CONGESTION MANAGEMENT PROCESS

CAMPO
CAPITAL AREA METROPOLITAN PLANNING ORGANIZATION
CENTRAL TEXAS

Texas A&M Transportation Institute

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INTRODUCTION

Traffic congestion has become an increasing component in the lives of Capital Area residents. According to the Urban Mobility Report, produced by the Texas A&M Transportation Institute, the amount of commuter delay has nearly doubled in 20 years from 36 hours annually in 1997 to 66 hours in 2017 in the Capital Area.[1] In 2017, congestion has cost the region approximately $1.25 billion in lost personal productivity, increased shipping times of goods, and extra fuel consumed. This increased congestion serves as an indicator of the region's strong economy, with more people and their vehicles moving to the area and commuting to and from work. However, it also serves as a sign that the transportation system needs expansion, alternative approaches, and more efficient operations to facilitate better traffic flow. As congestion increases, the resulting delays can negatively impact further economic growth in the region.

To better understand regional congestion and to identify and monitor approaches to mitigate said congestion, the federal government has required metropolitan planning organizations (MPOs), such as CAMPO, to implement a Congestion Management Process (CMP). The CMP is a systematic and regionally-accepted approach for identifying, implementing, monitoring, and reporting on strategies for addressing congestion. A key focus of the CMP involves the assessment of alternative strategies (other than the provision of additional single-occupancy vehicle (SOV) capacity) for congestion management, to identify their effectiveness and to increase funding and implementation of those strategies found effective.

The Congestion Management Process includes the following key components:

- Development of congestion management objectives
- Establishment of measures of multimodal transportation system performance
- Establishment of a congestion management network
- 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
- Evaluation of the effectiveness of implemented strategies

Federal regulations require metropolitan areas with population exceeding 200,000 (known as Transportation Management Areas (TMAs)), to develop a CMP for implementation and integration into the metropolitan transportation planning process. Since EPA has not declared the Capital Area as a non-attainment area for emissions, the CAMPO's CMP will have fewer requirements than those MPOs located in non-attainment areas. However, with the continued growth of the region, and the looming possibility of the region surpassing allowable emissions levels, this CMP may require future modifications requiring the additional analysis of all projects prior to implementation.

Contrary to some MPOs use of the CMP as a plan, which requires updating every few years, the CMP is actually a process used to monitor mobility in the region. The intent of the CMP is to use its results to assist in the planning process. The CMP can help MPOs identify poor-performing roadways needing improvement, and recommend solutions that do not necessarily involve road widening and new construction. In addition, the CMP will provide information for implementers, policymakers and the general public about the state of congestion in the region.

REGIONAL CMP GOALS AND OBJECTIVES

Per federal regulation and guidance, the CMP requires a set of congestion management objectives that define what the region wants to achieve in regard to addressing congestion. The overarching intent for managing congestion through this process, expressed in both federal regulation and guidance, involves the implementation of congestion management strategies that can provide benefit without the need of adding capacity. Added capacity should be seen as a last resort, and when implemented, efforts should be undertaken to integrate other strategies to enhance and optimize the effectiveness of the improvement.

In September 2019, CAMPO approved the Regional Transportation Demand Management (TDM) Plan, which identifies a series of strategies designed to reduce automobile trips, roadway congestion, and parking demand by redirecting travel towards other modes, times, and routes. The CMP ties into the TDM Plan, in that federal regulations require an assessment of implemented congestion management strategies, such as TDM, to evaluate their effectiveness. The results of the evaluation will help decision-makers identify which strategies to continue and which to perhaps terminate.[2] Through the use of congestion management objectives and performance measures, the CMP provides a mechanism for ensuring that investment decisions are made with a clear focus on desired outcomes.

Based on the objectives of the TDM plan, and in conjunction with the goals and objectives of the 2040 Long Range Plan, the following objectives have been identified for addressing congestion in the region:

Objectives

- Identify and support TDM projects and strategies before capacity projects when developing corridor studies, long range plans, and other planning documents;
- Incorporate TDM measures into capacity expansion projects to maximize the roadway's effectiveness and extend the lifespan of the roadway.
- Improve the efficient transportation of goods to, from, and through the region to sustain its economic competitiveness.
- Improve safety on the region's roadways, not just to reduce fatalities, injuries, and property damage, but to reduce the non-recurring congestion that crashes cause.
- Incorporate technological solutions to enhance the management and operations of the transportation system.
- Implement projects that encourage everyday use of active transportation, such as walking and bicycling, for commuting or other trips.
- Reduce the number of single-occupant vehicles, through the promotion and availability of transit, carpools, and vanpools, to ensure efficient use of the roadway network.
- Educate interested employers and trip generators on options, including flex schedules and teleworking
- Provide travelers with pre-trip traffic information and alternate route options in order for travelers to assess their travel options.

CMP SYSTEM MONITORING AND PERFORMANCE MEASURES

Federal CMP guidance promotes the development of performance measures to track system performance to both measure that extent of congestion in the region, as well as to measure the benefits of congestion-reduction and mobility-enhancement strategies for people and goods.

The CMP's performance measures serve several key purposes. These measures help quantify the improvement or degradation of the transportation system as a whole over time. They also help MPOs and localities in identifying poorly performing roadways in need of improvement. Finally, and one of the most important reasons, these performance measures help MPOs measure the benefits of instituted transportation improvements to identify approaches proven to reduce congestion and improve overall network performance.

Data Sources

The CMP revolves around data collection to calculate the level of congestion on the system, as well as the benefits of project implementations. While federal guidance provides a list of potential performance measures for consideration, some of the proposed measures require additional data collection, which may prove costly in terms of money and staff resources. In addition, some of the proposed measure have qualitative factors that may need addressing before their use in the CMP. The proposed performance measures utilize accessible, low-cost datasets that allow the MPO to conduct the required analysis without the time and money required to collect and process data:

- *Roadway Highway Inventory Network Offload (RHINO)* - TxDOT annually produces a roadway inventory of public roadways in the state. Key information used include miles, lane miles, daily vehicle miles of travel and daily truck vehicle mileage of travel.
- *INRIX Speed Data* - INRIX is a private company that captures and provides speed and travel time information from various sources including GPS, cell phones, and in-car navigation systems. The data includes average speeds in 15 minute increments for each section of its roadway network. INRIX data allow for use of actual speed information instead of estimates and reduce the need for physical travel time runs.
- *Crash Records Information System (CRIS)* – TxDOT provides crash record information from CRIS, which includes crash locations and severity, which when integrated in the CMP, can identify roadways in potential need of safety improvements.
- *Capital Metro Automatic Passenger Counter (APC) data* – Capital Metro collects ridership information, including boardings, alightings, and ridership at each stop. These data allow for the assignment of transit ridership by CMP roadway segment to estimate the percentage of transit usage for each segment.

