2009

Congestion Management Process

Tulsa Transportation Management Area

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Executive Summary

- The Tulsa Congestion Management Process (CMP) provides common performance measures to identify and monitor congestion as inputs into the Regional Transportation Plan (RTP) and the Transportation Improvement Program processes.

- The Tulsa CMP identifies the regional transportation network as defined by the RTP as the basis of the geographic extent for addressing congestion.

- Congestion is identified in two categories: Recurring and Non-Recurring. Each is addressed with a different set of strategies.

- Congestion is defined using the levels of performance identified in this document. Those transportation systems not meeting the level of performance are considered congested.

- Determining levels of service for roadways and intersections using traffic counts and speed is proposed for measuring congestion.

- Transit level of service is based on ridership and seat availability.

- Various Transportation Control Measures grouped under Transportation Demand Management options and Transportation System Management options are identified specifically for implementation with specific schedules and responsibilities.

- Monitoring the implementation of strategies on a recurring basis is addressed, as well as seeking funding for those strategies through the project selection process.

1.0 INTRODUCTION

The Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users (SAFETEA-LU) legislation mandates establishing a Congestion Management Process (CMP) in metropolitan areas with a population over 200,000, or Transportation Management Areas (TMA).

The CMP should enable the Metropolitan Planning Organization (MPO) to measure congestion and identify recurring congestion as well as incident-related congestion. The CMP identifies measures to alleviate congestion and provides a framework with implementation schedules, responsibilities, and possible funding sources for the proposed implementation strategy.

This document describes the congestion management process for the INCOG region and several on-going short-range planning efforts.

1.1 Background

Federal requirements state that TMAs must maintain a CMP and integrate it into the transportation planning and decision-making processes, particularly the Regional Transportation Plan (RTP) and the annual Transportation Improvement Program (TIP).

The Congestion Management requirement was introduced in 1991. Previous laws referred to this set of activities as a Congestion Management System (CMS), but SAFETEA-LU refers to a CMP, reflecting the goal of the law to utilize a process that is an integral component of metropolitan transportation planning.

The Federal regulation at *23 CFR Part 500 Section 109* identifies the required components for a CMP as noted below. The metropolitan transportation planning regulations adopted under SAFETEA-LU address the CMP at *23 CFR Part 450 Section 320*.

REQUIRED ELEMENTS OF A CONGESTION MANAGEMENT PROCESS

Federal regulations (23 CFR Part 500 Section 109) state that a congestion management system must include:

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;

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;

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;

Identification and evaluation of the anticipated performance and expected benefits of appropriate traditional and nontraditional congestion management strategies;

Identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy; and

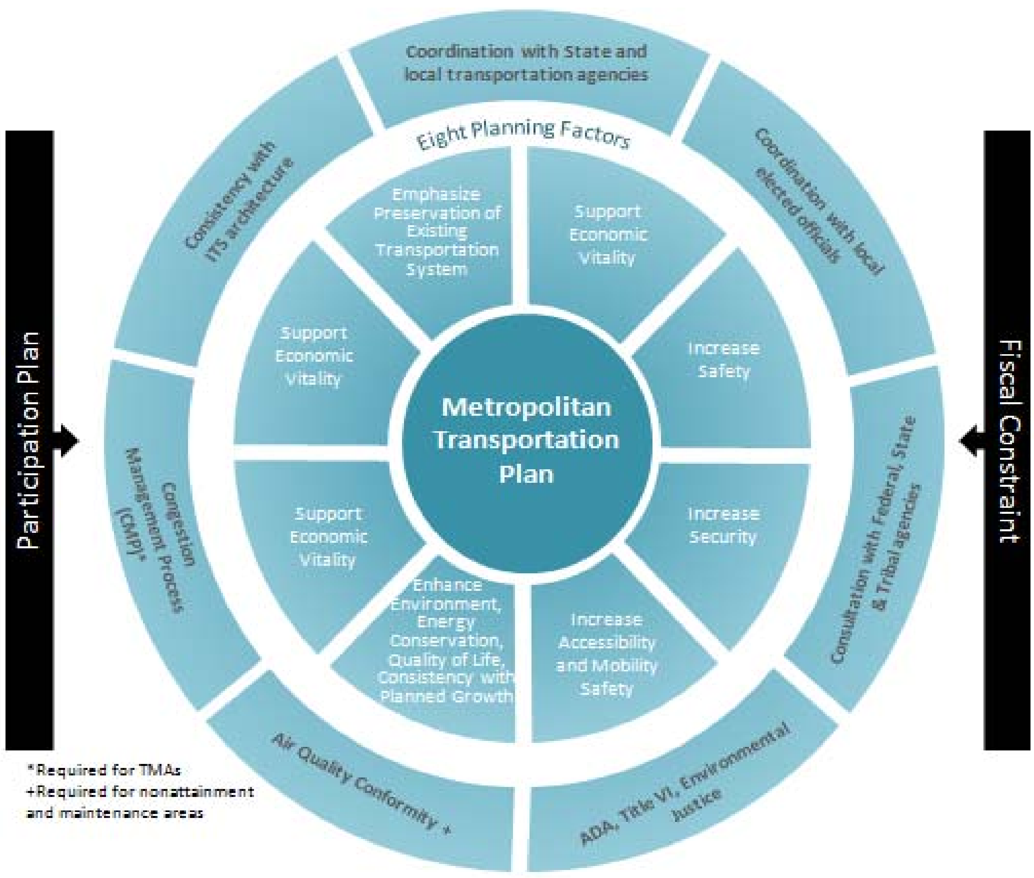
Implementation of a process for periodic assessment of the efficiency and effectiveness of implemented strategies, in terms of the area's established performance measures.

1.2 Congestion Management in Metropolitan Context

A CMP, in general, provides linkages to the goals expressed within the Regional Transportation Plan, with operational objectives and strategies from the TIP, as identified by the MPO.

