (i.e. where they work). The following were the most frequently reported pairs of zip codes, including the number of mentions, in terms of origin and destination:

- ☐ 76513 – 76513 (13)
- ☐ 76502 – 76513 (10)
- ☐ 76502 – 76502 (10)

Fig. 5: Responses to survey Question 8 - In which zip code do you live?

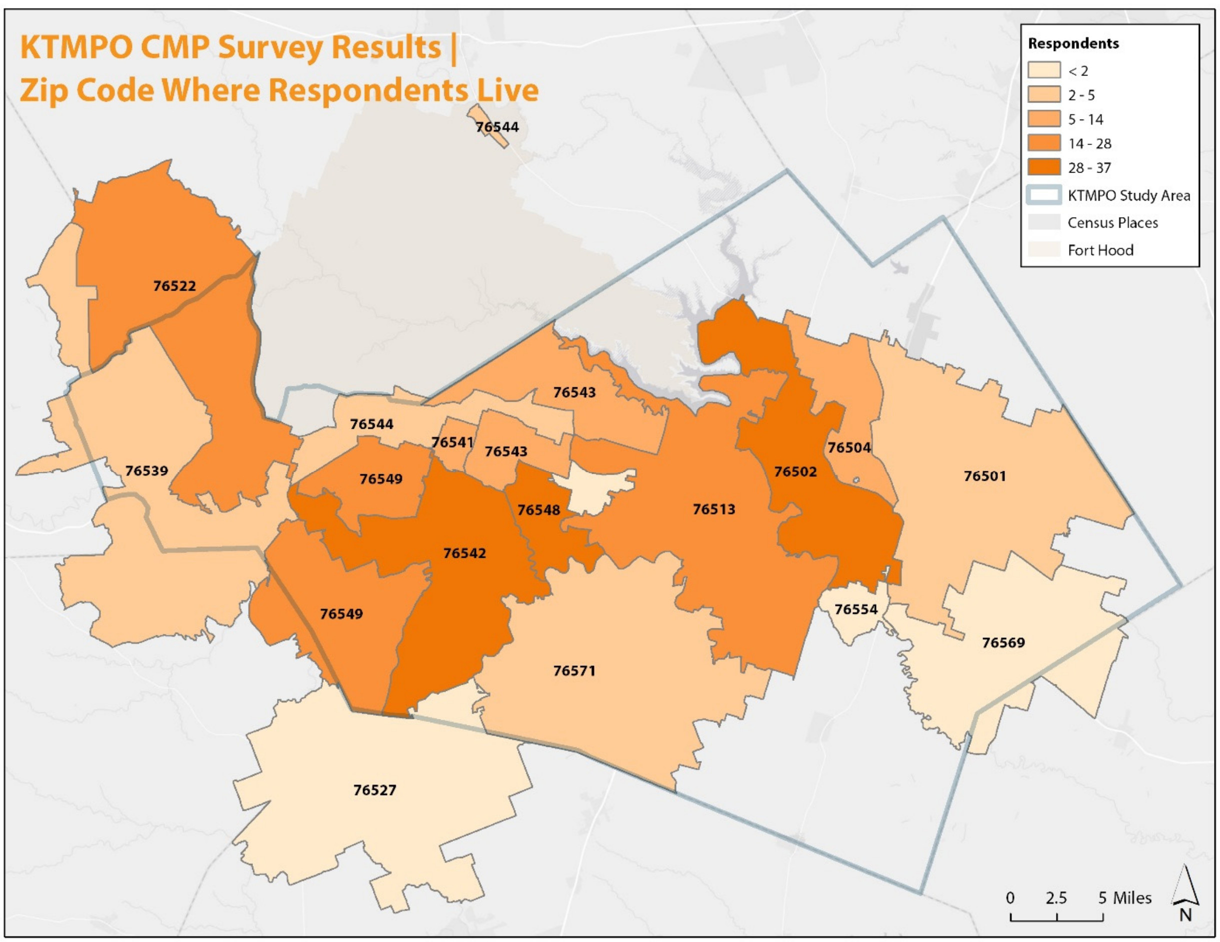
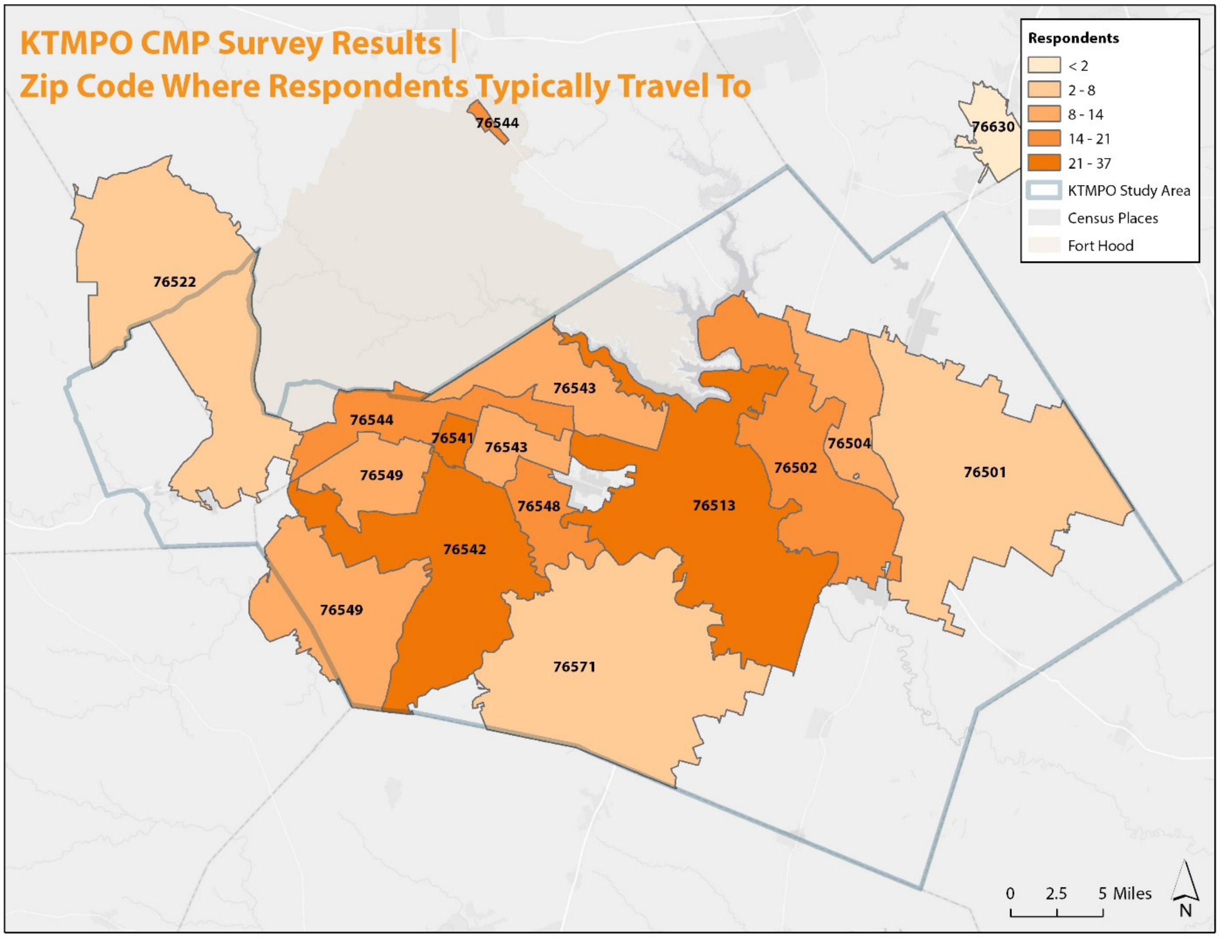