Due to the availability of data at the time of production, Calendar Year 2017 serves as the baseline year for the CMP. Due to delays in formalizing datasets, future year analyses will continue to be approximately two years behind.

While this document identifies the above-mentioned data sources for current use, the MPO will continue to search for more comprehensive datasets, which may replace what is currently available. In addition, the MPO recognizes that datasets may improve and change over time, due to available technologies and improved methodologies. While these improvements might benefit the overall results, the MPO will need to be able to explain these changes in its reporting.

Key Performance Measures

Based on the available data, a series of performance measures have been identified for the CMP. These measures provide a picture of system performance in terms of speeds, expected travel times, truck/goods-based travel, transit, and the level of safety. With additional data sources, other aspects of transportation performance can be added to the CMP. The key performance measures identified are as follows:

Average Speeds

Average speeds for this report come from INRIX. The report not only provides an average speed for each segment, but also provides breakdowns for average AM, PM, mid-day, and low-volume (free-flow) speeds.

Travel Time Index (TTI)

The Travel Time Index (TTI) compares peak period travel time to low-volume travel time. The Travel Time Index includes all travel conditions, including recurring and non-recurring (e.g. crashes, stalls, etc.) incidents. The TTI indicates the average amount of extra time expected for any trip. For example, a TTI value of 1.50 indicates a 20-minute trip in the off-peak will take 30 minutes in the peak.

Planning Time Index (PTI - 80th and 95th Percentile)

The Planning Time Index (PTI) reflects how much total time a traveler should allow for ensuring on-time arrival in the event of an unexpected problem on the roadway. The CMP uses two planning time indices – the 80th percentile PTI (PTI80) and the 95th percentile PTI (PTI95).

The PTI80, based on the 20th percentile travel speeds from the INRIX dataset, provide an estimate of average travel times during the worst travel day of the week. These speeds and travel times most likely occur due to non-recurring events, such as crashes. Research conducted through the Second Strategic Highway Research Program (SHRP2) identified that operational improvements, such as incident management programs, improved PTI80 values.[3]

PTI95, based on the 5th percentile travel speeds, provide an estimate of average travel times on the worst travel day of the month. These speeds and travel times most likely occur due to a major event, such as extreme weather, a large-scale HAZMAT spill, or a traffic fatality. Responding agencies have minimal control over weather-related impacts. While operational improvements might have some impact in terms of shortening incident time, extreme incidents may still take several hours to clear.

Total Delay and Costs

The CMP separates delay into two variables – Person Delay and Truck Delay. Person delay measures the amount of delay that individual road users experience, including drivers and passengers. This variable is based on vehicle volumes on a facility from the RHINO network and congested travel time information from the INRIX data, combined with average vehicle occupancy estimates (1.5 persons per vehicle). For this CMP, the value of time per person was calculated at $18.12 per person per hour, based on the 2019 Urban Mobility Report developed by the Texas A&M Transportation Institute.[4]

Truck delay specifically looks at the amount of delay experienced by trucks on the system. While calculated similarly to person delay in terms of data sources, truck delay is calculated based on the truck – not on the number of people in the truck – to reflect the cost of delay for goods delivery. The value of truck delay per hour per the 2019 Urban Mobility Report equaled $52.14 per hour.

Wasted Fuel Consumption and Costs

The CMP also estimates the amount and value of fuel wasted due to congestion. The process calculates the amount of fuel consumed at congested speeds in comparison with the amount of fuel that would be consumed at free-flow/low-volume speeds.[5] A monetary value can be calculated for wasted fuel by multiplying the amount of wasted fuel with the average cost of fuel for vehicle travel ($2.17/gallon) and truck travel ($2.31/gallon-diesel).

Total Congestion Cost

Total Congestion Costs for CMP segments are calculated by adding the cost of person delay and truck delay on the segment to the cost of estimated wasted fuel resulting from the delay.

Safety Performance

Crash information comes from TxDOT's Crash Records Information System (CRIS), which provides information about crashes in the region. Crashes were assigned to their respective CMP segment for analysis. To promote alignment with FHWA Safety Performance measures, the CMP reports the following safety information:

- Fatalities (2016-2018)
- Fatality Rates (fatalities per 100 million vehicle miles traveled)
- Serious Injuries (2016-2018)
- Serious Injury Rates (serious injuries per 100 million vehicle miles traveled)
- Non-motorized (bicyclists/pedestrian) fatalities and serious injuries combined (2016-2018)

The use of three years of data helps to smooth out any anomaly years. Injury and fatality rates are calculated by averaging the three years of data (2016-2018) and dividing it by the number of annual vehicle miles traveled (expressed in crashes per 100 million vehicle miles traveled) for the year of analysis (2017).

Transit Availability and Usage

The CMP should also identify and monitor other modes of transportation if the information is available. For transit usage, Capital Metro provides datasets on its infrastructure, including routes and stops throughout its system. To report on transit availability, the CMP reports on the number of transit stops per CMP segment and the number of routes passengers have access to on the segment. In addition, the CMP will report on the number of transit boardings per segment. This will allow for assessing of growth of transit usage along each segment.

CARTS provides commuter and local transit services in smaller communities throughout the region, including circulator routes in Georgetown, Bastrop, and San Marcos. CARTS currently does not have automated passenger count systems that allow for segment-based transit calculations. As data become available, they should be integrated into the analysis.

CMP NETWORK

The CMP network consists of roadways within the CAMPO boundaries (Bastrop, Burnet, Caldwell, Hays, Travis, and Williamson Counties) based on the following criteria:

INRIX Data Availability – As mentioned prior, the CMP relies on data collection to calculate congestion levels, measure improvement and degradation of the network, and to estimate the benefits of project implementations. As INRIX was identified as the most comprehensive dataset available for the cost and effort, segments on the CMP network must have corresponding INRIX data available in order to conduct the required calculations. As the geographic availability of INRIX data expands, CAMPO should modify the CMP network to incorporate additional segments.

