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Congestion Management Process

HOUSTON-GALVESTON AREA COUNCIL
TRANSPORTATION

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INTRODUCTION

What is Congestion?

The Federal Highway Administration defines congestion as: “The level at which the transportation system performance is no longer acceptable due to traffic interference. The level of acceptable system performance may vary by type of transportation facility, geographic location, and/or time of the day.” In other words, congestion is when the transportation network is no longer functioning efficiently due to traffic.

There are two types of congestion: recurring congestion and non-recurring congestion.

Conditions that can lead to recurring congestion include:

- Bottlenecks – These are sections on a road where there is a change in traffic capacity leading to congestion at that section and upstream of it. An example of a bottleneck is a section of roadway where two lanes are reduced to one lane.
- Excess Demand – This refers to a condition on a roadway where more vehicles are on the road than the capacity of the road.
- Same Locations – Congestion that frequently occurs along the same segment of roadway for various reasons, such as poor access management.
- Commuters – This refers to people who travel from home to work and vice versa, likely during same time of the day, resulting in morning and evening rush hours.
- Seasonal and Long-Term Construction – Increase traffic congestion that occur at the same time each year or major construction on the right of way of travel that result in one or more lane closures or in significant speed reduction. Either of these conditions results in a recurring congestion.

Conditions that can lead to non-recurring congestion include:

- Accidents – Incidents involving a collision between at least one vehicle and another vehicle, another road user, or a stationary roadside object, which may result in death, injury, or property damage. Accidents can severely affect traffic flow.
- Disabled Vehicles – Mechanically disabled vehicles blocking one or more travel lanes on a road or on the roadway shoulder affecting the flow of traffic.
- Weather – Atmospheric conditions that impact normal driving speeds on a roadway.
- Varying Locations – Congestion that normally does not happen at the same location consistently.
- Short-Term Construction/Maintenance – These refers to minor construction or maintenance work on a roadway that might lead to disrupted traffic for short time periods.

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How Does Congestion Impact the Houston Galveston Transportation Management Area?

Congestion has plagued the eight-county Houston-Galveston metropolitan planning organization area for decades and is indicative of a larger national problem. Based on the 2017 traffic scorecard by INRIX, the Houston region lost on average 75 hours a year per capita due to congestion. This translates into a very real cost of approximately $5 billion in lost hours regionally. Compared to 2007, the region has lost 56 hours per capita at a cost of $2.25 billion. The cost per driver for congestion in the Houston region was $1,012 in 2007 and increased to $1,507 in 2017. Congestion can also negatively impact safety, quality of life and health. For our region to grow sustainably and remain economically competitive, the implementation and continual monitoring of congestion management strategies is critical.

What is a Congestion Management Process?

The purpose of a congestion management process (CMP) is to reduce congestion by implementing best practices that have been shown to improve the performance of a transportation system. A CMP is an eight-part process that weaves congestion management into transportation planning. It is essentially a roadmap that guides the region towards reducing congestion as it plans and implements transportation projects.

The eight parts of the congestion management process are:

1) Develop Regional Objectives – Select objectives that will have the greatest impact on mitigating congestion.
2) Define the CMP Network – Identify what are the boundaries of the roadway congestion area.
3) Develop Multimodal Performance Measures – Preparing means of identifying what measures are most important in assessing congestion.
4) Create a Performance Monitoring Plan – How do we develop and where did we receive the data to determine the performance measures?
5) Analyze Congestion Problems and Needs – Identify the core issues as they relate to issues how they shall be measured at the system and project/segment level.
6) Identify and Assess Strategy – Develop strategies that will mitigate congestion based on the problems identified. Since modal shift is key, a robust multimodal component to congestion mitigation is essential.
7) Program and Implement Strategies – Implement the CMP in coordination with the RTP and TIP to provide parameter and constraints on project proposals and prefer those that move towards reducing congestion in the funding of future roadway and other multimodal projects.
8) Determine Strategy Effectiveness – Evaluations should occur annually to determine if strategies and performance are working. Changes to performances and/or strategies should be considered if performance falls significantly below expectations.

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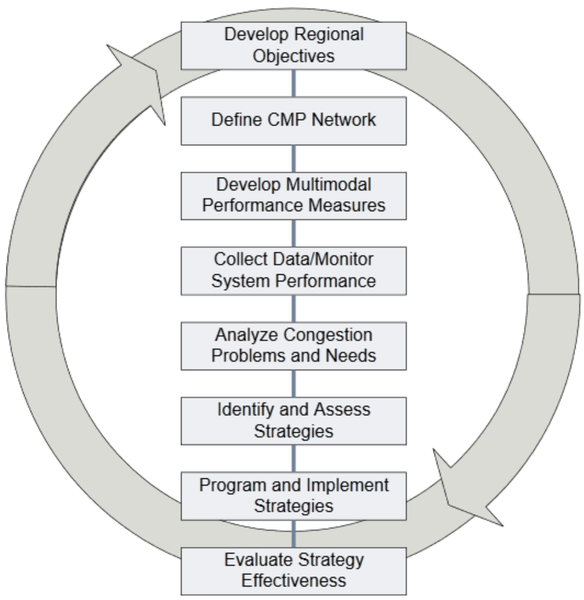
The figure below shows how each element of the congestion management process works together.



Why Create and Continue to Update the Congestion Management Process?

The congestion management process is a structured continuous process for analyzing regional congestion issues. It is also federally mandated for metropolitan planning organizations (MPOs).

The Houston-Galveston Area Council (H-GAC) is the MPO responsible for the development and implementation of the CMP in the Houston-Galveston Transportation Management Area. The TMA consists of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. H-GAC is also a voluntary association of 131 local governments and elected officials in the 13-county Gulf Coast planning region of Texas. Its service area is 12,500 square miles and contains more than 7 million people.

The CMP informs and feeds into the Regional Transportation Plan (RTP), our region's long-range transportation plan, and the Transportation Improvement Program (TIP), our fiscally constrained financial plan. The process, if executed, allows for informed decision-making and assists with greater stewardship of public funds by helping H-GAC analyze projects with an eye towards congestion reduction.

The purpose for this CMP update is to provide a clear document that captures the way we currently manage and analyze congestion in our region. This update will be replaced within one to two years with another that will incorporate the most recent changes to the RTP, new performance measures set for safety, and the work of a new taskforce to look at new opportunities to integrate tools, such as COMPAT by the Texas Transportation Institute of Texas A&M and TOPS-BC by the Federal Highway Administration.

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History of the Congestion Management Process Success

Past strategies outlined in the congestion management process have proven successful in the region. One example is Gulf Coast Regional Tow and Go™ Program. The Tow and Go program rapidly removes roadway vehicles that are disabled or involved in accident-mitigating roadway congestion in the Houston-Galveston Transportation Management Area.

According to the 2019 H-GAC Annual Mobility Report, incidents that did not involve heavy trucks were cleared 5% faster in 2019 versus 2018 (30.1 minutes compared to 31.8 minutes). Expansion of service to all of unincorporated Harris County as well as the cities of Bellaire, Jersey Village, La Porte, and Humble, Texas, in 2020 will extend the scope and amount of congestion relief realized by this incident management program.

SECTION 1 – DEVELOPING REGIONAL GOALS AND OBJECTIVES FOR CONGESTION MANAGEMENT

This update to the congestion management process has three goals for the region, with related objectives. Both align with the 2045 Regional Transportation Plan. They are to:

- Move people and goods efficiently
- Strengthen regional economic competitiveness
- Preserve and protect natural and cultural resources

Congestion in our region creates real impacts to our economy. Competing in a global economy requires the Houston-Galveston region to have a well-functioning transportation system (especially for movement of freight) that is not slowed by severe roadway or other transportation congestion. The ability for people and goods to move through our region with less delay will help improve quality of life and the ability to attract new businesses. It will also result in improved air quality.

Our objectives related to these goals are to:

- Increase reliability of travel
- Increase truck time reliability
- Reduce single occupancy vehicle use
- Move toward meeting federal air standards

Increased reliability refers to our ability to travel in "free-flow" conditions. Free flow conditions refer to times where road travel operates at the designed speed and does not slow as a result of volume of vehicles or crash incidents and/or accidents.

As our region is expected to grow exponentially, targets to maintain truck time reliability the same will require significant work, as will our work to shift people movement towards more efficient methods. Both will ensure the Houston-Galveston TMA improves its standing as compared to other regions to support job growth, improved quality of life, and economic competitiveness.

Reducing single occupancy vehicle use ensures that we are using our transportation network more efficiently. This requires seeing capacity through a new lens and focusing on increasing the number of people we can move through our network without increasing the number of vehicles. Doing so saves the region money, improves congestion, and improves air quality.

SECTION 2 – DEFINING THE CONGESTION MANAGEMENT PROCESS NETWORK

The goals and objectives outlined in Section 1 will be applied to a defined physical network (specific boundaries applied to highways, roadways, etc.) that we will monitor and measure for congestion mitigation and management. This is called the congestion management process network.

The network for this CMP is identical to the region's conformity network and will be presented in two tiers: 1) a tier for applying regionwide performance measures related to congestion, as required by the Federal Highway Administration, and 2) a second broader tier of regionally significant highways and roadways for identifying problems on a local (e.g. segment, corridor) basis.

- The Tier 1 network consists of freeways, highways, tollways, HOV lanes, HOT lanes, and principal arterials in the Transportation Management Area that form the National Highway System. Together, these roadways provide robust sources for monitoring congestion data at a regional level for federal performance measures.

- Tier 2 of the CMP network broadens to include the regionally significant network that is the conformity network. This network includes all roadways of a functional class of principal arterials or above as well as FM 1488 and SH 146. These additional roadways are essential for more robust regional congestion analysis and monitoring.

Table 2.1 CMP Roadway Classifications

Category	Description	Comments
Freeways / Highways	• All access-controlled facilities, including (but not limited to) interstates and U.S. highways	• Toll facilities within these corridors will be captured as an attribute in the facility description
Tollways, HOV, and HOT Lanes	• All toll facilities, high occupancy lanes, and HOT toll lanes within the regional National Highway System	• Toll facilities within the corridor of a non-toll facility will be referenced within a separate category
Principal Arterials	• Principal arterials as classified by the H-GAC Travel Demand Model Summary Road Type Equivalency	Includes H-GAC facility types: • 09 – principal arterial with some grade separations • 10 – principal arterial – divided • 11 – principal arterial – undivided • 19 – saturated arterial
Selected Minor Arterials	• FM1488 and SH146	

***** A Transportation Management Area is a federal designation of any area with over 200,000 residents based on the last census.

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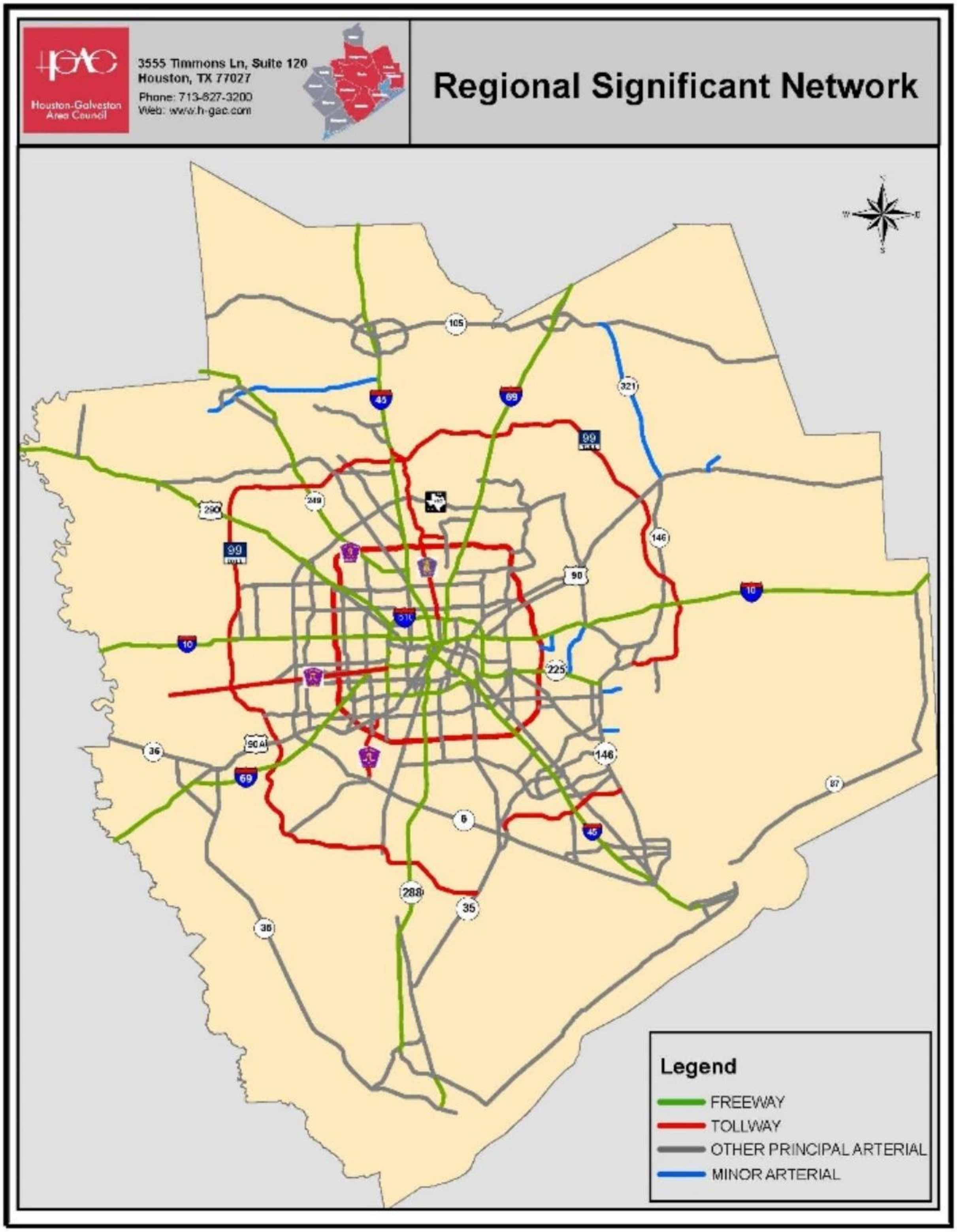
Houston-Galveston Congestion Management Process Network



SECTION 3 – DEVELOP MULTIMODAL PERFORMANCE MEASURES

How Will We Measure the Levels of Congestion?

Performance measures provide clear indicators of progress achieved towards congestion management process objectives. They can also indicate points of weakness in achieving progress.

Since congestion is a large umbrella, it is not realistic nor efficient to look at every component or element that worsens conditions. Performance measures must target substantive key areas that, if addressed, will make the most meaningful impact to reducing congestion.

In this congestion management process, we outline systemwide and localized performance measures that will be applied to the CMP network. The systemwide performance measures are required for collection in the region for the National Highway System. They gauge how we are doing in managing congestion on a systemwide basis.

The localized performance measures (by corridor, segment) allow for better analysis of congestion and its causes in the region. The localized and systemwide measures are listed in Figure 3-1 below.

Figure 3-1: CMP Performance Measures

CMP Objective	Systemwide Measure	Local Measures
Increase reliability	Percentage person-miles traveled on Interstate that are reliable/Level of Travel Time Reliability (LOTTR)	Annual person-hours of delay per mile
	Percentage person-miles that traveled on non-interstate NHS that are reliable/LOTTR	Texas congestion index
	Peak hour excessive delay	N/A
Increase truck travel time and reliability	Truck travel time reliability index on the interstate	Texas truck congestion index Truck delay per mile
Reduce single-occupancy vehicle trips	Percentage of commuting trips	Commute to work rate driving alone - census tract level
Move towards meeting federal air standards	Reduce NOx emissions	N/A

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Definitions for Systemwide and Local Measures

Percentage of miles that are travelled on interstate that are reliable/LOTTR

Percentage of miles that are travelled on non-interstate that are reliable/LOTTR

Level of time travel reliability (LOTTR) refers to what is known as the ability to travel in “free flow” conditions. Free flow conditions are defined as the ability to travel on the interstate unfettered by substantial congestion. This is the same measure for non-interstates and tollways. The source for the information is the Texas Transportation Institute (TTI) of Texas A&M. Information is only provided by TTI at the aggregate level and is not available at the segment or sub-aggregate level.

Peak hour excessive delay

TTI ranks the annual hours of delay per driver in the Houston-Galveston Transportation Management Area.

Truck travel time reliability index

Measures the time it takes trucks to travel area interstates during morning and peak hours. A measure of 2.2 means that it took 2.2 times as long as it would take at average expected speeds without congestion to travel the same segment of road. It is less reliable since it is a longer time than would be expected. Information is only provided by TTI at the aggregate level and is not available at the segment or sub-aggregate level.

Increasing the number of non-single occupancy vehicles (non-SOVs)

Percentage of commuting trips taken place using other travel modes besides driving alone. Non-SOV trips include carpools, vanpools, transit, bicycling, and walking. The 2022 target is lower due to the impact of the COVID-19 pandemic and expected short term negative impacts to transit and vanpooling usage. The U.S. Census American Community Survey (ACS) is the source of the data.