Fig. 6: Responses to survey Question 9 - To which zip code do you travel to the most?



The frequency of the mentioned zip code pairs reveals that the most common trip of the respondents is contained within the Belton/Temple area. However, it should be pointed out that these are relatively large zip codes that may capture more responses simply because of their size. Also, there were several zip codes respondents reported to travel to outside of the metro area, but no more than two people did so for each of those zip codes.

In response to Question 10 about how long it takes to get to a most frequent destination, on average, respondents stated that this type of trip would take about 15 minutes without traffic. However, in response to Question 11, they reported to need about 15 extra minutes to reach their most frequent destination on time while accounting for traffic congestion. In the worst case, up to one hour of extra time was needed.

In order to avoid congestion, respondents reported (in response to Question 12) that they would most likely leave at a different times (83%) or take alternative routes (66%). Fig. 6 provides the full results showing what decisions travelers in the Killeen/Temple metro area make to avoid congestion. Furthermore, respondents believed that the most effective strategies for addressing congestion in the metro area, in order of most reported, were to improve traffic signal coordination (59%), increase roadway capacity (58%), and implement dedicated turn lanes (43%). The full results are shown in Fig. 8

Fig. 7: Responses to survey Question 12 - What actions do you take to avoid traffic congestion?

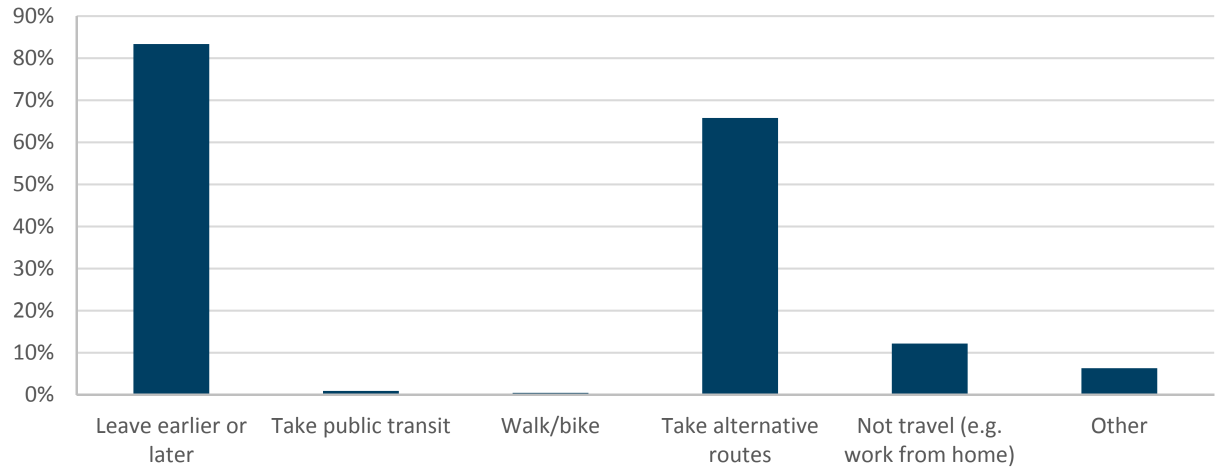
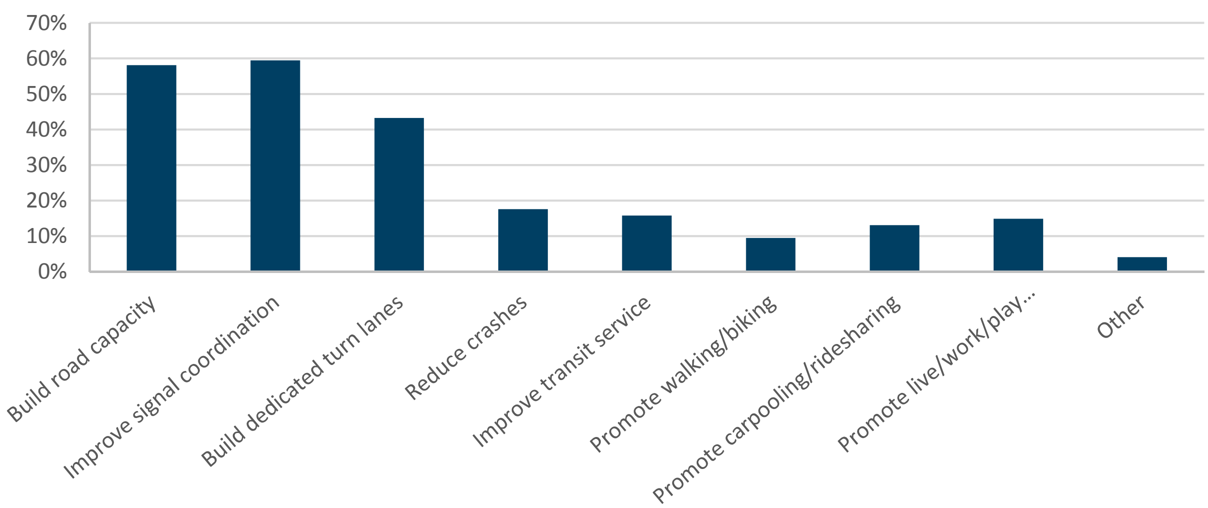


Fig. 8: Responses to survey Question 13 - What do you believe are the most effective strategies for addressing traffic congestion in the Killeen/Temple metro area?

