Ozarks Transportation Organization

CONGESTION MANAGEMENT SYSTEM – PHASE I

Approved by the Board of Directors
October 2005

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This report was prepared in cooperation with the USDOT, including FHWA and FTA, as well as the Missouri Department of Transportation.

Introduction

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 required establishment of a Congestion Management System in each Transportation Management Area (TMA). In subsequent transportation bills (TEA-21 and SAFETEA-LU) this requirement has been retained. A TMA is defined as a Metropolitan Statistical Area with a population over 200,000. Following the 2000 census, the Springfield Metropolitan Area was redesignated as a TMA, thus requiring the development of a Congestion Management System (CMS) for the Ozarks Transportation Organization (OTO) study area. By federal law, a CMS must address such transportation planning techniques as measuring congestion, identifying recurring congestion and incident related congestion. The CMS Plan must also recommend measures to alleviate congestion. This document describes in detail the congestion management system in practice within the Ozarks Transportation Organization study area (see Map 1).

The intent of the CMS plan is to improve effectiveness of the existing and future transportation system through the implementation of Transportation System Management (TSM), which includes Intelligent Transportation Systems (ITS) and Travel Demand Management (TDM) techniques. TSM technologies help monitor and manage traffic flow performance and efficiency, The CMS addresses incident management through quicker response, clean up times, alternative routing, work zone notification, and provides traditional engineered-based techniques to address congestion at key "chokepoints". TDM strategies focus on reducing single occupant vehicle (SOV) use and promoting alternative modes of transportation.

Identified benefits of a CMS Plan will include:

- A better understanding and measurement of congestion
- The selection and evaluation of congestion mitigation measures
- Improved system performance
- A cleaner and healthier environment

The CMS consists of three main parts. Phase I is identification of congestion and specific strategies to address congestion. Phase II includes identifying where congestion is occurring or is expected to occur during the twenty-year plan horizon and implementation of identified strategies. Phase III is to develop a monitoring program to determine if selected strategies are effective in dealing with the congestion at the identified locations, and if not identify other strategies to be tried to deal with congestion.

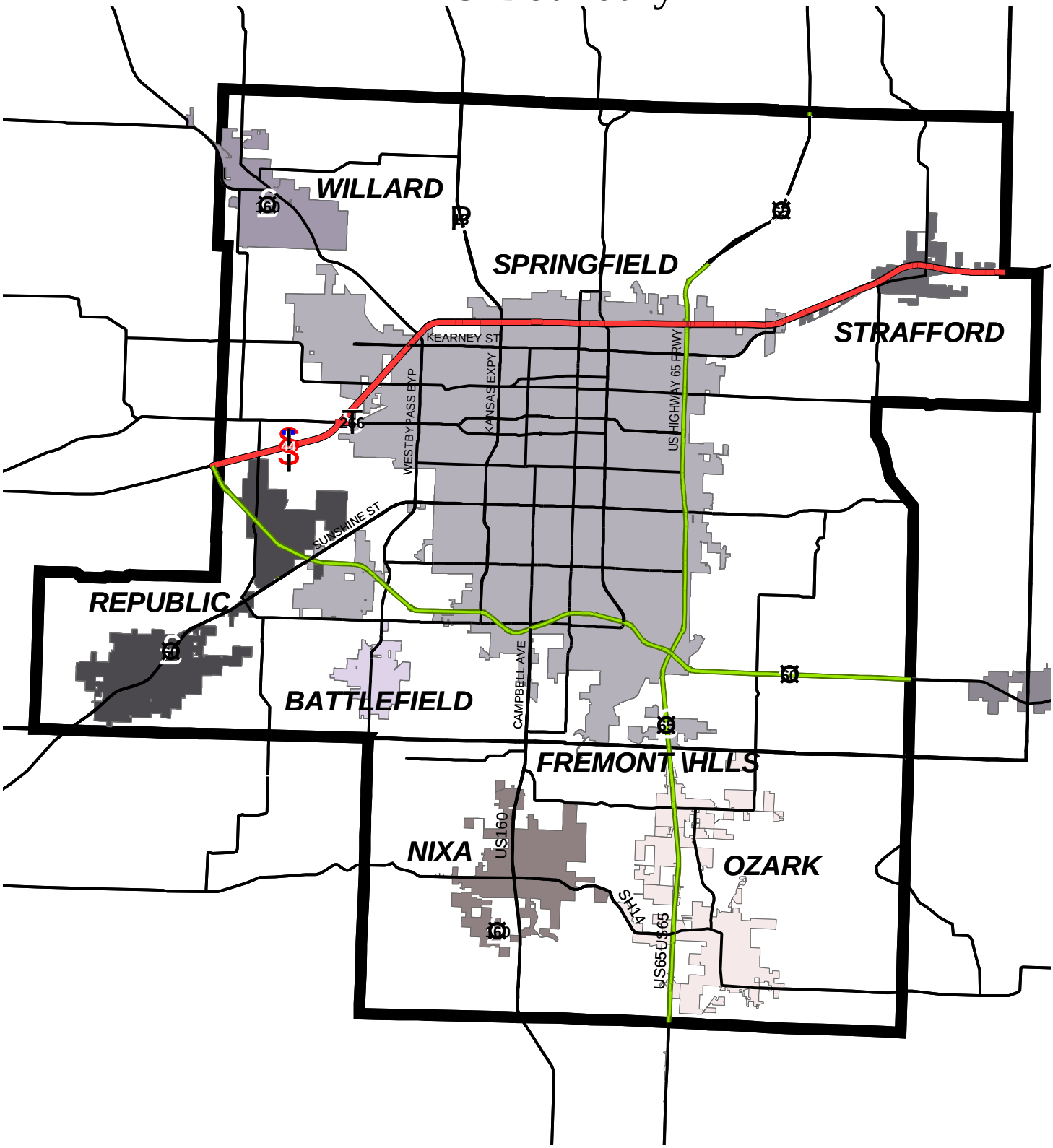
Background

A Congestion Management Subcommittee comprised of local jurisdiction and state transportation experts was formed in 2003, which guided the development of the Ozarks Transportation Organization's first congestion management system plan.

The following actions were identified as part of the Ozarks Transportation Organization Congestion Management System work plan:

1. Formulation of performance measures
2. Methods to monitor and evaluate conditions on the identified transportation network

Map 1
MPO Boundary



3. Identification of corridors, intersections and interchanges that are considered congested based on methods established in this CMS
4. Identification of high accident incident locations
5. Identification of cost-effective congestion mitigation strategies to address areas where congestion problems are most severe
6. Implementation and assessment of these strategies to relieve current or projected levels of congestion
7. Evaluation of the impact of the congestion mitigation strategies implemented

Congestion Management System Process

This section will provide an overview of the Congestion Management System process. The CMS can be described in terms of a four-step process to define, identify, mitigate, and monitor recurring congestion as well as the integration of the CMS Plan into the overall Ozarks Transportation Organization planning process (see Figure 1). This four-step process is summarized below:

1. **System Definition:** Identification of the transportation mode(s) and network(s) for incorporation in the analysis.

2. **Congestion Definition and Identification:** With an understanding of the available data, develop a definition of congestion (including objective congestion measures) and apply to the regional network determined in Step 1.

