

# Congestion Management Process



**September 2009**

**APPENDIX G: 2035 Regional Transportation Plan Update**



# Houston–Galveston Area Council Congestion Management Process

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APPENDIX G of the 2035 Regional Transportation Plan Update

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# Resolution

NO. 2013-04

ADOPTION AND INCORPORATION OF THE CONGESTION MANAGEMENT PROCESS INTO TO THE *2035 REGIONAL TRANSPORTATION PLAN* UPDATE:

WHEREAS, the *2035 Regional Transportation Plan Update* was adopted by the Transportation Policy Council on October 22, 2010; and,

WHEREAS, federal regulations require the development and integration of a congestion management process (CMP) in metropolitan regions with population of more than 200,000 people; and,

WHEREAS, the CMP ensures that lower cost traffic and travel demand management options have been properly considered, and if warranted, incorporated into proposed expansion of existing or construction of new regionally significant added capacity roadway projects,

**NOW, THEREFORE, BE IT RESOLVED BY THE TRANSPORTATION POLICY COUNCIL FOR THE HOUSTON-GALVESTON TRANSPORTATION MANAGEMENT AREA THAT THE CMP IS ADOPTED AND INCORPORATED INTO THE 2035 REGIONAL TRANSPORTATION PLAN UPDATE, AS AMENDED.**

**PASSED AND APPROVED** this 25th day of January 2013, at a regularly called meeting of the Transportation Policy Council.

APPROVED:

Hon. Ed Emmett, Chairman  
Transportation Policy Council

ATTEST:

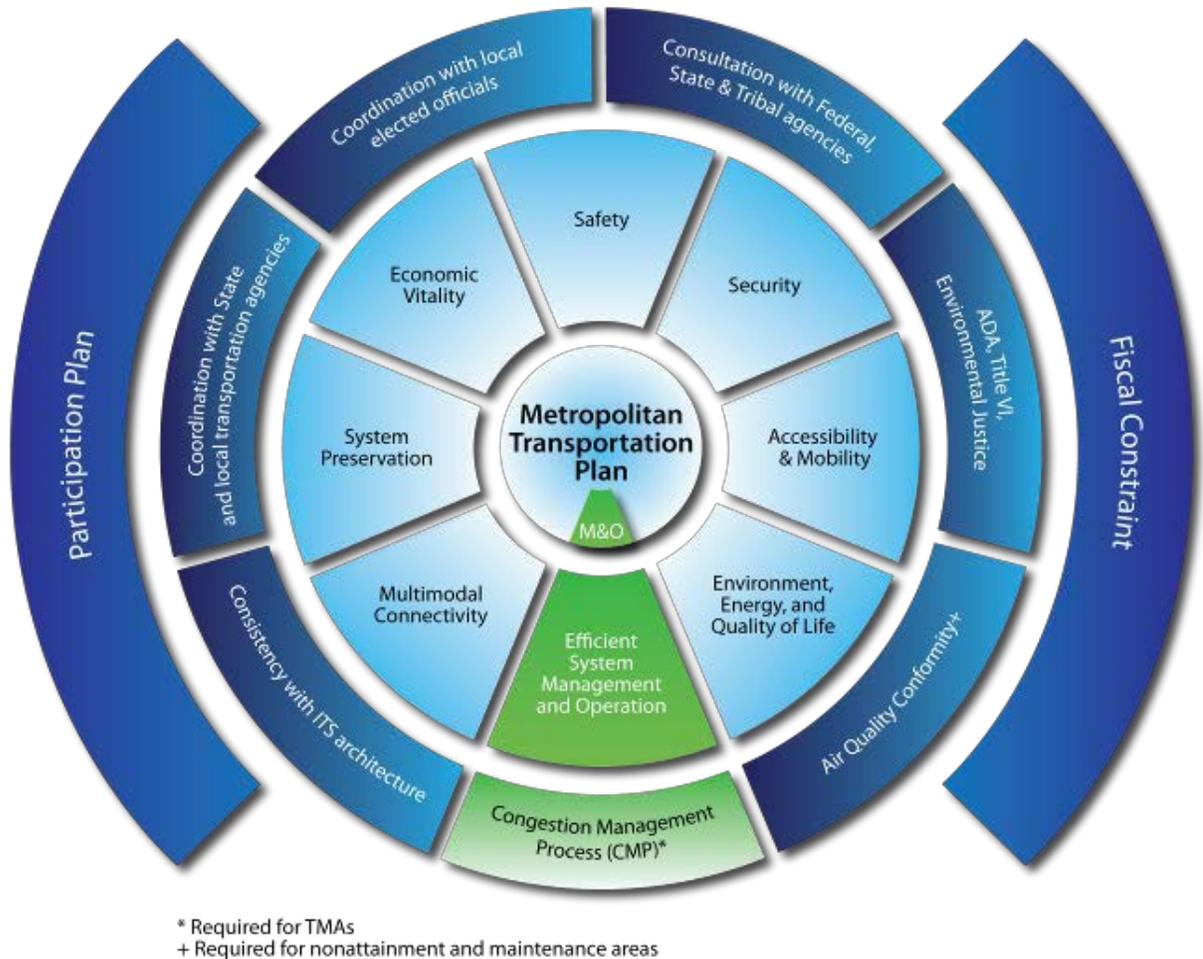
Hon. Tom Reid, Secretary  
Transportation Policy Council

## CHAPTER 1 INTRODUCTION

### 1.1 OVERVIEW

The planning process is a mix of vast number of priorities, requirements and needs on many levels.

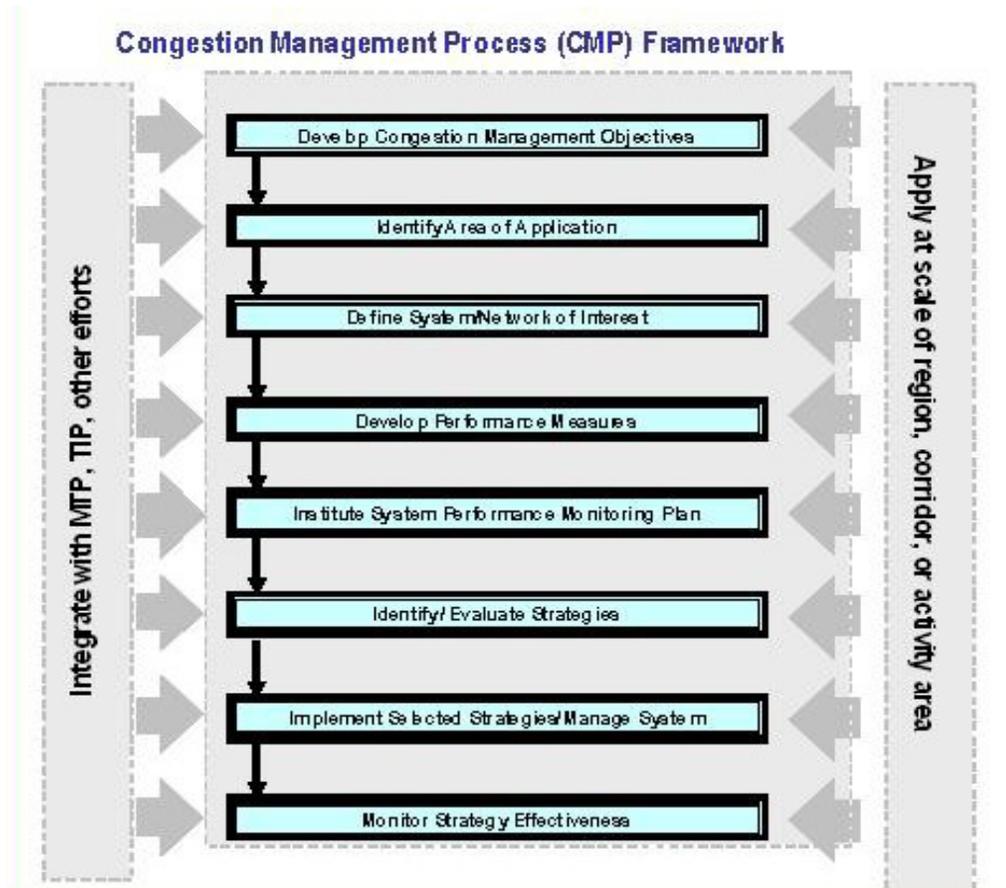
The Congestion Management Process (CMP) is a cog in the wheel of the planning process. Figure 1.1 shows how all these pieces fit together in the planning process.



**Figure 1.1 Metropolitan Transportation Planning Requirements Test**

The CMP is a systematic approach applied in a metropolitan region to identify congestion and its causes, proposes mitigation strategies, and evaluates the effectiveness of the implemented strategies. The CMP is an integral part of the planning process and influences the decision-making process in the selection of projects and strategies for the Regional

Transportation Plan (RTP), Transportation Improvement Program (TIP), and State Transportation Improvement Program (STIP). Figure 1.1 shows the framework of the CMP developing goals, defining the network, system performance monitoring, identify/evaluate strategies, and monitor performance. These elements are contained in this document and have been pulled from other planning documents.



**Figure 1.2 Congestion Management Process Framework**

Traffic congestion detracts from a region's ability to grow and prosper. High levels of congestion may cause businesses and residents to relocate due to traffic delays and air-quality degradation. The overall lifestyle and health of the inhabitants are also adversely affected by high levels of congestion. The traditional solution to congestion is to add capacity, or lanes, to the road network. These lanes are typically used by single-occupant vehicles (SOV), and are expensive to construct.

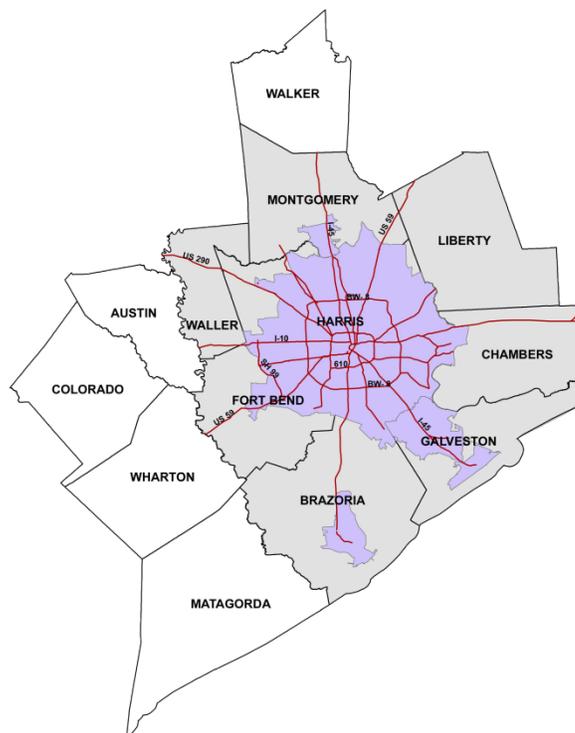
The *Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU) of 2005* transformed the CMS plan into the CMP, placing higher priorities on transportation projects providing operational management strategies that enhance regional mobility of vehicular traffic without necessarily resorting to the construction of additional roadway capacity. The CMP is fully integrated into the planning process as shown in Figure 1.2 above.

While major funding is still required for increasing roadway capacity of the transportation system, the CMP seeks less expensive options to use in, or with, larger transportation projects. The result is an increase in efficiency and management of transportation systems, enhanced mobility, and better utilization of assets.