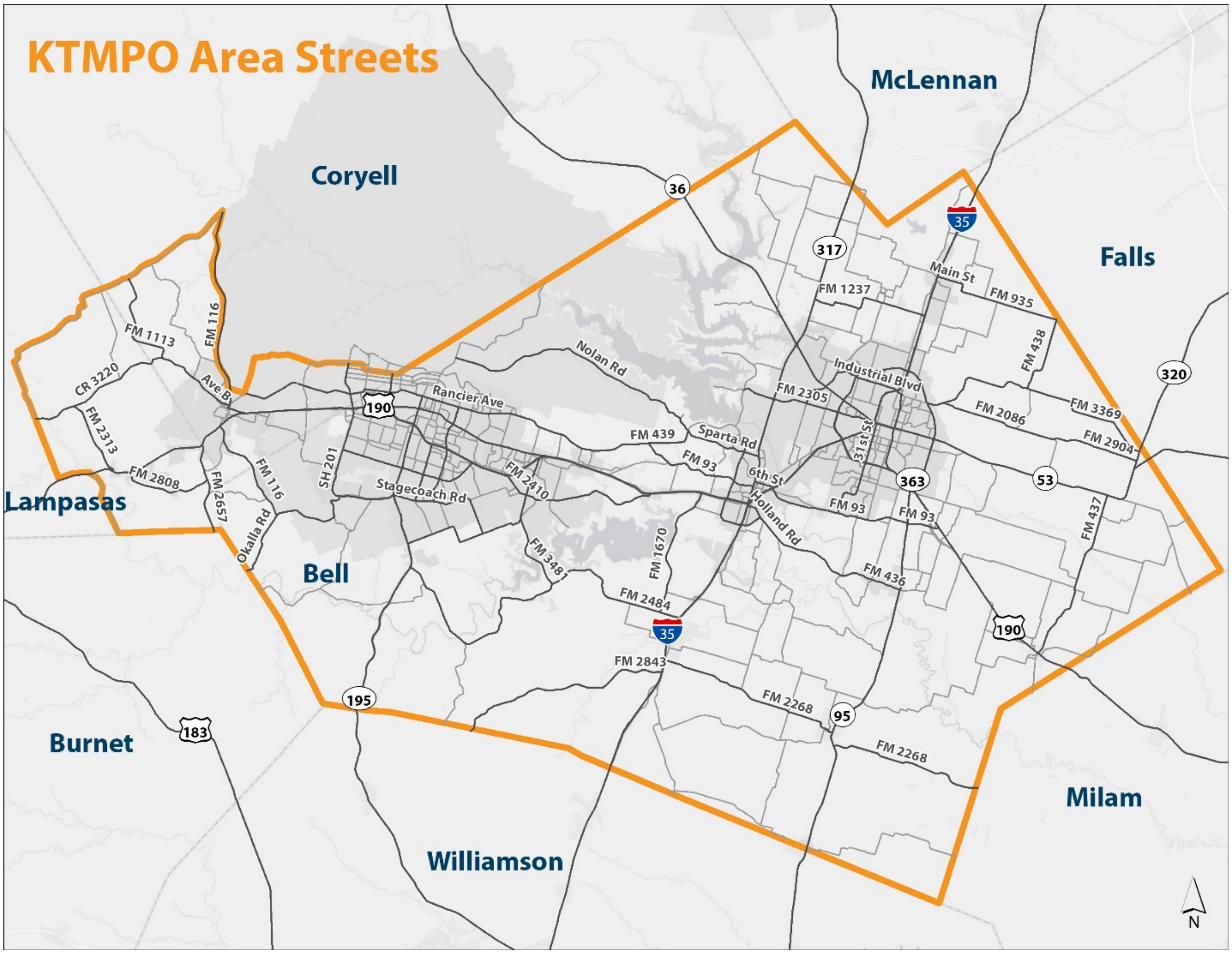


Overall, the respondents of this survey are reliant on their personal vehicles to mostly travel relatively short local trips within Killeen, Belton, or Temple. During these trips, respondents typically experience around 15 minutes of delay when traveling during peak periods—most often a result of bad traffic signal timing or roadway construction. Congestion is reported to be concentrated at important arterial/collector roads that connect with either US 190 or IH-35. Many of the respondents leave earlier or later than they normally would or search for alternative routes in order to avoid congestion and ensure they reach their most frequent destination on time. Many of the respondents believe the congestion issues of the metro area could be addressed with better traffic signal coordination and increased roadway capacity.

KTMPO Congestion Survey Questions

1. Based on your daily travel experience, do you believe traffic congestion is a significant problem in the Killeen/Temple metropolitan area?
   - ☐ Yes
   - ☐ No
2. Which of the following best fits your definition of traffic congestion? (Select up to 3)
   - ☐ Travel time is too long
   - ☐ Travel time varies too much day-to-day
   - ☐ Roadway speeds are too slow
   - ☐ There are too many roadway users
   - ☐ Takes too many traffic signal cycles to get through an intersection
   - ☐ Can't easily reach my destination
   - ☐ Other ____
3. What do you perceive are the biggest causes of traffic congestion in the Killeen/Temple metro area? (Select up to 3)
   - ☐ Inadequate roadway capacity
   - ☐ Ineffective/poorly timed traffic signals
   - ☐ Lack of dedicated turn lanes
   - ☐ School zones
   - ☐ Roadway construction
   - ☐ Inclement weather
   - ☐ Lack of alternative transportation options (e.g. transit, bicycle lanes, etc.)
   - ☐ Lack of alternative route options
   - ☐ Crashes/traffic incidents
   - ☐ Special Events
   - ☐ Slow-moving/freight vehicles
   - ☐ Other ____
4. How often do you experience traffic congestion in the Killeen/Temple metro area? (Select 1)
   - ☐ Daily – regularly, during peak travel periods (7AM-9AM and 4PM-6PM)
   - ☐ Daily – regularly, during off-peak travel periods
   - ☐ Daily – intermittently/sporadically
   - ☐ A few times a week