Annual person-hours of delay per mile

TTI ranks the most congested roadways in the state by measuring the total annual hours of extra travel time experienced by each roadway user during all times of day and dividing that total by the roadway length. This measure accounts for actual travel speed, free flow travel speed, roadway volume, and vehicle occupancy relative to the length of the roadway.

Annual truck delay per mile

Like the total annual hours of delay for all users per mile discussed above, TTI has calculated the total annual hours of extra travel time experienced by trucks during all times of day and divided that total by the roadway length. This measure accounts for actual travel speed, free flow travel speed, and truck volume relative to the length of the roadway.

Texas congestion index

This congestion index is calculated by TTI to compare the peak-period average travel time and the free flow travel time. The score is arrived at by dividing the congested (peak hour) travel time by the free flow travel time. A score of 1.0 would mean that the average travel time during peak hours is identical to free flow conditions and therefore not a congestion concern. However, a score of 2.0 would mean that it

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would take, on average, twice the time during peak hours to travel the same segment during free flow conditions. This calculation does not account for traffic volumes or vehicle occupancy.

Texas congestion index (trucks only)

As discussed above, this index is calculated by TTI to compare the peak-period average travel time for truck traffic and their free flow travel time. A score of 1.0 would mean that the average travel time during peak hours for trucks is identical only to free flow conditions and therefore not a congestion concern. However, a score of 2.0 would mean that it would take, on average, twice the time during peak hours for trucks to travel the same segment during free flow conditions. This calculation does not account for truck volumes.

Commute to work rate driving alone

The American Community Survey conducted by the U.S. Census Bureau captures the numbers of respondents who work and how they get to work. This allows them to compute a drive alone rate that impacts the level of congestion in the region.

Reduce NOx emissions

H-GAC's eight-county MPO area does not meet federal standards for ozone attainment and must continue to work towards meeting those standards. Ozone is a secondary pollutant that forms in the atmosphere via a chemical reaction that combines nitrogen oxides (NOx) in the presence of sunlight. Most NOx emissions in our region are generated by on-road and non-road mobile sources.

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SECTION 4 – COLLECT DATA AND MONITOR PERFORMANCE

H-GAC has developed a strategy for acquiring, analyzing, and monitoring the data associated with the performance measures identified in Section 3. Several sources of data are used to compile the information, which will be used on an ongoing basis to monitor performance. In the figures below, we outline the source of data for each performance measure.

How Will We Collect the Data Needed to Monitor Performance?

Figure 4-1: CMP Performance Measures with Data Sources

CMP Objective	Systemwide Measure	Data Source(s)	Local Measure	Data Source(s)
Increase reliability	Percentage person miles that traveled on Interstate that are reliable/LOTTR	Texas Transportation Institute	Annual person-hours of delay per mile Texas truck congestion index	Texas Transportation Institute
	Percentage person miles that traveled on non-interstate NHS that are reliable/LOTTR	Texas Transportation Institute	Texas congestion index	Texas Transportation Institute
	Peak Hour Excessive Delay	Texas Transportation Institute	N/A	Texas Transportation Institute
Increase truck travel time and reliability	Truck travel time reliability index on the interstate	Texas Transportation Institute	Truck delay per mile	Texas Transportation Institute
Increase number of non-single occupancy vehicle (SOV) trips	Percentage of trips	American Community Survey (Census estimate)	Commute to work rate driving alone-Census tract level transit desert	American Community Survey H-GAC modeling
Move towards meeting federal air quality standards	NOx emissions	Texas Commission on Environmental Quality	N/A	N/A

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H-GAC will need to integrate data from these multiple sources into a single database. Integration of data types into a single location would allow ease in access and data analysis. Data should be inspected for outliers and other flaws. If data is incomplete or missing, it should be corrected or disregarded.

Monitoring Performance

Evaluation of system performance and effectiveness should occur annually during the second half of the year to allow for the most recent year’s data to be used in congestion management process analysis. This practice will keep the data current and consistent from year to year. Once per year, data should be shared in the H-GAC Annual Mobility Report.

Data analysis should be consistent among separate datasets. If a performance measure is being calculated for historical data, the timeline of analysis should be consistent between data types. Primary types of data shall be consistent with the RTP/CMP goals, objectives, and performance measures.

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SECTION 5 – IDENTIFYING PROBLEMS AND NEEDS

Congestion along the congestion management process network is evaluated both systemwide, using the region's performance measures, and along network segments using available data to identify and prioritize problem areas. To evaluate whether the network is succeeding in achieving the goal of improving the movement of people and goods, the region uses measure of travel time reliability, hours of peak hour excessive delay, and the response time to incidents/crashes along the network.

How Will We Identify Systemwide Needs and Problems?

Targets aligned with the federally required performance measures have been set for the CMP network in order to measure systemwide performance on the National Highway System. Some targets may appear "flat" when compared to 2020 actual performance. Flat performance, in these cases, would still indicate progress towards the target due to expected growth in the region's population.

Below are the targets set for systemwide congestion management as well as our current performance related to these metrics.

Figure 5-1: Tier I CMP Network Systemwide Measures

Objectives	Performance Measures	2020 Actual*	2022 Target
Increase reliability	Percentage person miles that traveled on interstate that are reliable/LOTTR	69%	69%
Increase reliability	Percentage person miles that traveled on non-interstate NHS that are reliable/LOTTR	80%	80%
Increase reliability	Peak hour excessive delay	14	14
Increase truck travel time and reliability	Truck travel time reliability index on the interstate	2.2	2.2
Increase number of non-single occupancy vehicle (SOV) trips	Percentage of trips	21.1%	20%
Moving toward meeting federal air standards	Emission reductions of NOx (kg/day)	158.32	1429.08

Targets Explained

Level of travel time reliability

Percentage person miles that traveled on interstate that are reliable/LOTTR

Percentage person miles that traveled on non-interstate NHS that are reliable/LOTTR

Travel time reliability is when the travel time along a roadway remains consistent during peak periods compared to free flow conditions. The level of travel time reliability (LOTTR) is a measure comparing long travel time to typical travel time. The closer those travel times are, the more reliable the travel times are for a roadway. The percentage of network mileage that is reliable means that travel times for those portions of the network are always consistent.

Based on a comparison of the LOTTR in 2018 and 2019 for the regional network, the mileage of reliable interstate roadways increased by 7% from 64.4% to 69%. The mileage of non-interstate roadways increased by 8% from 74.5% in 2018 to 80.2% in 2019. This increase in reliable system mileage is indicative of achieving the RTP goal of moving people and goods efficiently, and exceeding performance targets of 63% reliable interstate mileage and 73% non-interstate mileage.

Performance Measure	2018 Condition	2019 Condition	2022 Target
Interstate LOTTR	64.4%	69%	63%
Non-interstate LOTTR	74.5%	80.2%	73%

Peak hours excessive delay

TTI ranks the annual hours of delay per driver in the Houston-Galveston Transportation Management Area. This measure is a systemwide measure while the delay per mile is tracked by segment.

Truck travel time reliability (TTTR) index

TTTR assesses how reliable freight movement on the interstate is with a high standard of 95% on-time deliveries. Truck travel reliability in 2019 was 2.18, which is a 1% reduction from the 2018 score of 2.15. This means that a truck trip of 30 minutes requires 65 minutes for the truck to arrive on-time 95% of the time. This index is still within the performance target of 2.2.

Performance Measure	2018 Condition	2019 Condition	2022 Target
TTTR index	2.15	2.18	2.2

Reduce single-occupancy vehicle trips

Reducing single-occupancy vehicle trips refers to the percentage of commuting trips not conducted driving alone in a car. Non SOV trips include carpools, vanpools, transit, taxis, transportation networking companies (such as Uber and Lyft), bicycling, and walking. The 2022 target is lower due to the impact of the COVID-19 pandemic and expected short term negative impacts to transit and vanpooling usage.

The percentage of the region’s commuters who use an alternative mode of transportation to work at least once a week increase from 20% in 2018 to 21% in 2019, which exceeds to performance target of

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20%. These modes include transit, vanpool, carpool, biking, walking, and teleworking.

Performance Measure	2018 Condition	2019 Condition	2022 Target
Non-Single Occupant Vehicle Trips	20.1%	21.1%	20.0%

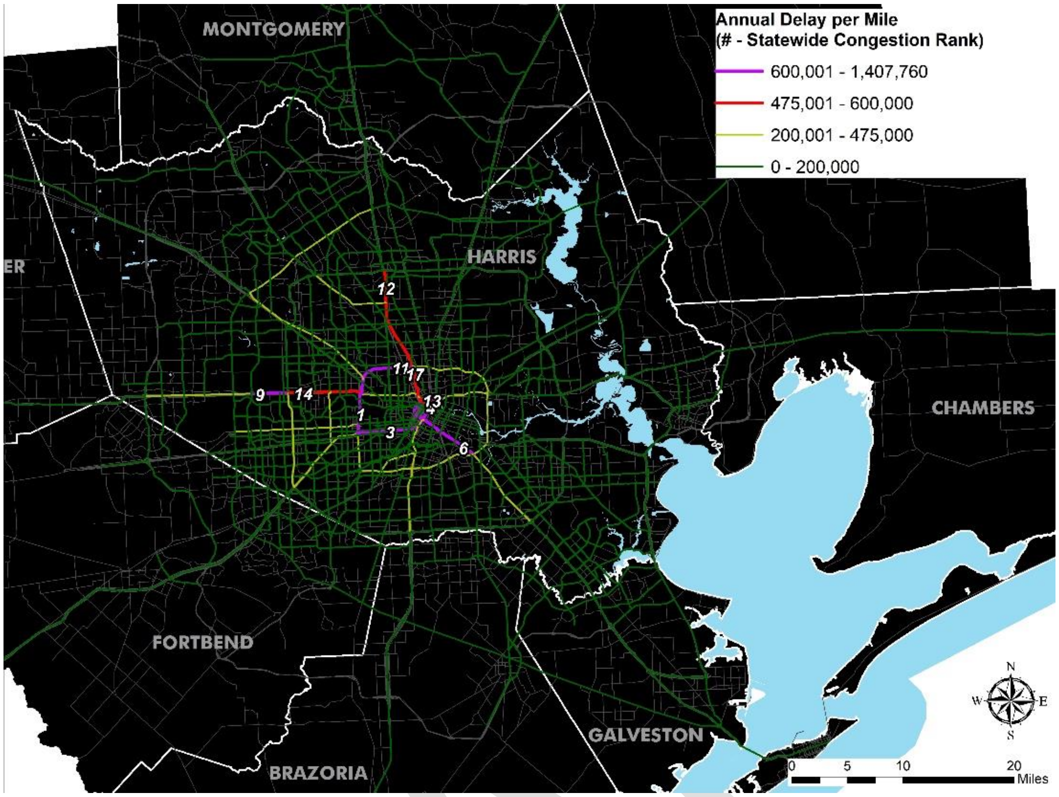
How Will We Identify Local Needs and Problems for Corridors or Segments?

Measures Explained

Annual person-hours of delay per mile

TTI ranks the most congested roadways in the state by measuring the total annual hours of extra travel time experienced by each roadway user during all times of day and dividing that total by the roadway length. This measure accounts for actual travel speed, free flow travel speed, roadway volume, and vehicle occupancy relative to the length of the roadway. Using this measure, the region has five of the top 10 most congested roadways in the state, including the most congested. The table below includes the top 10 most congested roadways in the region, along with the statewide rank, segment length, and the annual person-hours of delay per mile.

2019 Statewide Congestion Rank	Road Name	From	To	Segment Length	Annual Delay per Mile
1	W Loop Fwy / IH 610	Katy Fwy / IH 10 / US 90	Southwest Fwy / US 59 / IH 69	3.62	1,407,760
3	Southwest Fwy / IH 69 / US 59	W Loop Fwy / IH 610	South Fwy / SH 288	5.44	1,094,921
4	Eastex Fwy / IH 69 / US 59	SH 288	IH 10	3.03	961,140
6	Gulf Fwy / IH 45	IH 10 / US 90	S Loop E Fwy / IH 610	7.89	770,136
9	Katy Fwy / IH 10 / US 90	N Eldridge Pkwy	Sam Houston Tollway W / SL 8	3.28	649,542
11	N Loop W Fwy / IH 610	North Fwy / IH 45	Katy Fwy / IH 10 / US 90	6.22	605,689
12	North Fwy / IH 45	Sam Houston Tollway N	N Loop Fwy / IH 610	9.26	578,657
13	IH 10 / US 90	North Fwy / IH 45	Eastex Fwy / US 59	1.57	543,269
14	Katy Fwy / IH 10 / US 90	Sam Houston Tollway W / SL 8	W Loop N Fwy / IH 610	6.62	509,813
17	North Fwy / IH 45	N Loop Fwy / IH 610	IH 10 / US 90	3.11	483,306



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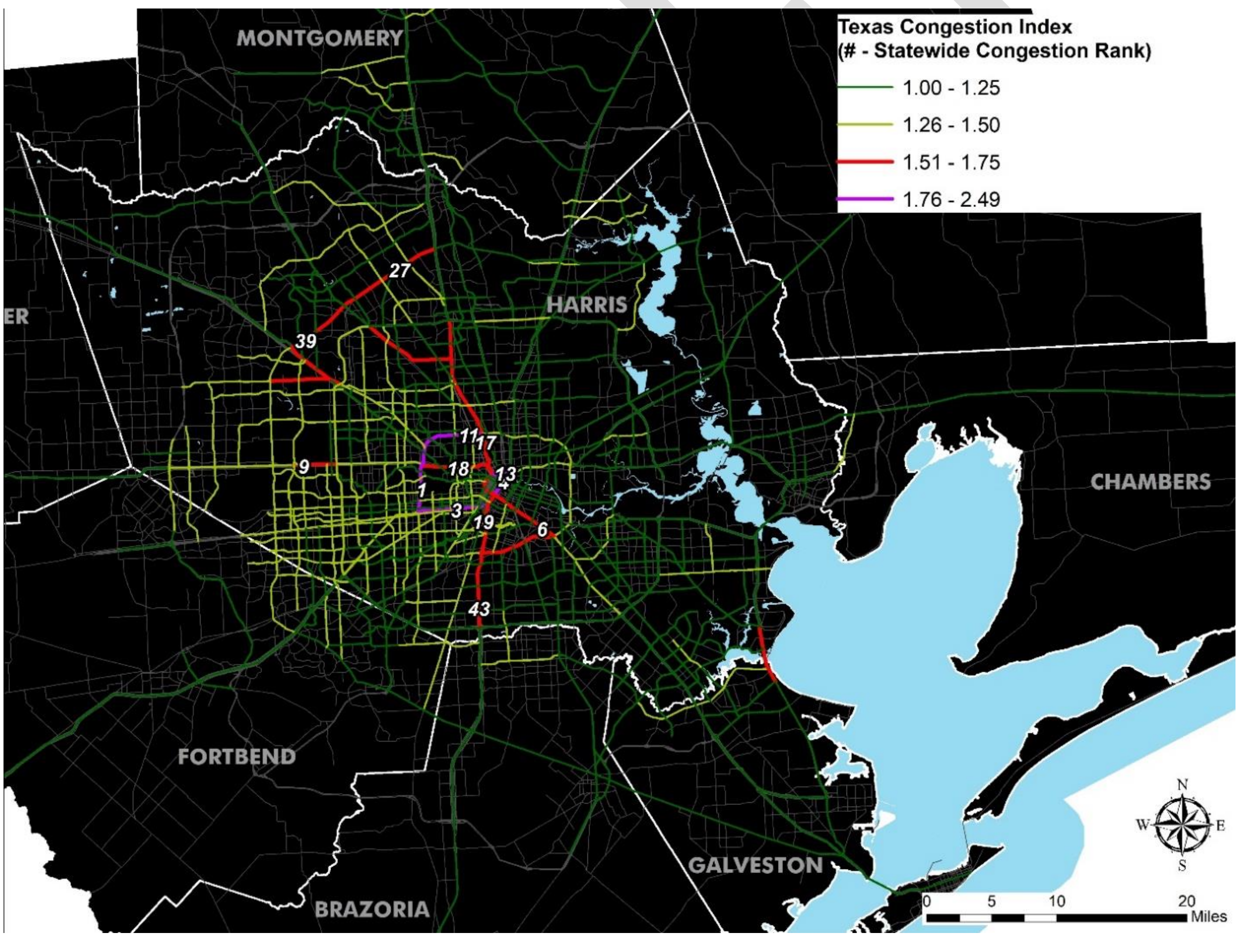
Texas congestion index

This congestion index is calculated by TTI to compare the peak-period average travel time and the free flow travel time. The score is arrived at by dividing the congested (peak hour) travel time by the free flow travel time. A score of 1.0 would mean that the average travel time during peak hours is identical to free flow conditions and therefore not a congestion concern. However, a score of 2.0 would mean that it would take, on average, twice the time during peak hours to travel the same segment during free flow conditions. This calculation does not account for traffic volumes or vehicle occupancy. Below is a table of the top 10 most congested roadways based on this travel time index.