In order to do that, a CMP further provides analytical, systematic methods to monitor and evaluate system performance while attempting to deal with congestion in a holistic manner. Options related to land use, travel demand management, traffic or transit operations, as well as new capacity, are all considered and evaluated as a part of the process.

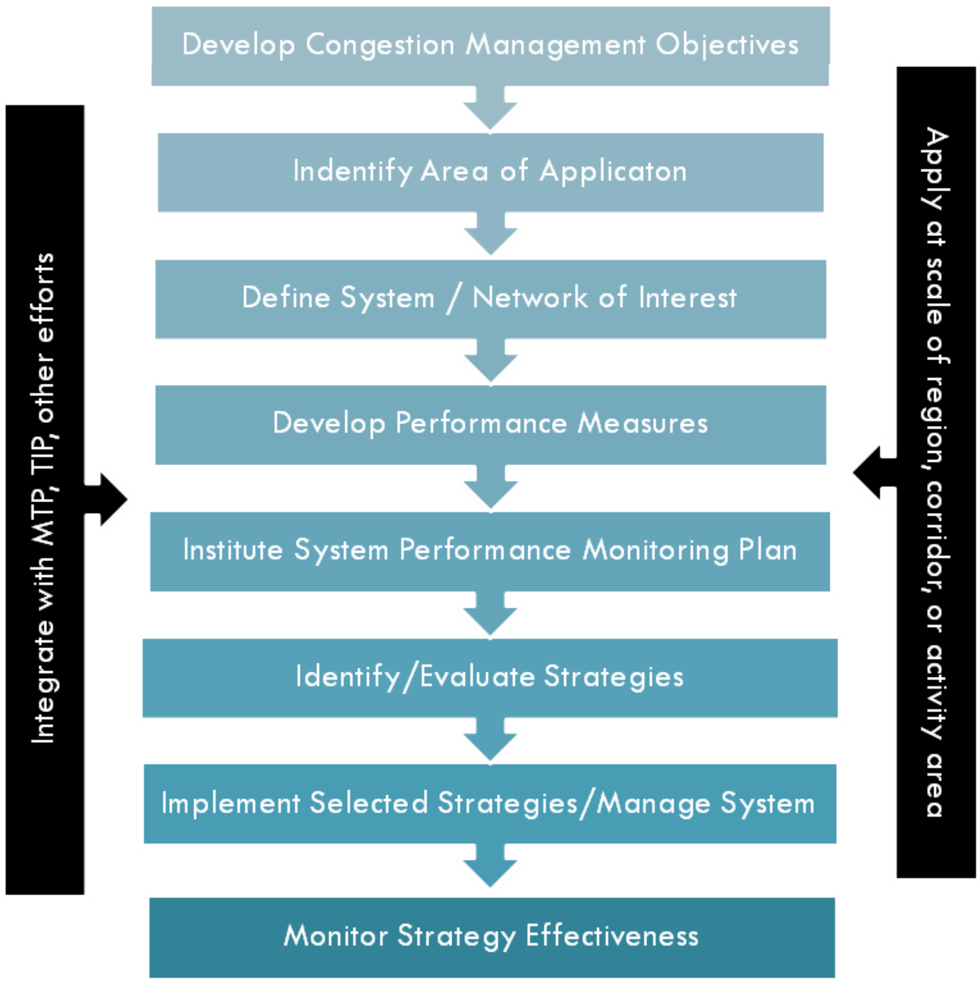
Added capacity projects (except safety improvements or bottleneck elimination) in non-attainment areas may not be programmed for funding unless the project is addressed through a CMP. In addition, The 1990 Clean Air Act Amendments require the Oklahoma Department of Environmental Quality (ODEQ) and MPOs that are in non-attainment areas to include Transportation Control Measures in the State Implementation Plan (SIP).



1.3 The Congestion Management Process Framework

Tulsa TMA adapted the framework suggested by the FHWA guidebook and involved several stakeholders to further develop the guidelines based on local standards.
The process of addressing congestion was developed through identification of the region and objectives, as well as system definition. This document describes this process in detail.

An Overview of Congestion Management Process (CMP) Framework



Source: FHWA

1.4 Congestion Management Objectives

The Congestion Management Process is defined for the Tulsa TMA within the context of the entire transportation planning process. INCOG, as the MPO, is responsible for developing the RTP, the TIP, and coordinating special studies as they relate to the transportation of people and goods in the region.

In that overall context, the CMP aims to improve the performance of roadways and Public Transportation by utilizing all the elements of specific plans, detailed studies, and funding opportunities.

Specific Objectives of Congestion Management Process in the Tulsa TMA

- Develop a methodology to address and mitigate congestion
  - Improve data availability
  - Increase awareness among stakeholders
  - Determine local performance measures tied to data availability
  - Develop local toolkit to realistically address congestion as it applies to the Tulsa TMA
  - Measure congestion and provide system performance to local decision-makers on a periodic basis
  - Review and revise the methodology based on feedback from stakeholders and partners
- Achieve acceptable Levels of Service (uncongested travel) over a period of a decade or less
  - Monitor performance of all modes based on the measures selected
- Develop a coordinated approach to alleviating congestion among the entities that must work together
  - Examples: Public Works Division of cities/counties and the DOT
  - Police, Fire, and EMSA working together to resolve incident-related issues that affect travel in Tulsa TMA
- Address issues related to freight movement with involved stakeholders

Correlation with other plans and programs

The RTP focuses on the long range vision and goals for the regional transportation system, wherein congestion is identified with respect to corridors and modes. Specific measures are used to identify those corridors.

The TIP seeks to fund projects with a short-range perspective by ranking and rating the regional projects and utilizing the monies available for Surface Transportation and other federal accounts. The TIP selection process utilizes specific Congestion Measures.