- ☐ A few times a month
- ☐ Other ____

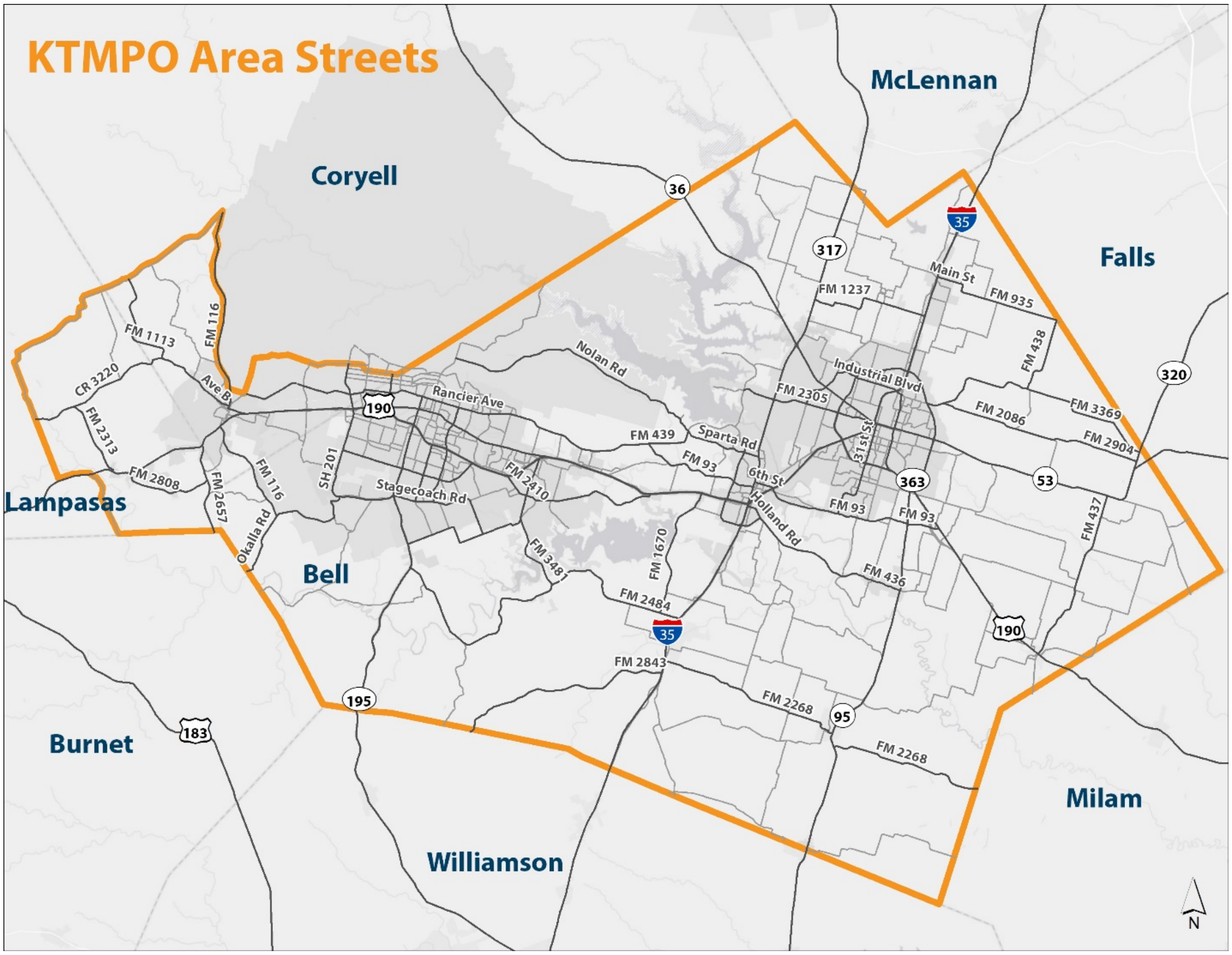


5. Using the map and/or the blanks below, locate three (3) road segments or intersections in the Killeen/Temple metro area where you believe congestion is currently the worst.

____

____

____



6. Using the map or the blanks below, locate three (3) road segments or intersections in the Killeen/Temple metro area where you think congestion will be the worst in 10 years.

____

____

____

7. What mode of transportation do you use most often? (Select 1)
   - ☐ Personal car
   - ☐ Public Transportation
   - ☐ Walking
   - ☐ Biking
   - ☐ Carpool/Rideshare
   - ☐ Other ______________________________

8. In which zip code do you live? ____________________

9. To which zip code do you travel to the most (for work, school, etc.)? __________________

10. How long would it take (in minutes) to get to your most frequent destination (e.g. work) from home with no traffic congestion?

    ____

11. How much extra time do you allow yourself (in minutes) to get to your destination on time to account for traffic congestion along your route?

    ____

12. What actions do you take to avoid traffic congestion? (select any that apply)
    - ☐ Leave earlier or later than you normally would for certain trips
    - ☐ Take public transit
    - ☐ Walk/bike
    - ☐ Take alternative routes
    - ☐ Not travel (e.g. work from home)
    - ☐ Other ______________________________

13. What do you believe are the most effective strategies for addressing traffic congestion in the Killeen/Temple metro area? (Select up to 3)
    - ☐ Construction of additional roadway capacity
    - ☐ Improved traffic signal coordination
    - ☐ Implementation of dedicated turn lanes
    - ☐ Projects/policies to reduce the number of crashes on roadways
    - ☐ Improving/expanding transit service to increase ridership
    - ☐ Projects/policies that promote walking and biking
    - ☐ Programs that incentivize carpooling/ridesharing, traveling at off-peak periods, or telecommuting
    - ☐ Land use policies that promote alternative forms of transportation and/or shorten travel times (e.g. mixed-use development featuring live/work/play options)

Appendix B

Detailed Congestion Hotspot Data

Congestion Data

The tables on pages B-3 through B-5 contain detailed data for each segment of the CMP network that was used to identify congestion hotspots in the region. The congestion scores were computed by first weighting the raw performance measure data based on how many data sources were reflected in each segment, as seen in the table below:

	Number of Sources	NPMRDS	INRIX	TDM	Google	Total
All Sources	5%	20%	50%	20%	5%	**100%**
TDM + INRIX	5%		60%	30%	5%	**100%**
TDM + NPMRDS	5%	50%		40%	5%	**100%**
TDM Only	25%			70%	5%	**100%**

The weighted raw data were then converted to scores on a scale of zero (0) to one (1), with a value of one representing the worst performing segment on the network and the remaining scores reflecting the relative performance of each segment against the rest. Finally, the individual performance measures were combined into a weighted "congestion score" metric for each direction of each segment that was then averaged for both directions on a segment to assign an overall congestion rank for the segment.

The weights for the congestion score computation are shown below:

Measure	TTI	Delay	V/C Ratio	2040 V/C Increase	Google Score	Data Availability Score
Weight	25%	25%	25%	5%	5%	15%

Prioritization Data

The table on page B-6 details the data for the individual weighting criteria used to prioritize the segments in the CMP network. The prioritization score calculation relies primarily on the severity of congestion on a segment, but also considers the volume of traffic, crash rates (overall and percentage that are rear-end collisions), presence of schools, presence of transit service, and number of times the segment was mentioned as a congestion hotspot in the 2016 KTMPO Congestion Survey (see Appendix A). The weights used for each criterion were developed in collaboration with the KTMPO Technical Advisory Committee (TAC) and are detailed below:

Criteria		Weight
Congestion Rank		30%
Volume		20%
Safety	Crashes	15%
	Rear-End Crashes	10%
Transit		15%
School		5%
Public Input		5%
Total		***100%***

Congestion Data (Arterial Segments)