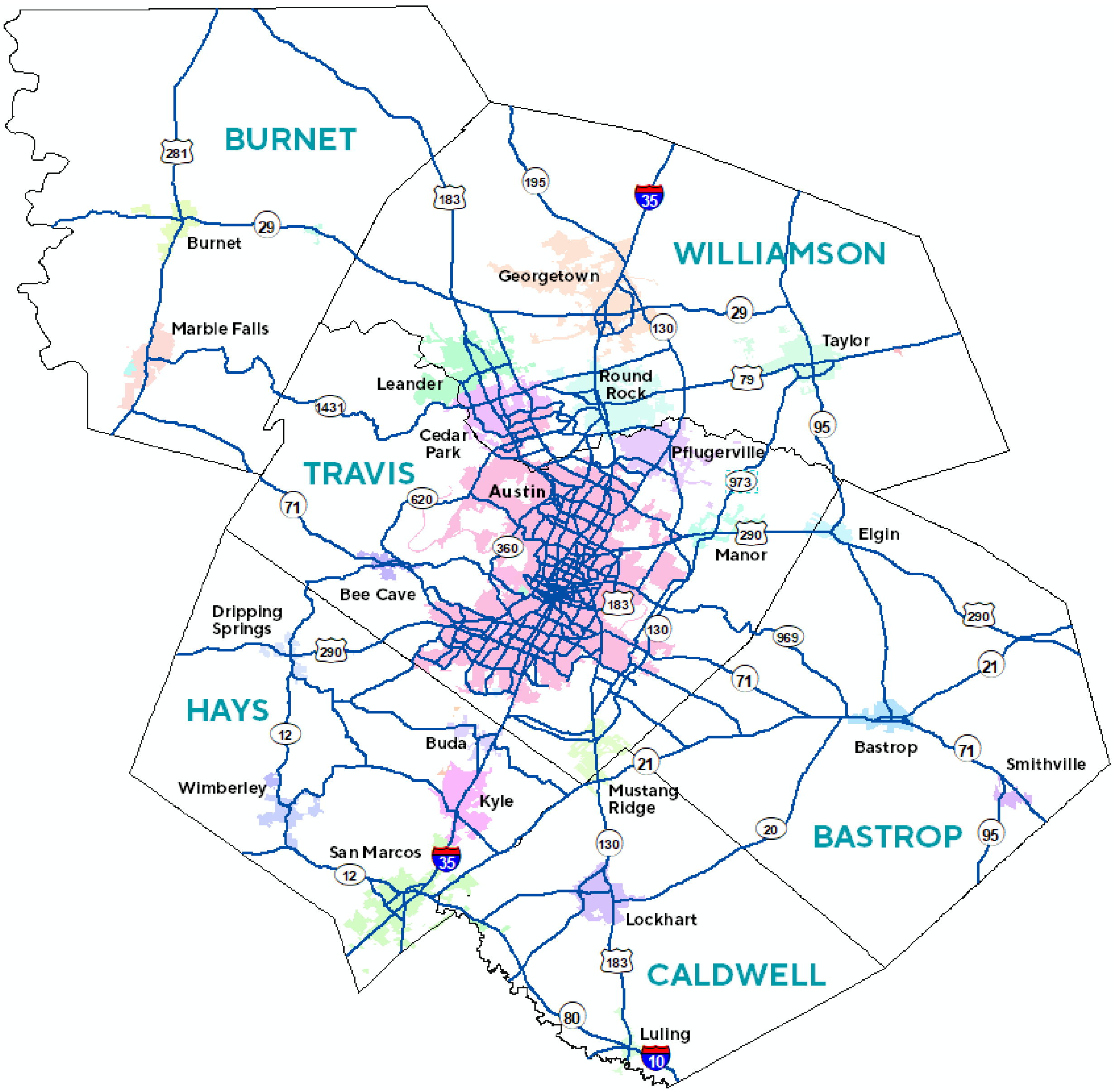
Functional Classification – Within the confines of INRIX data availability, the CMP network includes urban and rural interstates, freeways, expressways, toll roads, and arterials (both principal and minor). The network also includes major collectors with average annual daily traffic (AADT) of 5,000 vehicles per day per TxDOT's RHINO Network.

Frontage Roads – As of this version, frontage roads were not included in this assessment. Most of the frontage roads did not have complete INRIX data to conduct congestion calculations. Frontage roads that serve as the free lanes for toll facilities on US 290 East, MoPac, SH 45 were included to will provide free-versus-toll lane performance. The process will reassess frontage road data for limited-access facilities upon release of new INRIX data to allow for its inclusion.

City of Austin Vehicle and Transit Priority Networks – The City of Austin, as part of its Strategic Mobility Plan, has identified Vehicle and Transit Priority Networks. The Vehicle Priority Network includes streets carrying over 10,000 vehicles per day and represents the higher-traveled streets on the system. The Transit Priority Network reflects Capital Metro's high-frequency service, along with planned expansions, which carry the larger share of transit riders on the system. The CMP network includes most of these facilities where INRIX data are available.

In addition to the above-mentioned criteria, certain roadways were included to connect identified roadway segments to other CMP segments where a segment terminated without a connection. For example, FM 1431 contained a gap between Smithwick in Burnet County and Lago Vista in Travis County where the roadway was classified as a rural collector with under 5,000 vehicles per day. This segment was included in the CMP in order to provide connectivity with the other two portions of FM 1431.

Figure 1: CAMPO CMP Network



CMP NETWORK PERFORMANCE

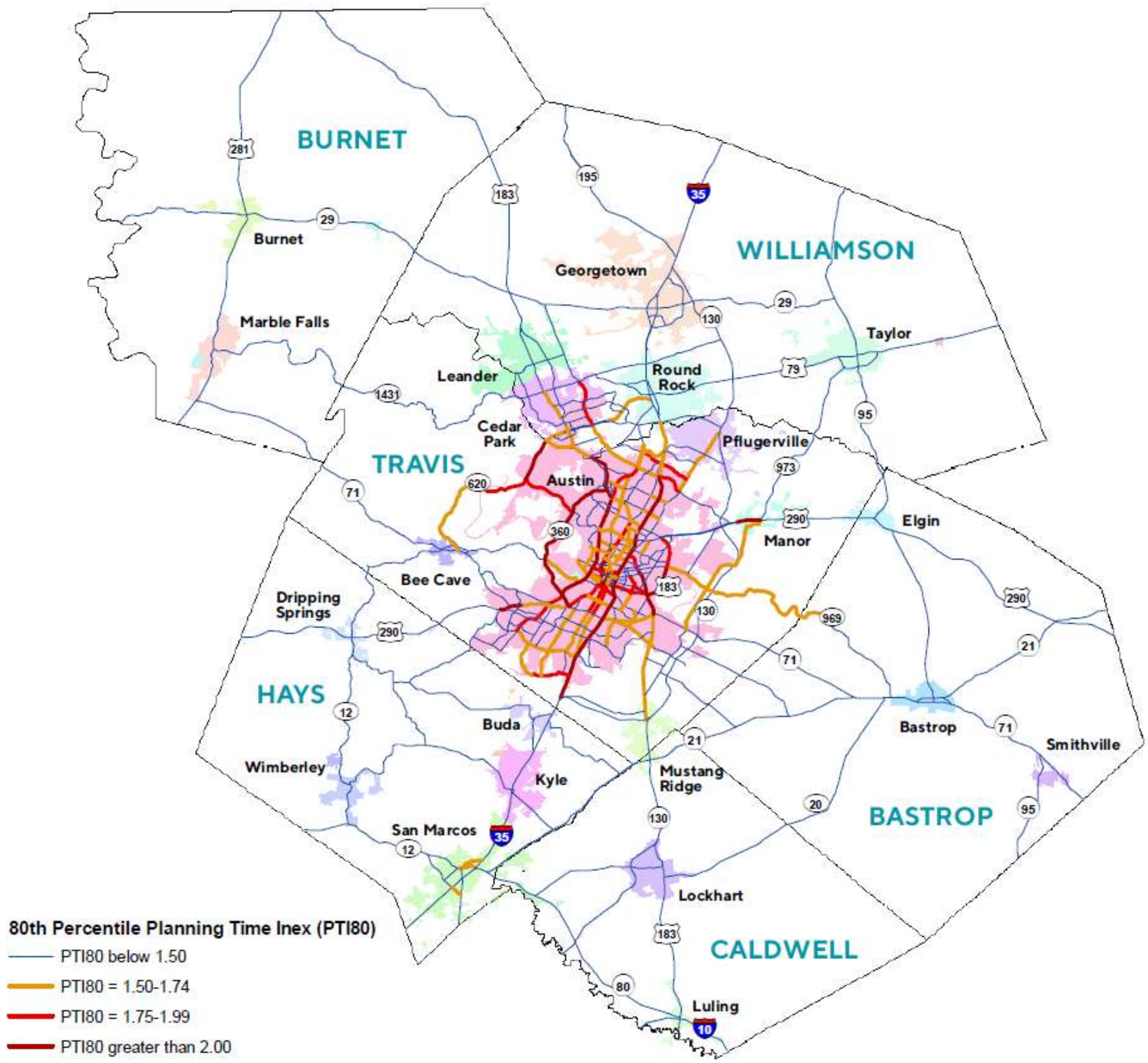
To identify poor-performance roadway segments, the CMP uses the 80th Percentile Planning Time Index (PTI80) to identify roadways that have a low level of reliability. In conjunction with FHWA performance measures, segments with a PTI80 value of 1.50 or greater were categorized as "unreliable" during peak travel times. Users should plan to spend an additional 50 percent more time to reach their destinations on these segments during peak periods