## 1.2 BACKGROUND

### 1.2.1 Geographical Background

The Houston-Galveston Area Council (H-GAC) is a voluntary association of 131 local governments and local elected officials in the 13-county Gulf Coast Planning region of Texas (Figure 1.3). Its service area is 12,500 square miles and contains over 6 million people.



**Figure 1.3 H-GAC Region, with Urbanized Areas & TMA Counties**

H-GAC is the Metropolitan Planning Organization (MPO) responsible for the development and implementation of the CMP in the Houston-Galveston Transportation Management Area (TMA). The TMA consists of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties. These counties are shown in Figure 1.3 in gray shading.

### **1.2.2 Document History and Success**

This CMP builds off the H-GAC CMS Plan. The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) required the development and implementation of a Congestion Management System (CMS) Plan for regions with a population of more than 2 million people. The H-GAC CMS Plan was adopted in 1997, and revised in 1998, 2004, and 2005. Some success has occurred since the beginning of the CMS Plan. The Federal Highway Administration's (FHWA) "Urban Congestion Report –April-June 2006" states:

- Travel demand in the region, in terms of Vehicle Miles Travel (VMT), decreased by 10%
- Hours of system congestion decreased by 18.50%
- Travel Time Index decreased by 4% between 2005 and 2006

The implementation of transportation demand management (TDM) and transportation system management (TSM) projects in the region are principal contributors to the reduction in congestion in the last five to ten years. These projects were completed with the management strategies required in the CMS Plan. This congestion management process will expand on this region's initial success.

## **1.3 GOALS, OBJECTIVES, AND FEDERAL REQUIREMENTS**

### **1.3.1 Goals**

There are two goals of the CMP for the Houston-Galveston TMA:

- To reduce and/or manage existing traffic congestion and prevent or manage its occurrence in areas that are currently not congested.
- To improve the day-to-day travel-time consistency on the various facilities and/or corridors of the transportation system: This consistency is determined by calculating a Travel-Time Index (TTX)

The CMP is a process that represents a path to reach these goals. The process uses the following steps:

- Measure multi-modal transportation system performance
- Identify the causes of congestion
- Assess alternative actions
- Implement cost-effective actions

- Evaluate the effectiveness of implemented actions

### 1.3.2 Objectives

#### *Commitment to Transportation Systems Management (TSM) Principles*

Project sponsors, implementing agencies, and the MPO must commit to the realistic and cost effective TSM principles as a requirement for both federal and state funding. Project design, concept, and scope must be consistent with any selected management strategies. This ensures that TSM principles are implemented in timely manner, which in turn will assist in congestion reduction and/or management.

The current congestion reduction strategy for the CMP is to apply cost-effective Travel Demand Management (TDM) programs before considering adding capacity. Some of these elements include:

- Tele-Commuting - Employees are allowed to work from home or another location (satellite office or neighborhood work center) to reduce commute travel. Telecommuting is often performed on a part-time basis, with employees working from home one or two days a week. It can also be used on a temporary basis, for example, while an employee is working on a particular project or when they are recuperating from illness.
- Flex-Timing - Employees are allowed some flexibility in their daily work schedules. For example, rather than all employees working 8:00 to 4:30, some might work 7:30 to 4:00, and others 9:00 to 5:30.
- Transit - Public Transit (also called Mass Transit) includes various services using shared vehicles to provide mobility to the public.
- Pedestrian and Bicycle improvements – Provide a better level of comfort for pedestrians and bicyclists like delineated bicycle lanes, pedestrian cross walks etc.
- HOV Lanes - High Occupant Vehicles including transit buses, vanpools, and carpools are only allowed to travel on these lanes.
- Incident Management Programs – Planned and coordinated programs to detect, respond to, and remove traffic incidents to restore normal traffic as safely and quickly as possible.
- Access Management Programs – This is defined as a process that provides access to land development while simultaneously preserving the flow of traffic on the surrounding road systems in terms of safety, capacity, and speed.
- Intelligent Transportation Systems (ITS) Applications – This refers to the information and communication technology applications integrated with

transport infrastructure and vehicles in order to efficiently operate transportation facilities.

- Implementation of Smart Streets – Smart Streets refer to ITS applications like camera, sensors etc., specifically used on arterial streets to efficiently manage traffic, parking and pedestrian movements on arterial streets.

#### *Consistency in Travel Time*

The FHWA states that about half of the delays experienced by travelers in the US are not due to the high traffic volumes. The public expects recurring congestion due to increase in the demand on the transportation system, and plans for it in their schedules. However, frustration occurs when non-recurring events increases congestion, thus creating inconsistency in travel time. Some of these events include stalled vehicles, spilled loads, accidents, maintenance/construction activities, special events, and weather.

Reducing the number of non-recurring events, and quickly resolving these events improves the Travel Time Index of the roadway, corridor, and the transportation system. The Travel Time Index can be improved by the timely implementation of safety, incident management, and transportation demand management programs.

#### *Inclusion in the Regional Transportation Plan*

Federal guidelines specify that the metropolitan planning process for a metropolitan planning area shall provide for consideration of projects and strategies that will:

- Sustain economic viability and global vitality
- Improve safety and security for everyone
- Increase accessibility and mobility for all users
- Preserve the environment
- Enhance the integration and connectivity between modes
- Encourage cost-effective system management and operation
- Emphasize the importance of maintaining the existing system

H-GAC's RTP is the cornerstone of the metropolitan planning process used to implement the federal guidelines. The RTP is both a strategic planning document and a long-range plan for transportation investments in the TMA for the next 20 to 30 years. It identifies and prioritizes projects and programs designed to improve the multimodal regional transportation system. The RTP is constrained by the available revenues anticipated to fund the maintenance, operation, and construction of the projects and

programs. It is also constrained by vehicle emissions budgets established to attain clean-air standards.

Project and program needs are identified based upon demographic and related travel demand forecasts. Projects included in the RTP are developed in consultation with the region's transportation providers including city, county, state and transit agencies. The TIP is the implementation tool for projects and programs included in the RTP. All regionally significant transportation projects, regardless of funding, must be included in the TIP for air quality conformity purposes.

To achieve these goals and objectives of the RTP, the objectives of a CMP are to:

- Identify locations of existing and future congestion;
- Specify strategies to minimize or eliminate recurring and non-recurring congestion;
- Evaluate effectiveness of the implemented strategies; and
- Evaluate alternative transportation strategies

### **1.3.3 Federal Requirements**

Other than changing the name of the Congestion Management System Plan to the Congestion Management Process, and calling for greater integration and effectiveness, SAFETEA LU legislation did not change the overall requirements. FHWA is working with MPOs to improve the CMP effectiveness by developing more detailed guidance on the requirements. The requirements of a CMS are cited in 23 CFR Part 500.109 (2008), and include:

1. Methods to monitor and evaluate the performance of the multimodal transportation system, identify the causes of congestion, identify and evaluate alternative actions, provide information supporting the implementation of actions, and evaluate the efficiency and effectiveness of implemented actions;
2. Definitions of the parameters for measuring the extent of congestion and for supporting the evaluation of the effectiveness of congestion reduction strategies for the movement of people and goods;
3. Establishment of a program for data collection and system performance monitoring to define the extent and duration of congestion, to help determine the causes of congestion, and to evaluate the efficiency and effectiveness of implemented actions;
4. Identification and evaluation of the anticipated performance and expected benefits of appropriate traditional and nontraditional congestion management strategies;

5. Identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy; and
6. Implementation of a process for periodic assessment of the efficiency and effectiveness of implemented strategies, in terms of the area's established performance measures.

#### **1.4 CONTENTS OF THE CONGESTION MANAGEMENT PROCESS**

The contents of the congestion management process include the following:

- Chapter 2 – Description of congestion and the development of performance measures and indices used to measure congestion and mobility. These performance measures and indices include Level of Mobility (LOM) and Travel Time Index.
- Chapter 3 - Documents the Congestion Mitigation Analysis (CMA) process. This process requires the consideration of transportation management strategies in roadway capacity projects that are being selected for the RTP.
- Chapter 4 - Describes the process of reporting the “State of Congestion” for the Houston- Galveston TMA.
- Chapter 5 – Integrating the CMP in the Regional Planning Process, and describes how the CMP will be used to rank and select projects based on congestion data and system operational performance.
- Appendix – Several appendixes contain examples and additional reference information.

## CHAPTER 2 CONGESTION AND MEASURING CONGESTION

### 2.1 WHAT IS CONGESTION?

FHWA 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. The first is recurring congestion such as:

- 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, etc.
- 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.

The second is non-recurring congestion such as:

- 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 a short time periods.

## 2.2 SCOPE OF THE CONGESTION PROBLEM

### 2.2.1 Growth in Demand Based on Growth in Metropolitan Population

The FHWA Nationwide Personal Transportation Survey (NPTS) states that 75% of Americans live in metropolitan areas. Data also suggests that there has been an increase in the number of vehicles available to each household (0.85 in 1960 to 1.90 in 2001). The average number of vehicles per household in Houston was 1.9, which is on par with the national average. Consequently, more people are traveling as single occupants in metropolitan areas. Over the past 50 years, 86% of the population growth occurred in the suburban regions. This resulted in an increase in travel distances and vehicular trips. Historically, roadway capacity has not kept up with the travel demand between residential areas and employment centers.

### 2.2.2 The “Price” of Congestion

According to the 2007 TTI State of Congestion Report, the yearly cost of congestion in the USA is 38 hours of average annual delay per peak-period road traveler at a cost of \$78.2 Billion for the 75 US metro areas.

TTI’s 2007 Urban Mobility Study of the H-GAC TMA indicates a Travel Time Index of 1.36, an annual delay of 124,131,000 hours at a cost of \$2,225 Million. The figures for peak period travelers in 2005 are 56 hours at an annual cost of \$1,012 per person.

### 2.2.3 Congestion Management Success

Data indicates that the average travel rate increased by 1.64 % from 1993 to 2005. However, it only increased by 0.09% from 2004 to 2005. From a regional perspective, this indicates that the increase in congestion was better managed.

The 2007 Urban Mobility Study cites the 5 basic operational treatments that helped control the increase in congestion, and saved the TMA 13,617,000 hours and \$240.8 Million. These five treatments have become the main issues that the CMP places upon projects:

- Freeway Incident Management - This is a planned and coordinated program to detect, respond to, and remove traffic incidents on Freeway facilities to restore normal traffic as safely and quickly as possible.
- Freeway Ramp-Metering – This is a process of managing freeway demand by controlling the traffic entering from the ramps using traffic signal on the ramp.
- Arterial Signal Coordination – This refers to good signal progression giving travelers a green along a major arterial corridor providing coordination between intersections. Such a coordination of traffic signal lights along a corridor minimizes congestion.

- Arterial Street Access Management - This is a process of managing access to land development while simultaneously preserving the flow of traffic on the surrounding road systems in terms of safety, capacity, and speed.
- HOV Lanes - High Occupant Vehicles including transit buses, vanpools, and carpools are only allowed to travel on these lanes.

Another contributor to congestion control was the implementation of the original CMS Plan during 1998 through 2003 based on Vision 2020 MTP concepts [available on request]. H-GAC results in the previous plans confirm benefits stated in the FHWA “Final Rule on Management and Monitoring Systems”. Efficient use of transportation funds were targeted at solutions that slowed congestion growth in a cost effective manner utilizing the methods below:

- Monitor and evaluate performance
- Identify alternative action
- Assess and implement cost-effective actions
- Evaluate the effectiveness of the implemented actions

## 2.3 MEASURING CONGESTION

### 2.3.1 Level of Mobility (LOM)

One of the key components of the CMP is the determination of performance measures. H-GAC has chosen to use the Level of Mobility (LOM) to measure congestion. LOM is a ratio of traffic volume and roadway capacity. It is based on directional 24 hour lane volumes of existing and near future roadways in the CMS roadway system.