2019 Statewide Congestion Rank	Road Name	From	To	Texas Congestion Index
4	Eastex Fwy / IH 69 / US 59	SH 288	IH 10	2.4
1	W Loop Fwy / IH 610	Katy Fwy / IH 10 / US 90	Southwest Fwy / US 59 / IH 69	2.32
3	Southwest Fwy / IH 69 / US 59	W Loop Fwy / IH 610	South Fwy / SH 288	1.99
11	N Loop W Fwy / IH 610	North Fwy / IH 45	Katy Fwy / IH 10 / US 90	1.85
13	IH 10 / US 90	North Fwy / IH 45	Eastex Fwy / US 59	1.83

6	Gulf Fwy / IH 45	IH 10 / US 90	S Loop E Fwy / IH 610	1.75
9	Katy Fwy / IH 10 / US 90	N Eldridge Pkwy	Sam Houston Tollway W / SL 8	1.75
19	South Fwy / SH 288	Gulf Fwy / IH 45	S Loop W Fwy / IH 610	1.66
27	Cypress Creek Pkwy / FM 1960	Tomball Pkwy / SH 249	North Fwy / IH 45	1.61
17	North Fwy / IH 45	N Loop Fwy / IH 610	IH 10 / US 90	1.58
18	Katy Fwy / IH 10 / US 90	W Loop N Fwy / IH 610	North Fwy / IH 45	1.58
39	FM 1960	Tomball Pkwy / SH 249	Northwest Fwy / US 290	1.58
43	South Fwy / SH 288	S Loop W Fwy / IH 610	Sam Houston Tollway S / SL 8	1.58



Annual truck delay per mile

Similar to the total annual hours of delay for all users per mile discussed above, TTI has calculated the total annual hours of extra travel time experienced by trucks during all times of day and dividing that total by the roadway length. This measure accounts for actual travel speed, free flow travel speed, and truck volume relative to the length of the roadway. The table below includes the top 10 most congested roadways for trucks using this measure.

2019 Statewide Congestion Rank	Road Name	From	To	Segment Length	Annual Truck Delay per Mile
4	Eastex Fwy / IH 69 / US 59	SH 288	IH 10	3.03	59,782
1	W Loop Fwy / IH 610	Katy Fwy / IH 10 / US 90	Southwest Fwy / US 59 / IH 69	3.62	54,415
6	Gulf Fwy / IH 45	IH 10 / US 90	S Loop E Fwy / IH 610	7.89	54,222
13	IH 10 / US 90	North Fwy / IH 45	Eastex Fwy / US 59	1.57	47,116
9	Katy Fwy / IH 10 / US 90	N Eldridge Pkwy	Sam Houston Tollway W / SL 8	3.28	39,101
3	Southwest Fwy / IH 69 / US 59	W Loop Fwy / IH 610	South Fwy / SH 288	5.44	36,994
11	N Loop W Fwy / IH 610	North Fwy / IH 45	Katy Fwy / IH 10 / US 90	6.22	34,779
12	North Fwy / IH 45	Sam Houston Tollway N	N Loop Fwy / IH 610	9.26	31,397
18	Katy Fwy / IH 10 / US 90	W Loop N Fwy / IH 610	North Fwy / IH 45	5.65	30,155
14	Katy Fwy / IH 10 / US 90	Sam Houston Tollway W / SL 8	W Loop N Fwy / IH 610	6.62	28,002

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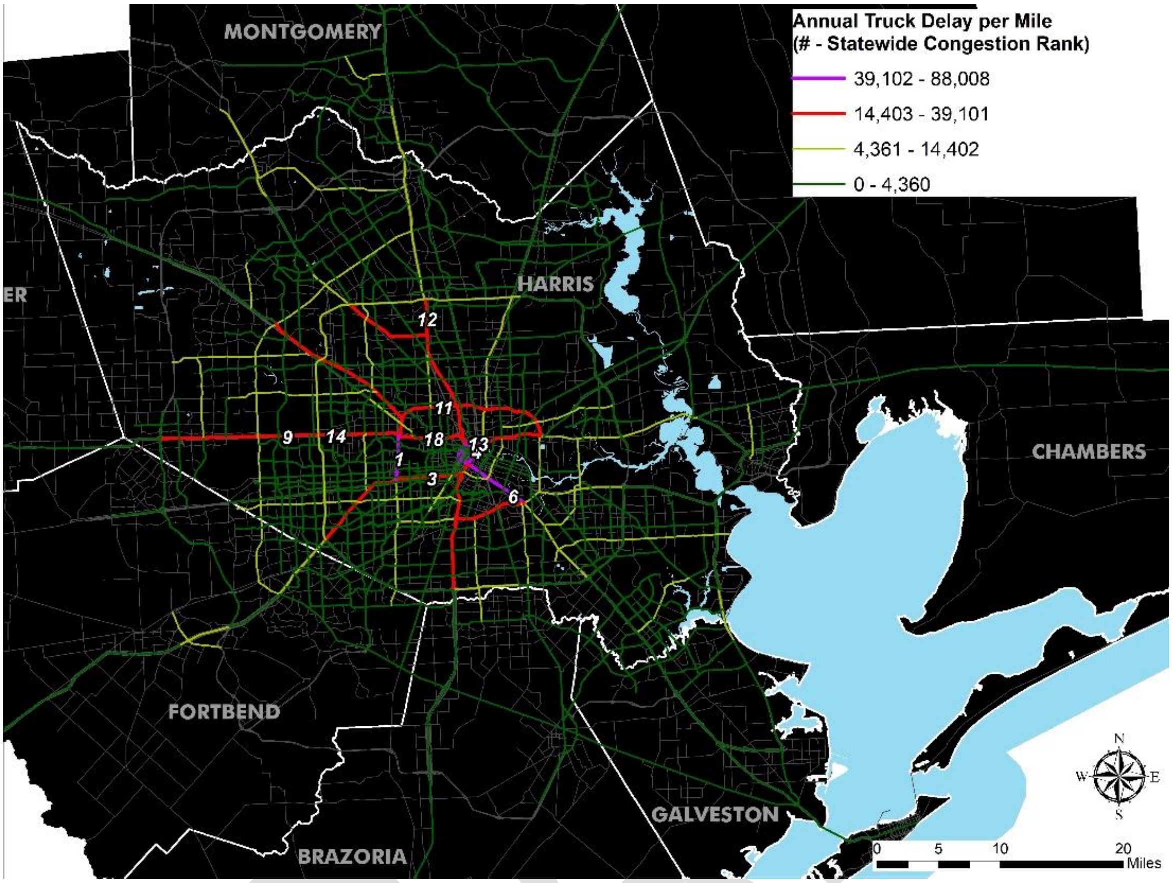
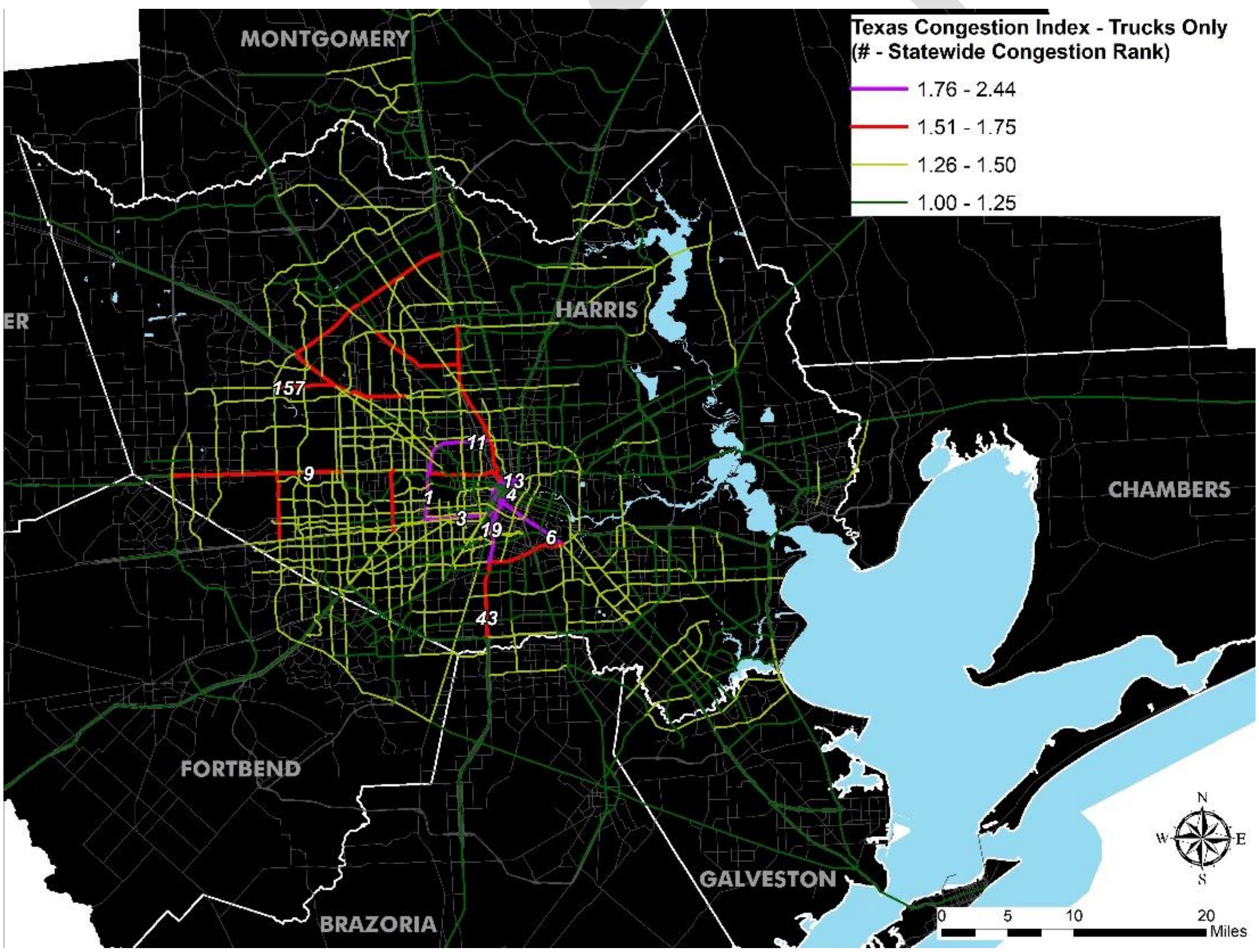


Texas congestion index (trucks only)

As discussed above, this index is calculated by TTI to compare the peak-period average travel time for truck traffic and their free flow travel time. A score of 1.0 would mean that the average travel time during peak hours for trucks only is identical to free flow conditions and therefore not a congestion concern. However, a score of 2.0 would mean that it would take, on average, twice the time during peak hours for trucks to travel the same segment during free flow conditions. This calculation does not account for truck volumes. Below is a table of the Top 10 most congested roadways based on this truck travel time index.

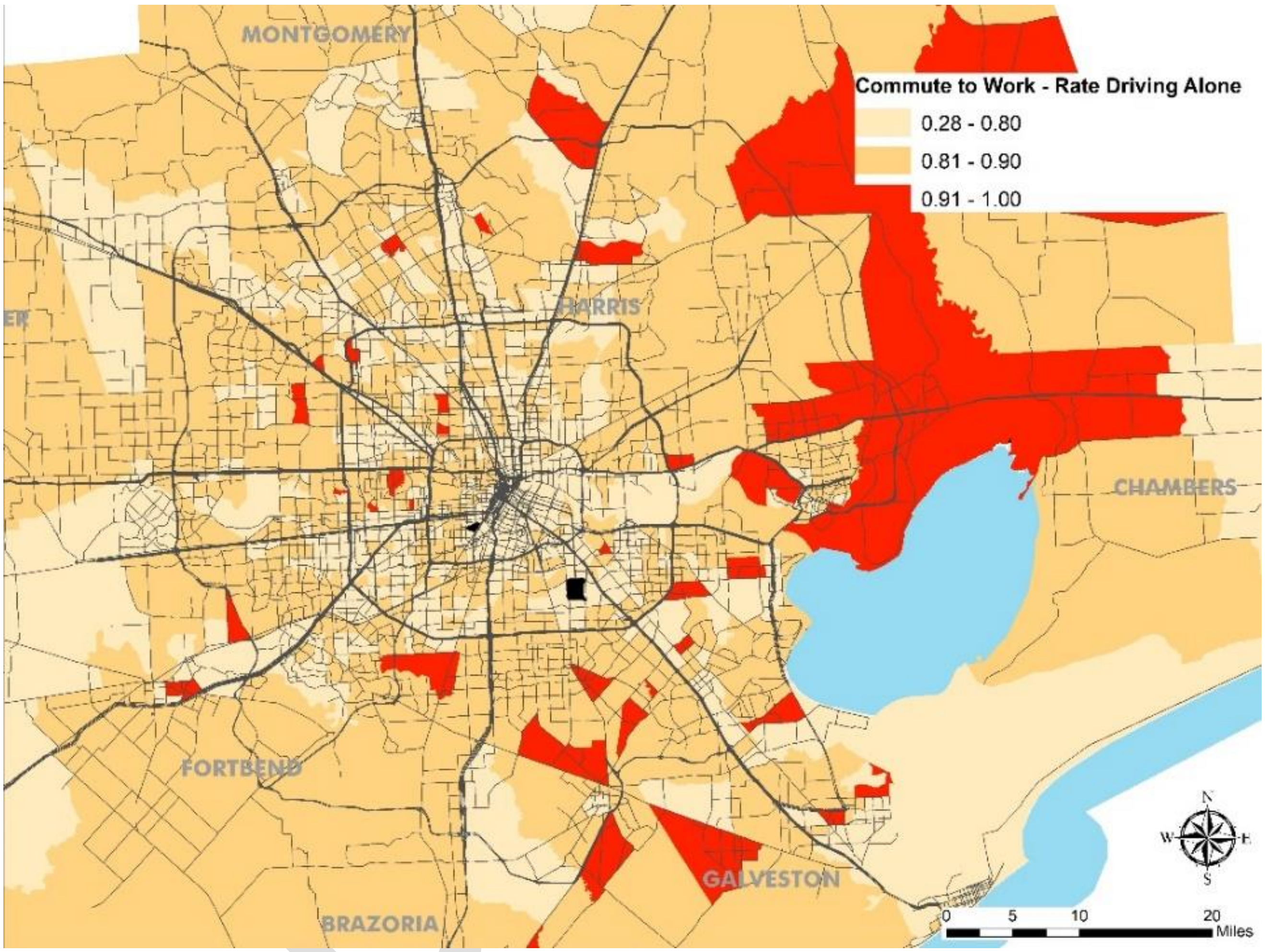
2019 Statewide Congestion Rank	Road Name	From	To	Texas Congestion Index (trucks only)
1	W Loop Fwy / IH 610	Katy Fwy / IH 10 / US 90	Southwest Fwy / US 59 / IH 69	2.44
4	Eastex Fwy / IH 69 / US 59	SH 288	IH 10	2.43
3	Southwest Fwy / IH 69 / US 59	W Loop Fwy / IH 610	South Fwy / SH 288	2.08

6	Gulf Fwy / IH 45	IH 10 / US 90	S Loop E Fwy / IH 610	1.83
13	IH 10 / US 90	North Fwy / IH 45	Eastex Fwy / US 59	1.82
11	N Loop W Fwy / IH 610	North Fwy / IH 45	Katy Fwy / IH 10 / US 90	1.8
19	South Fwy / SH 288	Gulf Fwy / IH 45	S Loop W Fwy / IH 610	1.76
9	Katy Fwy / IH 10 / US 90	N Eldridge Pkwy	Sam Houston Tollway W / SL 8	1.71
43	South Fwy / SH 288	S Loop W Fwy / IH 610	Sam Houston Tollway S / SL 8	1.64
157	Spencer Rd / FM 529	SH 6	Northwest Fwy / US 290	1.64



Commute choice

The region has a high portion of employees who work in and around the downtown Houston area and live outside of the downtown area. Identifying areas of the region with the highest rates of commuters who drive alone will indicate where carpooling or park and ride lots should potentially be located. The map below shows Census tract areas in red with high drive alone percentages.



SECTION 6 – CONGESTION MANAGEMENT STRATEGIES

Strategies that move people and goods efficiently include an array of projects and programs identified in H-GAC's Commute Solutions program, local and regional planning documents, and other agency best practices. These strategies are achievable and consistent with the character and needs of the Houston region's land use and transportation system, and with the congestion management process objectives defined in section 2. This chapter identifies various strategies to improve the efficient movement of people and goods and describes the region's methods for assessing the impact of those strategies.

What Congestion Management Strategies Should be Used?

This CMP suggests strategies that influence travel behavior and mode choice, while leaving as a last resort high-cost capacity increases that primarily serve single-occupant vehicle travel. The strategies all support our regional goals and objectives and fall into seven main categories: 1) transportation/travel demand management, 2) land use, 3) public transportation, 3) intelligent transportation system (ITS) and transportation systems management, 4) roadway/mobility, 5) bicycle and pedestrian, and 6) roadway capacity expansion, and 7) freight.