The following segments were identified as unreliable based on a PTI80 index of 1.50 or greater (a complete list of segments and their corresponding PTI80 indices can be found in Appendix A):

Table 1: Unreliable/Congested CMP Segments (Based on PTI80 index ≥1.50)

County	Facility Name	Segment Limits	PTI 80	County	Facility Name	Segment Limits	PTI 80
Travis	IH 35	MLK to Cesar Chavez	5.02	Travis	Brodie	Slaughter to FM 1626	1.69
Travis	IH 35	Cesar Chavez to Ben White	4.32	Travis	Parmer	IH 35 to MoPac	1.69
Travis	IH 35	MLK to Airport	3.99	Travis	35th Street	Balcones to MoPac	1.68
Travis	MoPac	Lake Austin Blvd to FM 2222	3.90	Travis	US 290/SH 71	Westgate to McCarty Lane	1.68
Travis	IH 35	Airport to US 183	3.10	Travis	Koenig/Allandale/Northland	Lamar to Balcones	1.66
Travis	Capital of Texas	Bee Caves to FM 2222	2.90	Travis	Berkman	51st to US 290	1.66
Travis	Airport	7th St. to MLK	2.61	Travis	5th Street	Congress to IH 35	1.65
Travis	MoPac	Lake Austin Blvd to Cap. of Texas	2.60	Travis	Braker	Jollyville to Burnet	1.65
Travis	IH 35	Ben Whilte to Slaughter	2.59	Travis	MLK	Lamar to IH 35	1.64
Travis	Lamar	Riverside to 15th St.	2.57	Travis	Braker	Lamar to Dessau	1.64
Travis	MoPac	US 183 to FM 2222	2.45	Travis	Guadalupe	MLK to 29th St.	1.64
Travis	Capital of Texas	FM 2222 to Spicewood Springs	2.41	Travis	US 183	SH 71 to SH 130	1.63
Travis	US 183	MoPac to Spicewood Springs	2.38	Williamson	US 183	McNeil to Lakeline Blvd	1.63
Travis	US 290	McCarty Lane to FM 1826	2.32	Travis	Koenig	IH 35 to Lamar	1.62
Travis	IH 35	Slaughter to SH 45	2.32	Travis	Airport	IH 35 to Lamar	1.62
Travis	Capital of Texas	Spicewood Springs to US 183	2.30	Travis	Bee Caves	MoPac to Capital of Texas	1.62
Travis	US 290	FM 973 to Parmer	2.28	Travis	12th Street	San Jacinto to IH 35	1.62
Travis	US 183	Airport/7th to MLK	2.21	Williamson	Parmer	FM 620 to McNeil	1.61
Travis	US 183	SH 71 to Airport/7th St.	2.19	Travis	Exposition	Lake Austin Blvd to 35th St.	1.61
Travis	IH 35	Parmer to US 183	2.18	Travis	Manchaca	Slaughter to Ben White	1.61
Travis	Guadalupe	12th St. to Cesar Chavez	2.18	Travis	Burnet	US 183 to MoPac	1.61
Travis	Cesar Chavez	S. 1st to Lamar	2.16	Travis	5th Street	Lamar to Congress	1.61
Travis	Capital of Texas	Lamar to Bee Caves	2.09	Travis	Parmer	McNeil to MoPac	1.61
Travis	FM 620	FM 2222 to Anderson Mill	2.06	Travis	MoPac Service Road	Merrilltown to Parmer	1.60
Travis	Lamar	15th St. to 29th St.	2.02	Travis	FM 969	US 183 to SH 130	1.60
Travis	Cesar Chavez	S. 1st to IH 35	2.01	Travis	FM 620	SH 71 to Colorado River	1.60
Travis	Riverside	IH 35 to Congress	2.00	Travis	S. Congress	Slaughter to Ben White	1.59
Travis	Lamar	US 183 to 51st St.	1.98	Williamson	FM 620	Anderson Mill to US 183	1.59
Travis	Lamar	29th St. to 51st St.	1.98	Travis	Ben White	IH 35 to US 183	1.59
Travis	Red Bud	Lake Austin to Westlake	1.96	Travis	Anderson Mill	US 183 to FM 620	1.58
Travis	S. 1st	Ben White to Cesar Chavez	1.93	Travis	Lake Austin Blvd	MoPac to Enfield	1.58
Travis	Pleasant Valley	Colorado River to Chestnut	1.92	Travis	5th Street	MoPac to Lamar	1.57
Travis	RM 2222	Capital of Texas to FM 620	1.92	Hays	Hopkins	Moore St. to IH 35	1.57
Travis	Howard	IH 35 to Wells Branch	1.92	Williamson	FM 620	SH 45 to IH 35	1.57
Williamson	Parmer	FM 620 to Whitestone	1.92	Travis	38th Street/35th Street	MoPac to Guadalupe	1.57
Travis	S. Lamar	Ben White to Riverside	1.90	Travis	Slaughter	IH 35 to Manchaca	1.56
Travis	MoPac	US 183 to Parmer	1.90	Travis	Cesar Chavez	MoPac to Lamar	1.56
Travis	7th St.	Pleasant Valley to Airport/US183	1.90	Travis	Wells Branch	IH 35 to MoPac	1.56
Travis	Riverside	Congress to Lamar	1.89	Travis	Congress	Cesar Chavez to 11th St.	1.56
Travis	US 183	MLK to US 290	1.89	Travis	St. John's	IH 35 to Lamar	1.56
Travis	MoPac	Slaughter to Capital of Texas	1.85	Travis	Rundberg	Lamar to Dessau	1.56
Travis	6th Street	Lamar to MoPac	1.85	Travis	Pleasant Valley/Todd Lane	William Cannon to Ben White	1.55
Travis	Cesar Chavez	Chicon to 7th	1.84	Hays	Aquarena Springs/University	IH 35 to Hopkins	1.55
Travis	Cesar Chavez	IH 35 to Chicon	1.83	Travis	S. 1st	Slaughter to Ben White	1.55
Travis	FM 620	FM 2222 to Colorado River	1.83	Travis	Burleson	Ben White to US 183	1.54
Travis	S. Congress	Ben White to Cesar Chavez	1.83	Travis	Burnet	Koenig to US 183	1.54
Travis	Parmer	IH 35 to Dessau	1.83	Hays	Wonder World	IH 35 to SH 123	1.54
Travis	FM 1626	Brodie to IH 35	1.81	Travis	45th Street	MoPac to Guadalupe	1.52
Travis	Guadalupe	MLK to 12th St.	1.81	Travis	38th Street/38-1/2 Street	Guadalupe to IH 35	1.52
Travis	Howard	Dessau to IH 35	1.79	Travis	Dessau/FM 685	Parmer to SH 130	1.52
Travis	Trinity	11th St. to MLK	1.78	Travis	Oltorf	IH 35 to Lamar	1.52
Travis	Barton Springs	Congress to Lamar	1.77	Travis	FM 973	SH 130 to US 290	1.52
Travis	15th Street/Enfield	Lamar to MoPac	1.76	Travis	Slaughter	Manchaca to MoPac	1.51
Travis	Airport	MLK to IH 35	1.76	Travis	FM 973	SH 71 to SH 130	1.51
Travis	Manchaca	Slaughter to FM 1626	1.74	Travis	FM 969	SH 130 to FM 1704	1.51
Travis	15th Street	IH 35 to Lamar	1.74	Travis	29th Street	Lamar to Guadalupe	1.51
Travis	IH 35	SH 45 to Parmer	1.73	Travis	Duval	San Jacinto to North Loop	1.51
Travis	Pleasant Valley	Oltorf to Colorado River	1.72	Travis	51st Street	Lamar to IH 35	1.50
Williamson	US 183	Whitestone to Lakeline Blvd	1.72	Travis	Lamar	US 183 to Braker	1.50
Travis	US 183	IH 35 to MoPac	1.72	Hays	SH 123/Loop 82	Hopkins to RR 12	1.50
Travis	Montopolis/Grove Blvd	Burleson to Riverside	1.71	Travis	MoPac	SH 45 to Slaughter	1.50