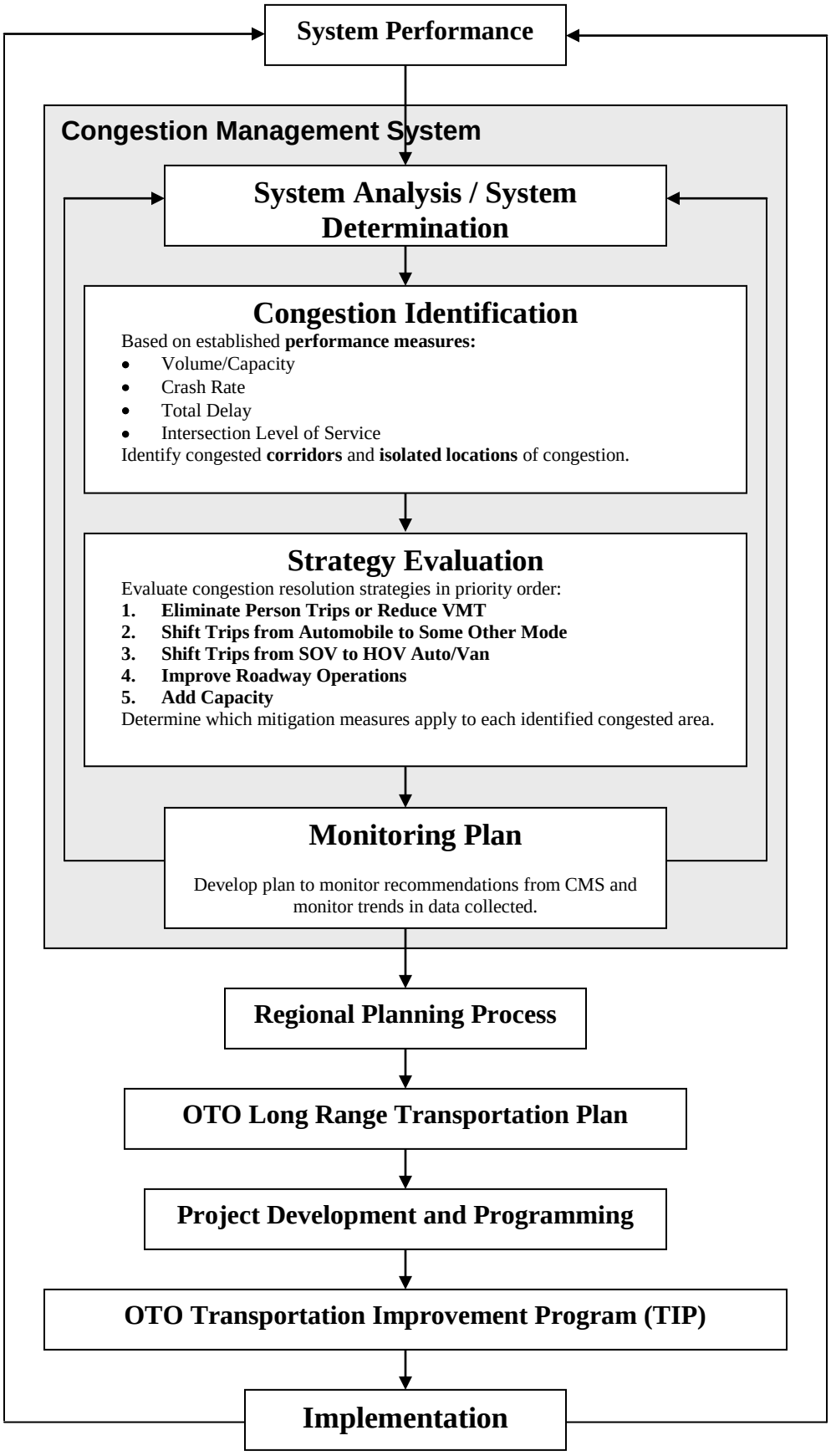
3. **Strategy Identification and Mitigation**: Using a "toolbox" of congestion mitigation strategies, identify strategies to apply to the congested corridors, intersections, and interchanges identified in Step 2.

4. **System Monitoring and Evaluation:** Outline data collection and monitoring efforts and to gauge the effectiveness of strategies recommended in the CMS report.

Integration into the Ozarks Transportation Organization Planning Framework

The integration of the CMS into the overall Ozarks Transportation Organization planning process is shown in Figure 1 on the following page. The process "begins" with an evaluation of the overall system performance. This is accomplished through the evaluation measures established in the CMS, and ongoing general data collection activities. This evaluation is the catalyst for general policy, program, and input into the CMS process. The outputs of the CMS (i.e. identified locations of congestion and recommended congestion mitigation measures) then are incorporated into the regional planning process where they are evaluated and prioritized and assimilated into the Long-Range Transportation Plan (LRTP). The LRTP sets an overall transportation policy framework for the region and identifies strategies and potential projects for implementation. Projects identified in the LRTP move into project development. After analysis, they are then programmed into the Transportation Improvement Program (TIP) along with other agency capital improvement programs for implementation.

Figure 1: Congestion Management System Procedural Overview



Congestion Management System Definition

Because of the state-mandated Missouri Planning Framework; Missouri Transportation Planning and Decision-Making Process, the emphasis in Missouri and the Ozarks Transportation Organization is the preservation of the region's most important travel corridors. Since the majority of transportation funds allocated to the Ozarks Transportation Organization study area are intended for use on Missouri Department of Transportation (MoDOT) roadways, the System has been defined as "all roads within the region considered part of the National Highway System (NHS)." The National Highway System (NHS) includes the Interstate Highway System as well as other roads important to the nation's economy, defense, and mobility. The NHS was developed by the United States Department of Transportation (DOT) in cooperation with the states, local officials, and metropolitan planning organizations (MPOs).

In addition to roads, other modes of transportation, including mass transit, bicycle, and pedestrian improvements, will be taken into consideration during the congestion identification stage and will play an integral part in the congestion mitigation strategy component. Using this definition allows the CMS to cover all regionally significant roadways (see Map 2). Since decisions on where funds will be spent on NHS roadways are done collaboratively between the Ozarks Transportation Organization and the Missouri Department of Transportation, these important players to addressing congestion would be able to participate in many data collection and strategy selection elements of the CMS. Other roadways may be examined for informational purposes.

Congestion Definition

The Transportation Research Board (TRB) has identified two definitions of congestion, as it relates to travel time and speed. "Congestion is travel time or delay in excess of that normally incurred under light or free-flow travel conditions."