Transportation Corridor Studies, NEPA documentation, and other special studies in the region are conducted based on funding availability and need. These studies again consider congestion measures and provide alternatives determined by the impact on congestion and other considerations such as costs and benefits.

All three elements of the planning processes embody elements of congestion management specific to a mode of transport, time horizon, and other regional objectives such as reducing delay and improving safety.

The CMP for Tulsa is largely defined in that context, seeking to harmonize the elements across all plans with a uniform set of measures aimed to minimize errors and avoid duplication. For example, the RTP considers the Volume to Capacity ratio as a criterion for identifying facilities for improvement, and the TIP also ranks projects based on the same measure. The CMP adheres to the same practice for all roadways utilizing the same measures to monitor performance.

2.0 TULSA TRANSPORTATION MANAGEMENT AREA

The Tulsa TMA's population in 2000 reached 701,580 people and has continued to grow. A majority of the growth is projected to take place in suburban towns and cities.

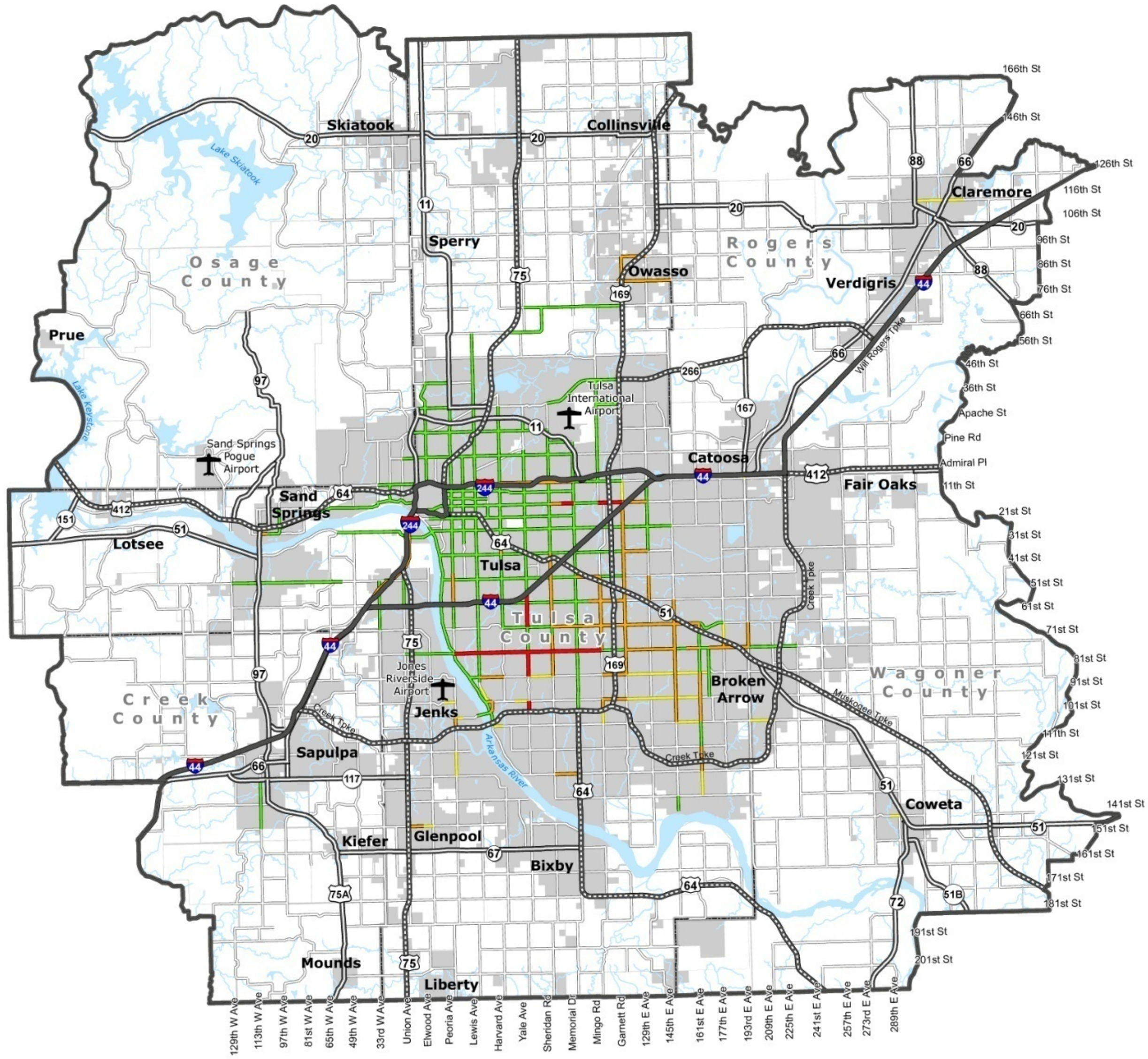
Increases in vehicle ownership and the number of trips, coupled with growth in population, have had an impact on overall travel outpacing roadway expansion. While the lengthening of typical "peak hour" has helped alleviate congestion, the relative cost of both recurring and non-recurring congestion can be measured from the increase in traffic counts against the backdrop of a limited roadway capacity.

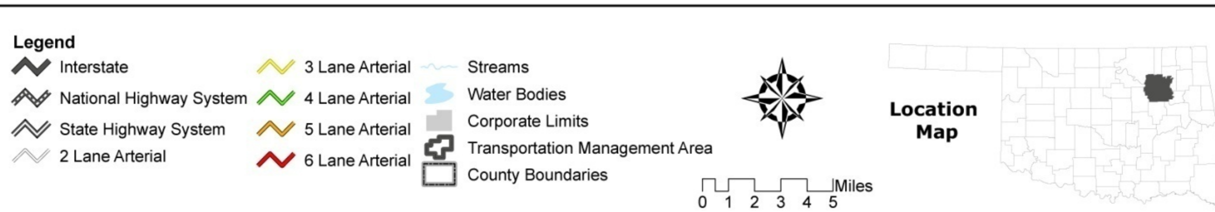
The city, on the other hand, is characterized by a variety of widespread commercial developments and a heavily traveled Riverside Drive. The city arterial street system is mainly laid on a grid following section lines and connected with several area expressways. The city is well-served with expressway and turnpike connectivity that helps in providing alternative routes and complementing the grid street pattern.