Setting mobility standards for the CMP provides a tool to summarize system performance and congestion. This summary is used to analyze the impacts of any change. If system performance falls below the standard, actions will be needed to restore or improve the LOM.

#### *Traffic Volume*

Traffic volume is the number of vehicles passing a given point in a given amount of time. Traffic volumes are required to perform various congestion calculations. Traffic volumes are collected by a various agencies using many different methods.

#### *Roadway Capacity*

TTI and H-GAC have developed a series of tables containing the evaluation of capacities for the different roadway facility types and developed area types (See Table 2.1). The evaluation capacities are based on assumed and/or typical signal green-times, percentage of commercial trucks and left-turn movements, directional traffic flow, peak-hour traffic levels and other factors.

**Table 2.1 Evaluation Capacity Table**

<b>Facility Type</b>	<b>Urban</b>	<b>Suburban</b>	<b>Rural</b>
Freeways	23,500	23,500	<b>16,500</b>
Tollways	18,000	18,000	-----
Expressways	11,000	11,000	-----
<b>Arterials</b>	<b>7,500</b>	<b>6,250</b>	<b>5,000</b>

*The LOM System*

The existing, or projected, traffic volume on the roadway is divided by roadway capacity to establish a Volume / Capacity (V/C) ratio. The V/C ratio is categorized into LOM. The evaluation capacities can be used for actual roadway capacities.

The H-GAC Travel Modeling Committee in 1997 designated the categories of LOM as Tolerable, Moderate, Serious, and Severe. They are shown in Table 2.2.

**Table 2.2 Level of Mobility Rating**

<b>LOM</b>	<b>V/C</b>
Tolerable	< <b>0.85</b>
Moderate	<b>&gt;= 0.85 &lt; 1.00</b>
Serious	<b>&gt;= 1.00 &lt; 1.25</b>
<b>Severe</b>	<b>&gt;= 1.25</b>

**2.3.2 Project Level Performance Measure**

The CMP measures congestion at the individual project level when added capacity roadway projects are being considered to resolve congestion problems. The CMP calls for a study of TSM/TDM elements before considering an added-capacity project.

**2.3.3 System Level Mobility Performance Measure**

Congestion measured at the system, or corridor /regional level. This measurement determines the State of Congestion on the various major corridors of the region. Further discussion of State of Congestion is found in Chapter 4.

**2.4 CMP ROADWAY SYSTEM**

The CMP roadway system, as adopted in 1997 and later revised in 1998, 2004, and 2005 as the CMS roadway system, is defined as roadways classified as principal (or major) arterials and above in the urban areas, and selected minor arterials and above in rural areas (Figure. 2.1). The facilities are also defined in the TxDOT Roadway Inventory Log (RI-2) and designated by the TPC. This network is periodically reviewed and revised as needed.

#### **2.4.1 Projects Requiring CMP Monitoring**

Projects require CMP monitoring if the project:

- Adds additional SOV capacity
- Is on the CMP roadway system
- Is where no facility exists today (analysis is done on the parallel roadways as well)
- Is in a congested area where added capacity projects may be needed
- Is deemed regionally significant such as fixed guide-way transit, major ports, airports, and their associated National Highway System (NHS) connectors

#### **2.4.2 Projects Not Requiring CMP Monitoring**

Projects may be exempted from CMP monitoring if the project:

- Is not on the CMP roadway system
- Has environmental clearance as evidenced by a Finding of No Significant Impacts or a Record of Decision (FONSI/ROD) on or before April 01, 1993 and has been revised every three years
- Fills a gap in the system or alleviates “bottlenecks”

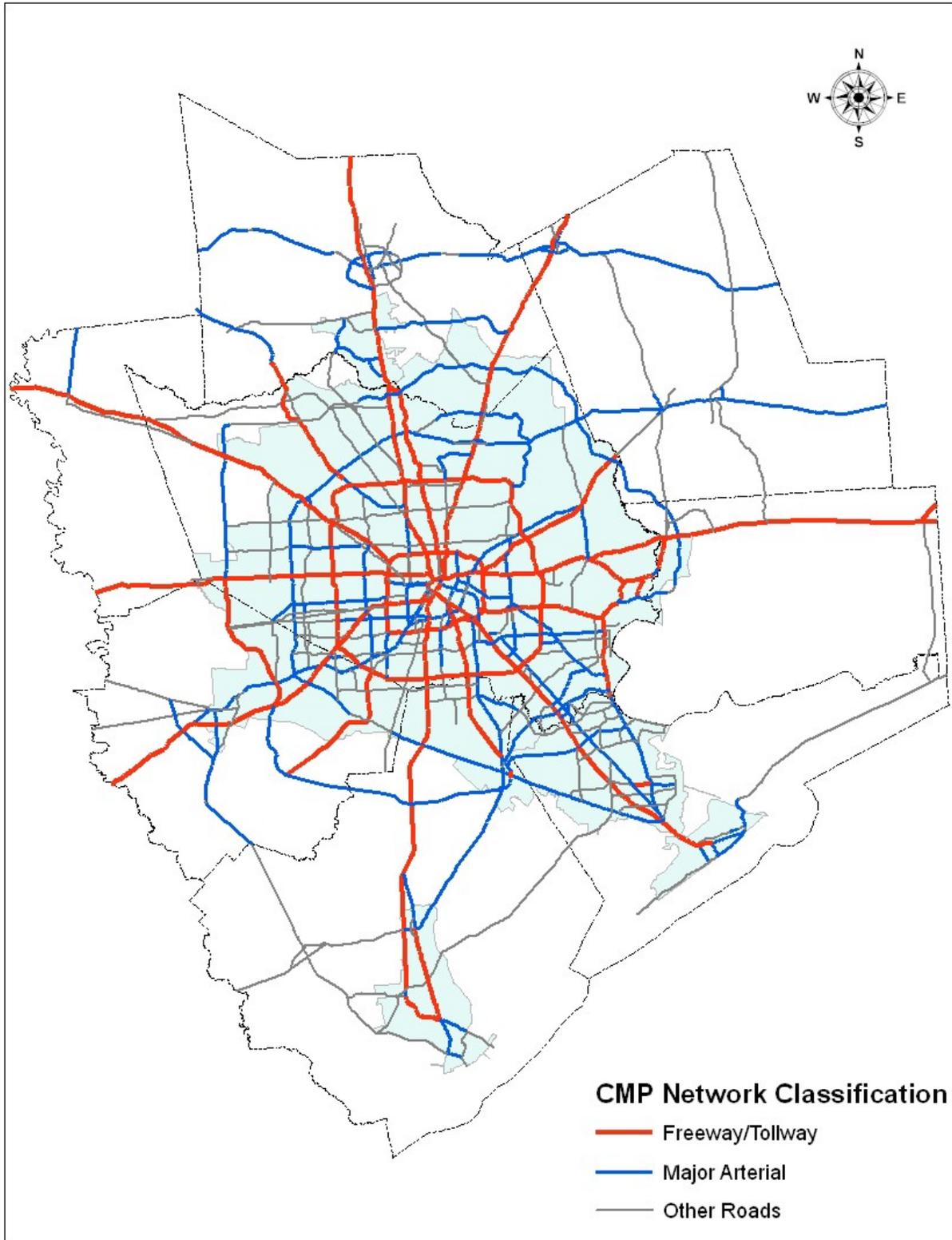


Figure 2.1 CMP Network with Urbanized Areas

## 2.5 TSM/TDM STRATEGIES

CMP monitoring focuses on the effectiveness of TSM/TDM strategies. TSM/TDM strategies affect travel speeds and/or vehicle miles traveled.

### 2.5.1 TSM/TDM Strategies for Roadways

TSM/TDM strategies for roadways include:

- Demand management (carpool, vanpool, etc.) – This refers to strategies that reduces the number of vehicles coming on to the road. Examples of demand management include encouraging commuters to use carpool or vanpool etc.
- Operations management – This refers to strategies that improves the efficiency of traffic movement and minimizes delays.
- Other transportation control measures (signal synchronization, flow signal, etc.)

### 2.5.2 TSM/TDM Strategies for Transit

TSM/TDM strategies for transit include:

- Improvements on or adjacent to TSM improved corridors
- Improving existing High Occupancy Vehicle (HOV) lanes within existing right-of-way
- Park-and-Ride Facilities –Facilities that allow commuters to park their vehicles and ride transit, carpool, or vanpool to their desired destination.
- Transit centers –Sheltered waiting areas located where several bus routes converge. Transit centers serve as efficient hubs that allow bus riders from various locations to assemble at a central point to take advantage of express trips or other route-to-route transfers.

### 2.5.3 Evaluating TSM/TDM Strategies

#### *TCM Tools*

Software developed by Sierra Research, Inc. to evaluate the cost- effectiveness of implemented Transportation Control Measures (TCMs). This software assists with the analysis of TCM strategies in the CMA process.

H-GAC contracted with ICF Kaiser and RSM Services to expand the scope of the TCM tools to develop capabilities of corridor-level analysis. The TCM TOOLBOX was adopted in January 1997. It is an integrated system of software modules designed to analyze the travel and emissions

impacts of transportation projects, in particularly transportation control measures. The enhanced TCM tools allow analysts to evaluate projects that are not generally included in regional travel demand models such as ridesharing and transit use.

The EXPLORA module can be applied at regional and/or sub-regional (or corridor) levels. The LOM performance measure is quickly assessed at the regional level to determine the significance of potential TCM projects.

### *Results*

TSMs that have significant impacts on improving traffic flow and alleviating congestion are classified into six major categories, as shown in Table 2.3.

**Table 2.3 TSM Capacity Improvements and Benefits**

<b>TSM Categories</b>	<b>% Capacity Increase</b>	<b>Benefit</b>
Capacity Increases	15.3%	Flow Improvement
Traffic management systems (Regional Computerized Traffic Signal System (RCTSS))	10.0%	Flow Improvement
Traffic signal timing and coordination	5.0%	Flow Improvement
Freeway traffic management system (incident management)	2.15%	Flow Improvement
Access management (signal timings + intersection modifications)	6.0%	Flow Improvement
Intersection modifications	1.0%	Flow Improvement
Pedestrian and bicycle program	6%	Flow Improvement
Intermodal transportation projects	6%	Flow Improvement

## **CHAPTER 3 CONGESTION MITIGATION ANALYSIS (CMA) PROCESS**

### **3.1 THE CMA PROCESS FOR THE RTP AND TIP**

The Houston–Galveston TMA does not meet national ambient air quality standards for the pollutant ozone. Because it is a non-attainment area, federal guidance requires an analysis of added capacity projects as part of the congestion management process. Figure 3.1 below describes the decision points in the metropolitan planning process, particularly at it pertains to inclusion in the RTP and TIP.

### **3.2 CMA PROCESS FOR ADDED-CAPACITY PROJECTS**

#### **3.2.1 Regionally Significant Projects**

The MPO is responsible for ensuring that Congestion Mitigation Analysis (CMA) is done on all Federal and State assisted regionally significant added capacity projects on the CMP roadway system. A sample CMA report is included in Appendix D. Ideally, CMAs are performed during the four to ten year short-range planning period in the RTP, prior to TIP submittal by the project sponsor, and are reviewed and approved by H-GAC Staff.