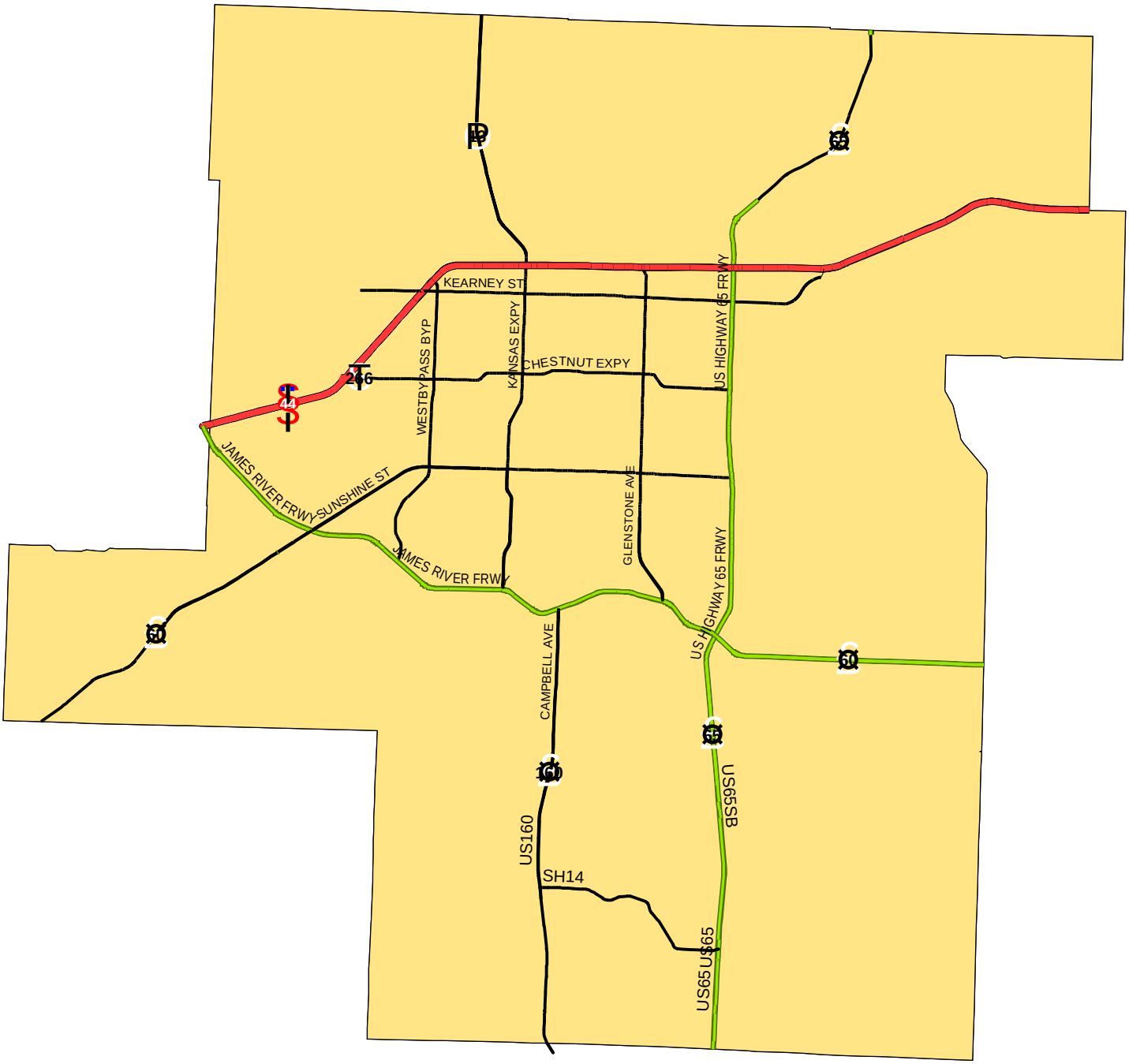
There are two primary causes identified for congestion. They are (a) recurring congestion that tends to be concentrated into short time periods, such as "rush hours" and is caused by excessive traffic volumes resulting in reduced speed and flow rate within the system, and (b) non-recurring congestion caused by unforeseen incidents (road accidents, spills, and stalls) which affect the driver behavior to a considerable extent. A successful congestion management program should address both types of congestion.

Every day traffic incidents obstruct urban, suburban and rural highways, impeding mobility and disrupting the traffic. Incidents are events that reduce the traffic carrying capacity of a highway, such as spilled loads, stalled vehicles, at-grade railroad crossings and accidents. When they occur during rush hours they cause serious congestion usually far out of proportion to their degree of severity. Secondary incidents are also a concern. Delays related to incidents increase at a faster pace with the growth of traffic volumes and it is estimated that by 2005 incidents will cause 52 – 58% of congestion nationally according to the Texas Transportation Institute Urban Mobility Study.

Incident Management is defined as a sequence of pre-planned and integrated activities that, applying both human and technological resources, remove incidents as quickly and safely as possible and restore capacity to the highway. While many of these techniques are not new, the

Map 2

Congestion Management System Definition
National Highway System



difference is that these resources are used more effectively. Time is essential since on average it can take four minutes to return to normal traffic conditions for every one minute a roadway is obstructed.

Incidents may be predictable or unpredictable. See Table 1 below.

Table 1: Incident Types

Predictable	Unpredictable
Maintenance Activities	Accident
Construction	Stalled Vehicle
Special Events (ball games, fairs, parades, etc.)	Maintenance Activities
	Spilled Load
	At-Grade Highway Rail-Grade Crossing Activity

Reiss, Robert A. and Dunn, Walter M., Freeway Incident Management Handbook, Report No. FHWA-SA-91-056, July 1991

Incidents may be minor or major. As seen in Table 2, about 2/3 of all incidents caused delays result from minor incidents. Exceptions to the criteria shown below can occur.

Table 2: Incident Magnitudes

Characteristic	Minor	Major
Duration	< ½ hour	> ½ hour
Blockage	Shoulder Area Only	One or More Traveled Lanes
Contribution to Overall Incident Caused Delay	65%	35%

Reiss, Robert A. and Dunn, Walter M., Freeway Incident Management Handbook, Report No. FHWA-SA-91-056, July 1991

Incidents have negative impacts on safety, on the efficiency of agencies operations, and on traffic congestion. Rapid clearance of incidents reduces the amount of time which responders and motorists are exposed to traffic hazards and “secondary incidents”. Besides, simultaneous incidents can severely compromise agencies’ abilities to respond effectively.

For purposes of this document the CMS is defined as "a systematic process that provides information on transportation system performance and alternative strategies to alleviate congestion and enhance the mobility of persons and goods to levels that meet state and local needs."

Critical to the concept of congestion management as outlined in ISTEA, TEA-21 and SAFETEA-LU is the notion that the acceptable system performance may vary by type of transportation modes and systems, geographic location, and/or time of day. The CMS reflects parameters that identify the degree to which travel time and/or delays are within locally acceptable standards of mobility, to meet the needs of individual states or metropolitan areas.

Congestion Identification

Evaluation Criteria used for CMS Performance Measures

The selection and application of performance measures for a CMS (locally or at the state level) requires consideration of several factors. Some of the factors as applicable to Ozarks Transportation Organization study area are outlined below:

- Facility Type
- Usable at the regional, sub area, or corridor level
- Usable for individual transportation projects
- Capable of discriminating between peak period, off-peak, and daily congestion levels
- Constitutes a direct measure of congestion
- Relatable to existing data collection and analysis methods
- Understandable to the transportation profession and the public
- Capable of supporting evaluation of congestion management and mobility enhancement strategies

Performance measures should enable a Metropolitan Planning Organization to define and measure congestion both spatially and temporally. In practice, many of the measures are link or site specific. The measures such as volume to capacity ratio (V/C), level-of-service, and intersection delay belong to such a class of measures.