They also utilize one or more of the following approaches:

1. Provide the infrastructure to walk, bike, or use transit
2. Enable living, working, and playing within proximity
3. Provide other influences to discourage single-occupant vehicle trips
4. Consider alternatives of transport of goods by truck

Travel Demand Management

Transportation demand management (or TDM) strategies expand mode choice; market to and educate users of travel options; and outline pricing strategies that influence travel behavior and mode choice. The cost of these strategies tends to be low to moderate (or they can generate revenue) and have benefits such as reducing peak period travel and reducing single-occupant VMT. These provide several environmental benefits, including improved air quality and reduced greenhouse gas emissions. TDM strategies can be grouped well with various land use, public transportation, and bicycle and pedestrian strategies.

Pricing strategies place value on how and when travelers utilize roadways and parking facilities. These are regulatory in nature and can influence travel behavior and mode choice. Pricing can be categorized into legislative, congestion tolling, and parking management strategies. Pricing, especially dynamic pricing, can discourage single-occupancy vehicle trips during peak hours and encourage a shift to other modes.

Legislative pricing is deployed by states to place a value on how often drivers access all public roadways. Emissions pricing, VMT fees, pay-as-you-drive insurance, and vehicle restriction zones are all legislative regulations that discourage the frequency, length, and location of vehicle trips. Congestion tolling applies a premium to traveling along critical corridors during peak hours. Parking management strategies influence the utilization of on- and off-street parking facilities to create parking opportunities for those willing to pay for convenience. The revenue can be used to maintain, improve,

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and promote transit, biking, and walking facilities. An additional transportation demand management strategy is to establish transportation management associations (TMAs). These provide transportation services, such as organizing vanpools, through public-private partnerships in specific high-activity employment or commercial areas.

TDM Strategies		Approach	Move People and Goods Efficiently	Strengthen Regional Economy
Trip Choice*	Telecommuting	1,2	X	X
	Rideshare	1	X	X
	Car share	1	X	
	Guaranteed ride home	1	X	X
	Alternative work hours	1	X	X
	Transportation management associations	1,3	X	
Education	Commuter travel options material (Commute Solutions)	1,3	X	X
	Alternative mode event promo	1,3	X	X
	Bicycle / Pedestrian educational material	1,3	X	X
Legislative Pricing	Regional excise tax	3	X	X
	Congestion pricing	3	X	X
	Carbon pricing tax	3	X	X
	Emissions-based registration fee	3	X	X
	Pay-as-you-drive insurance	3	X	X
Congestion Tolling	Traditional toll lanes	1,3	X	X
	High-occupancy toll lanes	1,3	X	X
Parking Management	Preferential parking	1,3		X
	Dynamic parking pricing	3		X

Note: *Home delivery services for goods and services had increased significantly prior to the advent of the COVID-19 pandemic. Since the start of the pandemic, delivery of goods and services has grown dramatically, affecting travel patterns for shopping trips. How they impact congestion is uncertain, and no travel models have been developed. Its impact is worthy of future inquiry.*

Land Use Strategies

Effective land use strategies are related to the built environment and enable living, working, and playing within proximity to decrease SOV trips; increasing walk, biking, and transit trips; and providing air quality benefits to the region. Design guidelines are important components to creating transit-friendly environments that align with the H-GAC Livable Centers initiative. Land use strategies generally have low to moderate costs and tend to involve the establishment of ordinances and the potential need for economic incentives that will encourage developer buy-in.

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Land Use Strategies		Approach	Move People and Goods Efficiently	Strengthen Regional Economy
Design Guidelines	Mixed-use development	2		X
	Infill and densification	2		X
	Transit-oriented development (TOD)	1,2	X	X
	Pedestrian-oriented development (POD)	1,2	X	X
	Efficient land use development practices	2		X
	Curbside management	1	X	

Public Transportation

Public transportation strategies include pricing and payment conveniences, increasing route coverage and frequency, improving stop access and amenities, providing operational efficiencies, and other technological improvements. These strategies range in cost from low to high. Constructing new transit corridors is understandably costlier than improving service frequencies. Predominant benefits of improving accessibility and user-friendliness include shifting mode share, increasing transit ridership, reducing VMT, and improving air quality. These work well as Complete Streets improvements alongside bicycle and pedestrian strategies, and land use strategies that enable living, working, and playing within proximity.

Public Transportation Strategies		Approach	Move People and Goods Efficiently	Strengthen Regional Economy
Convenience Pricing	Reduced fares	3		X
	Electronic fare collection	3		X
	Electronic payment system / Universal fare pass	3		
	Employer incentives	3		X
Access Convenience	Park & ride lots	1	X	X
	Intelligent transit stops	1		X
	Enhanced vehicle amenities	1		X
	Improved bike/ped facilities	1	X	X
Service Operations	Increase service	1	X	X
	Local circulator	1	X	X
	High-occupancy vehicle lanes	1	X	X
	Rail transit	1	X	X

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	Guideways	1	X	X
	Dedicated right of way	1	X	X
	Rail extension	1	X	X
	Realigned transit service	3		X
	Transit jump lanes	1	X	X
	Bus rapid transit	1	X	X
	Express bus service	1	X	X

Intelligent Transportation System and Operations

Intelligent transportation system (ITS) and transportation system management (TSM) strategies are intended to make the best use of existing roadway capacity. Strategies include signal coordination, highway ramp metering, traveler information systems, incident management, and service patrols. Costs vary and tend to be low to moderate. Large scale projects that involve the construction of new infrastructure and devices tend to be higher in cost than other projects. Benefits include reduced travel time, reduced stops, reduced delays, and improved safety.

ITS / Operations Strategies		Approach	Move People and Goods Efficiently	Strengthen Regional Economy
Operational	Traffic signal coordination	1	X	
	Reversible traffic lanes	1	X	
	Sustained enforcement	1	X	
	Incident management (Tow and Go)	1	X	
	Incident detection system	1	X	
	Service patrols	1	X	
	Ramp metering	1	X	
	Road weather management	1	X	
	Traffic surveillance and control systems	1	X	
	Speed harmonization	1	X	
	Special event / Work zone management	1	X	
	Electronic toll collection	1	X	
Informational	Advanced traveler information	3	X	
	Transit vehicle travel information	3	X	

Bicycle and Pedestrian

These strategies facilitate a shift to walking and biking as a viable mode for trips by providing new sidewalks and bicycle lanes, improved facilities near transit stations, bike sharing, and exclusive non-motorized rights of way. Benefits include decreasing single-occupancy vehicle trips, VMT, and improving regional air quality. Costs of these strategies tend to be low to moderate and work well when grouped with transit and other strategies as part of Complete Streets improvement.

Bicycle and Pedestrian Strategies		Approach	Move People and Goods Efficiently	Strengthen Regional Economy
Facility	New sidewalks and bike lanes	1	X	
	Bike/Ped facility near bus stop	1	X	X
	Safety / Accessibility improvements	1	X	
	Exclusive right of way / Open street	1	X	
Services	Bike share	1	X	
Education	Bike safety training	1	X	

Roadway/Mobility (Non-ITS) Strategies

These strategies are designed to help improve system operations and relieve bottlenecks on existing facilities through non-capacity adding improvements. This includes access management improvements (limiting the number of curb cuts), turning restrictions at key intersections, and adoption of a Complete Streets policy. These strategies range in cost from low to high based on the type and complexity of strategy implemented. They may be grouped with improved signage and ITS/operations strategies for additional benefits.

Roadway / Mobility Strategies		Approach	Move People and Goods Efficiently	Strengthen Regional Economy
Design Guidelines	Access management	1	X	
	Restricting turns	1	X	
	Convert to one-way	1		
	Road signage improvement	1		
	Road diet	1		
	Grade separation (no added capacity)	1		
	Acceleration/Deceleration lanes	1		
	Complete Streets policy	1,2	X	X

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Roadway Capacity Expansion

Highway strategies that add roadway capacity include the construction of a new roadway or bypass, road widening to add through lanes, adding capacity to an existing interchange, or grade separation of existing intersections (that add capacity). Adding capacity should be considered the strategy of last resort due to stresses on public resources related to sprawl.

These strategies range in cost from moderate to high based on the type of strategy implemented, with new right-of-way resulting in higher costs than design improvements. Predominant benefits of these strategies include increased capacity as well as improved mobility and traffic flow. These types of roadway projects and strategies may be coupled with improved signage and ITS/operations strategies for additional benefits to travelers.

Roadway Capacity Expansion Strategies		Approach	Move People and Goods Efficiently	Strengthen Regional Economy
Facility	New freeways	1	X	
	Add travel lanes	1	X	
	New arterial roadways	1	X	
	Grade separation (add capacity)	1	X	
	Rail grade separation	1	X	
	Intersection improvement	1	X	

Freight Mobility Strategies

Freight strategies work to enhance the mobility of goods and the reliability and safety of the Regional Freight Network. These multimodal strategies range in cost from relativity low for strategies such as wayfinding signage and truck lane striping on freight impacted roads to high cost for freight shuttles on a separate right of way. The benefits of freight mobility strategies include reduced truck trips, reduced emissions, increased economic competitiveness, and improved safety.

Freight Mobility Strategies		Approach	Move People and Goods Efficiently	Strengthen Regional Economy
Facility	Dedicated truck lanes	1,2	X	X
	Freight shuttle (reserved right of way)	1,2	X	X
	Truck parking expansion	1.2		
	Comprehensive interconnected pipeline system	1,2	X	X

	Maintenance and use of Gulf Intercoastal Waterway	1,2	X	X
Design Guidelines	Geometric roadway design improvements (turning radii, ramp configurations)	4	X	X
	Intermodal connector improvements	4	X	
	Implementation of 18'6 ft vertical clearances on regional freight routes	4		
Informational	Regional freight traveler information system	4	X	
	Queue detection at port terminals	4	X	
	Expansion of truck parking availability system (TPAS)	4	X	
	Virtual container yard/Matchback system	4	X	X
	Weigh in motion technology	4	X	X
Operational	Comprehensive traffic management centers	4	X	
	Tow and Go program for heavy duty vehicles	4		
	Container on barge	4	X	X
	Congestion tolling	4	X	
Education	Educate local jurisdictions, businesses, communities, and decisionmakers about the economic importance of moving freight efficiently	4		X
	Educate the public about safety issues related to multimodal freight transportation	4		

How Should These Strategies be Evaluated?

There are many ways to evaluate and measure congestion. Below we list the methods we currently use as well as a few others that could be used in conjunction with existing practices. A summary of each analysis method is presented below. The congestion management strategies listed above, and analysis methods mentioned below, together make up the regional congestion management toolbox.

Intelligent Transportation System Deployment Analysis System (IDAS)

The Intelligent Transportation System Deployment Analysis System (IDAS) is an ITS/operations sketch-planning analysis tool that interfaces with planning data prepared from existing regional travel demand models. IDAS was first developed in 1998 for the Federal Highway Administration (FHWA) and was updated several times through the 2000s. IDAS provides a comprehensive analysis tool for determining the system, subarea, corridor-specific impacts, benefits, and costs of the full spectrum of operations and ITS deployments and strategies. IDAS was designed to meet the needs of MPOs by offering the capability for a systematic assessment of operations and ITS with one analysis tool, with the overall goal of assisting these agencies in integrating ITS into their ongoing transportation planning process. Although IDAS has not been used by H-GAC in the past, it could be linked with the Regional Travel Model to assess the impacts of various operations, ITS, and roadway capacity projects as defined in the CMP toolbox.

LOSPLAN

Currently, congestion mitigation analysis required to justify adding SOV capacity to transportation facilities is conducted using the Florida Department of Transportation (FDOT) level of service software known as LOSPLAN. LOSPLAN was developed by the Transportation Research Center at the University of Florida for FDOT as stand-alone computational application that employs the 2010 Highway Capacity Manual methodologies for automobiles and other leading methodologies for the bicycle, pedestrian, and bus modes to compute level and quality of service for planning and preliminary engineering. LOSPLAN can compute both level of service for roadways as well as volume to capacity ratio.

Regional Travel Demand Model

H-GAC's traditional four-step Regional Travel Demand Model is used to support a variety of analytical needs such as preparation of various system and subarea analyses, including the RTP, transit projects, toll projects, ongoing evaluations of the region's air quality conformity analysis, and other technical analysis. In some cases, the results from the Regional Travel Model will be used to assess the impacts of alternative strategies, specifically the additional system capacity (freeway, arterial roadway, and new roadway facility construction) projects.

Regional travel demand model outputs (VMT, VHT, and other measures) can be used to illustrate the location, duration, and extent of congestion for the region at baseline conditions. The travel demand model can then be used to forecast congested conditions assuming currently programmed TIP projects. These model outputs can in turn be used as inputs into the ITS Deployment Analysis System (IDAS), the Tool for Operations Benefit/Cost (TOPS-BC), and/or other tools to calculate a variety of performance measures to evaluate the impacts of many of the types of strategies in the toolbox. They can also help allocate benefits to subregions. These data can include changes in travel time, speed, mode share, or trip reduction, for example, that can either directly measure or indirectly measure the CMP performance measures for the no-build and build conditions.

Simulation Model

Simulation models are designed to assess the travel impacts of multimodal and roadway specific projects. The use of simulation models requires that the analysis area be relatively constrained to a small subarea of the regional network, usually a corridor or specific project area. Expansion of the analysis to a broader region would require significantly more resources. These models are effective in evaluating the buildup, dissipation, and duration of traffic congestion, and model outputs can be used to calculate measures of effectiveness such as vehicle/person miles traveled, vehicle/person hours of travel, travel time/queue length, throughput/delay, emissions, and fuel consumption. Simulation results can be used to conduct a benefit valuation of individual strategies or set of strategies. Information on calculation of various measures of effectiveness using simulation outputs is available in FHWA's Traffic Analysis Toolbox3. Emerging methods for using simulation model outputs to calculate travel time reliability impacts are detailed in SHRP 2 projects L04, L05 (Technical Reference), and L08.

Tool for Operations Benefit/Cost (TOPS-BC)

TOPS-BC is one of several benefit/cost tools that can be used to evaluate operational and ITS improvements. An early generation of spreadsheet tools was developed by FHWA and state and local agencies for targeted analysis, including SCRITS and CAL-B/C4. Following these initial efforts, FHWA developed the ITS Deployment Analysis System (IDAS), which included a network-based model able to incorporate regional and statewide travel demand models. The major benefit of IDAS is that by using existing travel demand models, it incorporates the same set of assumptions used for other regional planning activities. The inclusion of an assignment module also allows analysts to account for traffic shifts that may result from operational and ITS deployments. As a network model, however, IDAS has a steeper learning curve than spreadsheet tools and may require a level of effort beyond what is feasible for a relatively limited improvement.

TOPS-BC essentially reflects the incorporation of IDAS into a spreadsheet format, which is accessible to a wider range of users and provides relatively quick assessments of ITS and operational projects with limited data. The tool is supported by the U.S. Department of Transportation's benefit and cost databases, allowing users to access and incorporate national experience in impact measurement.

Two separate versions are available: the standard version and the development version. The TOPS-BC User's Manual7 provides more instructions on how to use the tool, along with some case studies.

Due to the characteristics described above, TOPS-BC is recommended as a key method for evaluating congestion management for H-GAC and its planning partners, as it provides the following features:

- The ability to investigate the expected range of impacts associated with previous deployments and analyze many transportation system management and operational strategies
- A screening mechanism to help identify appropriate tools and methodologies for conducting a benefit-cost analysis based on analysis needs
- A framework and default cost data to estimate the life-cycle costs (including capital, replacement, and continuing operating and maintenance costs) of various transportation system management and operational strategies
- A framework and suggested impact values for conducting simple sketch planning level benefit-cost analysis for selected transportation system management and operational strategies

Trip Reduction Impacts of Mobility Management Strategies (TRIMMS)

TRIMMS is a modeling tool developed by the Center for Urban Transportation at the University of South Florida. It provides TDM cost-benefit analysis of strategies that directly affect the cost of travel, such as pricing (subsidies, mile-based charges) and travel time. It also provides this analysis for employer based TDM support, such as telecommuting, alternative work schedule, and program support strategies (e.g., guaranteed ride home).

TRIMMS considers program costs and annualized benefits – such as air pollution (VOCs, CO, NOx), added congestion, excess fuel consumption, global climate change (CO2), health and safety, and noise pollution – and provides this analysis at a regional or worksite level. User-defined or default inputs and

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elasticity parameters can be selected. Results predict mode share and VMT changes, annualized peak and off-peak costs and benefits, changes in emission pollutants (VOCs, CO, CO2, NOx) and estimates regarding the probability of reaching the desired cost-benefit ratio.

SECTION 7 – IMPLEMENTATION STRATEGIES

This section describes how congestion management process projects are programmed and implemented through inclusion of CMP strategies in the Regional Transportation Plan (RTP), Transportation Improvement Program (TIP), sub-regional plans, and the Regional ITS Architecture. It also presents a process for conducting a CMP project level analysis for various transportation investment types.