Figure 2: Congested CMP Segments



CONGESTION MANAGEMENT STRATEGIES

One of the key purposes of the CMP is to identify a set of recommended activities to effectively manage congestion without the need to build additional capacity. To that end, the CMP identifies a series of congestion management strategies to help reduce congestion. Many of these strategies come from CAMPO's Transportation Demand Management (TDM) Plan approved in September 2019. The list of strategies below have been split into four categories:

- Roadway improvements that include physical roadway modifications, access consolidation and control, intersection improvements, complete street development, and lane management.
- Public transit enhancements to make transit a more attractive and competitive mode for transportation.
- Bicycle and pedestrian improvements to promote active transportation modes and expand connectivity for those without access to motor vehicles.
- Operational and technology-based solutions to maximize the efficiency of the existing infrastructure and allow for better system management.

While this is a comprehensive set of options, the CMP does not restrict options not listed that may show a positive impact on congestion.

Roadway Improvements

Tolled Managed/Express Lanes	Tolled Managed Lanes or Express Lanes are a set of lanes separated from existing non-tolled lanes that are managed through congestion pricing to help ensure a more reliable travel option. These lane have technologies installed to increase tolls when traffic is heavy and lower them when traffic is light. This makes their usage less desirable during congested times and preserves faster speeds during peak travel periods. If desired by the system's operator and policy makers, these lanes can have tolls waived for public transit buses and registered van pools to promote multi-passenger vehicle usage.
High-Occupancy Vehicle/High-Occupancy Traffic (HOV/HOT) Lanes	HOV/HOT lanes are designated lanes primarily for use by transit and vehicles carrying at least two people. These lanes allow multi-passenger vehicles to travel faster and avoid congestion during peak periods. Since these lanes do not experience nearly the congestion of freeway lanes, the HOT component allows for single-occupancy vehicles to use the lanes for a charge.
Hard Shoulder Running	Hard shoulder running allows for the usage of a paved shoulder as a travel lane during peak travel periods. It can help alleviate increased travel demand by providing additional capacity during peak travel times without physically expanding the roadway.
Transit on Shoulder	Transit on Shoulder is a limited form of hard shoulder running, converting the paved shoulder into a dedicated transit lane during peak travel periods. This allows for faster, more reliable transit operability and enhances transit as a commuting option.
Access Management	Access management strategies provide congestion and safety benefits by reducing the number of potential conflict points on a facility. More driveways, intersections, and access points create more opportunities for turning traffic to interfere with the flow of a facility. In addition, more access points create more opportunities for crashes. Strategies include medians, turn lanes, side/rear access points between businesses, and shared access.

Bottleneck Removal	Bottleneck removals address short-distance capacity reductions, which can include main lane interactions with entrance/exit ramps, extreme roadway curves, substandard design elements, and other physical limitations that form a capacity constraint. Examples for addressing bottlenecks include extending acceleration/deceleration lanes, hard shoulder running during peak periods, entrance/exit reconfiguration, and adding lanes within the existing space, if available.
Intersection Reconfiguration	Intersections inherently contribute to congestion as traffic in one set of directions must stop to allow the other directions to flow. In addition, poorly designed intersections can restrict flow through them as traffic waiting to turn can interfere with through traffic. Improvements such as the installation of turn lanes, increasing turn lane bays, improved signal timing, and in some cases, innovative designs such as roundabouts, can reduce restrictions and increase throughput.
Grade Separations	Intersections with a high volume of traffic limit can create both a congestion and a safety problem. Traffic signals create flow interruptions, which can result in severe queueing during peak travel periods. In addition, the amount of traffic increases the opportunity for a crash. Grade-separating these locations allow an uninterrupted flow of traffic at least in one direction while significantly reducing the safety threat posed by trains, pedestrians, or other vehicles.