Congestion Indicators

The congestion indicators provide a basis for evaluating the transportation system operating conditions and help to identify the location, extent, and severity of congestion. These indicators can also be used to evaluate the effectiveness of implemented congestion management strategies. In this section we will only refer to recurring congestion and strategies. Non-recurring congestion will be covered in a later section.

Conventionally, congestion has been measured independently for different modes. A diversity of statistical measures has been used to associate the capacity to the volume of use on particular facilities. However, no single measure or small combination of measures will adequately capture the conditions in all areas, nor allow suitable analysis of alternative strategies or congestion mitigation measures.

The selection and application of performance measures for a CMS (locally or at the state level) requires consideration of several factors. Some of the factors as applicable to Ozarks Transportation Organization study area are outlined below:

Congestion Indicators for the Ozarks Transportation Organization Area

The Ozarks Transportation Organization study area has a population of 257,000 and approximately 244,000 in its urbanized area. The Ozarks Transportation Organization surveyed local governments and transportation agencies in the region to determine the availability of congestion related data and developed a list of measures that could be used. This work led the Ozarks Transportation Organization to develop a list of five distinct questions that should be addressed by the congestion management system and that would be suitable to the region.

1. What facilities are congested during the peak hour?
2. What is the duration of congestion?
3. What is the impact of accidents on congestion?
4. How badly are travelers delayed?
5. What impact does intersection/interchange level-of-service play in determining regional congestion problems?

The answers to the questions above allow aggregation of subareas into corridors or larger areas for purposes of developing strategies to alleviate congested conditions. It also makes possible to distinguish congestion on the expressway system from congestion on the arterial system.

The five questions, the quantifiable congestion indicator to be used to answer each of the questions, the required data, and the initially proposed performance standards are detailed below.

1. What facilities are congested during the peak hour?

Recurring congestion occurs on roadways which are over, at or nearing capacity. By examining the volumes of roadways during the peak hour, we are able to define which roadways are congested.

Congestion Indicator:

- Volume to capacity (v/c) Ratio

Data Required:

- Peak hour volumes
- Hourly roadway capacities

Performance Standard:

- Congested roadways are defined as those with a peak volume to capacity (V/C) ratio of LOS E or greater (.86 or above)

LOS	v/c Ratio
A, B, &C	Less than .77
D	.78 to .85
E	.86 to 1.0
F	Varies

2. What is the duration of congestion?

The length of time spent on congested roadways indicates the extent to which congestion effects total travel time. It also is an indicator of little choice to drivers in their travel schedule. Time spent by drivers/passengers in congestion is the time-cost of congestion. This is defined as the length of time spent on roadways under congested conditions. We will only look at the length of congestion for those facilities that have been determined to be congested by Measure 1 above.

Congestion Indicator:

- Time period for which LOS E is exceeded.

Data Required:

- 15 min traffic counts where available
- Hourly traffic counts
- Peak hour v/c ratio

Performance Measure

- Congested roadways are defined as those with a peak volume to capacity (V/C) ratio of LOS E or greater (.86 or above). Each roadway with a V/C Ratio of .86 or above will be examined further to assign a time period of congestion. This will be tracked over time to determine if the time period of congestion for a given roadway is increasing, decreasing or is experiencing no change.

3. What is the impact of accidents on congestion?

Accidents reduce roadway capacities temporarily. A recent estimate of incident-related delay for medium-sized urban areas indicates that as much as 60% of delay is caused due to incidents. Given that perspective, for the Ozarks Transportation Organization region, traffic accidents (as a surrogate measure of all incidents) are important in prioritizing congested corridors.

Congestion Indicator:

- Crash rate (actual three year crash rate by functional classification of each corridor divided by the MPO average crash rate for each functional classification designation)

Data required:

- Crash rate for each facility
- Average Crash Rates by Functional Classification for MPO area

Performance Standard:

- Less than ½ average crash rate versus MPO average= low crash rate
- Between ½ average crash rate and 1.5 of the average crash rate = medium crash rate
- Greater than 1.5 the average crash rate = high crash rate

4. How badly are travelers delayed?

Total delay is directly related to the time value cost of congestion when compared with acceptable LOS conditions. The delay is estimated based on the peak hour incident rate (per million VMT), and congested traffic conditions, as compared with an acceptable travel speed. The acceptable speed depends on the functional classification and capacity of roadways, and the adjacent land-use intensity.

Congestion Indicator:

- Total delay (difference between actual travel time based on posted speed limit and posted speed limit)

Data Required:

- Peak hour travel time

Performance Standard:

- An initial acceptable average travel time during the peak hour for each roadway has been determined by comparing actual travel speed to the posted speed limit. If the actual speed is less than 21 miles below the posted speed, the roadway is classified as congested.
-

5. What impact does intersection/interchange level-of-service play in determining regional congestion problems?

This performance measure, intersection level of service (LOS), looks at the overall performance (generally, in terms of delay experienced by the user) of a given intersection. As in the roadway volume to capacity performance measure discussed above, the Ozarks Transportation Organization applied the generally accepted letter grade system to the intersection LOS measure and assumed that LOS "E" and "F" could be assumed to be congested intersections.

Congestion Indicator:

- Intersection Level of Service Rating

Data Required:

- Average delay at intersection/interchange during peak period
- Average delay at intersection/ interchange during non-peak periods
- Peak hour traffic counts
- Green signal duration
- Turning movements

Performance Standard:

- Congested intersections are defined as those with a LOS of E or greater.

Level of Service for intersections is determined by measuring the signalized intersection control delay for arterials and expressways. A control delay of 55 to 80 seconds is considered to have a LOS E. The level of service for interchanges will be determined by looking at what percentage of the roadway's capacity is being utilized by traffic. The higher the ratio, the closer the

roadway's capacity is to being filled. As stated earlier, the Ozarks Transportation Organization utilized a generally accepted measure of assigning letter grades (A-F) to ranges of the volume/capacity (v/c) ratio. Following this system, we have assumed that roadway and intersection/interchange congestion exists on segments with a Level of Service (LOS) "E" and LOS "F" .

Note: Intersection level of service performance measure is limited to those arterial intersections for which data has been collected in the last four years. Additional information is expected to be available in 2006.

Collection of Congestion Data

The primary purpose of compiling data is to identify recurring congestion and document the magnitude of this congestion. Traffic counts are compared to capacity, expressed as a level of service. Traffic counts (and traffic volume forecasts) can serve as an initial screen to locate congested routes and future problems. Travel time or speed studies are conducted by field study and are the most useful in locating "bottlenecks" and causes of congestion.

The method used to measure and monitor travel times and vehicle speeds within the Ozarks Transportation Organization study area for purposes of determining congestion is called the "floating car" method. A floating car is equipped with a laptop personal computer to gather data on speed and travel time as the car is driven on area expressways and arterials.

A summary of the available or ongoing data collection is presented below.