How Should the CMP be Integrated with Regional Planning and Programming Documents?

This section describes how the CMP coordinates with regional plans, including the Regional Transportation Plan (RTP), Transportation Improvement Program (TIP), corridor plans, and the Regional ITS Architecture. The CMP informs and receives information from these planning and programming documents.

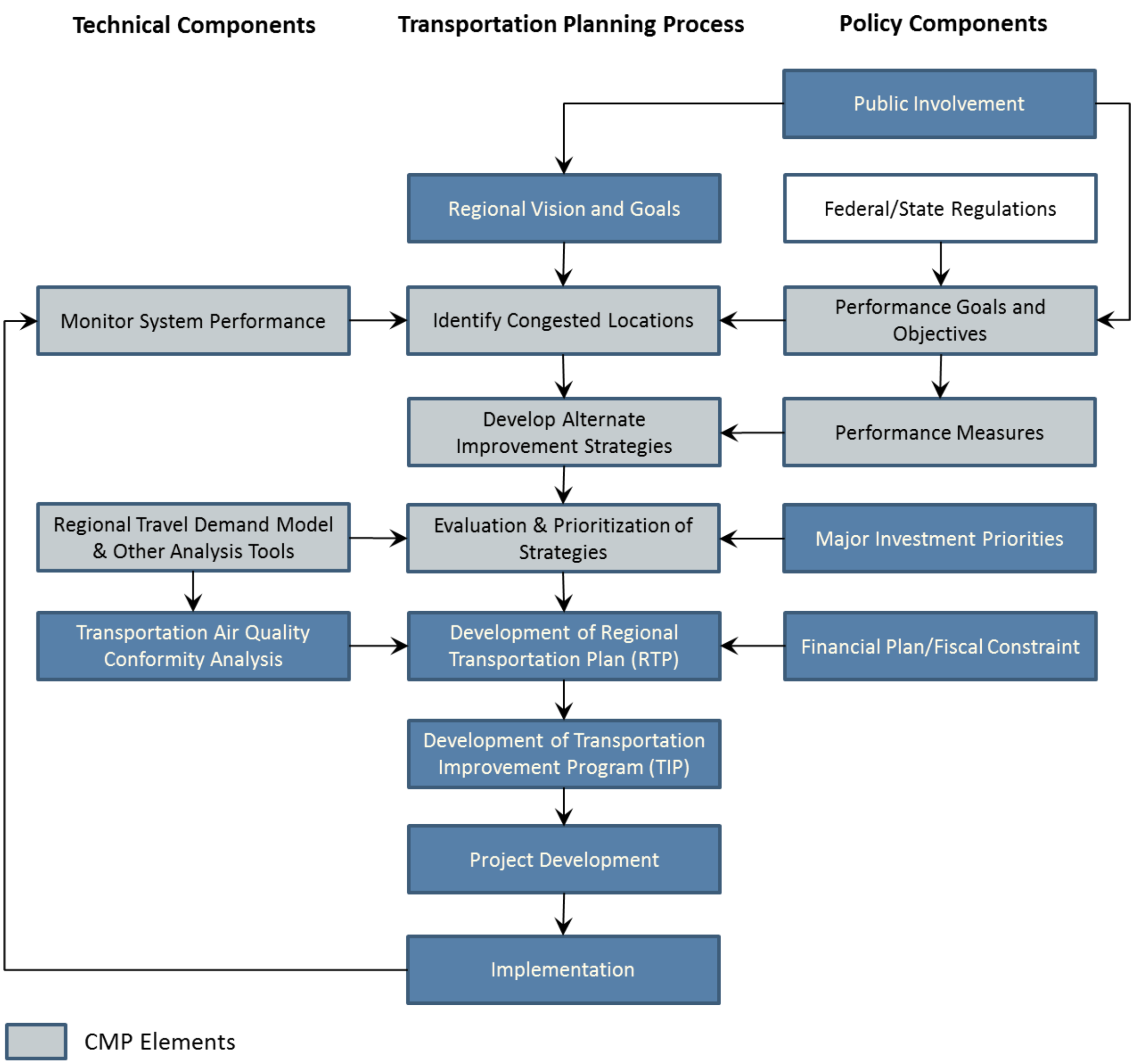
Regional Transportation Plan (RTP)

The RTP provides a framework for the long-range achievement of the Houston region's transportation system's goals, objectives, and strategies. Updated every four years, the RTP is a multimodal plan that identifies all regionally significant projects and programs planned for the region regardless of the likely funding source. Once a project is included in the RTP, it proceeds through the project development process, including environmental review, preliminary engineering, and right-of-way acquisition. The CMP is an integral part of the long-range planning process and relates to the RTP in the following ways:

- The RTP's vision statement and goals inform the development of CMP's goals, objectives, and performance measures.
- The CMP provides problem areas and strategies that contribute to the RTP's recommendations for future study areas and investment priorities.
- The CMP toolbox provides strategies for developing and evaluating projects and programs that maintain or reduce congestion.
- The CMP defines a process for programming and implementing the most cost-effective strategies by introducing them into the RTP process and subsequently for programming into the TIP.
- Once projects are implemented, the CMP provides a mechanism for ongoing system monitoring, both to assess the performance of the system and to evaluate the effectiveness of the congestion management strategies that have been implemented.

Figure 7.1 shows how the CMP is integrated into various technical and policy components of the transportation planning process. The next RTP update will provide policy direction based on analysis and the program or geography-specific knowledge gained through the CMP. The RTP then sets the direction for the next cycle of these planning efforts.

Figure 7.1: Integration of the Congestion Management Process in the Transportation Planning Process



Source: Adapted from *The Transportation Planning Process: Key Issues - A Briefing Book for Transportation Decisionmakers, Officials, and Staff*, Updated September 2007, Publication No. FHWA-HEP-07-039, http://www.planning.dot.gov/documents/BriefingBook/BBook.htm

Transportation Improvement Program (TIP)

The Transportation Improvement Program is a short-range program that identifies the highest priority projects and programs to be funded and implemented in the Houston region over the next four years. The program identifies federal, state, and local funding for transportation projects that will be implemented within the TIP's four-year timeframe. Updated every two years, the TIP is the implementation plan for projects in the RTP.

H-GAC staff establish evaluation criteria for projects to be added to the TIP in coordination with the TIP subcommittee. The criteria established supports the goals and investment strategies of the Regional Transportation Plan. The project selection process established by H-GAC primarily includes a cost-benefit analysis where safety, delay, and air quality emissions benefits are calculated and included in the project score. Additionally, planning factor narratives are submitted with the projects. These narratives are scored and included in the final project score. Once projects are selected, added capacity projects are evaluated using the Congestion Mitigation Analysis tool. Projects that meet the CMP thresholds are added to the TIP for implementation.

In addition to the programming of surface transportation projects, the CMP strategies adopted by the TPC are funded through a set-aside of funds. Programs such as Commute Solutions and Tow and Go are funded from set-aside funds. Funding for these programs is also included in the TIP document.

Project Development/NEPA Process

The CMP supports the link between planning and project development by providing information to support project development activities, including corridor alternatives analysis and environmental analyses conducted under the National Environmental Policy Act (NEPA). The CMP relates to these processes in the following ways:

- The CMP provides system performance information that can be used by H-GAC to identify corridors or segments in need of detailed analysis through corridor and NEPA studies.
- Documentation of the need for capacity enhancement (based on the analysis of alternative strategies) should be included in the NEPA project purpose and need statement.
- The CMP toolbox provides a starting point for identifying alternative congestion mitigation strategies for consideration in corridor and NEPA studies. Corridor/NEPA documents should include a discussion of how the CMP toolbox strategies were considered.
- Congestion mitigation strategies are evaluated as an alternative to the added capacity improvement. If the CMP alternative alone cannot meet the travel demand needs in the corridor, supplemental corridor-level CMP strategies that complement the major investment are considered to improve the long-term effectiveness of the improvement.
- The CMP toolbox identifies potential analysis tools for evaluating project alternatives. Simulation or other appropriate analysis tools from the toolbox are used to conduct an evaluation of the actions to assess their impacts in the corridor. The extent to which these actions can alleviate travel demand and congestion in the corridor compared to the baseline condition are documented as part of the study.
- Monitoring the effectiveness of implemented improvement projects provides data that supports use of congestion management strategies in future projects.

Regional Intelligent Transportation Systems (ITS) Architecture

The CMP relates to the Regional Intelligent Transportation System (ITS) architecture in the following ways:

- The Regional ITS architecture is an important resource for identifying sources of data in the region that can support monitoring and reporting of congestion using CMP performance measures.
- All ITS strategies implemented from the CMP toolbox should be consistent with the Regional ITS architecture. The Regional ITS architecture and the CMP toolbox should be reviewed for consistency and reconciled as necessary when either is updated.

How Will Projects be Analyzed for Congestion Management Using the CMP?

This section presents the CMP analysis process for assessing the potential of CMP strategies in terms of established congestion management objectives and performance measures. A CMP analysis process is defined for each of the following types of transportation investments:

- **Major Investments.** These are federal and state assisted, regionally significant added capacity projects located on the CMP network. Significant added capacity projects tend to have a substantial cost (greater than $100 million) and significantly impact regional or corridor travel patterns. Project descriptions typically include a new roadway or bypass; major or minor road widening to add through lanes on an existing highway; major roadway reconstruction; adding capacity to a corridor by improving many related intersections; new interchange or adding capacity to an existing interchange; grade separation of existing intersections (that add capacity); etc.
- **Other Investment Types.** These are federal and state assisted projects with total project costs (federal request and local match that exceed $100 million that encompass the following improvement types: transportation demand management, land use, public transportation, bicycle/pedestrian, Intelligent Transportation Systems (ITS) and operations, roadway/mobility (Non-ITS), or added capacity projects located on the CMP network.
- **Accelerated Projects.** These are projects that are introduced late in the RTP planning cycle due to accelerated growth or congestion relief, connection with an existing project, or new funding opportunities. As a result, the implementation of the projects does not correspond with the typical evaluation process and timeline required for projects already documented in the RTP.
- **Exempted Projects.** Projects are exempt from a CMP analysis if the proposed project solves a safety or bottleneck problem. The criteria for determining whether a project is categorized as a safety or bottleneck project is described at the end of this section.

The CMP analysis process involves conducting either a quantitative or qualitative assessment of the extent to which congestion mitigation strategies can alleviate travel demand and congestion in the corridor. The level of analysis varies depending on the type of transportation investment:

- **Major Investments.** The CMP analysis process for major investments consists of conducting a quantitative analysis of corridor alternatives to assess the extent to which congestion mitigation strategies can alleviate travel demand and congestion in the corridor. Congestion mitigation strategies must be considered as an alternative to capacity. Project sponsors are required to report on the specific strategies that will be implemented as part of the project, as well as quantitatively document the benefits of the project's ability to relieve congestion, improve trip reliability, and/or to define how it meets one or more of the CMP goals and objectives.
- **Other Investment Types.** All roadway added capacity projects with total project cost (federal request and local match less than $100 million) will follow the same CMP analysis process as major investment projects. The CMP analysis process for other investment types is less rigorous compared to that for major investments and consists of a qualitative assessment of the congestion reduction impacts of the project in terms of CMP objectives and performance measures. The assessment criteria are similar to those established for the Transportation Improvement Program.
- **Accelerated Projects.** The CMP analysis process for accelerated projects may be quantitative or qualitative, depending on whether the project is categorized as a major investment or other investment type.
- **Exempted Projects.** Safety and bottleneck projects are exempt and do not require a CMP analysis to be conducted.

Project sponsors are required to complete the CMP Project Analysis Form and submit it to H-GAC. The "Preliminary Questions" section of the form must be completed for all projects, regardless of investment type. For major investments, the "CMP Analysis for Major Investments" section of the form must be completed. For other investment types, the "CMP Analysis for Other Investment Types" section of the form must be completed. Instructions for completing the form are provided in Appendix B. H-GAC staff will review and approve the forms and, if necessary, contact the submitting agency regarding any questions.

An overview of the CMP analysis process for each investment type is summarized in Table 7.1 and Figure 7.2. The table identifies the criteria used to define each investment type (e.g., major investments, other investment types, accelerated projects, exempted projects), an overview of the CMP analysis process for the investment type, CMP Project Analysis Form requirements, and the timing of the CMP analysis within the overall project development process. The figure graphically depicts the criteria for determining investment type, type of CMP analysis, and CMP Project Analysis Form requirements. The CMP analysis process for each investment type is discussed in more detail following the table.

Figure 7.2: CMP Analysis Process

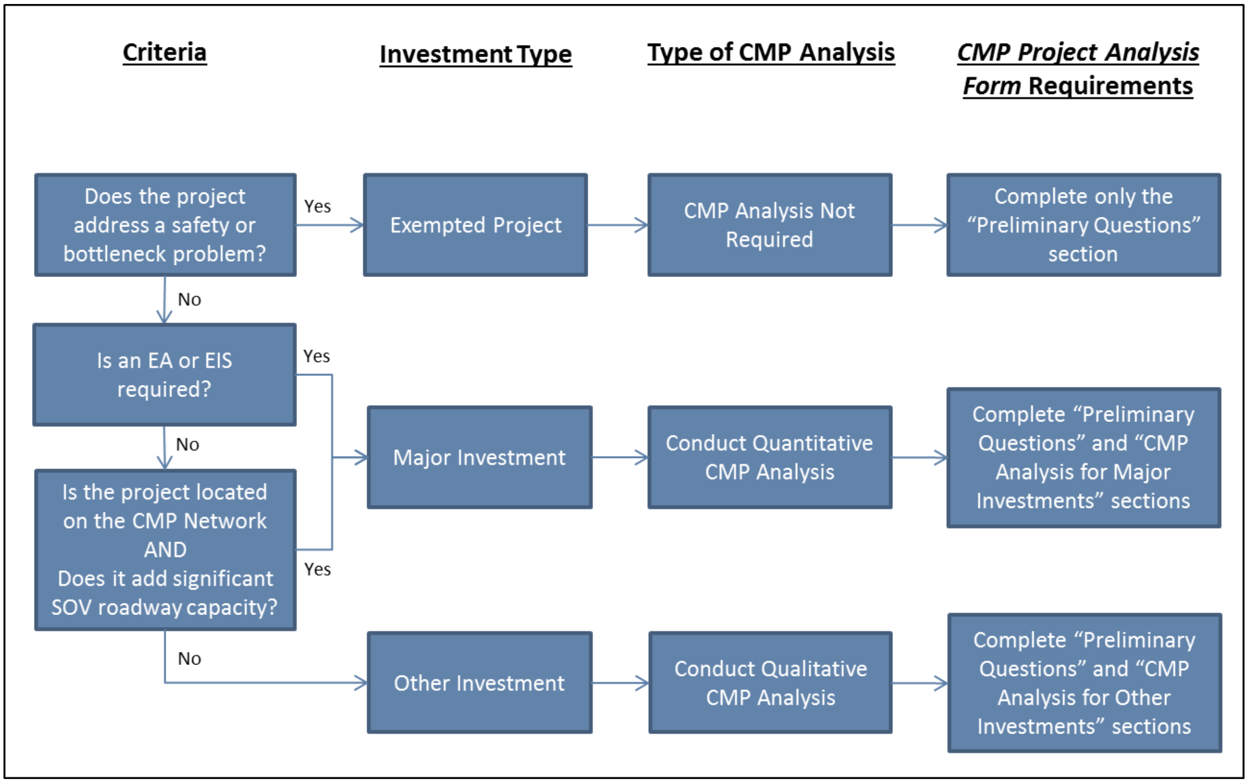


Table 7.1: CMP Analysis Process

	Investment Type			
	Major Investments	**Other Investments**	**Accelerated Projects**	**Exempted Projects**
Criteria for Defining Investment Type	• Environmental assessment (EA) or environmental impact statement (EIS) required, OR • Project located on CMP Network AND adds significant SOV capacity	• Project is not on CMP network, OR • Project does not add significant SOV capacity • NOTE: Other investment type could include capacity-adding projects not on the CMP network	• The same criteria as major investments or other investment types applies	• Project solves a safety or bottleneck problem, as defined by the criteria in Table 8.3
CMP Analysis Process	• CMP serves as warrant for justifying additional SOV capacity • Quantitative CMP analysis • Use CMP report to identify deficiencies on project corridor • Use CMP toolbox to identify congestion mitigation strategies and/or suggested analysis tools for inclusion in the corridor alternatives analysis and/or NEPA documentation. • Consider CMP strategies as an alternative to capacity, and/or bundle CMP strategies into the added capacity project. • Quantitatively document congestion reduction impacts in terms of CMP objectives and measures • Justify reasons for not implementing congestion mitigation strategies	• Other investment projects are subject to less rigorous congestion analysis • Qualitative CMP analysis • Use CMP toolbox to identify congestion mitigation strategies and/or suggested analysis tools • Conduct qualitative analysis of congestion impacts based on planning factors • Qualitatively document congestion reduction impacts of the project in terms of CMP objectives and measures	• The same CMP analysis process as major investments or other investment types applies • H-GAC reviews the CMP analysis process results • H-GAC conducts a scoping meeting with the consultant/project sponsor to discuss alternatives analysis and incorporate CMP strategies into the preferred project alternative • A kickoff meeting is convened, and accelerated environmental assessment, design, and implementation process schedules are defined and implemented	• Project does not require a CMP analysis

	Investment Type			
	Major Investments	**Other Investments**	**Accelerated Projects**	**Exempted Projects**
CMP Project Analysis Form Requirements	• Project sponsor completes both the "Preliminary Questions" and "CMP Analysis for Major Investments" sections of the CMP Project Analysis Form	• Project sponsors complete both the "Preliminary Questions" and "CMP Analysis for Other Investments" sections of the CMP Project Analysis Form	• Project sponsors complete the "Preliminary Questions" and either the "CMP Analysis for Major Investments" OR the "CMP Analysis for Other Investments" sections of the CMP Project Analysis Form (depending on investment type)	• Project sponsors complete only the "Preliminary Questions" section of the CMP Project Analysis Form
Timing of CMP Analysis	• Conduct CMP analysis as part of corridor alternatives analysis or NEPA document preparation • Pre-requisite for TIP project application	• Conduct CMP analysis as part of mobility study, traffic operations analysis, or local/regional study • Pre-requisite for TIP project application	• The same timing of CMP analysis as major investments or other investment types applies (depending on investment type)	• CMP analysis not required • Submit CMP Project Analysis Form to H-GAC as part of TIP project application

CMP Analysis for Major Investments

Federal law prohibits regions designated as nonattainment for ozone or carbon monoxide standards from programming projects that result in a significant increase in carrying capacity for single-occupant vehicles (SOV) in its TIP, unless the project is addressed in the region's CMP. Therefore, a CMP analysis is required for all federal and state assisted regionally significant added capacity projects located on the CMP network.