Transit and Other Multi-Passenger Transportation

Expanded Transit	The provision of expanded service through additional public transit routes, park-and-ride facilities in developing areas, connections to existing service routes and facilities, and additional buses on existing routes for increased frequency.
Bus Rapid Transit (BRT)	A higher-speed bus system using dedicated transit lanes that reduce reliance on congested general purpose lanes. In conjunction with fewer stops, prohibition of vehicles turning across BRT lanes, and signal priority, BRT systems can offer faster, more frequent, and more reliable transit service.
Vanpools	Vanpooling allows for 5-15 individuals with a similar commute trip where the participants share their own driving responsibilities, thereby covering the primary "cost" of operation. Vanpool users share operational costs, which may be partially or fully subsidized by employers, transit authorities, or other governmental entities. Vanpool users can also receive a pre-tax benefit for their share of costs.
Carpools	Carpooling allows for shared vehicle use with at least one additional person, reducing individual travel and fuel costs, as well as overall vehicles on the road. While carpool opportunities may be company-centric, several online carpool matching services, such as Waze Carpool and RideAmigos exist to connect travelers.

Transit Incentives	The provision of transit incentives by companies can give employees a discounted way to work while improving overall mobility in the region. While contributing to the reduction in congestion, promoting transit usage allows for employers to reduce their need and associated costs for parking provision.

Active Transportation

Pedestrian Facility Expansion and Improvement	Assuring a safe and connected pedestrian network allows for the promotion of walking over driving as an active travel option. This includes the addition of new sidewalks or walking paths to connect neighborhoods to workplaces and other commercial opportunities, the maintenance of existing sidewalks to ensure user safety, adding pedestrian accommodations at signalized intersections for all users, and the provision of lighting to add security during night-time use.
Bicycle Facility Expansion and Improvement	Assuring a safe and connected bicycle network allows for the safe use of bicycles for commuting over driving. This includes the construction and maintenance of bike lanes and trails, the connection of non-continuous bike lanes on a facility, and the installation of safety elements to provide a level of protection for bicycle network users.
Bike to Work	Bike to Work programs encourage active transportation usage for commuters by reducing barriers to using bike travel. Examples of implementation include options for transporting bicycles on buses and trains, the installation of onsite bike storage, and the provision of showers and lockers to help accommodate cyclists.
Bike Share	Bike share programs provide rental of a shared bike for a nominal fee, providing access to travelers who would like to utilize active transportation but do not want to pay to own, store, and maintain a personal bike. Bike share programs also offer a last-mile option for transit users who still have a distance to go after their stop.

Operational and Technology-Based Solutions

Dynamic Traveler Information	Dynamic traveler information provide real-time information to travelers to help find information about travel options. These tools, often provided through websites and smart phone apps, as well as on dynamic message signs on roadways, give users up-to-date information about roadway congestion, wait times for various modes, transit delays, and potential route variations and barriers. This helps users make informed decisions on travel including which routes or modes to take, and when is the best time to travel.

ITS Communication Networks	Creating an ITS communication network will allow for the installation of technologies, such as traffic signals, CCTV cameras, dynamic message signs, and traffic detection systems. These communications allow for real-time transmission of information to traffic management personnel and the traveling public. These networks can include fiber-based or wireless communications.
Traffic Signal Coordination and Centralization	Improvements in traffic signal technology has allowed for the communication and coordination of traffic signals along arterials to improve traffic flow. Communications to a centralized computer system can assess flow conditions and modify signal timing along a corridor to improve it. Also, a centralized system can also identify signal malfunctions, which potentially can be quickly addressed remotely from an operation center instead of sending out a maintenance crew to repair the signal.
Traffic Management Centers/System Monitoring Technology	Roadway system monitoring can provide information about system performance in real time. Radar and Bluetooth-detection units provide segment speeds and can identify roadway segments with abnormally low speeds. CCTV cameras allow for traffic management staff to monitor the system for incidents. Loops, radar, and certain camera systems can provide roadway vehicle volumes and classification information. The information from these systems often transmit to a Traffic Management Center (TMC), which houses staff that can initiate efforts to address any system breakdowns identified through these systems, including the dispatch of incident management personnel to address a crash or stall, or maintenance personnel to quickly repair an infrastructure issue contributing to congestion.
Parking Management	Parking management can impact congestion by informing the public about parking availability, influencing when travelers commute, and potentially influencing mode choice. Capturing real-time parking information to users and ensuring the availability of spaces to reduce circling around parking facilities. If parking options appear limited, travelers may choose to take transit or other modes of transportation to get to their destination. In addition, variable pricing of parking, based on demand, may also influence travelers to investigate alternative modes to avoid paying the elevated prices.
Incident Management	Incident management addresses non-recurring congestion stemming from crashes or disabled vehicles, which impede the flow of traffic. Efforts such as service patrols, towing programs, and coordinated response allow for the faster removal of vehicles from incident scenes allow for faster restoration of traffic flow.

Special Event Management	Special events, such as sporting events and festivals, create an increase in travel demand, usually at non-traditional peak travel times. Some events may require road closures, creating additional impacts on the rest of the transportation system. Special event management strategies, including pre-event traveler information, staging of responders, and increased transit operations, can allow for pre-event planning by travelers, quicker response to incidents, and alternatives for getting to the event.
Work Zone Management	While not a strategy to fund as a stand-alone approach, effective work-zone management helps minimize the congestion caused by maintenance and construction activities. It should be considered as a component for construction activities. Examples include pre-zone traveler information and queue warnings to inform travelers to consider other routes, and incident management plans to address crashes and stalls that can exacerbate an already-restrictive roadway.

Other Strategies

Flexible Work Hours	Flexible work schedules involve the shifting of workday start and end times, or the option of compressed work schedules (such as 4-10 hour workdays). This strategy allows for commutes that avoid peak hours of traffic, thus reducing the number of vehicles operating during peak hours.
Telecommuting/Teleworking	Telecommuting/teleworking allows employees to regularly work from home or some alternate location, reducing the number of vehicles in congested traffic or removing vehicles from the transportation system completely during peak travel times.
Flexible Emergency/ Guaranteed Ride Home Programs	Flexible Emergency/Guaranteed Ride Home (GRH) programs provide free rides home in case of emergency, illness, or unexpected circumstances, including unplanned overtime, for regular users of alternative modes of transportation. Providing access to emergency transportation reduces barriers for those interested in switching transportation modes or utilizing shared mobility services but choose to use personal vehicles in the event of an unexpected circumstance.
Car Sharing	Car sharing allows for travelers that might not need a car on a regular basis to share vehicles among multiple users without the cost of ownership. Usually a subscription-based program, subscribers pay a charge with each trip needed. For users of alternative modes, car sharing allows for continued use of those modes and provides a car only when needed.

IMPLEMENTATION OF CMP STRATEGIES

The following projects have been identified as including at least one of the above-mentioned CMP strategies.