Table 3: Available or Ongoing Data Collection

Data	Source of Data	Coverage	Frequency of Data Collection
1. Traffic Counts	• Missouri Department of Transportation • City of Springfield Department of Public Works	• Ozarks Transportation Organization area • Springfield City limits	• Every year on rotating schedule • Every year on rotating schedule (turning movements)
2. Travel Time	• Missouri Department of Transportation • Springfield Public Works	• Ozarks Transportation Organization area • Springfield City limits	• Every 3 years • As needed
3. Accident	• Missouri Highway Patrol • Missouri Department of Transportation	• Ozarks Transportation Organization study area	• Every 3 years

Traffic counts are performed by the Missouri Department of Transportation (MoDOT) on state highways. MoDOT conducts average daily traffic counts at several stations. Within the corporate limits of the City of Springfield, the Public Works Department is responsible for traffic count

data on arterial streets and intersections. Ramp counts and intersection turning movements are not counted at any regular frequency. There is a limited number of vehicle classification counts performed by MoDOT in the Ozarks Transportation Organization Study Area.

The Missouri Department of Transportation compiles accident data by each city and county every year and that data is made available to the MPO. It is originally collected from the Missouri Highway Patrol, and some data from local sheriff and police departments. The data includes accident counts and type of vehicles involved. The crash rate in a corridor is computed by facility type. The rate is expressed in terms of number of accidents per million vehicle miles traveled. The rate is also computed for a section of a corridor.

Identification of Congested Facilities

Based on the data collected the Ozarks Transportation Organization will identify congested locations during Phase II of the CMS. For consistency sake, the congested facilities are divided into each of the five congestion indicators detailed earlier in this report. Those five congestion indicators are:

1. What facilities are congested during the peak hour?
2. What is the duration of congestion?
3. What is the impact of accidents on congestion?
4. How badly are travelers delayed?
5. What impact does intersection/interchange level-of-service play in determining regional congestion problems?

Strategies For Recurring Congestion Mitigation

To facilitate evaluation, a "toolbox" of congestion mitigation measures was assembled that includes all strategies that could be used to address congestion. The methodology for the "tool-box" is a top-down approach, proceeding by breaking large general aspects of a problem into smaller more detailed constituents.

The top-down approach ensures that solutions that would eliminate or shift auto trips or improve roadway operations are evaluated before adding roadway capacity. This hierarchy is consistent with Ozarks Transportation Organization's overall goals for the region and with the USDOT charge to address all other possible solutions before recommending road capacity increases. Within each of these strategies, specific mitigation measures are outlined and described in detail. This package of solutions to congestion includes measures involving *all* modes of transportation as well as encouraging more efficient patterns of land use and development.

Strategy #1: Improve Roadway Operations

- **Intersection Geometric Improvements:** Improvements to intersection geometrics (reassignment of lane operation or provision of additional lanes at intersection) to improve overall efficiency and operation.

- **Intersection Channelization:** Intersection improvements that provide physical separation and/ or delineation of conflicting vehicular and pedestrian traffic movements.

- **Intersection Turn Restrictions:** Prohibit certain intersection turn movements to reduce conflicts and increase overall intersection performance.

- **Intersection Signalization Improvements:** Improving signal operations through re-timing signal phases, adding signal actuation, etc.

- **Coordinated Intersection Signals:** Improve traffic signal progression along identified corridors.

- **Elimination of Bottlenecks:** Eliminating high-traffic areas where one or more travel lane(s) are dropped.

- **Ramp Metering:** Metering vehicular access to a freeway during peak periods to optimize the operational capacity of the freeway.

- **Incident Management – Detection, Response & Clearance:** Utilize traveler radio, travel alert notification (via e-mail, fax, etc.), and general public outreach to enhance incident-related information dissemination. (A more detailed look at incident management techniques is included later in this section.)

- **Access Control:** Reduction or elimination of "side friction", especially from driveways via traffic engineering, regulatory techniques, and purchase of property rights.

- **Median Control:** Reduction of centerline and "side friction", via traffic engineering and regulatory techniques.

- **Frontage Roads:** Auxiliary roadways that provide a separated lane or lanes for access to abutting land uses along freeways or arterials, thus reducing the number of access points on main line travel through lanes.

Strategy #2: Reduce VMT At Peak Travel Times

- **Land Use Policies/Regulations:** Encourage more efficient patterns of commercial or residential development in defined growth areas. Specific land use policies and/or regulations that could significantly decrease both the total number of trips and overall trip lengths, as well as making transit use, bicycling and walking more viable include, but are not limited to:
    - Encouraging development in existing centers and/or communities (i.e. infill development)
    - Discouraging development outside of designated growth areas
    - Promoting higher density and mixed uses in proximity to existing or planned transit service
    - Establishing a policy for new and existing subdivisions to include sidewalks, bike paths, and transit facilities where appropriate

- **Telecommuting:** Encouraging employers to consider working at home or other remote locations options full- or part-time.

- **Employer Flextime Benefits/Compressed Work Week:** Encouraging employers to consider allowing employees to maintain a flexible schedule – thus allowing the employee the option to commute during non-peak hours.

Strategy #3: Shift Trips from Automobile to Other Modes

- **Exclusive Right of Way – New Bus Facilities:** Includes Busways, Bus Only Lanes, and Bus Bypass Ramps. Most appropriately applied to freeways and expressways with high existing transit ridership rates. Busways may be combined with HOV lanes.

- **Fleet Expansion/Bus Service Expansion:** Expansion of existing rail and/or bus capacity to provide increased service, along with improvements of service frequency and service area expansion throughout the region.

- **Traffic Signal Preemption:** Improve traffic flow for transit vehicles traveling through signalized intersections.

- **Transit Fare Reductions/Reduced Rate of Fare:** Includes system-wide reductions, off-peak discounts, deep discount programs and employer sponsored transit pass programs.

- **Transit Information Systems:** In-vehicle and station information systems to improve the dissemination of transit-related information to the user in real time.

- **Intelligent Bus Stops:** Increasing ridership by providing real-time vehicle, schedule, and transfer information.

- **Improved Intermodal Connections:** Improve the efficiency and functionality of Intermodal connectors where several modes of transportation are physically and operationally integrated.

- **Improved/Expanded Bicycle Network:** Includes on-road facilities, pathways, and greenways.

- **Bicycle Storage Systems:** Providing safe and secure places for bicyclists to store their bicycles with incentives to reduce number of automobile parking spaces.

- **Improved/Expanded Pedestrian Network:** Includes sidewalks, overpasses/tunnels, greenways and walkways.

Strategy #4: Shift Trips from SOV to HOV Auto/Van

- **Add High Occupancy Vehicle Lanes:** Most appropriate use on freeways and expressways. Requires vehicles traveling in such lanes to have a minimum number of passengers (usually 2 or 3).

- **Parking Management:** Preferential parking for carpools and vanpools as a low-cost incentive that can be used to encourage the utilization of alternative commuting modes.

- **Rideshare Matching Services:** Providing carpool/vanpool matching (where people who live and work close to each other are matched) and ridesharing information, resources, and services.

- **Vanpool/Employer Shuttle Programs:** Organizing groups of commuters to travel together in a passenger van or employer-provided shuttle on a regular basis.

- **Employer Trip Reduction Programs:** Organizing groups by offering pre-tax incentives or transit subsidies on a regular basis.

- **Improved/Increased Park-n-Ride Facilities & Capital Improvements:** Identifying any facilities that are in any phase of planning along corridors and address improvements to new or existing facilities.