#### **3.2.2 Added Capacity Justification**

Certain aspects of a regionally significant added capacity project must be studied before it is justified. Added capacity projects must show that cost effective demand management and system management strategies fail to reduce congestion to acceptable levels. Project sponsors, the MPO, and other agencies must consider this as a precondition for projects seeking Federal or State funding.

#### **3.2.3 Not Regionally Significant Projects**

Letters of Waiver (LOW) are issued for projects that do not require a CMA because they (1) are not on the CMP Roadway System; (2) are not regionally-significant; (3) are less than one mile in length; or, (4) are grandfathered before this process was implemented. Letters of Waiver document the reasons a project does not meet the CMA criteria and are kept with project file records.

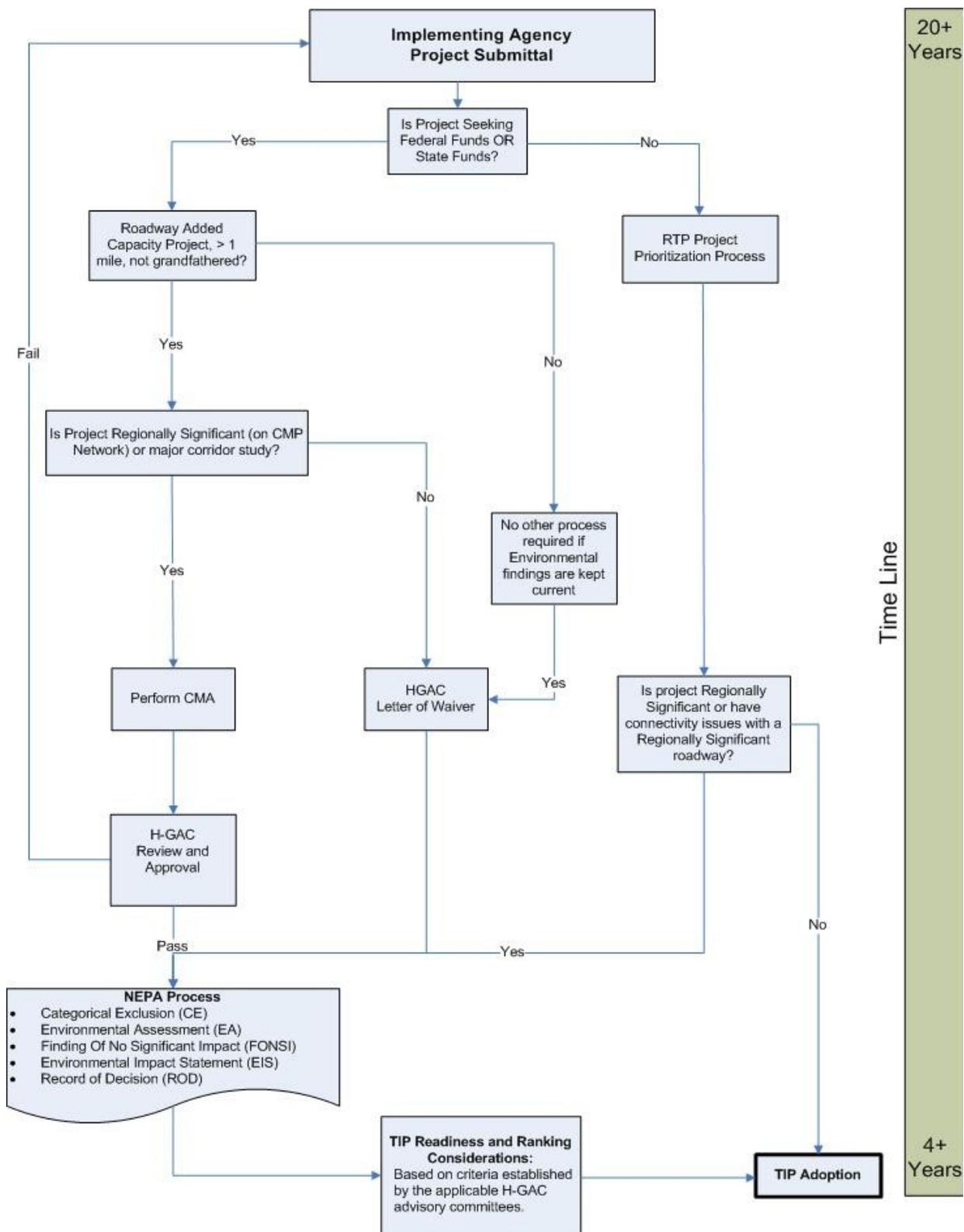


Figure 3.1 Congestion Management Process Project Flow

### **3.2.4 Other Exemptions from CMA Requirements**

Projects may also be exempt from CMAs if the proposed project:

- Solves a safety problem and does not include adding capacity, such as grade-separations;
- Solves a bottleneck problem by widening or adding lanes and is less than 1 mile in length;
- Is a recent added capacity project that has received an environmental Finding of No Significant Impact (FONSI) or Record of Decision (ROD) prior to the April 01, 1993 deadline, and, depending on the level of activity, has been kept current within 36 months of the FONSI/ROD; or
- Is a "Grandfathered" project with high level of activity toward being let to contract?

It is important to note that the amount of neighboring projects with TSM/TDM designs may cause a proposed project to lose CMA exemption because of forced scope changes.

### **3.3 CMA INCLUSION IN THE MAJOR INVESTMENT STUDY (MIS)**

A highway or transit project in a corridor that has a substantial cost and will significantly impact capacity, traffic, level of service, or mode share will require a Major Investment Study (MIS).

MIS is a subset of the more comprehensive metropolitan transportation system planning process. Metropolitan planning regulations require major investment studies to support decisions on significant transportation investments. While federally funded major transportation investments are being contemplated, the MIS identifies all reasonable alternative strategies for addressing the transportation demands and other problems at a corridor or sub-area level of the metropolitan area. Also as a part of the MIS, refined costs and revenue figures are developed which indicate how the project is expected to be financed and operated. The MIS provides information to elected officials, technical staff, the business community, and the general public on the costs, benefits, and impacts of these alternatives so that an informed choice can be made.

H-GAC expects a CMA to be included in the MIS process as a foundation of planning and programming decision making.

### **3.4 LETTER OF COMMITMENT FOR TSM/TDM**

Previous mobility studies indicate that TSMs/TDMs in the region help to manage congestion. However, many TSMs/TDMs projects are not proposed by the same project sponsor, or at the same time, of the added capacity project they are incorporated in. FHWA states that TSMs/TDMs in the added capacity project needs only be programmed by the time the added-capacity project is completed. The programming implies that the TSM/TDM is already selected for funding and/or has

the commitment of the project sponsor. Once the TSM/TDM is determined to have a significant impact, a Letter of Commitment (LOC) from the added capacity project sponsor is necessary. The LOC should state the project sponsor's intent of implementing the TSM/TDM projects.

## CHAPTER 4 MEASURING MOBILITY

### 4.1 THE PURPOSE OF MEASURING

Decision makers need to implement projects that have the best cost-benefit ratio to improve the quality of life. The primary purpose of the CMP is to reduce, manage, and monitor congestion within the region. TSM/TDM strategies are typically considerably less expensive to implement than adding capacity. Quantitative measures produce data needed to determine TSM/TDM strategy recommendation. They also produce historical data to make comparisons. The CMP is intended to be a data driven decision process. CMP data with other ranking criteria will determine what projects and strategies are most beneficial.

### 4.2 METHODS OF MEASUREMENTS

#### 4.2.1 A Variety of Choices

There are several methods to measure congestion. The Travel Time Index is the primary measure of congestion, and can be used at the regional, sub-regional, corridor, and project level. The percent of congested roadways are additional measures that can be used, and are typically used for area mobility measures. Regional LOM (as described in Section 2.3.1) and multiple modes are measured to determine the State of Congestion for the TMA.

Other elements such as incidents, crashes, Park and Ride facilities, and facilities that support congestion mitigation should be included. Information such as utilization of bikeways, sidewalks, and pedestrian paths are also helpful.

Quantitative numbers for incidents and crashes provide an indication of how safe the regions roadways operate. Information about clearance time and severity are indicators of the quickness incidents can be cleared. The Houston region has several programs for incident management that would facilitate the data collection process.

#### 4.2.2 The Travel Time Index

##### *Free Flow and Travel Rate*

The Travel Time Index is a dimensionless quantity that compares travel conditions in the peak period to travel conditions during free flow, or posted speed limit, conditions (See Equation 4.1). It is described as the length of extra time a traveler spends in the transportation system during a trip. This index reflects travelers' perceptions of travel time on the roadway, transit facility, or other transportation network element. This index can establish a comparison between travel time increases compared to free flow, and then relate this to the desired conditions. The same index

formula can be applied to various system elements with different free flow levels. The result is expressed as a Travel Rate (in minutes per mile). The Travel Rate can be averaged for freeways and arterial streets using the amount of travel on each portion of the network (volume). Table 4.1 presents examples of free-flow speeds. Table 4.2 gives an example of The Travel Time Index values.

*Corridor and Daily Index Values*

A corridor value can be derived by using the number of persons on each facility type (modes) to calculate a weighted average of the conditions (free flow) on adjacent facilities. The corridor value can be calculated for hourly conditions and weighted by the number of travelers (person-miles traveled) to estimate peak period or daily index values. The values in Table 4.3 show examples of peak vs. off peak speeds.

*The Travel Time Index Equation*

The Travel Time Index in Equation 4.1 compares measured travel rates to free-flow conditions for any combination of freeways and principal arterials. Equation 4.1 also illustrates a relatively simple version of calculation using VMT. Passenger Miles of Travel (PMT) could also be used, as could a value of time calculation that incorporates persons and freight travel.

**Equation 4.1 The Travel Time Index Equation**

$$\text{Travel Time Index} = \frac{\left[ \frac{\text{Freeway Travel Rate}}{\text{Freeway Free-flow or Posted Speed Limit Rate}} \times \frac{\text{Freeway Peak Period VMT}}{\text{Freeway Peak Period VMT}} \right] + \left[ \frac{\text{Principal Arterial Street Travel Rate}}{\text{Principal Arterial Street Free-flow or Posted Speed Limit Rate}} \times \frac{\text{Principal Arterial Street Peak Period VMT}}{\text{Principal Arterial Street Peak Period VMT}} \right]}{\text{Freeway Peak Period VMT} + \text{Principal Arterial Street Peak Period VMT}}$$

**4.3 EXPECTATIONS IN CONGESTION MITIGATION**

In a typical application, the target Travel Time Index values are developed with input from citizens, businesses, decision makers, and transportation professionals. They link the community vision for its transportation system, land uses, and its “quality of life” issues to the improvement strategies, programs, and projects that government agencies and private sector interests will implement.

The process of linking these aspects is integrated with the RTP. The result of the process is the identification of expected congestion. The expectation must be reasonable and realistic, as overstatement or understatement can distort congestion mitigation goals.

The level of information needed to carry out this type of process is not currently distributed in most urban areas. The values can, however, be interpreted from existing input processes, as seen in table 4.3.