The CMP analysis process for major investments consists of conducting a quantitative analysis of corridor alternatives to assess the extent to which congestion mitigation strategies can alleviate travel demand and congestion in the corridor. First, the baseline condition is assessed to determine whether the problem/deficiency can be addressed without building more road capacity. Next, congestion mitigation strategies are evaluated as an alternative to the added capacity improvement. The CMP toolbox provides a starting point for identifying alternative congestion mitigation strategies while simulation or other appropriate analysis tools from the CMP toolbox are used to conduct an evaluation of the actions to assess their impacts in the corridor. If the CMP analysis indicates that congestion mitigation strategies are insufficient to meet the travel demand needs in the corridor and additional SOV capacity is warranted, then the analysis must identify supplemental congestion mitigation strategies to improve the long-term effectiveness of the capacity improvement.

The extent to which these actions can alleviate travel demand and congestion in the corridor compared to the baseline condition are documented as part of the CMP analysis. Project sponsors are required to report on the specific strategies that will be implemented as part of the project as well as quantitatively document the benefits of the project's ability to relieve congestion, improve trip reliability, and/or to define how it meets one or more of the CMP goals and objectives. If congestion mitigation strategies are not feasible or warranted as part of the project, an explanation must be provided as part of the CMP analysis.

Project sponsors are required to complete both the "Preliminary Questions" and "CMP Analysis for Major Investments" sections of the CMP Project Analysis Form and submit it to H-GAC. Ideally, a CMP analysis is performed by the project sponsor during the four- to 10-year short-range planning period in the RTP, prior to submittal of the TIP project application. The CMP analysis could be conducted as part of corridor alternatives analysis or NEPA document preparation, or it could be conducted as a separate analysis. Completing the CMP analysis is a prerequisite for consideration under H-GAC's TIP project application process.

Because major investment projects are often implemented by other local agencies, project sponsors should contact H-GAC staff at the start of a study or project that will likely add SOV road capacity to the CMP network. H-GAC staff will work with the consultant/project sponsor to discuss the alternatives analysis and incorporate congestion mitigation strategies into the preferred project alternative.

CMP Analysis for Other Investments

The CMP analysis process for other investment types is less rigorous compared to that for major investments and consists of a qualitative assessment of the congestion reduction impacts of the project in terms of CMP objectives and performance measures. Completing the CMP analysis for other investments will assist H-GAC in assessing the project's expected impact on overall congestion goals and objectives for the region.

The CMP toolbox can be used to identify congestion mitigation strategies to solve a specific problem, or to identify an appropriate analysis tool for evaluating the benefits of a specific strategy type. The congestion reduction impacts of the project are assessed in terms of various qualitative criteria depending on the type of strategy, as shown in Table 7.2. The assessment criteria are similar to those established for the Transportation Improvement Program. The process also includes qualitatively documenting the benefits of the project's ability to relieve congestion, improve trip reliability, and/or to define how it meets one or more of the CMP goals and objectives.

Project sponsors are required to complete both the "Preliminary Questions" and "CMP Analysis for Other Investment Types" sections of the CMP Project Analysis Form. The CMP analysis can be conducted as part of a mobility study, traffic operations analysis, or other local/regional study, and it is a prerequisite for consideration under H-GAC's TIP project application process.

Table 7.2: Qualitative Assessment for Other Investment Types

Strategy Type	Qualitative Criteria
Transportation Demand Management Strategies	• Does the project strongly support or enhance travel demand management programs that are already in place and that have regional significance? If yes, please explain. • Will the project reduce traffic congestion by reducing vehicle trips or VMT? If yes, please explain. • Will the project reduce vehicle emissions? If yes, please explain. • Does the project include marketing, education, and incentive programs that encourage shift to alternative modes? If yes, please explain.
Land Use Improvements	• Does the project provide or demonstrate the potential for a transit connection? If yes, please explain. • Does the project provide an accessible pedestrian/bicyclist environment that meets or exceeds TxDOT's policy for bicycle and pedestrian accommodation? If yes, please explain. • Is the project identified within an H-GAC Special Districts study, an H-GAC Livable Centers study, or a comparable multi-jurisdictional or local plan study? If yes, please explain.

Strategy Type	Qualitative Criteria
Public Transportation Improvements	• Does the project provide connection to other transit services? If yes, please explain. • Does the project include pedestrian and bicycle accommodations? If yes, please explain. • Is the project an intrinsic part or does it demonstrate the potential for transit-oriented development? If yes, please explain. • Does the project provide access to job opportunities, unmet, or enhanced needs? If yes, please explain. • Does the project use Intelligent Transportation Systems and other operation/service enhancing technologies? If yes, please explain. • Does the project address a need for expanded transit service capacity? If yes, please explain.
Bicycle/ Pedestrian Improvements	• Does the proposed facility meet or exceed TxDOT's policy for bicycle and pedestrian accommodation and American Association of State Highway and Transportation Officials (AASHTO) design guidelines for pedestrian and/or bicycle facilities? If yes, please explain. • Does the proposed facility provide safe and convenient routes across barriers, such as freeways, railroads, and waterways, or does it close a gap in the existing bicycle network that aligns with a regional bikeway shown on the Regional Bikeway Concept Map? If yes, please explain. • Does the proposed facility provide or demonstrate the potential for a transit connection? If yes, please explain. • Does the proposed facility provide connections to regional destinations? If yes, please explain. • Is the project identified within an H-GAC Special Districts study, an H-GAC Livable Centers study, or a comparable multijurisdictional or local plan study? If yes, please explain.
Intelligent Transportation Systems (ITS) and Operations Strategies	• Is the project an integral part of an incident management system, or will it contribute to a reduction in incident clearance time? If yes, please explain. • Will the system utilize dynamic management of the facility to enhance travel time reliability (e.g., ramp metering, variable speed limits, variable pricing, etc.)? If yes, please explain. • Does the project coordinate traffic signal systems across jurisdictional boundaries and improve progression? If yes, please explain. • Does the project improve accuracy, timeliness, and availability of real-time information to the public? If yes, please explain. • Does the project improve automated traffic data collection and archiving ability? If yes, please explain. • Will the project give priority to emergency vehicles, transit, or high-occupancy vehicles? If yes, please explain. • Is the project consistent with the regional ITS Architecture? If yes, please explain.
Roadway/ Mobility Improvements (Non-ITS)	• Will the project improve operational efficiency/reliability on a designated freight corridor? If yes, please explain. • Will the project improve a roadway on which fixed route transit service is being provided or otherwise used by other transit services outside of a fixed route

Strategy Type	Qualitative Criteria
	service area? If yes, please explain. • Does the project incorporate access management principles, such as raised medians, turn lanes, sharing/combining access points between businesses, or innovative intersections to reduce conflict points (e.g., roundabout, diverging diamond, single point urban interchange, etc.)? If yes, please explain. • Does the project include pedestrian/bicycle accommodations that meet or exceed TxDOT's policy for bicycle and pedestrian accommodation and AASHTO design guidelines? If yes, please explain. • Does the project integrate Complete Streets design principles? If yes, please explain.
Roadway Capacity Expansion (off the CMP Network)	• Does the project provide a needed connection or additional capacity as identified in an adopted thoroughfare plan? If yes, please explain. • Does the project include segments of high congestion, and will the project help to mitigate this congestion? If yes, please explain. • Does the project provide access to existing and/or future business and job activity centers, shopping, educational, cultural, and recreational opportunities? If yes, please explain. • Will the project accommodate or create significant benefits to at least two additional modes of travel, or complete a link to intermodal or freight facilities of regional importance? If yes, please explain. • Does the project impact a network-level change in congestion? If yes, please explain.
Freight	• Does the project implement 18'6'' vehicle clearances on interstates and highways? • Does the project provide dedicated truck lanes? • Does the project provide critical urban or rural freight corridors? • Does the project improve connectivity to the region's ports? • Does the project include Intelligent Transportation Systems that will create or improve freight travel information or freight data collection?

CMP Analysis for Accelerated Projects

One gap identified in the 2015 CMP update is related to the process of reviewing and planning for accelerated projects not considered and/or documented for programming in the RTP. In previous H-GAC planning cycles, some projects or strategies have been introduced late in the planning process due to one of the following factors:

- Accelerated growth or congestion relief
- Connection with an existing project
- Additional/new funding opportunities

While these projects typically moved smoothly through H-GAC's planning process, the implementation of the projects did not correspond with the typical evaluation process and timeline required for projects already documented in the RTP. In the 2009 CMP, H-GAC proposed an accelerated project process to ensure that proper analysis was conducted for an accelerated project that was not in the RTP. A similar approach is recommended in this current CMP/RTP update cycle.

The CMP analysis process for accelerated projects is dependent on whether the project is categorized as a major investment, other investment type, or exempted project, using the same criteria defined previously in Table 7.1. The process includes the following steps:

1. Project sponsors complete the “Preliminary Questions” and either the “CMP Analysis for Major Investments” or the “CMP Analysis for Other Investments” sections of the CMP Project Analysis Form, depending on the investment type.
2. H–GAC reviews the CMP analysis process results.
3. H-GAC conducts a scoping meeting with the consultant/project sponsor to discuss alternatives analysis and incorporate congestion mitigation strategies into the preferred project alternative.
4. A kickoff meeting is convened, and accelerated environmental assessment, design, and implementation process schedules are defined and implemented.

The CMP analysis should be completed before start of the environmental assessment process and potential incorporation in the TIP. The congestion mitigation strategies identified to be most beneficial are required to be incorporated into each of these projects. The process also includes documenting the benefits of the project’s ability to relieve congestion, improve trip reliability, and/or to define how it meets one or more of the CMP goals and objectives.

H-GAC should meet with TxDOT and other relevant agencies to periodically review projects, determine where they are in the process, identify which elements/documents need to be completed, and identify the agency/jurisdiction responsible for performing the work.

CMP Analysis Exemptions

Projects are exempt from a CMP analysis if the predominant improvement type solves a safety or bottleneck problem. Table 7.3 identifies site characteristics and typical strategies used to distinguish safety and bottleneck improvement projects. Project sponsors must work with H-GAC staff to confirm that a safety or bottleneck issue exists.

No CMP analysis is required to be conducted for safety and bottleneck projects. Project sponsors complete only the “Preliminary Questions” section of the CMP Project Analysis Form and submit it to H-GAC as part of the TIP project application.

Table 7.3: Project Types Exempt from CMP Analysis

Project Type	Site Characteristics	Typical Strategies

Safety Projects	Any of the following conditions may exist or help to identify a safety condition: • The predominant improvement type addresses an immediate safety need along a corridor or intersection as documented in a regional/local traffic or safety study • The project location has been identified as a regional crash hotspot or location of high crash incidence by procedures developed by H-GAC	Safety improvements do not include adding capacity and can be accommodated within existing right-of-way. Safety exempt project types include[1]: • Railroad/highway crossing • Projects that correct, improve, or eliminate a hazardous location or feature • Safer non-federal aid system roads • Shoulder improvements • Increasing sight distance • Highway Safety Improvement Program (HSIP) implementation projects • Traffic control devices and operating assistance other than signalization projects • Railroad/highway crossing warning devices • Guardrails, median barriers, crash cushions • Pavement resurfacing and/or rehabilitation • Pavement marking • Emergency relief (23 USC 125) • Fencing • Skid treatments • Safety roadside rest areas • Adding medians • Truck climbing lanes outside the urbanized area • Lighting improvements • Widening narrow pavements or reconstructing bridges (no additional travel lanes) • Emergency truck pullovers
Bottleneck Projects	Typical bottleneck locations include lane drops, weaving areas, freeway on-ramps, freeway exit ramps, freeway-to-freeway interchanges, changes in highway alignment, tunnels/underpasses, narrow lanes/lack of shoulders, or at traffic control devices. The following conditions exist or help to identify a recurring bottleneck condition[2]: • A traffic queue exists upstream of the bottleneck, wherein speeds are lower while free flow conditions exist elsewhere on the facility. • A beginning point for a queue. There should be a definable point that separates upstream and downstream conditions. The geometry of that point is often coincidently the root cause of the operational deficiency.	Bottleneck improvements are low cost, less than 1 mile in length, and typically include the following strategy types: • Low cost capacity improvements (e.g., auxiliary lanes, shoulder conversions) • Minor intersection/interchange modifications (restriping to change lane configuration, merge/diverge areas, or weaving areas, ramp modifications) • Traffic control device improvements (e.g., ramp metering, signal timing, etc.)

Project Type	Site Characteristics	Typical Strategies
	• Free flow traffic conditions downstream of the bottleneck that have returned to nominal or design conditions. • As it pertains to an operational deficiency, a predictable recurring cause that is theoretically "correctable" by design. • Traffic volumes that exceed the capability of the confluence to process traffic. Note: this applies to recurring events more so than nonrecurring.	

Notes: [1] Safety exempt project types are the same as those defined in federal regulation (40 CFR 92.126) to be exempt from conformity requirements

[2] Source: FHWA Guidance on Localized Bottlenecks, http://ops.fhwa.dot.gov/bn/lbr.htm#g9

Quantitative Analysis

The quantitative analysis for project evaluation occurs after a project is selected but before funds are assigned. In the quantitative analysis, H-GAC staff evaluate changes in the peak period volume to capacity ratio.

Peak period volume to capacity (V/C ratio) measures the level of congestion on the roadway by dividing the volume of traffic during the peak period by the capacity of the roadway. It is based on directional 24-hour lane volumes of existing and near future roadways in the CMP network.

"Levels of Mobility" for measuring severity of congestion were included in the 2013 CMP, as adopted by the Transportation Policy Council for the Houston-Galveston TMA. Each level was tied to the Volume to Capacity ratio. The analysis adopted is listed below in Figure 7.3.

Figure 7.3: Levels of Mobility

Levels of Mobility	Volume to Capacity Ratio
Tolerable	< 0.85
Moderate	> = 0.85
Serious	> 1.00 and <1.25
Severe	>1.25

SECTION 8 – CMP STRATEGY EFFECTIVENESS

The purpose of this step is to ensure that the implemented strategies are having the desired impact in terms of managing congestion in the Houston-Galveston Transportation Management Area. We use the term congestion management rather than congestion reduction to acknowledge that success in congestion management in our region, due to our rapid growth, may not be always result in a reduction and in fact my appear flat or even as a modest increase as reflected in certain performance measures.

The Unknown

Congestion has changed considerably in the Houston-Galveston TMA since the advent of the COVID-19 pandemic in early 2020. Telework has expanded dramatically resulting in significantly reduced roadway congestion, especially during a.m. and p.m. peak periods. 2020 congestion indicators will certainly reflect the profound impact of COVID-19 on roadway congestion. While the impacts of the pandemic will likely lessen in 2021 and 2022, a long-term increase in teleworking from pre-pandemic levels is likely.

Retail services are also undergoing a fundamental shift in the delivery of services and goods. In-person purchases at stores and restaurants are often replaced with deliveries. Whether this is merely a shift or a reduction in vehicle miles travelled is uncertain. However, it is likely a trend that will require further monitoring.

The Houston-Galveston region is prone to flooding and tropical events, which can alter congestion for several weeks to a few months. Large-scale construction projects can also have regional and sub-regional impacts during and after completion. Planned and unplanned events must be considered along with mitigation efforts over time. Continual monitoring of the CMP strategies considering all the above factors is essential to practical analysis.