Strategy #5: Add Capacity

- **Freeway Lanes:** Increasing the capacity of congested freeways through additional travel lanes.

- **Arterial Lanes:** Increasing the capacity of congested arterials through additional travel lanes.

- **Interchanges:** Any programmed/scheduled interchange additions

Mitigation Strategies to Address Non-Recurring Congestion

Based on the inventory of congested facilities that is established in Phase II of the Congestion Management System, a listing of mitigation strategies for each facility in priority order from the **Available Strategies For Congestion Mitigation** table will be used to address congestion at each identified location. Included will be an explanation of how the strategies selected will be integrated into the UPWP or TIP. This section will be completed in Phase II. A Congested Facilities Task Force will be established to look at congestion mitigation strategies for specific corridors.

Incident programs vary in cost and sophistication, but all consist of detection/verification, response, clearance, traffic management, and information/routing programs. Incident detection and verification brings incidents to the attention of agencies responsible for traffic flow and safe operation on roads and highways. The faster an incident is detected, the faster it is cleared. There is a diversity of methods that can improve this process such as video cameras, electronic traffic monitoring devices, CB radios, and visual observation. Dispatchers should be trained to obtain precise information on location and magnitude of the incident, determining whether it is an incident or a stall, whether it is blocking the traffic, whether there are injuries, the type and number of vehicles, and other issues that would help the response team.

Table 4 lists options that may be used to reduce detection and verification time.

Table 4: Options for Reducing Detection and Verification Time

Type of Program	Potential Benefits	Potential Costs	Comments
Peak Period Motorcycle Patrols	Very Substantial Benefits	Moderate to Substantial Costs	Roving motorcycle patrols can provide added surveillance along high incident segments on freeway
Dedicated Freeway/Service Patrols	Moderate to Very Substantial Benefits	Moderate to Very Substantial Costs	Roving patrols along high incident segments of the freeway can serve to reduce incident detection times
Motorist Aid Call Box/Telephone	Moderate Benefits	Substantial Costs	May incur added costs or complications because of required utility work
Incident Phone Lines	Minor Benefits	Moderate Costs	Requires an initial publicity effort and continued cooperation with media agencies
Cellular Telephones	Very Substantial Benefits	Minor Costs	Information should be distributed to cellular phone users describing proper incident reporting techniques
Citizen Band (CB) Radio Monitoring	Moderate Benefits	Minor Costs	Information should be distributed to CB radio operators describing proper incident reporting techniques
Volunteer Watch	Minor Benefits	Minor Costs	Training efforts may be wasted on short-term or non-dedicated volunteers
Ties with Transit/Taxi Companies	Substantial Benefits	Minor Costs	Can be expensive to cover all routes or limited to only those who travel on the freeway or other high incident areas
Aircraft Patrol	Minor to Very Substantial Benefits	Minor to Very Substantial Costs	May be limited by noise or density restrictions
Electronic Loop Detection	Moderate Benefits	Substantial Costs	Can also serve other operations functions, but may give false calls in incident detection
Video and Closed Circuit TV	Very Substantial Benefits	Very Substantial Costs	Can also serve many other operations functions such as volume, speed, and vehicle classifications of incidents
Central Information Processing and Control Site	Substantial Benefits	Substantial Costs	Centralization of information allows for better verification of incidents

* Mannering, Fred, Hallenbeck, Mark, Koehne, Jodi, Framework for Developing Incident Management Systems, Washington State Transportation Center, University of Washington, August 1991.
http://plan2op.fhwa.dot.gov/pdfs/Pdf1/Edl02810.pdf

Once the response agencies are properly notified, each responsible agency must ensure the use of adequate wrecker equipment and fully trained certified personnel to handle the incident. An effective response process depends on having accurate information about the incident and resources that are necessary to clear the facility and return it to normal conditions. Incidents can be cleared with many techniques and equipment. Therefore, agencies must have adequate training to select the best response. The faster personnel and equipment reach an incident site the faster the incident is cleared, decreasing personnel costs associated with the incident management and costs to motorists associated with delay.

Table 5 shows recommended procedures that decrease response time.

Table 5: Options for Improving Response Time

Type of Program	Potential Benefits	Potential Costs	Comments
Personnel Resource List	Substantial Benefits	Minor Costs	Can save time in locating specially trained personnel if list is comprehensive (involving all responding agencies) and frequently updated
Equipment and Materials Resource List	Substantial Benefits	Minor Costs	Can save time in locating specially trained personnel if list is comprehensive (involving all responding agencies) and frequently updated
Peak Period Motorcycle Patrols	Very Substantial Benefits	Moderate to Substantial Costs	Roving motorcycle patrols can provide added surveillance along high incident segments of freeway
Dedicated Freeway/Service Patrols	Moderate to Very Substantial Benefits	Moderate to Very Substantial Costs	Roving patrols can reduce the response times required by response vehicles departing from a location removed from the freeway
Personnel Training Program	Substantial Benefits	Moderate Costs	An emphasis on personnel training through knowledge and repetition of tasks can reduce required response times
Tow Truck/Removal Crane Contracts	Moderate Benefits	Minor Costs	Provides faster access to equipment, but may create dissention with other capable private agencies
Improved Interagency Radio Communication	Substantial Benefits	Minor to Moderate Costs	Adequate communication between the various responding agencies can help to insure that the closest response vehicle is called to the incident scene
Ordinances Governing Travel on Shoulder	Minor Benefits	Minor Costs	Can provide additional travel lane for response vehicles during emergencies but may be severely limited by space constraints
Emergency Vehicle Access	Moderate Benefits	Moderate Costs	Requires identification of those freeway links that suffer from poor access
Alternative Route Planning	Moderate Benefits	Minor Costs	If properly planned, can allow quicker access to incident site by response vehicles
Equipment Storage Sites	Moderate Benefits	Minor to Moderate Costs	Provides faster access to equipment or materials
Administrative Traffic Management Teams	Minor Benefits	Minor Costs	Provides a forum to discuss and provide funding for area incident management programs aimed at improving response times
Public Education Program	Substantial Benefits	Minor Costs	Can educate drivers regarding disabled vehicle removal policies and can resolve many incidents without the need for an actual response
Central Information Processing and Control Site	Substantial Benefits	Substantial Costs	Provides a single location for monitoring incidents, so that data from multiple sources can be used to more quickly determine the appropriate response action
Closely Spaced Milepost Markers	Moderate Benefits	Minor Costs	Always fast, accurate, easy location of incidents, which improves the speed with which response actions can be brought to bear

* Mannering, Fred, Hallenbeck, Mark, Koehne, Jodi, Framework for Developing Incident Management Systems, Washington State Transportation Center, University of Washington, August 1991. http://plan2op.fhwa.dot.gov/pdfs/Pdf1/Edl02810.pdf

The effectiveness of the response is also a function of how well the personnel at the scene manage the incident site. First responders should direct all driveable accident vehicles to a safe location out of traffic and then direct other response vehicles to park out of traffic and if possible on the right shoulder. Each agency should coordinate activities with the incident managers and maintain a cooperative effort. Table 6 shows recommended techniques to improve site management.