**Table 4.1 Examples of Free Flow Speeds (Source: Texas Transportation Institute)**

<b>Freeway Mainlane</b>	<b>Freeway HOV</b>	<b>Major Street</b>	<b>Bus on Street</b>	<b>Rail in Street</b>	<b>Bike</b>
60	60	35	15	20	15

**Table 4.2 Example of Travel Time Index Values (Source: Texas Transportation Institute)**

<b>Area Type</b>	<b>Peak</b>	<b>Off Peak</b>
Central Business District	1.7	1.2
Central City/Major Activity Center	1.5	1.1
Suburban	1.3	1.0
Fringe	1.0	1.0

**Table 4.3 Examples of Peak and Off Peak Travel Time Speeds (Source: Texas Transportation Institute)**

<b>Area Type</b>	<b>Freeway Mainlane</b>		<b>Freeway HOV</b>		<b>Major Street</b>		<b>Bus on Street</b>		<b>Rail in Street</b>		<b>Bike</b>	
	<b>Peak</b>	<b>Off Peak</b>	<b>Peak</b>	<b>Off Peak</b>	<b>Peak</b>	<b>Off Peak</b>	<b>Peak</b>	<b>Off Peak</b>	<b>Peak</b>	<b>Off Peak</b>	<b>Peak</b>	<b>Off Peak</b>
Central Business District	35	50	35	50	21	29	9	13	12	17	9	13
Central City / Major Activity Center	40	55	40	55	23	32	10	14	13	18	10	14
Suburban	46	60	46	60	27	35	12	15	15	20	12	15
Fringe	60	60	60	60	35	35	15	15	20	20	15	15

## 4.4 DATA SOURCES

### 4.4.1 Data Types and Quality

There are several items that can be measured to report the state of congestion in the region. The most common are:

- Travel time
- Traffic volumes
- Incident data
- Segment lengths
- Speed limits
- Vehicle occupancy
- Crash data

The quality and coverage of the data varies based on several issues:

- Data sources are in varying stages of maturity, availability, and usefulness
- Data can be obtained through partnerships, such as Houston TranStar, and through individual owners and operating agencies
- Advancing technology provides a reporting at a more in depth level to historic reporting

### 4.4.2 Where Data Comes From

Some of the data is collected by devices that are used by operations personnel to manage traffic more efficiently. Other data is collected by agencies as part of ongoing operations, project development, and a variety of other purposes. The data from the various sources is gathered and processed. The missing data is collected based on a sampling plan that is weighted by growth and severely congested areas. Data sources, quality, and coverage are listed in Table 4.4.

Manual data collection comes from a variety of sources. Agencies use traffic counts for signal timing, special studies, traffic signal warrants (defines the minimum condition under which traffic signal is required), etc. Travel times and volumes are required for traffic models, and may be collected before and after a project to determine the project's success. Below is a list of sources and the data type that has been collected.

- H-GAC — TIP project information (before and after)

- H-GAC — Model calibration
- Consultants — Warrant studies
- H-GAC — Congestion Mitigation Analysis (CMA)
- TxDOT — HOV lane analysis
- Consultants and agencies — Tube Counts
- Consultants and agencies — Manual Travel Time Runs

Special data for critical corridors is required and collected by a collaborative effort of TxDOT, Metropolitan Transit Authority of Harris County (METRO), Houston-Galveston Area Council (H- GAC), and others. Special data typically includes:

- Vehicle occupancy
- Speed
- Mode split (other than transit)
- Duration of congestion

**Table 4.4 Potential Sources of Continuous Data**

Type of Data	Source	Quality	Facility Type	Coverage
Travel Time	AVI	Good	ML, HOV Most freeways	All of Harris and parts of Montgomery & Galveston
Incident Data	RIMS	Good	ML, HOV for freeways & FR & some arterials	All of Harris and parts of Montgomery and Galveston
Volume Data	Wavetronics	TBD	ML, HOV Most freeways	All of Harris and parts of Montgomery and Galveston
Crash Data	CRIS	TBD	On system and off system roadways	Statewide
Volume Data	Responsible Agencies	TBD	Arterials	Metro Area

## 4.5 GEOGRAPHIC AREA MEASURED

The TMA is a large area to measure, and it is cost prohibitive to collect data on all roadways. However, pooling data from several entities provides sufficient coverage. As the CMP focuses on congestion, it is reasonable to assume that more data is collected at congested areas. Though the entire H-GAC region will be monitored, the focus will be on congested areas primarily in urban centers. The first set of data will be collected and analyzed to define congested areas and then

periodically samples will be collected. Travel time and traffic volume will be collected on the first data set and due to the dual use of model calibration and CMP congestion report.

## **4.6 ROADWAYS**

All existing and proposed roads adopted by the TPC to be functionally classified as principal arterials are considered "regionally significant" for CMP monitoring and processing. Principal arterials are defined as facilities classified as minor arterials and above in the rural areas and major arterials and above in the urban areas.

The CMP shall also monitor other regionally significant transportation facilities; such as fixed guideway, transit, major ports, airports, and their associated NHS connectors. A CMP Roadway System was developed, adopted by the TPC, and is shown in Figure 2.1. Samples of each roadway classification are created, and reporting is based on congestion level and growth these samples are shown in Figure 4.1.

## **4.7 REPORTING CONGESTION AND MOBILITY**

### **4.7.1 Informal Reporting**

Congestion data is reported every TIP cycle, and more often as needed. It is envisioned that the information is arranged and displayed as day to day tools of transportation decision makers. The results are available to the general public, and shown in maps, tables, graphs etc.

### **4.7.2 Formal Reporting**

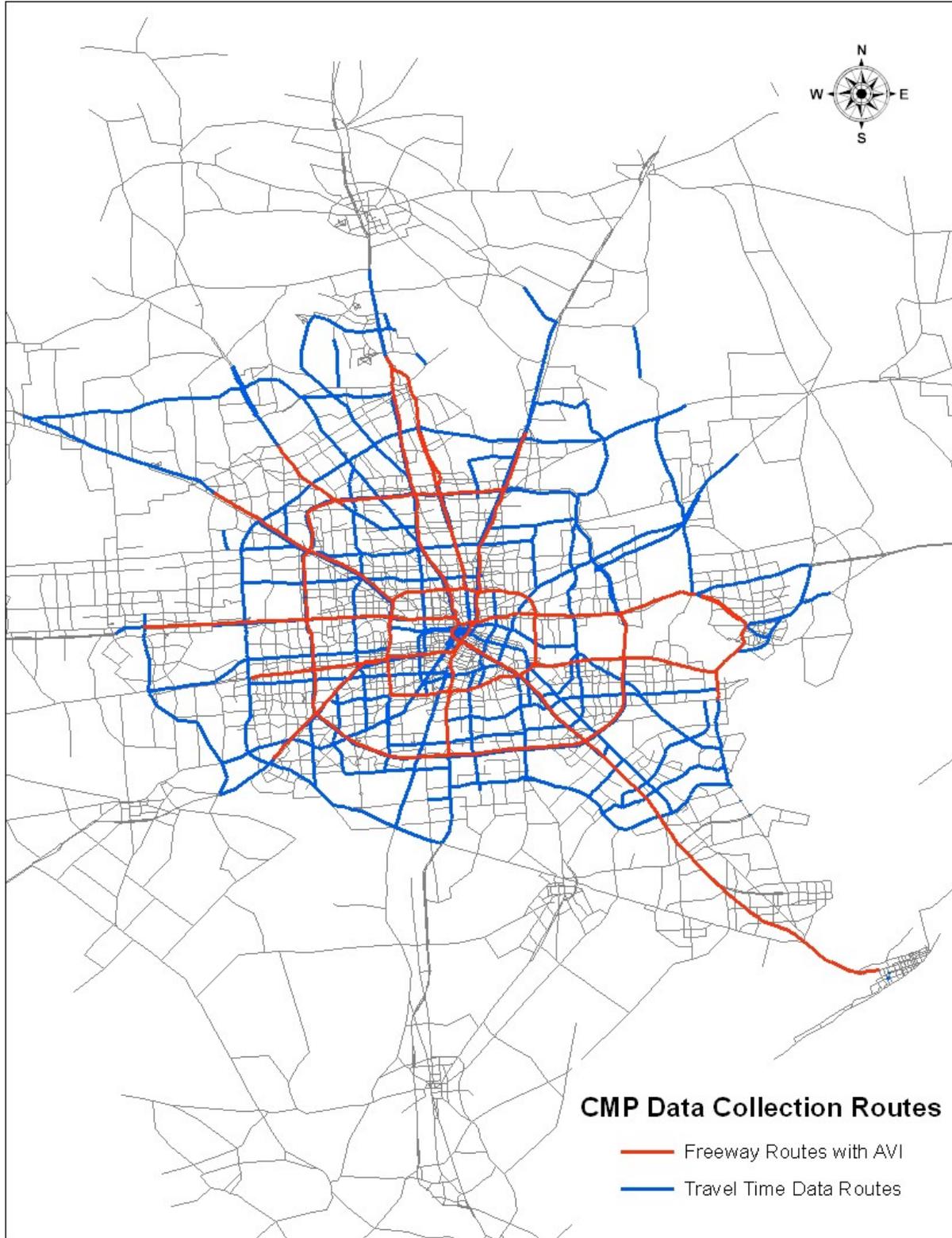
A Mobility Report should be generated in conjunction with an RTP update or TIP development, and be transmitted to FHWA. It describes the current congestion conditions and the effectiveness of the strategies implemented. The Mobility Report should be used to benchmark CMP goals, and to provide a tool for prioritizing future projects.

The Mobility Report should have a chapter listing which TSM/TDM commitments have been implemented and which have not. It should also predict the data needed for the next Mobility Report.

The Mobility Report should also contain a variety of maps, tables, graphs, and other visual aides to convey current congestion levels to agencies and the public. The aides may become tools for guiding the project selection processes.

Data will be collected by functional classification and geographic area. Based on the analysis of the large sample collected, guidelines for a CMP geographic data collection will be developed so during

normal cycles agencies can contribute to the data collection process. The large model calibration data collection will be done approximately every 10 years and CMP sample about every two years.



**Figure 4.1 CMP and Modeling Network Roadway Data Collection Routes**

## **CHAPTER 5 INTEGRATING THE CONGESTION MANAGEMENT PROCESS (CMP) IN THE REGIONAL PLANNING PROCESS**

### **5.1 INTEGRATION OF THE CMP INTO METROPOLITAN TRANSPORTATION PLANNING**

The basic process to incorporate the CMP into the metropolitan transportation planning process is to:

- Monitor transportation systems using performance measures
- Identify congested locations
- Identify causes of congestion
- Evaluate and identify alternative actions
- Select solutions
- Implement solutions
- Evaluate the results (CMA and State of Congestion Report)

These factors also influence the ability of the project to be implemented. Most projects go through an analysis to justify the efficiency of the project. Large projects go through a Major Investment Study (MIS), while smaller projects go through a Congestion Mitigation Analysis (CMA) described in Chapter 3. The CMAs are identified in the planning process, and evolve with the project as it progresses through the planning, design, and implementation stages.

### **5.2 INTEGRATION OF THE CMP INTO OTHER REGIONAL PLANNING PROCESSES**

#### **5.2.1 Regional Mobility Report**

Previous CMSs were too focused on the CMS process to be integrated into the regional planning process. Though congestion was considered in the project selection process, a formal process was not defined. This CMP has been developed to be more focused on multi-modal data, thus providing more support to long-range planning. It identifies the steps for incorporating congestion into the project selection process.

Most agencies measure some aspects of their systems for congestion, safety, and operations. H-GAC compiles these pieces, identifies gaps in the data, develops a data collection plan, and works with the regional agencies to improve the collected data. All the information is assembled to create the regional Mobility Report.

### **5.2.2 Project Selection in the Planning Process**

Congestion measurements will eventually drive the planning process, and ultimately the projects that get implemented. The planning process needs to remain flexible to consider a range of types and sizes of projects. TSM projects typically get implemented because of their scope, budget, and urgency. TSM and bottleneck projects are typically smaller when compared to the larger projects that most people associate with the planning process.