Specific Roadway system characteristics are shown in the table below.

	2000 (Base Year)	2030	Difference	Percent Change
Lane Miles				
Expressways	872	966	94	10.7%
Turnpikes	286	290	4	1.4%
Arterial Streets	8,815	10,015	1,200	13.6%
Total Lane Miles	9,973	11,267	1,298	13.0%
Travel				
Vehicle Miles/Day	21,209,000	28,172,000	6,963,000	36.14%
Vehicle Hours/Day	576,000	748,000	172,000	29.8%
Average Speed (mph)	36.8	37.7	0.9	2.4%

MAP 1: Tulsa TMA Roadway System Map





Most heavily traveled expressway segments are also identified as a part of 2030 Transportation Plan development process.

Expressway Segment	Current Traffic	2030 Forecast Traffic
US-169 (51st St. to 61st St.)	108,600	140,000
I-44 (Harvard Ave. to Yale Ave.)	88,600	120,000
US-64/SH-51 Broken Arrow Exp. (21st St. to Harvard Ave.)	86,400	123,000
US-64/SH-51 Broken Arrow Expressway (I-44 to US-169)	83,300	143,000
US-412/US-64 (33rd W Ave. to Downtown Tulsa)	61,400	76,000
US-75 (I-44 to 61st St. South)	48,700	80,000
US-75 (36th St. North to 56th St. North)	36,700	82,000

Source: 2007 ODOT AADT and INCOG 2030 Travel Model

3.0 CONGESTION IN TULSA

In the Tulsa area, there are two primary causes of congestion.

1. Recurring congestion that tends to be concentrated into short time periods, such as "rush hours" and is due to excessive traffic volumes resulting in reduced speed and flow rate within the system:
   - Recurring Congestion will be identified using the accepted levels of performance for each mode and facility type.

2. Non-recurring congestion caused from unforeseen incidents (accidents, spills, stalls and construction), which affects the driver behavior to a considerable extent:
   - Non-recurring congestion related to accidents and construction will be identified from the causes that result in deteriorated levels of performance as identified for each mode and facility type.

3.1 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 the implemented congestion management strategies.

Conventionally, congestion has been measured independently for different modes. A number of statistical measures have been used to associate the capacity with the volume of use on particular facilities. However, no single measure or small combination of measures will adequately capture the conditions in all areas, or allow suitable analysis of alternative strategies or congestion mitigation measures.

The selection and application of performance measures for congestion management, however, requires consideration of several factors. The factors applied to the Tulsa TMA are outlined in the next section.

3.2 Evaluation Criteria used for CMP Performance Measures for Roadways

Performance measures are based on several factors:

- Facility Type (Expressway, Arterial, Signalized/Unsignalized intersections)
- Usable at the regional or corridor level (able to be applied regionally, in an objective manner)
- 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 transportation professionals and the public
- Capable of supporting evaluation of congestion management and mobility enhancement strategies

Performance measures should enable an MPO to define and measure congestion both spatially and temporally. In practice, many of the measures are segment- or site-specific, such as volume to capacity ratio (V/C), level of service, and intersection delay. Congested roadways were mapped in the *Destination 2030* Long Range Transportation Plan using these criteria.

Public Transportation
Metropolitan Tulsa Transit Authority (MTTA) provides bus services within the Tulsa metropolitan region. The service consists of 22 weekday routes including 2 express routes.

INCOG, with the assistance of local governments serving on the Congestion Management Working Group, compiled the travel data available from cities and counties in the region.

Availability of Ongoing Data Collection

Data	Source of Data	Coverage	Frequency of Data Collection
Traffic Counts data	City of Tulsa	City of Tulsa	every year
	ODOT (Tulsa Management Area)	Tulsa Transportation Management Area	every year
	City of Broken Arrow	City of Broken Arrow	every year
	Tulsa County	Tulsa County	every 5 years or other interval
	Other cities	Respective city limits	every 5 years or other interval
Travel speed data	INCOG	Highways	every 2 years
		Arterials	every 2 years
Accident data	Department of Public Safety	Tulsa Transportation Management Area	every year
	Oklahoma Department of Transportation (ODOT)		

The Congestion Management Process is documented by taking into account all of this background information.

4.0 TRANSPORTATION SYSTEM

Roadway Network for Congestion Management (see Map 1)
Roadways that meet at least one of the following criteria will be included in the Congestion Management Network

- All National Highway System (NHS) Routes
- All Arterials in the Tulsa TMA as identified in the RTP

Transit Network for Congestion Management
The public transportation network that serves the INCOG region will be considered for the purpose of congestion management

Performance Measures: Identification and Use of Performance Measures
The following performance measures have been identified for Congestion Management in the Tulsa TMA. Roadway criteria for congestion will be included in the Congestion Management Process. All of these performance measures are mapped (see maps 2 through 6) with the available data.

1. **Volume to Capacity Ratio**

This measure gauges the intensity of roadway congestion at a particular location (roadway segment or intersection), and helps to understand the traditional measures, such as Level of Service (LOS).

All significant roadways in Tulsa TMA are measured at two incremental levels: LOS ‘C’ and LOS ‘D’. For the purpose of promoting an acceptable level of service within Tulsa TMA, LOS ‘C’ is recommended.