Next Steps

H-GAC will utilize the targets and performance measures identified in this CMP to gauge progress and success with respect to congestion mitigation. Strategy success will be linked to the achievement of regionwide annual and biennial targets and improvement of segment level congestion in the worst areas of the region on an annual basis. Success will also be monitored utilizing the CMP analyses performed for non-exempt, added-capacity projects, evaluating the implementation of the congestion management strategies identified and their effectiveness. The most successful strategies across projects will be identified that help the region meet project, segment, and regionwide objectives and metrics.

There is work under way to update the Regional Transportation Plan, Bikeways Layer, the High Capacity Transit Plan, and other efforts. It is recommended that a task force convene after this update to review the results of these efforts and incorporate them into an update of the congestion management process for 2022. As part of this update, it is recommended that vehicle miles traveled (VMT) be considered for inclusion as a performance measure. Newly defined measures for safety and air quality should also be considered.

New tools have also been developed for measuring and managing congestion. This update should consider incorporating the new tools available through the Texas Transportation Institute (ex: the COMPAT tool), the Federal Highway Administration (ex: the TOPS-BC tool), or other tools that may become available.

APPENDIX A – ADDITIONAL NETWORKS FOR MONITORING AND MITIGATION

Congestion Strategy Networks – Tow and Go, Bikeways, Sidewalks, High Capacity Transit, Intelligent Transportation Systems

Figure A-1: Regional Tow and Go Network

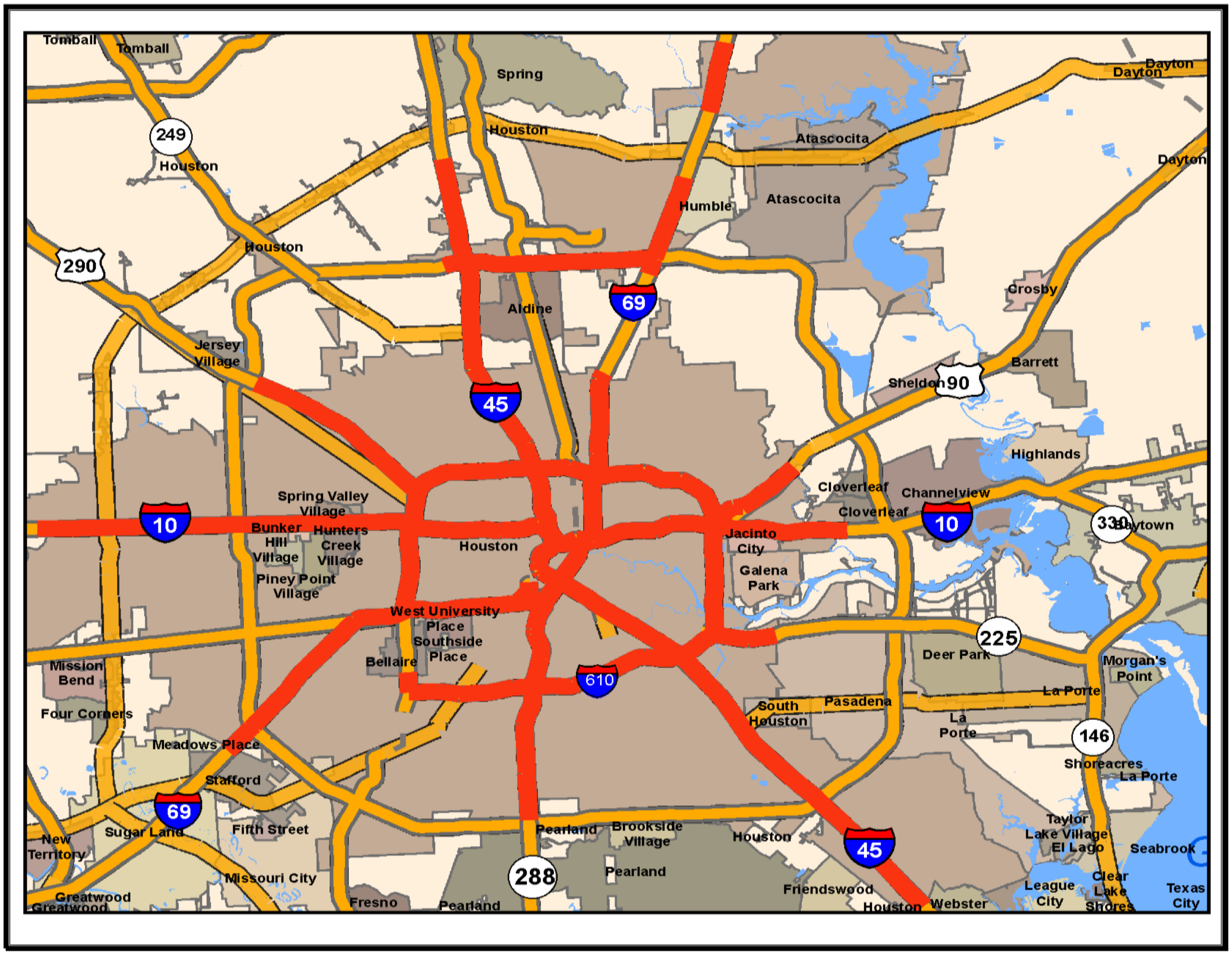


Figure A-1 shows the extent of the current and planned **Tow and Go network**. Designed to quickly remove disabled vehicles as the result of accidents or mechanical breakdowns, it has proven to be an effective means of mitigating congestion.

Figure A-2: Regional ITS Network

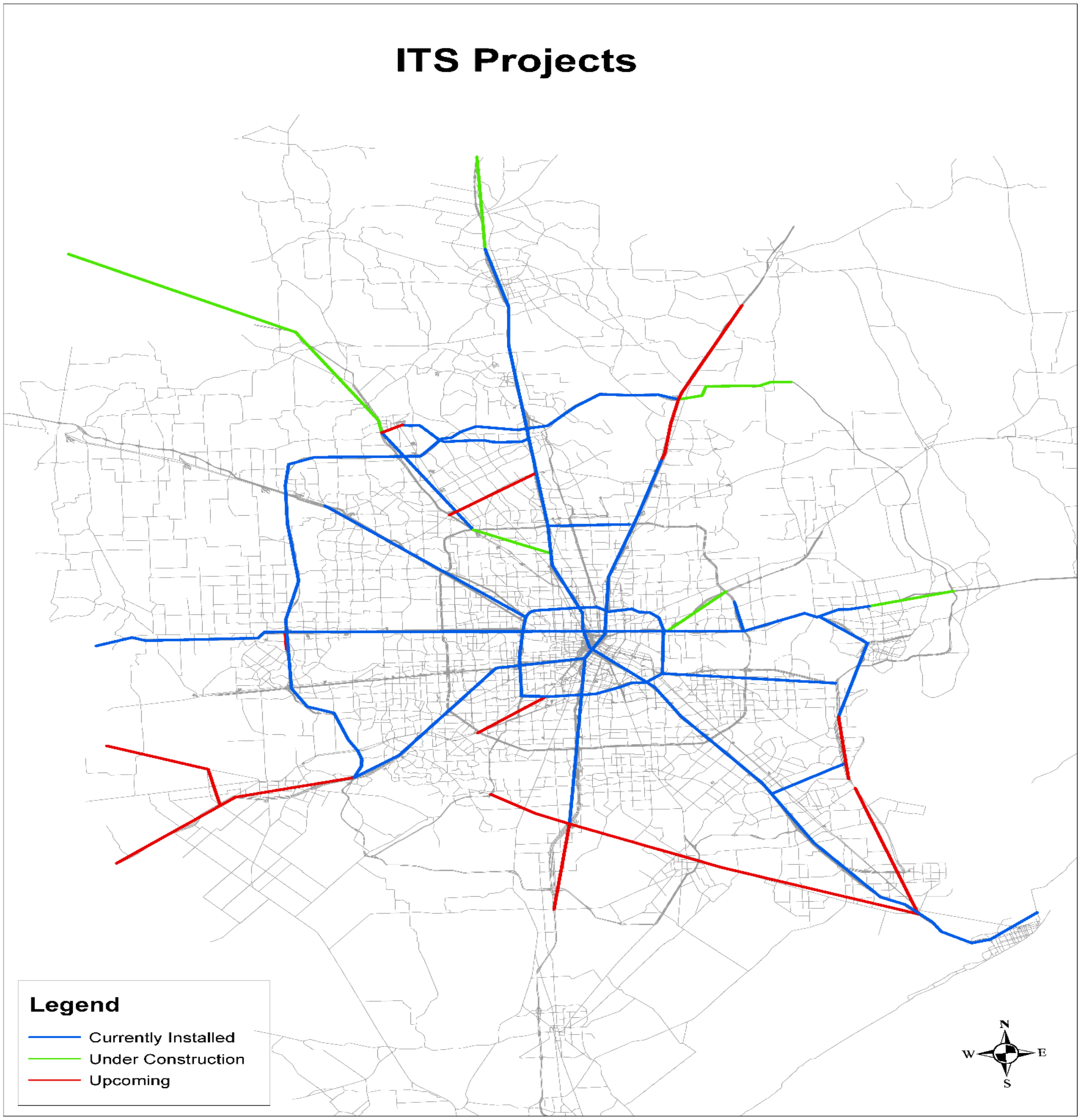


Figure A-2 shows the extent of the current and planned **Intelligent Transportation System (ITS).** Designed to provide timely information of traffic conditions and relieving bottlenecks, ITS is highly useful in providing information and choice.

Figure A-3: Fixed Guideway Transit Including Bus Rapid Transit

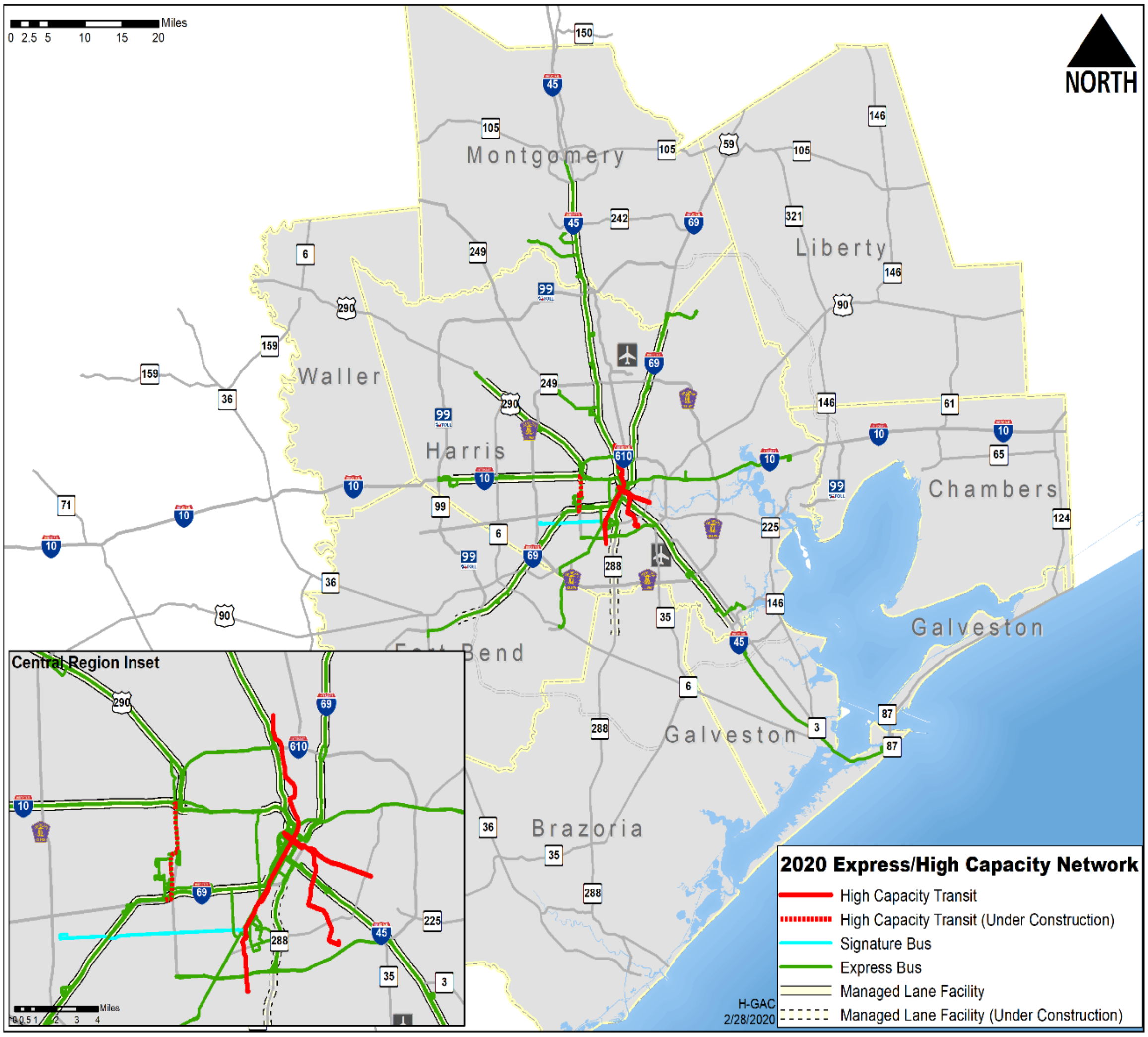


Figure A-3 shows the high capacity transit system, which currently consists of light rail and bus rapid transit. Extensive expansion of those modes along with commuter rail is expected by 2045.

Figure A-4: Regional Park and Ride Map

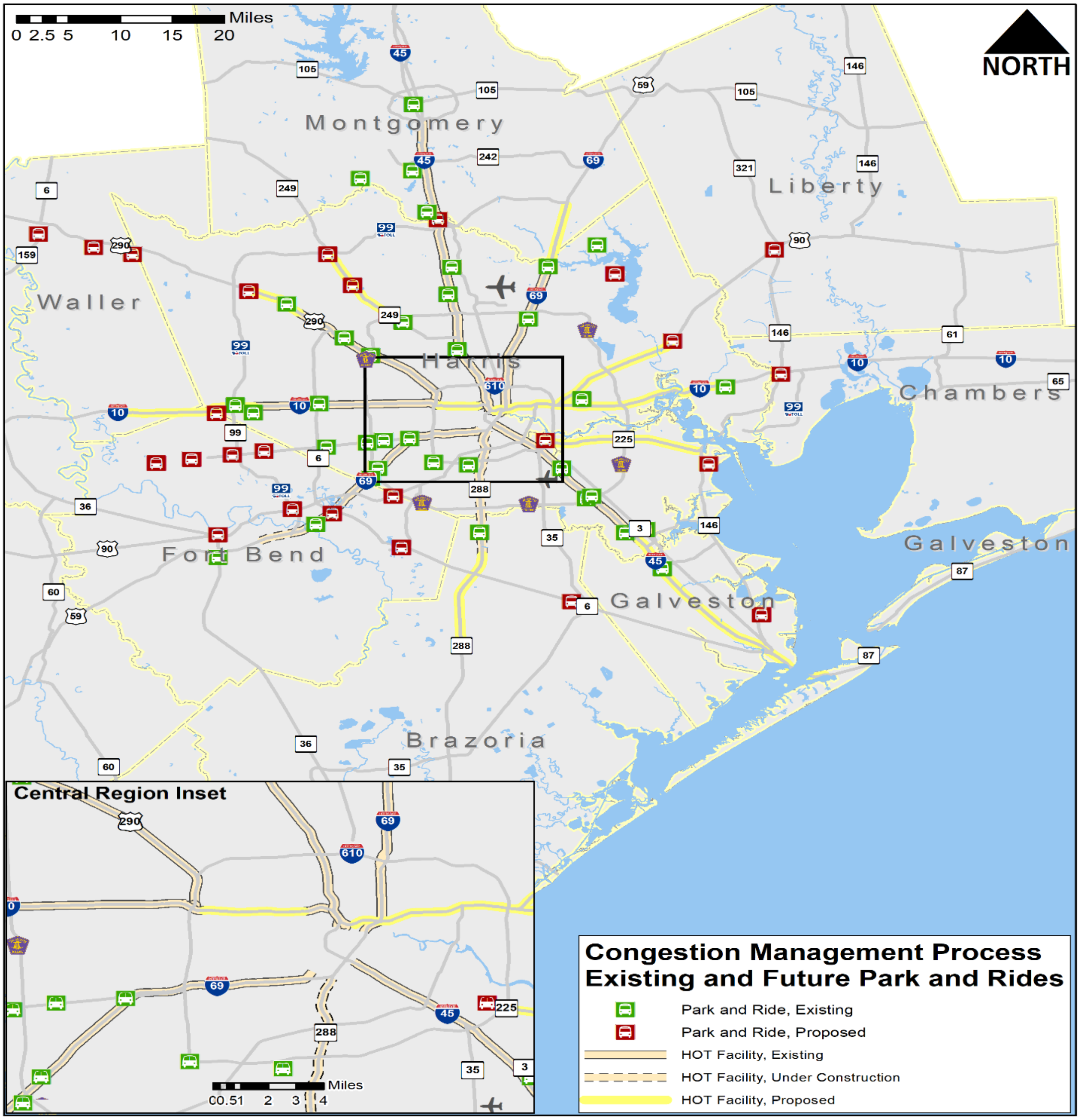


Figure A-4 shows the existing and planned network of park and ride/commuter service in the region. It includes METRO and other regional transit agencies. There are 45 existing and 25 planned park and ride locations in the regional networks. Commuter service primarily provides a travel option for lengthy single occupancy vehicle work trips.