Some of the many factors that are in the project selection process include:

- Congestion Relief
- Population and Economic Growth
- Safety
- Planned Development
- Funding
- Readiness and Letability

### **5.2.3 Operational and Management Strategies**

The CMP also provides guidelines for how to evaluate the causes of congestion. It also identifies and evaluates strategies and options for addressing congestion. The guidelines encourage the following operational and management strategies:

- System management
- Demand management
- Growth management
- Pricing

### **5.2.4 Regional Concept of Transportation Operations and Intelligent Transportation Systems**

A Regional Concept of Transportation Operations (RCTO) can identify gaps in the region where multi-modal plans are absent. It provides guidance to how multi-modal strategies can be consistently and supportively implemented in the region. The RCTO also confirms the

value of the Regional Intelligent Transportation System (ITS) Plan and the ITS Architecture that define the core ITS system. It provides opportunities for ITS technologies to be used in more CMP strategies.

Regional ITS goals identify a broad plan and concepts on how strategies and tools can solve some congestion problems. However, there is no current regional blueprint to show how these strategies and tools can be used together. The ITS Strategic Plan is currently being updated and should be complete by 2009.

## **5.3 ACCELERATED PROJECTS**

### **5.3.1 Accelerated Project Criteria**

One gap in the process is when a project gets injected late into the planning process due to the following factors:

- Accelerated growth or congestion relief
- Connection with an existing project
- Funding opportunities

These justified projects typically move smoothly through the planning process. However, there is no current process to evaluate them. The speed of the implementation of the projects does not correspond with the typical evaluation process and timeline.

### **5.3.2 Accelerated Project Process**

The following steps ensure that proper analysis is conducted on an accelerated project that is not in the long-range plan, or is moved up considerably in the process:

- The CMP process is completed by the agency, or its consultant
- H-GAC reviews the CMP process
- Scoping meeting with consultant to discuss alternatives analysis and incorporate TSM into preferred alternative
- Kickoff meeting
- Environmental assessment
- Design
- Letting

All projects need to have CMP on the checklist of items before being sent to FHWA for review (Appendix E). The CMP and CMA will need to be done before the environmental process and TIP selection. The TSMs identified to be most beneficial need to be incorporated into the project. The process should also include documenting the benefits of the project's ability to relieve congestion, improve trip reliability, or how it meets one or more of the regional goals.

H-GAC will meet with TxDOT and other related agencies to periodically review projects, determine where they are in the process, which documents still need to be completed, and who will perform the work.

**APPENDIX A**

**SAFETEA-LU GUIDANCE REGARDING METROPOLITAN  
TRANSPORTATION PLANNING**

## **APPENDIX A SAFETEA-LU GUIDANCE REGARDING METROPOLITAN TRANSPORTATION PLANNING**

§ 450.320 Congestion management process in transportation management areas.

(a) The transportation planning process in a TMA shall address congestion management through a process that provides for safe and effective integrated management and operation of the multimodal transportation system, based on a cooperatively developed and implemented metropolitan-wide strategy, of new and existing transportation facilities eligible for funding under title 23 U.S.C. and title 49 U.S.C. Chapter 53 through the use of travel demand reduction and operational management strategies.

(b) The development of a congestion management process should result in multimodal system performance measures and strategies that can be reflected in the metropolitan transportation plan and the TIP. The level of system performance deemed acceptable by State and local transportation officials may vary by type of transportation facility, geographic location (metropolitan area or subarea), and/or time of day. In addition, consideration should be given to strategies that manage demand, reduce single occupant vehicle (SOV) travel, and improve transportation system management and operations. Where the addition of general purpose lanes is determined to be an appropriate congestion management strategy, explicit consideration is to be given to the incorporation of appropriate features into the SOV project to facilitate future demand management strategies and operational improvements that will maintain the functional integrity and safety of those lanes.

(c) The congestion management process shall be developed, established, and implemented as part of the metropolitan transportation planning process that includes coordination with transportation system management and operations activities. The congestion management process shall include:

- (1) Methods to monitor and evaluate the performance of the multimodal transportation system, identify the causes of recurring and non-recurring congestion, identify and evaluate alternative strategies, provide information supporting the implementation of actions, and evaluate the effectiveness of implemented actions;
- (2) Definition of congestion management objectives and appropriate performance measures to assess the extent of congestion and support the evaluation of the effectiveness of congestion reduction and mobility enhancement strategies for the movement of people and goods. Since levels of acceptable system performance may vary among local communities, performance measures should be tailored to the specific needs of the area and established cooperatively by the State(s), affected MPO(s), and local officials in consultation with the operators of major modes of transportation in the coverage area;
- (3) Establishment of a coordinated program for data collection and system

performance monitoring to define the extent and duration of congestion, to contribute in determining the causes of congestion, and evaluate the efficiency and effectiveness of implemented actions. To the extent possible, this data collection program should be coordinated with existing data sources (including archived operational/ITS data) and coordinated with operations managers in the metropolitan area;

(4) Identification and evaluation of the anticipated performance and expected benefits of appropriate congestion management strategies that will contribute to the more effective use and improved safety of existing and future transportation systems based on the established performance measures. The following categories of strategies, or combinations of strategies, are some examples of what should be appropriately considered for each area:

- (i) Demand management measures, including growth management and congestion pricing;
- (ii) Traffic operational improvements;
- (iii) Public transportation improvements;
- (iv) ITS technologies as related to the regional ITS architecture; and
- (v) Where necessary, additional system capacity;

(5) Identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy (or combination of strategies) proposed for implementation; and

(6) Implementation of a process for periodic assessment of the effectiveness of implemented strategies, in terms of the area's established performance measures. The results of this evaluation shall be provided to decision makers and the public to provide guidance on selection of effective strategies for future implementation.

(d) In a TMA designated as nonattainment area for ozone or carbon monoxide pursuant to the Clean Air Act, Federal funds may not be programmed for any project that will result in a significant increase in the carrying capacity for SOVs (i.e., a new general purpose highway on a new location or adding general purpose lanes, with the exception of safety improvements or the elimination of bottlenecks), unless the project is addressed through a congestion management process meeting the requirements of this section.

(e) In TMAs designated as nonattainment for ozone or carbon monoxide, the congestion management process shall provide an appropriate analysis of reasonable (including multimodal) travel demand reduction and operational management strategies for the corridor in which a project that will result in a significant increase in capacity for SOVs (as described in paragraph (d) of this section) is proposed to be advanced with Federal funds. If the analysis demonstrates that travel demand reduction and operational management strategies cannot fully satisfy the need for additional capacity in the corridor and additional SOV capacity is warranted, then the congestion management process shall identify all reasonable strategies to manage the SOV facility safely and effectively (or to

facilitate its management in the future). Other travel demand reduction and operational management strategies appropriate for the corridor, but not appropriate for incorporation into the SOV facility itself, shall also be identified through the congestion management process. All identified reasonable travel demand reduction and operational management strategies shall be incorporated into the SOV project or committed to by the State and MPO for implementation.

(f) State laws, rules, or regulations pertaining to congestion management systems or programs may constitute the congestion management process, if the FHWA and the FTA find that the State laws, rules, or regulations are consistent with, and fulfill the intent of, the purposes of 23 U.S.C. 134 and 49 U.S.C. 5303.

**APPENDIX B**  
**GLOSSARY OF TERMS**

## **APPENDIX B: GLOSSARY OF TERMS**

Average Daily Traffic (ADT) - The average number of vehicles passing a fixed point in a 24-hour period. ADT is a measure of traffic volume on a roadway.

Clean Air Act Amendments (CAAA) - 1990 amendments to the Clean Air Act of 1970, which aims to substantially reduce air pollutants by specified target dates. This federal regulation classified the Houston-Galveston area as a nonattainment area for the pollutant ozone.

Congestion - The level at which transportation system performance is no longer acceptable due to traffic interference. The level of acceptable system performance may vary by type of transportation facility (major arterial, minor arterial, principal, transit), geographic location (metropolitan area or sub-area, rural area) and/or time of day. Congestion can be classified as either recurrent or non-recurrent. Recurrent congestion includes regular work commute or planned event trip delays and accounts for approximately 35% of all congestion; non-recurrent congestion includes minor and major incident delays and accounts for approximately 65% of all congestion.

Congestion Management System (CMS) - A management system or systematic process for identifying traffic congestion, mitigating congestion, and monitoring the effectiveness of congestion mitigation measures.

Congestion Mitigation Analysis (CMA) – Added-capacity roadway projects on the CMP Map (which are not waived for various reasons) are subject to CMA, where congestion level in terms of V/C Ratio is determined for the roadway: Then congestion mitigation factors as given in Table 2-3 for different applicable TSMs are applied to examine whether or not the congestion level is reduced to acceptable level: If congestion reduces to acceptable degree, then the added-capacity is not warranted on the roadway, otherwise it is justified.

Congestion Mitigation and Air Quality Improvement Program (CMAQ) - A \$6 billion program which helps implement projects designed to reduce emissions in areas not meeting federal health standards for air quality.

Employer Trip Reduction (ETR) programs - Employer-designed programs that minimize employee commuting levels. These programs are federally required in nonattainment areas.

Federal Highway Administration (FHWA) - A part of the U.S. Department of Transportation. FHWA is responsible for approving and funding all federal aid for any highway project or program.

Federal Transit Administration (FTA) - A part of the U.S. Department of Transportation. FTA is responsible for approving and funding all federal aid for any transit program or project.

Geographic Information System (GIS) - An organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.

High Occupancy Vehicle (HOV) - A vehicle with two or more occupants. Freeways and other roads carrying large traffic volumes may have lanes designated for HOV use such as vanpools, carpools, and transit.

Houston-Galveston Area Council (H-GAC) - The metropolitan planning organization for the Houston-Galveston area. One of its functions is to develop and coordinate the transportation planning and projects being implemented in the Gulf Coast State Planning Region.

Infrastructure - Term used to describe the physical assets of a society or community including roads, bridges, transit facilities, bikeways, sidewalks, parks, sewer/water systems, communications networks, and other capital facilities.

Intelligent Transportation System (ITS) - A computer/communications technology that provides the motorist with information about road conditions as well as monitors and controls vehicle operation on roadways.

Intermodal - Refers to the connections between transportation modes.

Intermodal Surface Transportation Act (ISTEA) of 1991 - A federal mandate that restructures funding for highway and transit programs. The Act also requires those transportation plans and programs developed by metropolitan planning organizations be comprehensive and Intermodal.

Long Range Transportation Plan - See Metropolitan Transportation Plan.

Management System - A systematic process, designed to assist decision-makers in selecting cost-effective strategies/actions to improve the efficiency and safety of, and protect the investments in, the nation's transportation infrastructure.

Metropolitan Planning Organization (MPO) - A forum for cooperative transportation decision making which is responsible for conducting and coordinating a transportation planning process in the region. Development of the Metropolitan Transportation Plan is the MPO's responsibility.

Metropolitan Transportation Plan (MTP) – It identifies existing and future transportation deficiencies and needs, as well as network improvements needed to meet mobility requirements over a twenty-year period. In nonattainment areas, this plan must also address how the transportation system of the region will improve air quality. To receive federal funding, transportation projects must be included in the Transportation Improvement Program (TIP) and MTP, formerly known as the Long-Range Transportation Plan.

Multimodal - Refers to the diversity of options for the same trip; also, an approach to transportation planning or programming which acknowledges the existence of or need for transportation options.