Segment ID	Description	Direction	Street Type	Weighted TTI	Weighted Delay	Weighted VC	Weighted 2040 Change	Speed Score	Delay Score	Capacity Score	2040 Score	Google Score	Confidence Score	Congestion Score	Arterial Rank	Arterial Segment Score	Arterial Segment Rank
1	AVE D - N 1ST ST TO BUSINESS 190	EB	A	0.251	50.35	0.61	0.44	1.00	0.71	0.62	0.02	1.00	0.50	0.71	13	0.68	7
1	AVE D - N 1ST ST TO BUSINESS 190	WB	A	0.352	43.85	0.68	0.53	0.94	0.62	0.81	0.27	0.00	0.25	0.64	21		
2	FM 116 - AVE D TO ELIJAH RD	NB	A	0.515	40.13	0.66	0.59	0.65	0.54	0.79	0.79	0.50	0.75	0.67	15	0.71	6
2	FM 116 - AVE D TO ELIJAH RD	SB	A	0.508	69.65	0.63	0.64	0.67	0.90	0.69	0.87	0.50	0.75	0.75	10		
4B	US 190 - US 190 BYPASS W TO US 190 BYPASS E	EB	A	0.352	35.92	1.40	0.56	0.92	0.48	1.00	0.52	0.00	0.75	0.79	3	0.78	2
4B	US 190 - US 190 BYPASS W TO US 190 BYPASS E	WB	A	0.439	44.03	0.88	0.54	0.81	0.63	0.94	0.37	0.00	0.75	0.76	8		
6	38TH ST - BUSINESS 190 TO RANCIER AVE	NB	A	0.667	25.69	0.31	0.56	0.15	0.27	0.12	0.50	0.50	0.75	0.30	47	0.40	20
6	38TH ST - BUSINESS 190 TO RANCIER AVE	SB	A	0.521	20.54	0.57	0.55	0.63	0.17	0.56	0.38	0.50	0.75	0.50	27		
7	BUSINESS 190 - US 190 TO ROY REYNOLDS DR	EB	A	0.435	71.41	0.77	0.59	0.85	0.92	0.88	0.65	0.00	0.50	0.77	6	0.75	4
7	BUSINESS 190 - US 190 TO ROY REYNOLDS DR	WB	A	0.541	58.59	0.82	0.56	0.54	0.83	0.90	0.54	0.50	0.75	0.73	11		
8	FM 2410 - US 190 TO WARRIORS PATH	EB	A	0.641	28.30	0.43	0.53	0.29	0.35	0.29	0.23	0.00	0.50	0.32	44	0.36	23
8	FM 2410 - US 190 TO WARRIORS PATH	WB	A	0.595	29.56	0.52	0.53	0.38	0.40	0.50	0.21	0.00	0.50	0.41	38		
9	FM 3470/STAN SCHLUETER LOOP - SH 201/CLEAR CREEK RD TO US 190	EB	A	0.448	128.46	0.63	0.63	0.79	0.98	0.67	0.83	0.50	0.75	0.79	4	0.78	1
9	FM 3470/STAN SCHLUETER LOOP - SH 201/CLEAR CREEK RD TO US 190	WB	A	0.450	56.70	0.72	0.64	0.77	0.77	0.83	0.85	0.50	0.75	0.77	6		
10	FORT HOOD ST - FM 3470/STAN SCHLUETER LOOP TO RANCIER AVE	NB	A	0.498	51.54	0.72	0.58	0.71	0.73	0.85	0.62	0.50	1.00	0.78	5	0.77	3
10	FORT HOOD ST - FM 3470/STAN SCHLUETER LOOP TO RANCIER AVE	SB	A	0.495	56.85	0.62	0.59	0.73	0.79	0.65	0.71	0.50	1.00	0.75	9		
11	HALLMARK AVE - FORT HOOD ST TO TRIMMIER RD	EB	A	0.690	46.78	0.39	0.51	0.08	0.67	0.27	0.15	1.00	0.75	0.43	34	0.57	11
11	HALLMARK AVE - FORT HOOD ST TO TRIMMIER RD	WB	A	0.426	28.61	0.82	0.51	0.87	0.38	0.92	0.13	1.00	0.75	0.71	12		
12	N 2ND ST - HALLMARK AVE TO RANCIER AVE	NB	A	0.571	3.72	0.43	0.46	0.44	0.02	0.31	0.04	0.00	0.25	0.23	50	0.39	21
12	N 2ND ST - HALLMARK AVE TO RANCIER AVE	SB	A	0.385	5.75	0.65	0.49	0.88	0.04	0.77	0.06	1.00	0.50	0.55	24		
13	WS YOUNG DR - ILLINOIS AVE TO FM 3470/STAN SCHLUETER LOOP	NB	A	0.324	14.15	0.50	0.82	0.98	0.06	0.48	0.90	1.00	0.50	0.55	25	0.52	14
13	WS YOUNG DR - ILLINOIS AVE TO FM 3470/STAN SCHLUETER LOOP	SB	A	0.437	17.60	0.43	0.70	0.83	0.15	0.33	0.88	1.00	0.50	0.50	28		
14	RANCIER AVE - FORT HOOD ST TO ROY REYNOLDS DR	EB	A	0.538	42.49	0.50	0.59	0.56	0.58	0.42	0.73	0.50	0.75	0.56	23	0.60	10
14	RANCIER AVE - FORT HOOD ST TO ROY REYNOLDS DR	WB	A	0.493	43.18	0.60	0.56	0.75	0.60	0.60	0.44	0.50	0.75	0.65	19		
15	ROY REYNOLDS DR - BUSINESS 190 TO RANCIER AVE	NB	A	0.610	27.19	0.47	0.58	0.35	0.31	0.40	0.58	0.50	0.75	0.43	33	0.62	9
15	ROY REYNOLDS DR - BUSINESS 190 TO RANCIER AVE	SB	A	0.325	40.21	1.04	0.57	0.96	0.56	0.98	0.56	1.00	0.75	0.82	2		
17	TRIMMIER RD - FM 3470/STAN SCHLUETER LOOP TO HALLMARK AVE	NB	A	0.538	38.88	0.62	0.53	0.58	0.52	0.63	0.29	1.00	0.75	0.61	22	0.74	5
17	TRIMMIER RD - FM 3470/STAN SCHLUETER LOOP TO HALLMARK AVE	SB	A	0.368	117.00	0.96	0.49	0.90	0.96	0.96	0.10	1.00	0.75	0.87	1		
18	WILLOW SPRINGS RD - US 190 TO WATERCREST RD	NB	A	0.654	28.00	0.73	0.84	0.23	0.33	0.87	0.92	0.00	0.50	0.48	30	0.56	12
18	WILLOW SPRINGS RD - US 190 TO WATERCREST RD	SB	A	0.552	61.68	0.63	1.19	0.50	0.85	0.73	0.98	0.00	0.50	0.64	20		
19	FM 2271 - LAKE RD TO FM 2305/W ADAMS AVE	NB	A	0.571	16.03	0.56	0.55	0.42	0.12	0.54	0.40	0.00	0.50	0.36	40	0.27	25
19	FM 2271 - LAKE RD TO FM 2305/W ADAMS AVE	SB	A	0.725	15.63	0.35	0.54	0.04	0.08	0.19	0.31	0.00	0.50	0.17	52		
21	FM 93/NOLAN VALLEY RD - WHEAT RD TO SH 317	EB	A	0.500	49.18	0.64	0.54	0.69	0.69	0.75	0.35	0.50	0.75	0.69	14	0.67	8
21	FM 93/NOLAN VALLEY RD - WHEAT RD TO SH 317	WB	A	0.562	162.71	0.46	1.28	0.48	1.00	0.38	1.00	0.50	0.75	0.65	18		
22	LAKE RD - FM 2271 TO SH 317	EB	A	0.680	37.31	0.36	0.53	0.10	0.50	0.21	0.19	0.00	0.50	0.29	49	0.24	26
22	LAKE RD - FM 2271 TO SH 317	WB	A	0.855	16.51	0.20	0.55	0.02	0.13	0.02	0.42	0.50	0.75	0.20	51		