Figure A-5: Regional Bikeways Map

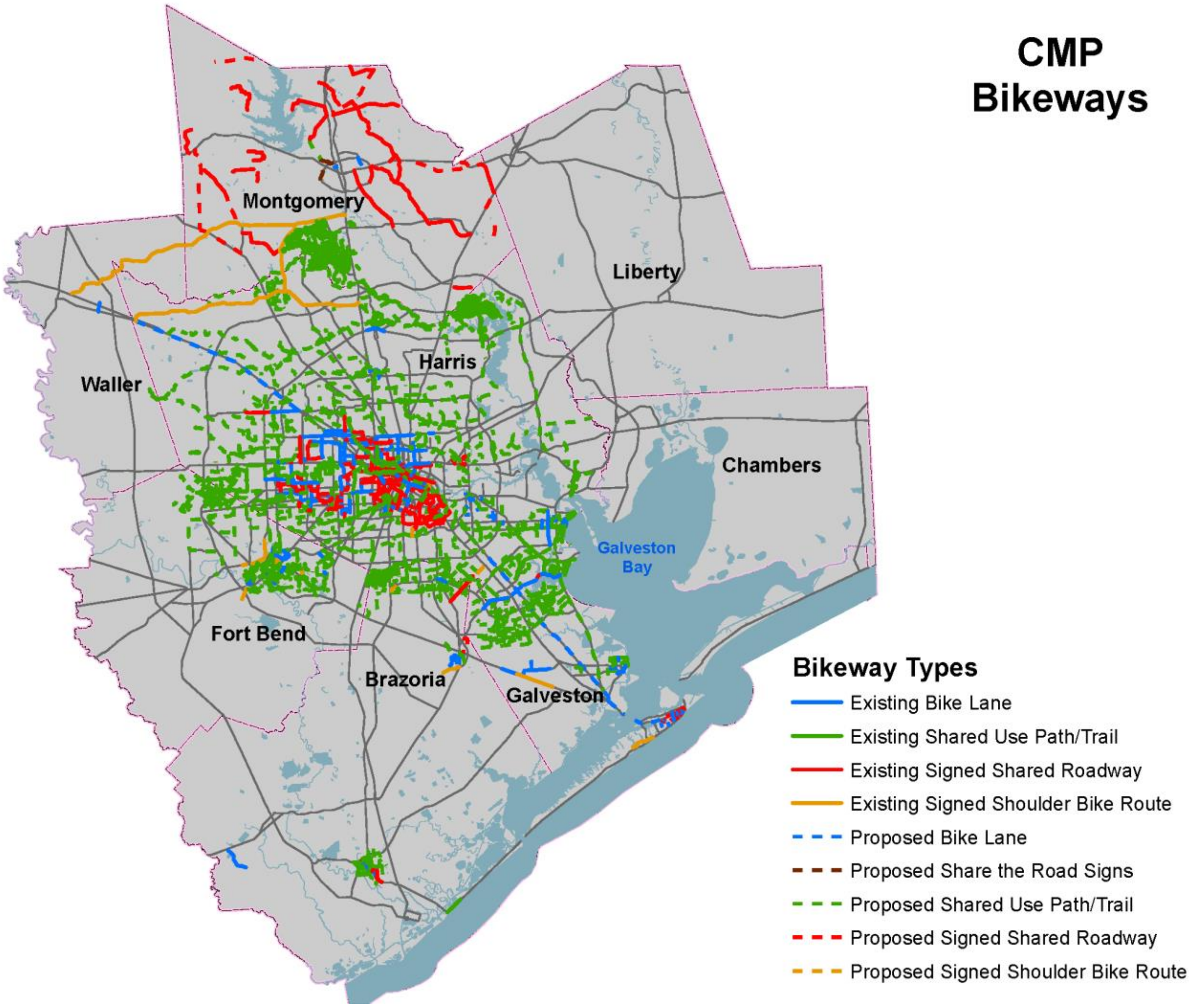


Figure A-5 shows the extent of the current bike network. Cycling has been an increasingly attractive mode for a variety of shorter trips that can be used instead of the automobile.

Figure A-6: Regional Pedestrian Sidewalk Map

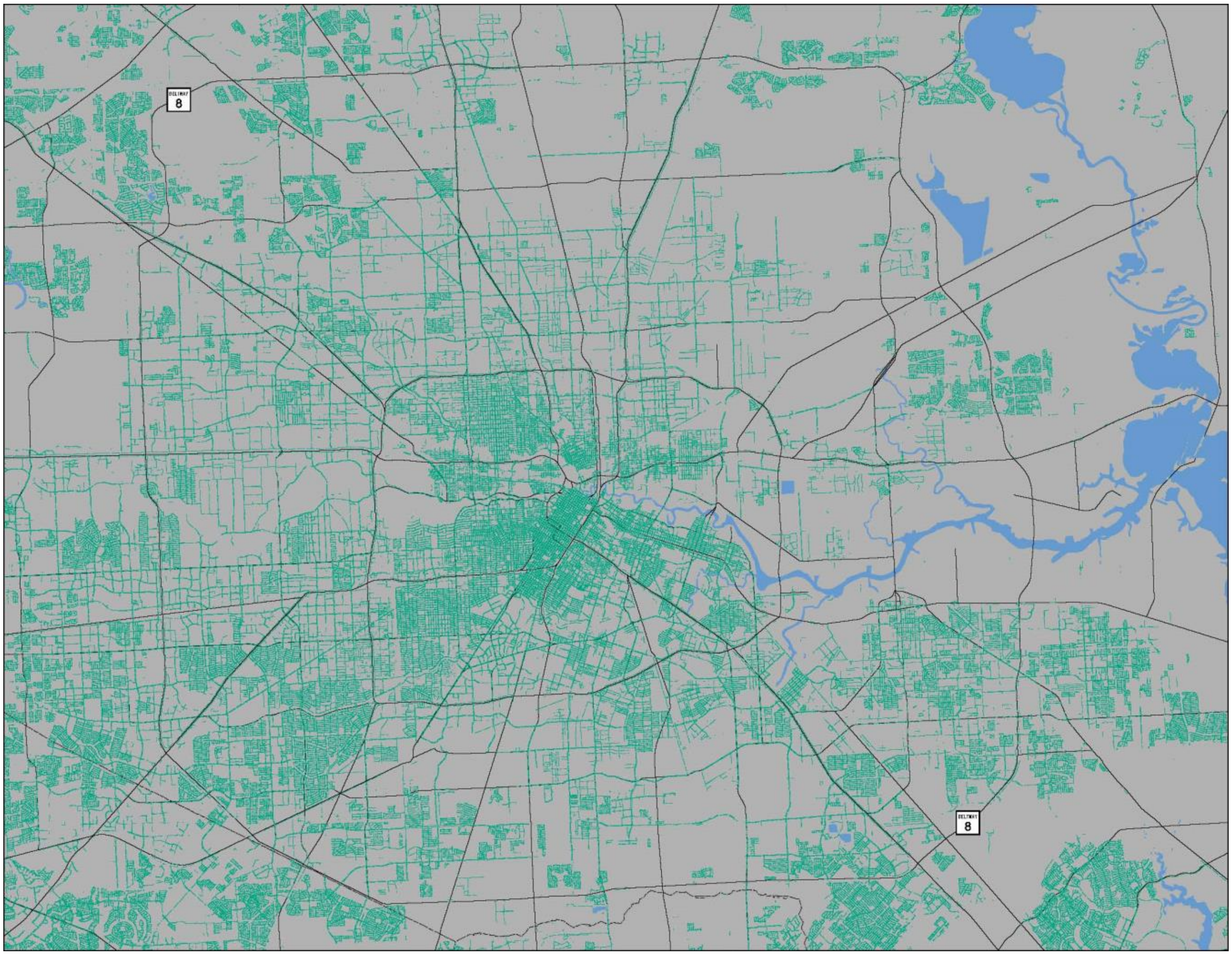


Figure A-6 shows the regional pedestrian sidewalk network. Efforts are underway by the City of Houston, METRO, and others to increase and upgrade their sidewalk infrastructure. The better the sidewalks are the more likely people are to use them for short trips or to walk to the bus stop instead of using their automobile.

APPENDIX B – CONGESTION MANAGEMENT PROCESS PROJECT ANALYSIS FORM

CMP Project Analysis Form

Applicant Information

Agency Name: Click here to enter text.
Agency Address: Click here to enter text.
Person Submitting Form: Click here to enter text.
Email: Click here to enter text.
Telephone Number: Click here to enter text.
Date: Click here to enter a date.

Preliminary Questions

This section is REQUIRED to be completed for all projects.

1. Describe the proposed improvement (facility, limits, project description).
Click here to enter text.

2. Does the project address a safety or bottleneck problem?
Yes | No

If yes, please explain. Click here to enter text.
If yes, the project is exempt from further CMP analysis. Stop and submit this form to H-GAC.
If no, continue to the next question.

3. Is an Environmental Assessment (EA) or Environmental Impact Statement (EIS) required for the project?
Yes | No

If yes, complete the CMP Analysis for Major Investments section (questions 6-12).
If no, continue to the next question.

4. Is the project located on the CMP network?
Yes | No

If yes, continue to the next question.
If no, complete *CMP Analysis for Other Investments* section (questions 13-15).

5. Does the project add significant SOV roadway capacity?
Yes | No

If yes, please explain. Click here to enter text.
If yes, complete CMP Analysis for Major Investments section (questions 6-12).
If no, complete CMP Analysis for Other Investments section (questions 13-15).

CMP Analysis for Major Investments

This section is to be completed for projects requiring an EA/EIS, or for significant SOV capacity-adding projects located on the CMP network.

6. Are there other congestion mitigation projects (e.g., transportation demand management, land use, public transportation, ITS and operations, pricing, bicycle and pedestrian, and bottleneck relief) within the project corridor that are programmed into the current TIP?
Yes No

If yes, identify the project name(s), state the project identification number (CSJ number), and MPO project identification number.
Project Name
Click here to enter text. CSJ # Click here to enter text.
MPO Project #
Click here to enter text.
Project Name
Click here to enter text. CSJ # Click here to enter text.
MPO Project #
Click here to enter text.
Project Name
Click here to enter text. CSJ # Click here to enter text.
MPO Project #
Click here to enter text.

7. Using the CMP report, is the corridor identified as deficient or needs improvement in any of the performance areas?
Yes | No
If yes, which performance areas?
Click here to enter text.

8. Can the problem/deficiency be addressed without building more road capacity?
Click here to enter text.

9. Describe any congestion mitigation alternatives to the proposed improvement that have been considered or will be evaluated to correct the deficiencies and manage the facility effectively (or facilitate its management in the future).
Click here to enter text.

10. Specify congestion mitigation strategies that will be implemented as part of the project.
Click here to enter text.

11. What are the specific congestion reduction impacts of the implemented strategies?
Click here to enter text.

12. If not implementing a congestion mitigation strategy, please explain reason.
Click here to enter text.

Stop and submit the completed form to H-GAC.

CMP Analysis for Other Investments

This section is to be completed for other investment types or for capacity-adding projects that are not located on the CMP network.

13. What type(s) of congestion management strategy/strategies is/are encompassed by the project/program according to the following strategy types:

Transportation Demand Management Improvements
Land Use Improvements
Public Transportation Improvements
Bicycle/Pedestrian Improvements
Intelligent Transportation Systems (ITS) and Operations Strategies
Roadway/Mobility (Non-ITS) Improvements
Roadway Capacity Expansion (Off the CMP network)

14. Complete the following qualitative criteria for the strategy type(s) encompassed by the project/program:

Transportation Demand Management Strategies

☐ Does the project strongly support or enhance travel demand management programs that are already in place and that have regional significance? Yes | No
If yes, please explain. Click here to enter text.

☐ Will the project reduce traffic congestion by reducing vehicle trips or VMT? Yes | No
If yes, please explain. Click here to enter text.

☐ Will the project reduce vehicle emissions? Yes | No
If yes, please explain. Click here to enter text.

☐ Does the project include marketing, education, and incentive programs that encourage shift to alternative modes? Yes | No
If yes, please explain. Click here to enter text.

Land Use Improvements

☐ Does the project provide or demonstrate the potential for a transit connection? Yes | No
If yes, please explain. Click here to enter text.

☐ Does the project provide an accessible pedestrian/bicyclist environment that meets or exceeds TxDOT's policy for bicycle and pedestrian accommodation? Yes | No
If yes, please explain. Click here to enter text.

☐ Is the project identified within an H-GAC Special Districts study, an H-GAC Livable Centers study, or a comparable multi-jurisdictional or local plan study? Yes | No
If yes, please explain. Click here to enter text.

Public Transportation Improvements

☐ Does the project provide connection to other transit services? Yes | No
If yes, please explain. Click here to enter text.

☐ Does the project include pedestrian and bicycle accommodations? Yes | No
If yes, please explain. Click here to enter text.

☐ Is the project an intrinsic part or does it demonstrate the potential for transit oriented development? Yes | No
If yes, please explain. Click here to enter text.

☐ Does the project provide access to job opportunities, unmet, or enhanced needs? Yes | No
If yes, please explain. Click here to enter text.

☐ Does the project use Intelligent Transportation Systems and other operation/service-enhancing technologies? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project address a need for expanded transit service capacity? Yes | No

If yes, please explain. Click here to enter text.

Bicycle/Pedestrian Improvements

☐ Does the proposed facility meet or exceed TxDOT's policy for bicycle and pedestrian accommodation and AASHTO design guidelines for pedestrian and/or bicycle facilities? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the proposed facility provide safe and convenient routes across barriers, such as freeways, railroads, and waterways, or does it close a gap in the existing bicycle network that aligns with a regional bikeway shown on the Regional Bikeway Concept Map? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the proposed facility provide or demonstrate the potential for a transit connection? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the proposed facility provide connections to regional destinations? Yes | No

If yes, please explain. Click here to enter text.

☐ Is the project identified within an H-GAC Special Districts study, an H-GAC Livable Centers study, or a comparable multi-jurisdictional or local plan study? Yes | No

If yes, please explain. Click here to enter text.

Intelligent Transportation Systems (ITS) and Operations Strategies

☐ Is the project an integral part of an incident management system, or will it contribute to a reduction in incident clearance time? Yes | No

If yes, please explain. Click here to enter text.

☐ Will the system utilize dynamic management of the facility to enhance travel time reliability (e.g., ramp metering, variable speed limits, variable pricing, etc.)? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project coordinate traffic signal systems across jurisdictional boundaries and improve progression? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project improve accuracy, timeliness, and availability of real-time information to the public? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project improve automated traffic data collection and archiving ability? Yes | No

If yes, please explain. Click here to enter text.

☐ Will the project give priority to emergency vehicles, transit, or high occupancy vehicles? Yes | No

If yes, please explain. Click here to enter text.

☐ Is the project consistent with the regional ITS architecture? Yes | No

If yes, please explain. Click here to enter text.

Roadway/Mobility Improvements (Non-ITS)

☐ Will the project improve operational efficiency/reliability on a designated freight corridor? Yes | No

If yes, please explain. Click here to enter text.

☐ Will the project improve a roadway on which fixed route transit service is being provided or otherwise used by other transit services outside of a fixed route service area? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project incorporate access management principles, such as raised medians, turn lanes, sharing/combining access points between businesses, or innovative intersections to reduce conflict points (e.g., roundabout, diverging diamond, single point urban interchange, etc.)? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project include pedestrian/bicycle accommodations that meet or exceed TxDOT's policy for bicycle and pedestrian accommodation and AASHTO design guidelines? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project integrate Complete Streets design principles? Yes | No

If yes, please explain. Click here to enter text.

Roadway Capacity Expansion (capacity-adding projects that are not located on the CMP network)

☐ Does the project provide a needed connection or additional capacity as identified in an adopted thoroughfare plan? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project include segments of high congestion, and will the project help to mitigate this congestion? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project provide access to existing and/or future business and job activity centers, shopping, educational, cultural, and recreational opportunities? Yes | No

If yes, please explain. Click here to enter text.

☐ Will the project accommodate or create significant benefits to at least two additional modes of travel or complete a link to intermodal or freight facilities of regional importance? Yes | No

If yes, please explain. Click here to enter text.

☐ Does the project impact a network-level change in congestion? Yes | No

If yes, please explain. Click here to enter text.

15. What are the specific congestion reduction impacts of the implemented strategies?

Click here to enter text.

Stop and submit the completed form to H-GAC.