National Ambient Air Quality Standard (NAAQS) - Federally mandated maximum levels (i.e. federal health standards) for air pollutants such as ozone.

National Environmental Policy Act (NEPA) - Federal act requiring a study on any environmental impact a federally funded or permitted project might cause.

National Highway System (NHS) - The network of roads including all interstate routes, regionally significant urban and rural principle arterials, potential strategic defense routes, critical highway connectors, and access to major ports, airports, public transportation, and Intermodal facilities.

Network - A transportation system with its many paths and routes often shown either graphically or mathematically.

Non-attainment Area - A designation by the Environmental Protection Agency of any place in the United States failing to meet national air quality standards (NAAQS). The Houston-Galveston area is a non-attainment area for ozone.

Performance Measures - Any of a variety of methods that can be used to determine the level at which a transportation system is operating. For congestion management, performance measures include travel time; delay; level of service; speed; and time rate.

Regional Computerized Traffic Signal System (RCTSS) - A centralized traffic signal system designed to improve traffic signal timing efficiency and minimize traffic delays.

Single-Occupant Vehicle (SOV) - Any vehicle where the operator is driving alone to work, school, and other destinations.

State Implementation Plan (SIP) - The CAAA requires the State to prepare a plan demonstrating how its nonattainment areas will reduce emissions from identified sources and achieves national air-quality standards by specified dates. The MTP must comply with or conform to the SIP.

Surface Transportation Program (STP) - A federal program designed to create flexible funding for transit and highway construction.

Technical Advisory Committee (TAC) - Committee which advises the Houston-Galveston Transportation Policy Council (TPC) on technical matters relating to transportation planning within the region. This committee is composed of representatives of local government, transportation modes, environmental interests, and other interests relevant to transportation planning and air quality.

Telecommuting - Using a home computer or a neighborhood work center for work, effectively eliminating the need to travel to a conventional workplace.

Teleconferencing - Using audio, video, and/or computer connections among sites for meetings, eliminate any need to travel to the meeting site.

Texas Department of Transportation (TxDOT) - State agency responsible for construction and maintenance of all Interstate, U.S., and State Highways and Farm-to-Market (FM) Roads within the state.

Transportation Conformity - A requirement of the CAAA that a regional emissions analysis be conducted on transportation programs and plans to ensure that these plans meet the State Implementation Plan's air quality goals.

Transportation Control Measure (TCM) - A transportation management strategy or group of strategies that consist of both Transportation System Management (TSM) and Transportation Demand Management (TDM) measures. Transportation Control Measures (TCM) strategies are intended to improve the mobility of goods and people with quantifiable air quality benefits. Most TCM strategies are considered relatively low capital cost solutions to congestion mitigation problems as compared to the traditional capital intensive solution of solving operational and travel demand problems with the addition of single-occupant vehicle (SOV) general purpose lanes.

Transportation Demand Management (TDM) - Strategies for easing or reducing transportation demand, specifically aimed at diverting people from driving alone. Programs used to improve air quality and congestion by decreasing vehicle miles traveled and vehicle trips.

Transportation Improvement Program (TIP) - An MPO-prepared document that identifies specific highway and transit projects to be implemented in an area over a three-year period, i.e. this document covers the first three years of the MTP. To receive federal funding, a transportation project must be included in plan and TIP.

Transportation Management Area (TMA) - An urbanized area with more than 200,000 people.

Transportation Policy Council (TPC) - A body of 26 locally elected officials and area agency representatives who determine the policy direction of Intermodal and multimodal transportation planning in the Gulf Coast State Planning Region, i.e. the Houston-Galveston TMA.

Transportation System Management (TSM) - Strategies for improving the operations of the transportation system.

Unified Planning Work Program (UPWP) – It is an annual report prepared by the MPO describing transportation planning activities which will take place within the Gulf-Coast State Planning Region In a current one or two-year period.

United States Department of Transportation (USDOT) – The Principal federal funding and regulating agency for transportation facilities. FHWA and FTA are agencies within U.S. Department of Transportation.

Vehicle Miles Traveled (VMT) - Term used for describing the total number of miles traveled by a vehicle in a given time in a specified region.

**APPENDIX C**

**TRANSPORTATION CONTROL MEASURES (TCMs)**

## APPENDIX C: TRANSPORTATION CONTROL MEASURES (TCMs)

In 1994, Houston-Galveston Area Council (H-GAC) contracted Sierra Research, Inc. to develop software to quantify the impacts of Transportation Control Measures (TCMs). The final product is called TCM Tools. It consists of three separate computer programs; Transportation Module, Emission Module, and Cost-Effectiveness Module. The first module, Transportation Module, analyzes the transportation benefits of the TCMs, such as VMT reduction and speed increase. The second module, Emission Module, combines the estimated travel impact results generated from the Transportation Module with the emission factor data contained in Mobile5a, calculates the baseline emissions and pollutant reductions. The third module, Cost-Effectiveness Module, computes the cost-effectiveness for each TCM by using the travel impacts and emission reductions produced by the first two modules along with other data input by the user.

The following table shows the 28 TCMs selected for analysis in the Houston-Galveston region.

### TCMs Selected for Analysis

1. Land Use Densification
2. Mixed Land Use Development
3. Pedestrian Improvements
4. Traffic Signal Timing Improvements
5. Traffic Management Systems
6. College Traffic Management
7. High School Traffic Management
8. Transit Service Increases
9. Employee Transit Pass Subsidy
10. Park-and-Ride Lots
11. Non-Metro Service Area Transit
12. Fixed Commuter Rail
13. High Occupancy Vehicle Lanes
14. Highway Capacity Increases
15. Bicycle Improvements
16. Trip Reduction Ordinances
17. Ridesharing
18. Parking Management
19. Telecommuting
20. Flexible Work Hours
21. Compressed Work Week
22. Gasoline Tax/Cost Increase
23. Emission Pricing
24. Roadway Pricing

25. Motorist Information System
26. Incident Management and Response
27. Special Events Management
28. Control of Truck Movements

28 TCMs selected. Five of those are TSMs; #4 Traffic Signal Timing Improvements, #5 Traffic Management System, #25 Motorist Information System, #26 Incident Management and Response System, and #28 Control of Truck Movement.

TCM Tools software runs on Lotus platform.

## TCM #4 - TRAFFIC SIGNAL TIMING IMPROVEMENTS

### Description

Under this measure, the existing traffic signal timing system would be optimized. This strategy does not include any hardware improvements to the system. The measure will increase average vehicle speeds through a decrease in stop-and-go traffic. Inputs are needed for estimated changes in possible induced trips and speeds for peak and off-peak periods. No additional trips are induced.

### Strategy

Traffic signal timing improvements are implemented such that speeds increase by 5.0 percent in the peak and 0 percent in the off-peak.

### Baseline Travel Characteristics - Supplied by User

- Total peak VMT
- Total off-peak VMT
- Average commute trip length
- Average non-commute trip length
- Percent of peak trips that are commute trips
- Percent of off-peak trips that are commute trips

### TCM-Specific Parameters - Supplied by User

- Change in peak trips
- Change in off-peak trips
- Percent change in peak speeds
- Percent change in off-peak speeds

### Assumptions in the Spreadsheet

- Speeds are input directly, not calculated according to the change in VMT

### Calculations in the Spreadsheet

- Change in total trips = (Change in peak trips)+(Change in off-peak trips)
- Change in peak VMT = (Change in peak trips)\*[(Percent of peak trips that are commute trips)\*(Average commute trip length) + (1-(Percent of peak trips that are commute trips))\*(Average non-commute trip length)]
- Change in off-peak VMT = (Change in off-peak trips)\*[(Percent of off-peak trips that are commute trips)\*(Average commute trip length) + (1-(Percent of off-peak trips that are commute trips))\*(Average non-commute trip length)]
- Change in total VMT = (Change in peak VMT)+(Change in off-peak VMT)

## TCM #5 - TRAFFIC MANAGEMENT SYSTEMS

### Description

Under this measure, a regionally coordinated traffic management system would be implemented. This strategy would include retiming the system to optimize air quality benefits and adding hardware improvements (e.g., installing a centralized computer system) to the existing signal timing system so that the maximum level of system coordination can occur. The measure will increase average vehicle speeds. Inputs are needed for the estimated changes in possible induced trips and speeds for peak and off-peak periods.

### Strategy

A traffic management system is installed to coordinate signal timing on a regional basis such that speeds increase by 15.0 percent in the peak and 0 percent in the off-peak. No additional trips are induced.

### Baseline Travel Characteristics - Supplied by User

- Total peak VMT
- Total off-peak VMT
- Average commute trip length
- Average non-commute trip length
- Percent of peak trips that are commute trips
- Percent of off-peak trips that are commute trips

### TCM-Specific Parameters - Supplied by User

- Change in peak trips
- Change in off-peak trips
- Percent change in peak speeds
- Percent change in off-peak speeds

### Assumptions in the Spreadsheet

- Speeds are input directly, not calculated by the change in VMT

### Calculations in the Spreadsheet

- Change in total trips = (Change in peak trips)+(Change in off-peak trips)
- Change in peak VMT = (Change in peak trips)\*[(Percent of peak trips that are commute trips)\*(Average commute trip length) + (1-(Percent of peak trips that are commute trips))\*(Average non-commute trip length)]
- Change in off-peak VMT = (Change in off-peak trips)\*[(Percent of off-peak trips that are commute trips)\*(Average commute trip length) + (1-(Percent of off-peak trips that are commute trips))\*(Average non-commute trip length)]
- Change in total VMT = (Change in peak VMT)+(Change in off-peak VMT)

## TCM #25 - MOTORIST INFORMATION SYSTEM

### Description

Under this measure, a system would be implemented for communicating information regarding traffic congestion conditions to motorists so that they can avoid badly congested areas. Inputs are needed for the average expected increase in freeway speeds and the percent of the freeway system that is affected.

### Strategy

Due to a motorist information system, there is a 15.0 percent increase in speeds on 17.8 percent of the freeways.

### Baseline Travel Characteristics - Supplied by User

Percent of VMT on freeways

### TCM-Specific Parameters - Supplied by User

Percent increase in freeway speeds

Percent of freeway system affected

### Assumptions in the Spreadsheet

No trip or VMT change

Only freeway travel is affected

### Calculations in the Spreadsheet

Percentage change in peak speeds = (Percent increase in freeway speeds)\*(Percent of VMT on freeways)\*(Percent of freeway system affected)

Percentage change in off-peak speeds = (Percent increase in freeway speeds)\*(Percent of VMT on freeways)\*(Percent of freeway system affected)

## TCM #26 - INCIDENT MANAGEMENT AND RESPONSE SYSTEM

### Description

Under this measure, a system would be implemented to shorten response time to incidents and manage clean-up operations more effectively, in order to reduce delay on freeways. Inputs are needed for the average expected increase in freeway speeds and the percent of the freeway system affected.

### Strategy

Due to an incident management and response system, there is a 20.0 percent increase in speeds on 28.5 percent of the freeways.

### Baseline Travel Characteristics - Supplied by User

Percent of VMT on freeways

### TCM-Specific Parameters - Supplied by User

Percent increase in freeway speeds

Percent of freeway system affected

### Assumptions in the Spreadsheet

No trip or VMT change

Only freeway travel is affected

### Calculations in the Spreadsheet

Percentage change in peak speeds = (Percent increase in freeway speeds)\*(Percent of VMT on freeways)\*(Percent of freeway system affected)

Percentage change in off-peak speeds = (Percent increase in freeway speeds)\*(Percent of VMT on freeways)\*(Percent of freeway system affected)

## TCM #28 - CONTROL OF TRUCK MOVEMENTS

### Description

Under this measure, truck movements would be restricted to certain times, to reduce truck traffic on congested roadways during peak periods and to improve traffic flow. Inputs are needed for the number of trucks trips expected to shift from the peak to the off-peak period.