Congestion Data (Arterial Segments Continued)

Segment ID	Description	Direction	Street Type	Weighted TTI	Weighted Delay	Weighted VC	Weighted 2040 Change	Speed Score	Delay Score	Capacity Score	2040 Score	Google Score	Confidence Score	Congestion Score	Arterial Rank	Arterial Segment Score	Arterial Segment Rank
23	LOOP 121 - IH 35 TO LAKE RD	NB	A	0.532	67.87	0.57	0.52	0.62	0.87	0.58	0.17	0.50	0.75	0.66	17	0.54	13
23	LOOP 121 - IH 35 TO LAKE RD	SB	A	0.602	24.67	0.50	0.50	0.37	0.25	0.46	0.12	0.50	0.75	0.41	37		
24	SH 317 - US 190 TO SH 36	NB	A	0.641	15.75	0.53	0.49	0.27	0.10	0.52	0.08	0.50	0.75	0.36	41	0.43	17
24	SH 317 - US 190 TO SH 36	SB	A	0.565	21.86	0.63	0.53	0.46	0.21	0.71	0.25	0.50	0.75	0.50	28		
25	FM 1741/S 31ST ST - CANYON CREEK DR TO SH 53/ADAMS AVE	NB	A	0.543	34.20	0.50	1.07	0.52	0.44	0.44	0.96	0.50	0.75	0.54	26	0.48	16
25	FM 1741/S 31ST ST - CANYON CREEK DR TO SH 53/ADAMS AVE	SB	A	0.658	35.50	0.33	1.06	0.19	0.46	0.17	0.94	1.00	0.75	0.42	36		
27	INDUSTRIAL BLVD - OLD HOWARD RD TO IH 35	EB	A	0.699	28.43	0.26	0.59	0.06	0.37	0.04	0.77	0.50	0.75	0.29	48	0.36	22
27	INDUSTRIAL BLVD - OLD HOWARD RD TO IH 35	WB	A	0.592	26.11	0.44	0.61	0.40	0.29	0.35	0.81	0.50	0.75	0.44	32		
29	FM 2305 /ADAMS AVE - FM 2271 TO 3RD ST	EB	A	0.649	21.50	0.37	0.56	0.25	0.19	0.23	0.48	0.50	0.75	0.33	43	0.32	24
29	FM 2305/ADAMS AVE - FM 2271 TO 3RD ST	WB	A	0.662	23.05	0.33	0.59	0.17	0.23	0.13	0.69	0.50	0.75	0.31	46		
30	SPUR 290/3RD ST - AVE E TO IH 35	NB	A	0.532	84.00	0.44	0.58	0.60	0.94	0.37	0.60	1.00	0.75	0.67	16	0.49	15
30	SPUR 290/3RD ST - AVE E TO IH 35	SB	A	0.671	30.63	0.30	0.54	0.13	0.42	0.10	0.33	0.50	0.75	0.32	44		
31	SPUR 290/S 1ST ST - S LOOP 363 TO AVE E	NB	A	0.671	57.33	0.27	0.59	0.12	0.81	0.06	0.75	0.00	0.50	0.36	42	0.41	18
31	SPUR 290/S 1ST ST - S LOOP 363 TO AVE E	SB	A	0.658	68.75	0.28	0.58	0.21	0.88	0.08	0.63	0.50	0.75	0.46	31		
33	SH 53/ADAMS AVE - 3RD ST TO E LOOP 363	EB	A	0.625	56.05	0.37	0.56	0.31	0.75	0.23	0.46	0.00	0.50	0.42	35	0.40	19
33	SH 53/ADAMS AVE - 3RD ST TO E LOOP 363	WB	A	0.621	46.17	0.33	0.59	0.33	0.65	0.13	0.67	0.00	0.50	0.39	39		

Congestion Data (Highway Segments)