Table 6: Options for Improving Site Management

Type of Program	Potential Benefits	Potential Costs	Comments
Incident Response Teams	Moderate to Very Substantial Benefits	Minor to Substantial Costs	Highly trained, coordinated response teams can greatly reduce site management delays and can reduce interagency conflicts
Personnel Training Programs	Substantial Benefits	Moderate Costs	Highly trained personnel can speed the management process as well as reduce the number of interagency conflicts that may arise
Peak Period Motorcycle Patrols	Very Substantial Benefits	Moderate to Substantial Costs	Motorcycle patrols have more maneuverability in highly congested areas and can access and carry out tasks vital to the incident management process
Improved Interagency Radio Communication	Substantial Benefits	Minor to Moderate Costs	Direct communication between the various responding agencies can reduce repetitious commands and improve interagency relationships
Command Posts	Moderate Benefits	Minor Costs	Allows information and instruction to disseminate from a single, central location, improving efficiency and reliability of information
Identification Arm Bands	Minor Benefits	Minor Costs	Allows quick differentiation between respondents and public or media personnel who may also be present
Properly Defined Traffic Control Techniques	Substantial Benefits	Minor Costs	Provides greater safety for motoring public, as well as improving the safety of the respondents
Properly Defined Parking for Response Vehicles	Moderate Benefits	Minor Costs	Ensures that response vehicles and smooth operation of incident management processes are not impeded and do not block excess lanes
Flashing Lights Policy	Minor Benefits	Minor Costs	Need to consider safety of respondents, liability and impacts on normal traffic flow
Administrative Traffic Management Team	Minor Benefits	Minor Costs	Provides a forum to discuss and provide funding for area incident management programs aimed at improving site management efforts
Central Information Processing and Control Site	Substantial Benefits	Substantial Costs	Central Collection and analysis of incident information allows for more coordinated response to incidents
Alternative Route Planning	Moderate Benefits	Minor Costs	Serves to improve both response and clearance efforts
Incident Response Manual	Substantial Benefits	Minor Costs	Predetermined chain of command and responses can facilitate decision-making, communications, and site management

*Mannering, Fred, Hallenbeck, Mark, Koehne, Jodi, Framework for Developing Incident Management Systems, Washington State Transportation Center, University of Washington, August 1991.
http://plan2op.fhwa.dot.gov/pdfs/Pdf1/Edl02810.pdf

The progress of the wrecker crews needs to be monitored to ensure substantial progress is being made. Loading or major repairs should be relocated to the shoulder. A police vehicle should be kept on the scene to assist with traffic protection until the incident is completely cleared. Table 7 provides information on techniques that can help to clear incidents quickly.

Table 7: Options for Reducing Clearance Time

Type of Program	Potential Benefits	Potential Costs	Comments
Policy Requiring Fast Vehicle Removal	Very Substantial Benefits	Minor Costs	Serves to quickly restore the capacity of the roadway, but may require passage of an ordinance to be used
Accident Investigation Sites	Moderate Benefits	Moderate Costs to Substantial Costs	Serves to improve the safety of the motoring public, as well as improving the safety of the respondents, by removing the incident from the roadway
Dedicated Freeway/ Service Patrol	Moderate Benefits to Very Substantial Benefits	Moderate Costs to Very Substantial Costs	Specially equipped freeway/service patrol vehicles can clear most minor incidents without the assistance of other response vehicles
Push Bumpers	Moderate Benefits	Minor Costs	Allows minor incidents to be cleared quickly
Inflatable Air Bag Systems	Moderate Benefits	Moderate Costs	Improves Clearance times for incidents usually involving overturned trucks; however use is severely limited by the truck trailer type involved.
Responsive Traffic Control Systems	Moderate Benefits	Very Substantial Costs	Can improve clearance efforts by limiting congestion in the immediate area
Variable Lane Closure	Moderate Benefits	Minor Costs	Can speed clearance efforts by limiting congestion in the immediate area.
Ordinances Governing Shoulder Travel	Minor Benefits	Minor Costs	Can provide additional travel lane for removing disabled vehicles but may be severely limited by space constraints
Emergency Vehicle Access	Moderate Benefits	Moderate Costs	Requires identification of those freeway links, which suffer from poor access
Alternative Route Planning	Moderate Benefits	Minor Costs	If implemented simultaneously with motorist information programs, can serve to reduce congestion and improve mobility at the incident site by rerouting uninvolved vehicles.
Identification of Fire Hydrant Locations	Moderate Benefits	Minor Costs	Can greatly speed clearance efforts by allowing the quick location of utilities in incidents involving fire
Incident Response Teams	Moderate Benefits to Very Substantial Benefits	Minor Costs to Substantial Costs	Coordinated response teams should be trained in a variety of equipment use to provide greatest clearance capabilities
Personnel Training Programs	Substantial Benefits	Moderate Costs	An emphasis on personnel training through knowledge and repetition of tasks can reduce required clearance times
Incident Response Manual	Substantial Benefits	Minor Costs	Once developed, should be included in regular training procedures to further clearance efforts
Hazardous Materials Manual	Substantial Benefits	Minor Costs	Once developed, should be included in regular training procedures to further clearance efforts
Administrative Traffic Management Teams	Minor Benefits	Minor Costs	Provides a forum to discuss and provide funding for area incident management programs aimed at improving clearance times
Public Education Program	Substantial Benefits	Minor Costs	Can educate drivers regarding disabled vehicle removal policies and can result in the immediate clearance of disabled vehicles off the freeway.
Total Station Surveying Equipment	Very Substantial Benefits	Minor Costs	Can reduce the time required for accident investigation by nearly half.

* Mannering, Fred, Hallenbeck, Mark, Koehne, Jodi, Framework for Developing Incident Management Systems, Washington State Transportation Center, University of Washington, August 1991. http://plan2op.fhwa.dot.gov/pdfs/Pdf1/Edl02810.pdf

The final step of an incident management system is to alert motorists about the traffic situation. An effective motorists information system helps reduce traffic volumes and hazards near the incident site and provides information about the delay to motorists. Table 8 shows the various options for providing increased levels of incident information to motorists.

Table 8: Options for Improving Motorist Information

Type of Program	Potential Benefits	Potential Costs	Comments
Improved Media Ties	Moderate Benefits	Minor Costs	Information disseminated by the media must be effective and accurate and must therefore come from a single and central dissemination point.
Highway Advisory Radio	Minor Benefits to Moderate Benefits	Minor Costs to Moderate Costs	Variations include mobile and truck mounted, but in each case must be kept current and accurate to be utilized by the motoring public.
Variable Message Signs	Moderate Benefits	Minor Costs to Moderate Costs	Variations include flap, matrix, drum, permanent and portable, but in each case must be kept current and accurate to be utilized by the motoring public.
Radio Data Systems (RDS)	Substantial Benefits	Very Substantial Costs	Provides information to motorists when they want it, but is still in the early implementation stage.
Externally linked Route Guidance (ELRG) Systems	Very Substantial Benefits	Very Substantial Costs	Provides the most comprehensive information concerning traffic situations, but is still in development stage.

* Mannering, Fred, Hallenbeck, Mark, Koehne, Jodi, Framework for Developing Incident Management Systems, Washington State Transportation Center, University of Washington, August 1991.
http://plan2op.fhwa.dot.gov/pdfs/Pdf1/Edl02810.pdf

Recommended Incident Management Strategies

An Incident Management Task Force should be formed to develop specific actions for incident management in the Ozarks Transportation Organization area. Other MPOs have such a task force and a compilation of their recommendations are detailed on the following page.