### Strategy

10 percent of trucks trips shift from the peak period to the off-peak period.

### Baseline Travel Characteristics - Supplied by User

- Average trip length for trucks
- Total peak VMT
- Total off-peak VMT

### TCM-Specific Parameters - Supplied by User

- Number of trucks that shift from the peak to the off-peak period

### Assumptions in the Spreadsheet

- Elasticity of speed with respect to volume
- Only speeds are affected for vehicles other than trucks

### Calculations in the Spreadsheet

- Change in peak trips = (Number of trucks that shift from the peak to the off-peak)
- Change in off-peak trips = -(Change in peak trips)
- Change in total trips = (Change in peak trips)+(Change in off-peak trips)
- Change in peak VMT = (Change in peak trips)\*(Average trip length for trucks)
- Change in off-peak VMT = (Change in off-peak trips)\*(Average trip length for trucks)
- Change in total VMT = (Change in peak VMT)+(Change in off-peak VMT)
- Percentage change in peak speeds = -[(Change in peak VMT)/(Total peak VMT)]\*(Peak elasticity of speed with respect to volume)
- Percentage change in off-peak speeds = -[(Change in off-peak VMT)/(Total off-peak VMT)]\*(Off-peak elasticity of speed with respect to volume)

**APPENDIX D**  
**SAMPLE CMA REPORT**



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**HOUSTON-GALVESTON AREA COUNCIL**

PO Box 22777 • 3555 Timmons Lane • Houston, Texas 77227-2777 • 713/627-3200

September 13 - 2007

Charles U. Airiohuodion  
Advance Transportation Planning  
Texas Department of Transportation  
7721 Washington Avenue  
Houston – Texas 77007

**Re: Report of Congestion Mitigation Analysis (CMA) For SH 36 From 0.9 Miles South of the Brazos River to FM 1495 - CSJ # 0111-08-100**

**Dear Mr. Airiohuodion:**

The Houston-Galveston Area Council (H-GAC), the designated Metropolitan Planning Organization (MPO) for the region, has completed the Congestion Mitigation Analysis (CMA) for the above captioned project.

Please find attached the report of the CMA to be forwarded to the appropriate department of TxDOT.

The results of the analysis indicate that the level of mobility (LOM) for SH 36 From 0.9 Miles South of the Brazos River to FM 1495 has already deteriorated enough to justify added capacity.

Therefore, any widening of SH 36 From 0.9 Miles South of the Brazos River to FM 1495 will be consistent with the Congestion Management System (CMS) Plan of H-GAC.

Since this is a state highway in rural region with limited numbers of signals and sparsely populate area, as per Congestion Management System (CMS) Plan of H-GAC, we do not have any Transportation System Management (TSM) and Transportation Demand Management (TDM) options in our Tool-Box to apply as congestion mitigating factors to this corridor.

As such the implementing agency does not have to commit to include TSMs and TDMs as part of this roadway project.

If you have any comments or need additional information, please do not hesitate to contact me at (713) 993-4564.

Sincerely,

*Ilyas Choudry*  
**Ilyas H. Choudry**

**CONGESTION MITIGATION ANALYSIS (CMA)  
SH 36 From 0.9 Miles South of the Brazos River to FM 1495  
CSJ # 0111-08-100  
September 13 - 2007**

**FINDINGS**

The Level of Mobility (LOM) on SH 36 from 0.9 Miles South of the Brazos River to FM 1495 has already deteriorated significantly to justify adding additional road capacity. Since this is a State Highway in Rural Region with limited numbers of signals and sparsely populate area, as per Congestion Management Plan (CMS), we do not have a Transportation System Management (TSM) and Transportation Demand Management (TDM) in our Tool-Box to apply congestion mitigating factor to this corridor. It can be concluded that adding capacity on this roadway can be further investigated and is consistent with the CMS Plan of the Houston-Galveston Area Council (H-GAC) contingent to the considerations described below.

**BACKGROUND**

The current Congestion Management Systems (CMS) Plan for the Houston-Galveston metropolitan area was adopted in October 1997 and amended in December 1997, May 1998, and December 2004. The CMS requires the performance of a Congestion Mitigation Analysis (CMA), which was formerly known as Single Occupancy Vehicle Analysis (SOV), on significant added capacity roadway projects. It is the stated policy of the CMS to apply cost-effective Transportation System Management (TSM) measures and Travel Demand Management (TDM) as the first component of all congestion reduction strategies. Added capacity roadway projects, such as those being considered for this SH 36 are justified only if cost-effective demand and system management strategies fail to reduce vehicular congestion to acceptable (or tolerable) levels.

**PROJECT DESCRIPTION**

The limits of this project are SH 36 from 0.9 Miles south of the Brazos River to FM 1495. It is an existing 1.30-Miles long stretch of SH 36 with two lanes open ditch in rural area with limited development. It is being proposed to be widened to four-lane divided rural highway. The 85<sup>th</sup> Percentile Speed on the facility is approximately 58 MPH.

**TRAFFIC AND LEVEL OF MOBILITY (LOM)**

**Table 1** illustrates Levels of Mobility (LOM) used to define congestion by H-GAC. These LOMs were developed by the H-GAC Travel Modeling Committee in 1997 and approved by the Technical Advisory Committee (TAC). Roadway segments that fall above the tolerable level (i.e., volume/capacity (v/c) ratio  $\geq 0.85$ ) are considered congested, thus added capacity is considered to be justified.

**Table 1**  
**Summary of Levels of Mobility (LOM)**

LOM	Volume/Capacity (V/C) Ratio
Tolerable	< 0.85
Moderate	$\geq 0.85 < 1.00$
Serious	$\geq 1.00 < 1.25$
Severe	$\geq 1.25$

For the purpose of this CMA, the v/c ratios (LOMs) were calculated. Volume/capacity (v/c) ratios were calculated using capacities developed by H-GAC for the region's travel demand model as well as actual 24-hour traffic counts done by consultant C. J. Hensch & Associates, Inc. Adjusted capacities were determined using H-GAC's capacity tables, which are based on the standard "*Highway Capacity Manual*" procedures for different facility types and number of lanes, as well as other traffic-related factors. These include:

- Percent Trucks
- Number of Lanes
- Lane Utilization Factor
- Traffic Signal Timing  
[Green/Cycle Length (g/c) Ratio]
- Percent Left-turns
- Peak Hour Factor
- Peak Hour Directional Factors

Information for these factors was also collected in the field by consultant C. J. Hensch & Associates, Inc. As mentioned earlier, they also collected traffic volume information. Once the adjusted capacity was calculated using Capacity Tables, weighted average v/c ratio for Year 2007 was determined. This v/c ratio 0.91 is higher than 0.85: Since there are no mitigating factors, LOM for after case will also remain the same as the existing case and is given in **Table 2** as MODERATE.

### **CONGESTION REDUCTION STRATEGIES**

It is the stated policy of the Congestion Management System to apply cost-effective demand and system management measures as the first component of all congestion reduction strategies. Added capacity roadway projects are justified only if cost-effective demand management and system management strategies fail to reduce vehicular congestion to acceptable levels. Where demand or system management projects are feasible and cost-effective, project sponsors, or relevant implementing agencies and the MPO must commit to their implementation or incorporation into a proposed added-capacity project as a pre-condition to federal funding assistance. Project design, concept, and scope must also be consistent with any selected management strategies.

Since this is a State Highway in Rural Region with limited numbers of signals and sparsely populated area, as per Congestion Management Plan (CMS), we do not have a Transportation System Management (TSM) and Transportation Demand Management (TDM) in our Tool-Box to apply congestion mitigating factor to this corridor.

### **Analysis and Results**

Since v/c ratio suggests enough congestion in Year 2007 and with no TSM/TDM considered, results are given in **Table 2**.

**Table 2**  
**LOM for Year 2007**  
**SH 36 From 0.9 Miles South of the Brazos River to FM 1495**  
**CSJ # 0111-08-100**

	<b>LOM Before Implementation of TSM/TDM Projects (2007)</b>	<b>LOM After Implementation of TSM/TDM Projects (2007)</b>
Yr. 2007 Adjusted LOM	0.91	0.91

It is obvious that the LOM within the limits of the project is MODERATE in the existing Year 2007. Therefore, adding capacity is justifiable and can be further explored.

Information from TxDOT about exact time frame of construction of this project is being requested. Reason is H-GAC is responsible for evaluating the before-and-after results. H-GAC's consultant C. J. Hensch & Associates, Inc. has already collected the before implementation travel time runs for the performance evaluation.

**APPENDIX E**

**SAMPLE CMP PROJECT CHECK LIST**

## **APPENDIX E: SAMPLE CMP PROJECT CHECK LIST**

There are basically two components to the Houston-Galveston Area Council's Congestion Management Process (CMP).

One component of CMP is that as the different agencies in the region, submit added-capacity projects for an upcoming Transportation Improvement Plan (TIP); they need to follow the CMP requirements. These requirements in the form of check-list for an agency are:

- 1) First thing to determine is the project being submitted for TIP is added-capacity?
- 2) If the answer is "No" to Point 1, then it is of course not related to CMP;
- 3) If the answer is "Yes" to Point 1, then the staff of the lead agency needs to contact H-GAC to determine, if the added-capacity is on the CMP Network Map;
- 4) If the answer is "No" to Point 3, then agency has to request H-GAC to issue "Letter of Waiver (LOW)" and include this letter in their submittal for TIP;
- 5) If the answer is "Yes" to Point 3, then agency has to perform Congestion Mitigation Analysis (CMA) on the project and submit it for review and approval to H-GAC, prior to submitting the project for TIP (in order to know how to do CMA, one can refer to the Appendix for an example): Also agency can contact H-GAC for more information;
- 6) Also CMA needs to always be the first step of all the Major Corridor Studies.

The second component of CMP is the "State of the Congestion in the Region", where traffic and transportation data is collected six months prior to the start of an impending TIP and analyzed for Congestion Levels in various parts of the Houston-Galveston Region and then going back to collect the same data six months after the implementation of TIP and as such doing before and after implementation of TIP comparison to see how well the congestion levels are being managed and/or reduced in the region. Schedule about when, how and where to perform the data collection will be determined by H-GAC in consultation with and cooperation of all the related agencies in the region.

**APPENDIX F**  
**EXAMPLE MOBILITY REPORT**

## **APPENDIX F: EXAMPLE MOBILITY REPORT**

The mobility report will be generated from several sources. Freeway speeds are collected by the AVI (Automatic Vehicle Identification) system. Arterial speeds will be collected as part of a proposed data collection effort. This data collection effort will serve two functions. First it will be used for model calibration; secondly the data will be used for the congestion management report. In addition to travel time data traffic counts will be collected or gathered from local sources. The data will be formatted and aggregated by functional classification.

The report will likely be three reports; a two to four page press release; an 8 to 10 page executive summary; and a technical report that contains samples of the data collection. These reports will contain lots of graphics, maps, charts, and tables. The report structure will likely change as technology changes as well as improved data collection and analysis techniques improve. Lessons learned from the mobility report, Boston, Seattle and others will be used as guidance in project analysis and reporting.