Segment ID	Description	Direction	Street Type	Weighted TTI	Weighted Delay	Weighted V/C Ratio	Weighted 2040 V/C Increase	TTI Score	Delay Score	Capacity Score	2040 Score	Google Score	Confidence Score	Congestion Score	Highway Rank	Highway Segment Score	Highway Segment Rank
4A	US 190 - FM 1715 TO BUSINESS 190	EB	H	0.833	17.99	0.19	0.62	0.39	0.83	0.08	0.81	0.00	0.75	0.48	25	0.46	15
4A	US 190 - FM 1715 TO BUSINESS 190	WB	H	0.826	13.50	0.20	0.58	0.42	0.58	0.17	0.72	0.00	0.75	0.44	30		
4C	US 190 - SH 9 TO FM 3470/STAN SCHLUETER LOOP	EB	H	0.658	53.33	0.78	0.54	0.94	0.97	0.75	0.47	0.00	0.75	0.80	1	0.79	1
4C	US 190 - SH 9 TO FM 3470/STAN SCHLUETER LOOP	WB	H	0.671	43.94	0.77	0.53	0.92	0.94	0.72	0.36	0.00	0.75	0.78	2		
4D	US 190 - FM 3470/STAN SCHLUETER LOOP TO BUSINESS 190	EB	H	0.735	12.82	0.62	0.53	0.72	0.50	0.64	0.39	0.00	0.75	0.60	11	0.59	5
4D	US 190 - FM 3470/STAN SCHLUETER LOOP TO BUSINESS 190	WB	H	0.719	10.58	0.70	0.52	0.78	0.33	0.69	0.33	0.00	0.75	0.58	14		
4E	US 190 - BUSINESS 190 TO IH 35	EB	H	0.730	19.42	0.68	0.48	0.75	0.86	0.67	0.22	0.00	0.75	0.69	4	0.66	2
4E	US 190 - BUSINESS 190 TO IH 35	WB	H	0.769	15.92	0.55	0.50	0.64	0.75	0.61	0.28	0.00	0.75	0.63	9		
16	SH 195 - WILLIAMSON COUNTY LINE TO FM 3470/STAN SCHLUETER LOOP	NB	H	0.781	16.14	0.26	0.81	0.56	0.78	0.31	0.94	0.00	0.75	0.57	17	0.57	8
16	SH 195 - WILLIAMSON COUNTY LINE TO FM 3470/STAN SCHLUETER LOOP	SB	H	0.769	13.84	0.29	0.83	0.67	0.64	0.36	0.97	0.00	0.75	0.58	15		
20A	IH 35 - SALADO (FM 2268) TO US 190	NB	H	0.694	11.84	0.87	0.50	0.86	0.44	0.78	0.25	0.00	0.75	0.65	6	0.59	4
20A	IH 35 - SALADO (FM 2268) TO US 190	SB	H	0.794	8.65	1.21	0.37	0.53	0.22	0.94	0.14	0.00	0.75	0.54	19		
20B	IH 35 - US 190 TO S LOOP 363	NB	H	0.862	8.72	1.23	0.36	0.17	0.25	0.97	0.11	0.00	0.75	0.47	26	0.46	14
20B	IH 35 - US 190 TO S LOOP 363	SB	H	0.862	8.22	1.24	0.35	0.19	0.19	1.00	0.06	0.00	0.75	0.46	28		
20C	IH 35 - S LOOP 363 TO N LOOP 363	NB	H	0.833	16.89	1.08	0.37	0.33	0.81	0.89	0.17	0.00	0.75	0.63	8	0.54	12
20C	IH 35 - S LOOP 363 TO N LOOP 363	SB	H	0.893	7.99	0.93	0.38	0.08	0.17	0.83	0.19	0.50	1.00	0.46	29		
20D	IH 35 - N LOOP 363 TO FALLS COUNTY LINE	NB	H	0.847	11.16	1.18	0.34	0.22	0.39	0.92	0.03	0.00	0.75	0.50	22	0.54	11
20D	IH 35 - N LOOP 363 TO FALLS COUNTY LINE	SB	H	0.885	14.16	0.96	0.36	0.11	0.67	0.86	0.08	0.50	1.00	0.59	12		
26A	LOOP 363 - US 190 TO SPUR 290	NB	H	0.800	23.02	0.23	0.58	0.50	0.89	0.28	0.64	0.00	0.75	0.56	18	0.62	3
26A	LOOP 363 - US 190 TO SPUR 290	SB	H	0.500	90.42	0.22	0.54	0.97	1.00	0.22	0.44	0.00	0.75	0.68	5		
26B	LOOP 363 - SPUR 290 TO IH 35 S	NB	H	0.840	15.37	0.38	0.59	0.28	0.72	0.53	0.75	0.00	0.75	0.53	20	0.58	7
26B	LOOP 363 - SPUR 290 TO IH 35 S	SB	H	0.709	13.08	0.45	0.58	0.81	0.53	0.58	0.69	0.00	0.75	0.63	9		
26C	LOOP 363 - IH 35 S TO SH 36	NB	H	0.800	23.10	0.28	0.60	0.47	0.92	0.33	0.78	0.00	0.75	0.58	13	0.55	9
26C	LOOP 363 - IH 35 S TO SH 36	SB	H	0.833	13.77	0.35	0.65	0.36	0.61	0.50	0.83	0.00	0.75	0.52	21		
26D	LOOP 363 - SH 36 TO IH 35 N	NB	H	0.704	11.51	0.30	0.57	0.83	0.42	0.39	0.61	0.50	0.75	0.58	15	0.53	13
26D	LOOP 363 - SH 36 TO IH 35 N	SB	H	0.813	10.75	0.35	0.56	0.44	0.36	0.47	0.56	0.50	0.75	0.48	24		
26E	LOOP 363 - IH 35 N TO SH 53	NB	H	0.840	4.81	0.21	0.84	0.31	0.03	0.19	1.00	0.00	0.50	0.26	34	0.37	16
26E	LOOP 363 - IH 35 N TO SH 53	SB	H	0.746	5.76	0.34	0.72	0.69	0.08	0.44	0.92	0.50	0.75	0.49	23		
26F	LOOP 363 - SH 53 TO US 190	NB	H	0.847	6.57	0.23	0.72	0.25	0.11	0.25	0.89	0.00	0.50	0.27	33	0.23	18
26F	LOOP 363 - SH 53 TO US 190	SB	H	0.885	5.32	0.16	0.72	0.14	0.06	0.06	0.86	0.00	0.50	0.18	36		
28	SH 36/AIRPORT RD - LOOP 363 TO SH 317	NB	H	0.775	9.28	0.20	0.58	0.61	0.28	0.14	0.67	0.00	0.75	0.40	31	0.58	6
28	SH 36/AIRPORT RD - LOOP 363 TO SH 317	SB	H	0.493	14.73	0.89	0.57	1.00	0.69	0.81	0.58	0.00	0.75	0.77	3		
32A	US 190 SE - LOOP 363 TO PRITCHARD RD	EB	H	0.893	12.62	0.20	0.51	0.03	0.47	0.11	0.31	0.00	0.75	0.28	32	0.23	17
32A	US 190 SE - LOOP 363 TO PRITCHARD RD	WB	H	0.893	7.01	0.16	0.53	0.06	0.14	0.03	0.42	0.00	0.75	0.19	35		
32B	US 190 SE - PRITCHARD RD TO MILAM COUNTY LINE	EB	H	0.694	13.39	0.44	0.56	0.89	0.56	0.56	0.53	0.00	0.75	0.64	7	0.55	10
32B	US 190 SE - PRITCHARD RD TO MILAM COUNTY LINE	WB	H	0.781	9.73	0.32	0.54	0.58	0.31	0.42	0.50	0.00	0.75	0.46	27		

Prioritization Data (All Segments)