Table 9: Incident Management Actions

Phase	Component	Action
Immediate	Prevention	Design/construct highways with incident management specific elements i.e., Accident Investigation Sites, emergency vehicle access sites, Intelligent Transportation System infrastructure etc.
		Document and classify characteristics of each and every incident to develop improvement strategies for future incidents
		Define what constitutes a major event and require the event promoter to mitigate traffic congestion via a traffic plan
		Focus on driver education particularly adult/commuter drivers: move vehicles in non-injuries, be aware of location & safety features of roadway, report drunk or dangerous drivers, avoid rubbernecking, practice safe driving habits, report placard info, etc.
		Develop a checklist for planners and engineers to use when developing new highway plans which includes Intelligent Transportation System infrastructure elements
		Develop policy/legislation to remove abandoned vehicles from shoulder within 6 hours
	Detection	Invite broadcast media to meeting to see how they may help
		Improve communications e.g., more "* 55" signs
		Establish a cellular phone network of commuters trained to call a communications center with traffic reports
		Use existing temporary variable message signs at key interchanges
		Signage on all street over and underpasses with street name and refer to expressways by their numeric names
	Response	Ensure very prompt response from tow truck
	Clearance	Move vehicles as soon as possible even from shoulder or median
		First agency on site advise dispatcher about other resources that may be required
		Develop a coordinated media program to page media with incident locations and alternate routes
		All response personnel should leave the site as soon as possible
	Motorist Information	Invite broadcast media to meeting to see how they may help
		On future expressway construction projects include variable message signs at strategic locations
		Gain support of insurance companies in moving vehicles in non-injury incidents
		Include Auto Dealership Association for possible courtesy patrols
		Coordinate with the media to report incidents and problems and not predictable congestion
		Develop public education campaign (see Prevention above)

Intermediate	Detection	Include cooperation of wireless communications providers with regulation/legislation
	Response	OHP (for expressways) obtain an Alpha-numeric paging system
		Put radio station numbers in Alpha-numeric system to notify motorists via broadcast media
	Clearance	Establish an Incident Command System (on site protocol)
		Develop Alternate Route manual for multi-agency use
		Establish a courtesy patrol to help motorist with minor problems (via car dealerships participation)
	Motorist Information	Develop crawl message in cable interrupt system
		Public information that state law allows vehicles to be moved, e.g., "Don't Clog That Artery" campaign
Long Range	Prevention	Promote and support safer/smart vehicles (drunk drivers cannot start a car)
		Encourage Intelligent Transportation System measures to keep safe distance between vehicles
	Detection	Establish a central communication center for a coordinated response to an incident
		Employ Aircraft and video cameras on expressways
		Install permanent variable message boards and video surveillance at key locations
		Include space for radio reporters to monitor information in a Traffic Management Center
	Response	Establish a central communication center (Traffic Management Center) for a coordinated response to an incident
	Clearance	Establish traffic control, divert traffic (alternative routes), and advance warning to motorists
		Federal funding of an on-call push vehicle to assist courtesy patrol and assign one patrol per corridor
	Motorist Information	Involve TCI cable in establishing a 24-hr channel to illustrate real time incidents and alternate routes
		Present real-time traffic information on a web site

The implementation of all these actions is supported by the MPO and shall be considered a part of the Congestion Management System for the Ozarks Transportation Organization once the Incident Management Task Force has signed off on specific recommendations. Intelligent Transportation Management should help the Ozarks Transportation Organization minimize the impact of incidents through co-ordination and implementation of some of the actions mentioned in Tables 4-8.

System Monitoring

As the final step in the development of the regional Congestion Management System, the task of monitoring the system serves two main purposes:

1. To track the effectiveness of the implemented CMS strategies over time;
2. To continue data collection efforts to support/refine the CMS.

Effectiveness Tracking

The effectiveness of the implemented strategies put forth in this report will be monitored and tracked through subsequent years' CMS reports *and* through the Ozarks Transportation Organization informal activities review. The Ozarks Transportation Organization conducts this informal review during the development of the annual Unified Planning Work Program. This review includes:

- Progress towards the goals, objectives and activities defined in our Regional Transportation Plan.
- Projects programmed in the Transportation Improvement Program and their impact on regional transportation goals.
- Changes in social, economic, or transportation indicators that may need to be addressed by the MPO in the coming year.

As the member jurisdictions and agencies of the Ozarks Transportation Organization become familiar with the CMS process and the data collection efforts required to make the process effective, more time and resources will be devoted to monitoring the network conditions and reviewing CMS recommendations made from the previous year. This provides a mechanism to analyze the significance of the data that has been collected and to note any trends. It is expected that the increased data efforts from this, the Ozarks Transportation Organization's first CMS, will make it easier to perform an analysis to evaluate the conditions in our region.

Data Collection Activities to Support System Monitoring

In order to support both the monitoring of system effectiveness as well as increasing the database of congestion-related data to draw from for subsequent years' CMS analyses, the following data collection activities are proposed:

- **Intersection Turning Movement Count Data -** The intersection turning movement count data collection effort will supplement the existing information in the City of Springfield intersection database. Data will include total turning movement counts during morning and evening peak periods, overall intersection level of service ratings, and recommendations for improvement at CMS determined intersections.

- **Continuation of Roadway Travel Time Data -** The roadway travel time data collection effort will begin with the Missouri Department of Transportation in FY06. In the interim, the Congestion Management Task Force of the Ozarks Transportation Organization Technical Committee will calculate travel speed estimates. The data collected will include segment name and length, mean peak travel time, mean peak travel speed, total peak delay, peak delay

source, mean peak running speed, and percent time in delay. It is anticipated that the MPO will budget approximately $10,000 to purchase GPS equipment in the FY06 UPWP and the requisite amount of staff time included in the budget to complete the travel time runs.

- **Continuation of Transit Ridership Data Collection -** Transit ridership information will be collected and monitored by both the MPO and City Utilities Transit Services to see how transit ridership and overall service is varying by roadway segment. This ridership data, along with transit capacity information, will assist in developing an objective transit congestion performance measure to track and to identify specific locations of "transit congestion."

- **Continuation of Traffic Volume/Capacity Data Collection -** Data collected by all permanent automatic traffic counters, special project studies and other traffic count collection efforts will be used to update Average Annual Daily Traffic (AADT) data for the entire CMS network. In addition, updates will be made where necessary to the roadway capacities as they change due to any operational/capital improvements.

- **Continuation of Accident Data Collection-** Accident Data will continue to be collected by local enforcement officials and the Missouri State Highway Patrol for incorporation in the statewide accident database.

Phase II Identification of Congested Facilities and Mitigation Strategies

After the initial data collection phase, the Congestion Management System Task Force will be convened to assess current conditions and suggest strategies for implementation. This task force is included in the FY06 UPWP.

Phase III System Monitoring and Evaluation

Once strategies have been identified to mitigate congestion, the Congestion Management System Task Force will monitor the system and evaluate the effectiveness of implemented strategies.