Capacities for both LOS ‘C’ and LOS ‘D’ (at the most constrained segments/stretch of roadways) are given below.

Arterials	LOS ‘C’	LOS ‘D’	LOS ‘E’
2 Lanes	11,900	15,300	17,000
3Lanes	14,000	18,000	20,000
4 or 5 Lanes	23,800	30,600	34,000
6 Lanes	40,600	52,200	58,000

Expressways	LOS ‘C’	LOS ‘D’	LOS ‘E’
4 Lanes	56,000	72,000	80,000
6 Lanes	87,500	112,500	125,000
8 Lanes	115,500	148,500	165,000

Based on these criteria, segments where the volume exceeded the capacity were identified and mapped (see maps 2 and 3).

For the purpose of Congestion Management, roadways performing at LOS ‘C’ or better are considered to have an accepted level of performance. LOS ‘D’ and worse is considered unacceptable and must be improved.

2. **Average Travel Speed during peak hours**

Average Travel Speed helps with estimating the extent of congestion. Peak hour speed measurements will be used to identify congested roadway segments. An acceptable level of speed expressed at mid-segment level is:

Average peak hour speed < 25 MPH for Arterials

Average peak hour speed < 50 MPH for Expressways

INCOG conducted travel speed studies for various significant travel corridors for the purpose of measuring and monitoring congestion using a GPS-enabled floating car method. Results are mapped and presented in maps 4 and 5 for AM and PM peak periods.

3. **Transit Performance Measure**

A ‘rider per seat available’ during peak periods is a performance measure accepted by the public transportation industry. On a biennial basis, the CMP will incorporate data from MTTA, including peak period ridership data, seats available, and time of day operation, to identify and rank congested transit routes. A transit route is congested when the ratio of riders per seats available exceeds 0.8 (80% of capacity available) during peak periods.

MTTA provided data related to travel characteristics on various routes, and this was analyzed and mapped according to the level of ridership. Map 6 displays the busiest corridors in the MTTA system.

4. Intersection Load Factor

The "load factor" can range from 0 percent to 100 percent. If an approach had a "load factor" of 40 percent, it would mean that during 40 percent of the cycles (in the most congested 60-minute period on that approach), all the vehicles stopped in line for the signal when it changed to green did not get through that signal before it turned to red. If there were 25 vehicles in the queue at the time the signal turned green, and the last vehicle was the only one that did not get through the intersection the cycle, it would still be recorded as a "loaded cycle."

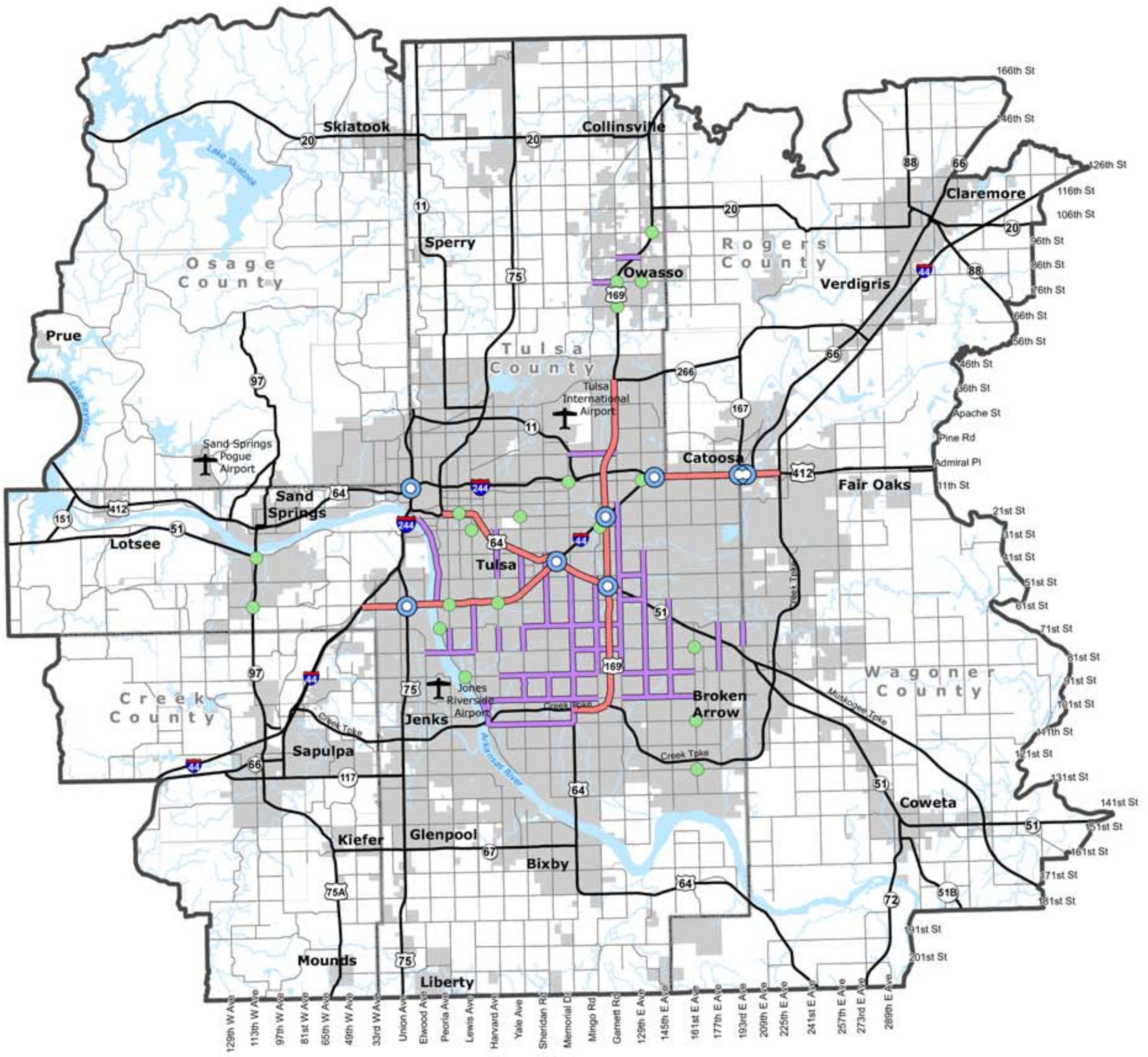
Level of Service	Load Factor (LF)
A	0 percent
B	1 – 10 percent
C	11 – 30 percent
D	31 – 70 percent
E	71 – 85 percent
F	86 – 100 percent

Highway Capacity Manual software can be used to determine the Level of Service for each intersection and then estimate the LOS based on turning movements.