	Street Name	CMP Segment ID	Type	Congestion Rank	Volume	Crash Count	Rear End Count	Crash Rate	Rear End Crash Rate	Rear End Crash %	School Count	Survey Mentions	Congestion Score	Volume Score	Crash Score	Rear End Crash Score	School Score	Transit Score	Survey Score	Prioritization Score
Arterials	Ave D	1	A	7	19,306	335	49	0.0174	0.0025	15%	0	0	0.68	0.5	0	0.5	0	1	0	**0.405**
	FM 116	2	A	6	9,127	280	24	0.0307	0.0026	9%	0	0	0.72	0	0.5	0	0	0	0	**0.292**
	US 190	4B	A	2	40,681	1485	307	0.0365	0.0075	21%	0	0	0.84	1	0.5	1	0	0	0	**0.626**
	38th St	6	A	20	13,580	206	20	0.0152	0.0015	10%	0	0	0.42	0.5	0	0	0	0	0	**0.225**
	BU 190	7	A	4	19,431	590	72	0.0304	0.0037	12%	0	7	0.76	0.5	0.5	0.5	0	0.5	0.5	**0.503**
	FM 2410	8	A	23	12,496	581	76	0.0465	0.0061	13%	0	7	0.38	0.5	0.5	0.5	0	0.5	0.5	**0.390**
	Stan Schleuter Loop	9	A	1	24,073	1161	106	0.0482	0.0044	9%	3	13	0.79	1	0.5	0	1	1	1	**0.763**
	Fort Hood St	10	A	3	21,831	799	124	0.0366	0.0057	16%	0	0	0.78	1	0.5	0.5	0	0.5	0	**0.583**
	Hallmark Ave	11	A	11	6,457	142	9	0.0220	0.0014	6%	0	0	0.58	0	0	0	0	1	0	**0.225**
	2nd St	12	A	21	8,109	88	9	0.0109	0.0011	10%	0	0	0.40	0	0	0.5	0	1	0	**0.220**
	WS Young Dr	13	A	14	18,250	662	61	0.0363	0.0033	9%	0	16	0.54	0.5	0.5	0	0	1	1	**0.436**
	Rancier Ave	14	A	10	14,750	482	54	0.0327	0.0037	11%	2	0	0.62	0.5	0.5	0.5	1	1	0	**0.610**
	Roy Reynolds Dr	15	A	9	6,013	56	4	0.0093	0.0007	7%	0	0	0.64	0	0	0	0	0	0	**0.191**
	Trimmier Rd	17	A	5	10,557	789	91	0.0747	0.0086	12%	3	16	0.75	0.5	1	0.5	1	1	1	**0.776**
	Willow Springs Rd	18	A	12	16,091	171	23	0.0106	0.0014	13%	0	0	0.57	0.5	0	0.5	0	1	0	**0.372**
	FM 2271	19	A	25	7,811	97	10	0.0124	0.0013	10%	0	1	0.28	0	0	0.5	0	0	0	**0.135**
	FM 93	21	A	8	7,213	87	15	0.0121	0.0021	17%	0	1	0.68	0	0	0.5	0	0	0	**0.254**
	FM 439	22	A	26	5,049	184	20	0.0364	0.0040	11%	1	2	0.26	0	0.5	0.5	0.5	0	0	**0.277**
	Loop 121	23	A	13	8,228	353	65	0.0429	0.0079	18%	2	8	0.55	0	0.5	0.5	1	0.5	0.5	**0.490**
	SH 317	24	A	17	7,698	639	108	0.0830	0.0140	17%	2	23	0.45	0	1	0.5	1	0.5	1	**0.560**
	31st St	25	A	16	16,410	757	65	0.0461	0.0040	9%	0	0	0.50	0.5	0.5	0	0	1	0	**0.374**
	Industrial Blvd	27	A	22	3,890	71	17	0.0183	0.0044	24%	0	0	0.38	0	0	1	0	0	0	**0.215**
	W Adams Ave	29	A	24	15,428	958	62	0.0621	0.0040	6%	0	9	0.34	0.5	1	0	0	0.5	0.5	**0.401**
	3rd St	30	A	15	9,682	170	10	0.0176	0.0010	6%	1	1	0.51	0	0	0	0.5	0.5	0	**0.252**
	1st St	31	A	18	11,883	159	13	0.0134	0.0011	8%	0	1	0.42	0.5	0	0	0	1	0	**0.276**
	E Adams Ave	33	A	19	6,800	164	6	0.0241	0.0009	4%	0	0	0.41	0	0	0	0	0.5	0	**0.149**
Highways	US 190	4A	H	15	10,872	96	7	0.0088	0.0006	7%	0	2	0.45	0.5	0	0	0	0	0	**0.234**
	US 190	4C	H	1	64,245	2733	585	0.0425	0.0091	21%	0	0	0.77	1	0.5	1	0	1	0	**0.657**
	US 190	4D	H	5	41,849	1205	166	0.0288	0.0040	14%	0	14	0.57	1	0.5	0.5	0	1	1	**0.595**
	US 190	4E	H	2	45,972	859	150	0.0187	0.0033	17%	0	10	0.63	1	0	0.5	0	1	1	**0.540**
	SH 195	16	H	8	12,929	379	30	0.0293	0.0023	8%	0	0	0.55	0.5	0.5	0	0	0	0	**0.341**
	IH 35	20A	H	4	55,734	943	201	0.0169	0.0036	21%	0	11	0.58	1	0	1	0	0	1	**0.524**
	IH 35	20B	H	14	94,603	985	223	0.0104	0.0024	23%	0	19	0.46	1	0	1	0	0	1	**0.487**
	IH 35	20C	H	12	58,041	1128	244	0.0194	0.0042	22%	0	15	0.53	1	0	1	0	0	1	**0.508**
	IH 35	20D	H	11	60,205	848	267	0.0141	0.0044	31%	0	0	0.53	1	0	1	0	0	0	**0.459**
	Loop 363	26A	H	3	16,726	104	14	0.0062	0.0008	13%	0	0	0.61	0.5	0	0.5	0	0.5	0	**0.357**
	Loop 363	26B	H	7	26,906	551	62	0.0205	0.0023	11%	0	9	0.56	1	0	0.5	0	1	0.5	**0.493**
	Loop 363	26C	H	9	20,870	369	38	0.0177	0.0018	10%	0	6	0.53	1	0	0.5	0	0	0.5	**0.435**
	Loop 363	26D	H	13	9,337	233	21	0.0250	0.0022	9%	0	1	0.52	0	0	0	0	0	0	**0.155**
	Loop 363	26E	H	16	5,931	144	16	0.0243	0.0027	11%	0	1	0.36	0	0	0.5	0	0	0	**0.159**
	Loop 363	26F	H	18	5,189	61	6	0.0118	0.0012	10%	0	1	0.22	0	0	0	0	0	0	**0.067**
	Airport Rd	28	H	6	15,469	155	8	0.0100	0.0005	5%	0	0	0.39	0.5	0	0	0	0	0	**0.216**
	US 190E	32A	H	17	11,077	126	8	0.0114	0.0007	6%	0	2	0.23	0.5	0	0	0	0	0	**0.169**
	US 190E	32B	H	10	11,403	104	9	0.0091	0.0008	9%	1	2	0.54	0.5	0	0	0.5	0	0	**0.336**

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