Project Type	Description	Limits	Cost	CSJ
Active Transportation	Construct bike/ped trail	Northern Walnut Creek Trail from West of Lamar to IH-35 in Austin	$2,009,050	0914-04-243
Active Transportation	South West Drive – Horseshoe to Lion Dr.	Construct .23 mile sidewalk on South West Drive	$305,762	
Active Transportation	SL 332 – SH 29 to CR 279	Liberty Hill Downtown Bike/Ped Loop	$1,348,481	0151-08-010
Active Transportation	US 290 at SH 130 Interchange	Add Shared Use Path Bridge at SH 130 Interchange	$1,337,399	0114-02-108
Active Transportation	Bastrop River Loop – Old Austin Highway to Walnut Street	Complete 1.8 mile "River Loop" shared-use path along Loop 150, SH 71, Water St, and Main St	$594,000	
Active Transportation	Guadalupe St in San Marcos – nine intersections	Install Countdown Pedestrian Signals, Audible Walk Signals and ADA Ramps	$178,145	0914-33-077
Active Transportation	San Marcos River – East of Hopkins to West of IH-35 SBFR	San Marcos River Shared Use Path	$2,244,356	0914-33-078
Active Transportation	Home Depot Boulevard – MoPac to William Cannon	Violet Crown Trail North: Construct 1.2 mile 12-foot wide natural composite trail	$1,471,250	
Active Transportation	Austin to Manor Phase II Urban Trail – Lindell Lane to Ben E. Fisher Park	Austin to Manor Phase II Urban Trail: Construct 12-foot concrete trail from Lindell Ln to Manor, Texas (approximately 2.9 miles)	$4,716,250	
Active Transportation	Various Locations	Construct 10 pedestrian hybrid beacons within the City of Austin	$1,459,500	
Active Transportation	800' West of US 183 to 500' East of Parmer Lane in Cedar Park	Shared Use Path: Adjacent To Roadway	$418,715	0914-05-190
Active Transportation	Heritage Trail at Creekside Plaza to 1.1 Miles NW Along Brushy Creek	Construct 10-Ft Wide Shared Use Path In Round Rock With Pedestrian Bridge	$1,449,837	0914-05-191

Project Type	Description	Limits	Cost	CSJ
Active Transportation	Blake Manor Rd – Proposed Wildhorse Connector to Travis County East Metro Park	Construct a new shared use path	$2,520,500	0914-04-273
Active Transportation	Bastrop State Park to Chestnut Street at Loop 150	Construct Multi-Use Path	$1,300,000	0914-18-109
Active Transportation	FM 2001 – Overpass Road to FM 119/Old Goforth Road	Construct a 10-foot wide multi-use path for pedestrian and bicycle traffic along the east side of FM 2001 and Overpass Road	$500,000	
Active Transportation	Hopkins St – CM Allen Parkway to Thorpe	Construct Multi-Use Bike/Ped. Facility	$2,000,000	0914-33-075
Active Transportation	SH 123 – IH 35 to Dezavalla Dr.	Construct Sidewalks	$700,000	0366-01-077
Active Transportation	SH 80 – SH 21 to FM 1984	Complete Gap in Shoulder For Bicycle Travel	$5,000,000	0286-01-058
Active Transportation	Elroy Road/Moores Bridge Road	Construct new sidewalk on both sides of Elroy Road within SH 130 right-of-way and a shared use path on FM 973 from Moores Bridge Road to Elroy Road.	$1,278,030	0000-00-002
Active Transportation	US 281 – Nature Heights Drive to Lantana Drive	Construct curb and gutter, sidewalks and shoulders	$1,350,000	
Active Transportation	Brushy Creek North Fork – Parmer Lane to Brushy Creek Road	Construct 3-mile shared-use path along Brushy Creek North Fork	$2,672,408	
Active Transportation	Construct 6-foot sidewalk on Sportsplex Drive in Dripping Springs	US 290 to Mighty Tiger Trail	$360,603	0914-33-079
Complete Streets	Hopkins St – Moore St. to Bishop St.	Reconstruct Roadway With Multi-Use Path, Sidewalks, And Curb And Gutter	$5,500,000	0914-33-074
Complete Streets	FM 1626 - West of Brodie Lane to Manchaca Rd.	Reconstruct an existing 2-lane arterial to a 4-lane arterial with a continuous left turn lane with 5 foot wide shoulders and 6 foot wide sidewalks on both sides.	$11,200,000	1539-02-026

Project Type	Description	Limits	Cost	CSJ
Complete Streets	FM 2001 – from Sun Bright Blvd. to FM 2001	Upgrade from a 2-Lane to a 4-Lane Divided Roadway with New Traffic Signals and Bicycle/ Pedestrian Improvements	$7,260,000	
Complete Streets	FM 2304 - Ravenscroft Drive to FM 1626	Reconstruct an existing 2-lane divided arterial to a four-lane divided arterial with bicycle lanes and sidewalks.	$9,500,000	2689-01-023
Complete Streets	Kenney Fort Blvd – Forest Creek Drive to SH 45	Construction of a new limited access six-lane divided major arterial with shared use path	$17,500,000	
Complete Streets	Lakeline Blvd – Lyndhurst Blvd to Parmer	Expand Current 2-Lane Roadway with 2 Additional Travel Lanes and Upgrade Bicycle Facilities and Sidewalks	$17,125,000	
Complete Streets	Slaughter lane – Mopac to Brodie Lane	Convert existing four-lane to six-lane divided roadway with shared use path and intersection improvements	$15,726,250	
Complete Streets	West Rundberg Lane - Burnet to Metric	Extend current roadway as a four-lane major divided arterial with sidewalks, bike lanes, and new signalized intersection	$11,000,000	
Complete Streets	William Cannon – Running Water Driver to McKinney Falls Parkway	Convert existing two-lane to four-lane divided roadway with shared use path and intersection improvements	$14,687,500	
Complete Streets	Braker Lane – Dawes Place to Samsung Blvd	Extend roadway as a four-lane divided roadway with bicycle and pedestrian facilities	$14,050,000	
Complete Streets	Braker Lane North – Samsung Blvd to Harris Branch Parkway	Widen current and extend roadway as a four-lane divided roadway with bicycle and pedestrian facilities	$21,340,000	