The turning movement data collection is expensive and time consuming. Due to lack of sufficient turning movement count data, INCOG has used average daily traffic counts at various intersections, as available, and analyzed those counts to determine LOS with available metrics.

Intersections performing at levels of service LOS ‘C’, LOS ‘D’, and LOS ‘E’ are mapped on various roadway segments.

MAP 2: LOS 'C' Roadways



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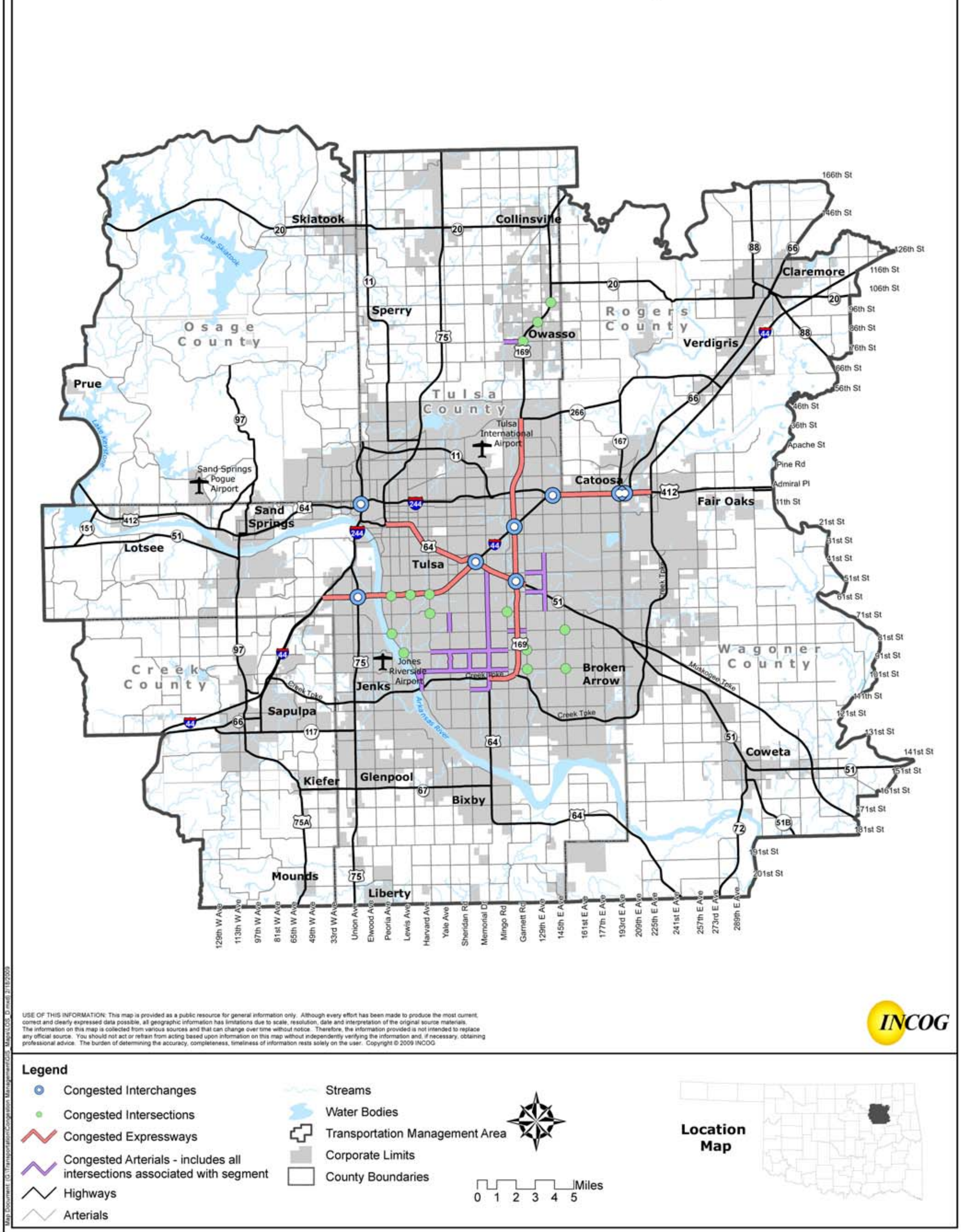
Legend

- Congested Interchanges
- Congested Intersections
- Congested Expressways
- Congested Arterials - includes all intersections associated with segment
- Highways
- Arterials
- Streams
- Water Bodies
- Transportation Management Area
- Corporate Limits
- County Boundaries