Project Type	Description	Limits	Cost	CSJ
Complete Streets	New Hope Drive – Ronald Reagan to CR 175/Sam Bass	Widen existing roadway and extend as a new four-lane divided roadway with bicycle and pedestrian facilities	$12,403,200	0914-05-197
Complete Streets	Pearce Lane – Kellam Road to Travis/Bastrop County Line	Widen existing two-lane facility to a four-lane divided arterial with bike lanes and sidewalks	$22,000,000	
ITS/Operations	FM 734 (Parmer) - SH 45 to US 290 E	ITS Deployment	$7,740,281	
ITS/Operations	RM 2222 – RM 620 to Bonaventure Dr.	Construct New 3 Lane Connector Road with Intersection and Operational Improvements at RM 620 and Bonaventure Dr.	$8,074,379	2100-01-060
ITS/Operations	RM 2222 – Loop 360 to IH-35	ITS Deployment	$4,918,628	
ITS/Operations	RM 620/SH71 – US 183 to US 290	ITS Deployment	$13,180,283	
ITS/Operations	SH 71	SH 130 to Norwood Lane	$1,033,062	
ITS/Operations	Various Locations	Procure and install vehicle detection at 400 signalized intersections within the City of Austin	$11,200,000	
ITS/Operations	Various Locations	Expand the Traffic Monitoring System including 275 CCTV cameras and video management system within the City of Austin	$1,400,000	
ITS/Operations	Various Locations	Implementation of an Emergency Vehicle Preemption (EVP) and Transit Signal Priority (TSP) system including enhancements to the City's Advanced Transportation Management System (ATMS) as well as related signal and communication system upgrades.	$7,280,000	
ITS/Operations	Loop 360 – MoPac to SH 71	ITS Deployment Including ITS Surveillance,	$6,999,130	

Project Type	Description	Limits	Cost	CSJ
		Weather and Travel Information Dissemination and Connections to Regional ITS Communication Network		
ITS/Operations	Various Locations	Continue and expand the HERO Program within Hays, Travis and Williamson Counties	$24,461,363	0914-00-421
Roadway Improvement	FM 2770 - .955 Miles South of SL 4 to 1.414 Miles South of SL 4	Add left turn lane and shoulders.	$2,250,000	3210-01-014
Roadway Improvement	FM 621 - De Zavala Drive to CR 266/ Old Bastrop Hwy	Widen 2-Lane Roadway to Include a Center Turn Lane and Shoulder Enhancements	$5,100,000	
Roadway Improvement	FM 969 - FM 3177 to FM 973	Widen FM 969, an existing 4-lane undivided arterial, to provide for a continuous left-turn lane, shoulders, and a sidewalk on one side of the roadway.	$18,128,600	1186-01-090
Roadway Improvement	Parmer at IH-35	Reconstruct intersection	$32,500,000	0015-13-396
Roadway Improvement	Lime Kiln Road – Post Road to Hilliard	Realignment and Intersection Improvements at Windermere Road	$5,222,500	
Roadway Improvement	RM12 at RM 3237	Intersection improvements including adding turn lanes and pedestrian crossings	$200,000	0285-03-059
Roadway Improvement	RM 3237 at FM 12	Intersection improvements including adding turn lanes and pedestrian crossings	$200,000	0805-04-030
Roadway Improvement	RM 967 at Robert S. Light	Add Left Turn Lane And Shoulders	$1,200,000	0016-16-029
Roadway Improvement	RM 967 – FM1626 to Oak Forest Drive	Widen roadway with center turn lane and shoulder enhancements	$5,315,000	
Roadway Improvement	RM 967 – Austin to China/Ash St.	Intersection Improvements	$1,730,000	
Roadway Improvement	SH 80 – CR 266 to .215 Mi E of CR 266	Install left turn lane	$750,000	0286-02-034
Roadway Improvement	SH 80 –.215 Mi E of CR 266 to CR 266	Install left turn lane	$750,000	0286-01-057

Project Type	Description	Limits	Cost	CSJ
Roadway Improvement	US 183 N – Williamson County Line to MoPac/SL1	Add two express lanes in each direction	$117,500,000	0151-06-143
Roadway Improvement	US 183 N – RM 620/SH45 to Williamson County Line	Add two express lanes in each direction	$117,500,000	0151-05-114
Roadway Improvement	US 290 at Trautwein	Intersection Improvements	$1,049,000	0113-07-072
Roadway Improvement	RM 3237 – RM 12 to RM 150	Construct turn-lanes at intersections and new roundabout	$8,287,500	
Roadway Improvement	US 183A – Hero Way to SH 29	Construct 4-lane tolled expressway	$259,100,000	0914-05-192
Roadway Improvement	SL 360 at Westlake Drive	Grade Separation Intersection	$48,000,000	0113-13-166
Roadway Improvement	SL 360 at Spicewood Springs	Grade Separation Intersection	$45,000,000	0113-13-167
Roadway Improvement	RM 620 – Deep Wood Drive to IH 35	Construct New 4-Ln Overpass At Georgetown RR And Lake Creek With Roundabout And Collector Roads	$21,538,000	0683-01-056
Roadway Improvement	Williams Drive – IH-35 to Jim Hogg	Intersection improvements and access management	$1,576,600	
Roadway Improvement	Wonder World Drive at Hunters Road	Intersection Improvements	$562,500	3379-01-016
Roadway Improvement	US 281 at FM 1431	Intersection improvements	$2,025,000	

EVALUATION OF CMP STRATEGIES

While the CMP promotes the usage of alternative strategies to addressing congestion outside of adding capacity, it also recognizes the importance of monitoring and analyzing the effectiveness of these strategies. FHWA guidance strongly promotes the evaluation of alternative strategies to determine the effectiveness of their implementation. Not only does the evaluation highlight the effectiveness of successful strategies, it also identifies strategies that may not provide much improvement in reducing congestion. The MPO, from these analyses, should take into consideration the level of success of each strategy in allocating funding for additional strategy implementation.

Prior to project selection, submitting agencies should have conducted an assessment of a proposed project using one of the many tools available to show potential benefits. These tools model how a project might improve roadway performance if implemented. However, the question that the CMP addresses is whether or not the project did actually improve roadway performance.

As part of the CMP, the MPO will conduct before-after analyses on implementations of alternative strategies to help identify their effectiveness. With the collection of the data that feed this process, the MPO will be able to report historical performance on facilities where projects will be implemented, as well as post-implementation performance with future data utilizing the same process. Questions for consideration include:

- Did congestion and travel reliability improve due to the project?
- Did transit usage increase on a segment with the implementation of a new route?
- Did the new bicycle/pedestrian path increase the number of bicyclists and pedestrians?
- Did fatalities and injuries decrease due to the implementation of the project?

The MPO should provide a report of these projects, on a regular basis, showing the levels of improvement actually recognized and quantified. While the purpose of these reports is to show the benefits of these implementations, they also serve to identify approaches that might not be providing the benefit originally assumed. The MPO and project submitters should look at these projects to see if any improvements could be made to these approaches to achieve the benefits originally proposed.

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[1] Texas A&M Transportation Institute, 2019 Urban Mobility Report

[2] *Code of Federal Regulations*, 23 CFR 450.320(c)6

[3] Transportation Research Board, Second Strategic Highway Research Program, *Analytical Procedures for Determining the Impacts of Reliability Mitigation Strategies*, Page 163, http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L03- RR-1.pdf

[4] Texas A&M Transportation Institute, *2019 Urban Mobility Report, Appendix C: Value of Delay Time for Use in Mobility Monitoring Efforts*, August 2019

[5] *2019 Urban Mobility Report, Appendix A: Methodology*, Page A-22