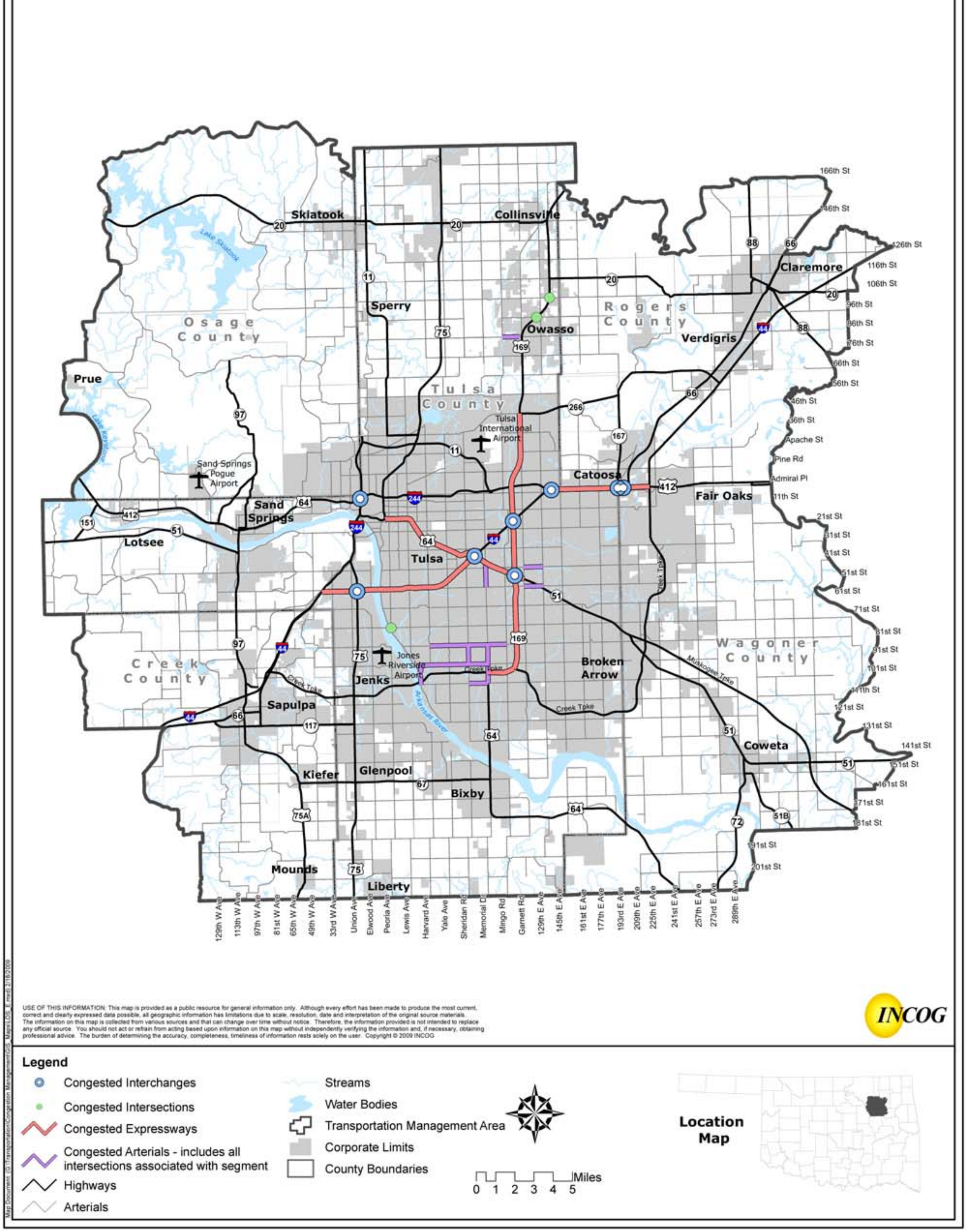
Miles 0 1 2 3 4 5

Location Map

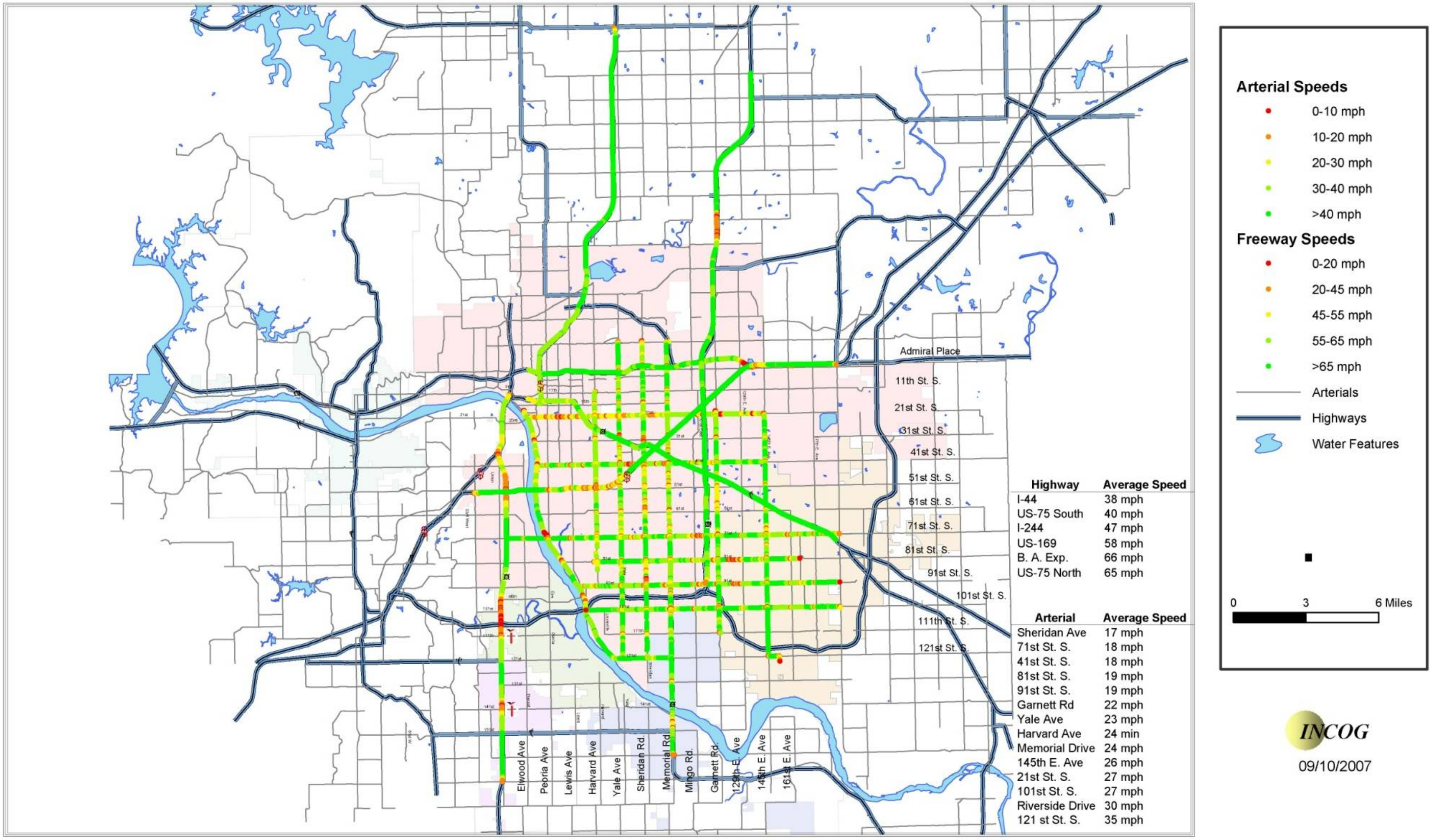
MAP 3: LOS 'D' Roadways



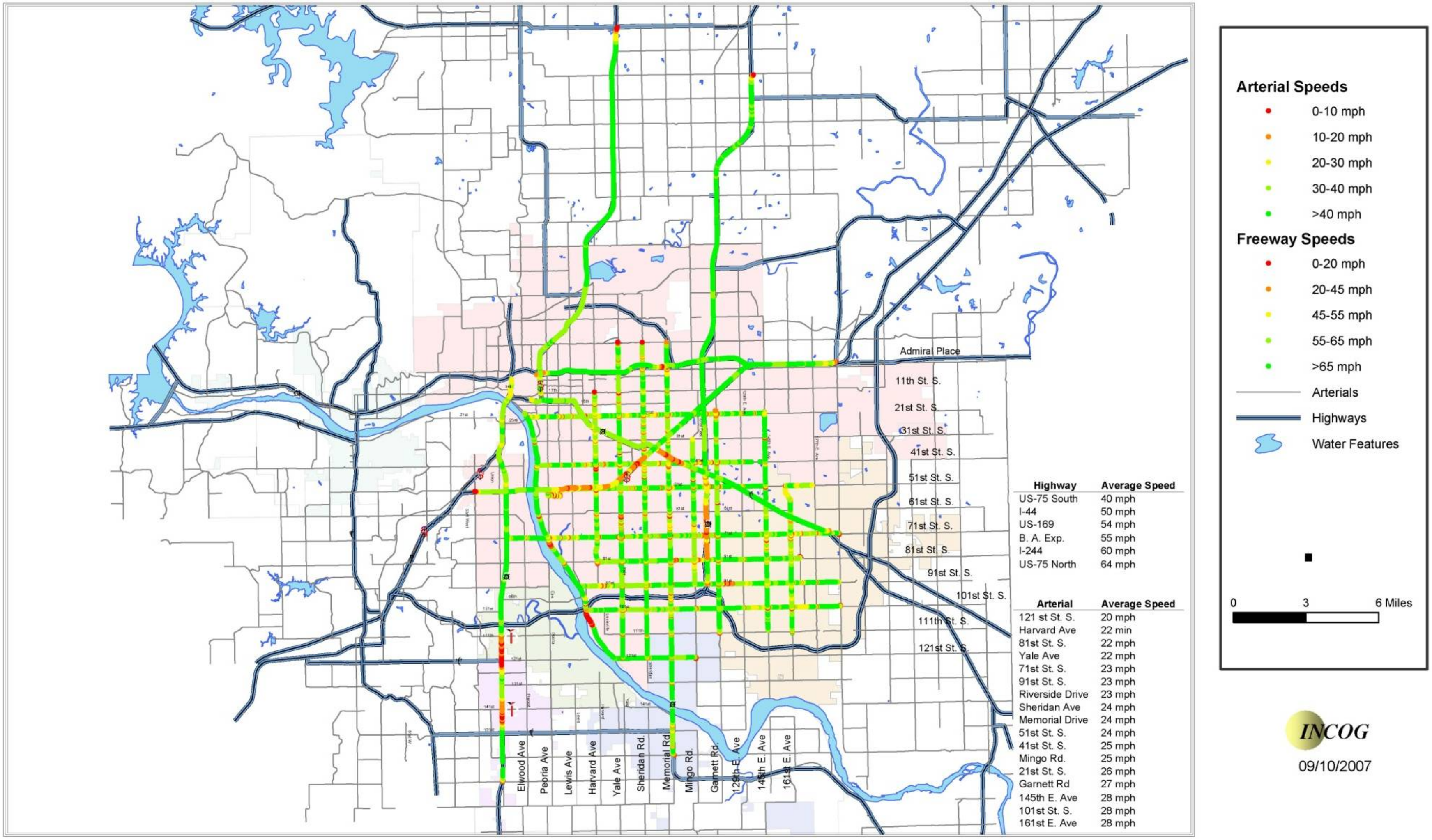
MAP 4: LOS 'E' Roadways



Map 5: TMA Longest Travel Times in Heavy Traffic Corridors - Southbound/Eastbound



Map 6: TMA Longest Travel Times in Heavy Traffic Corridors - Northbound/Westbound



Highway	Average Speed
US-75 South	40 mph
I-44	50 mph
US-169	54 mph
B. A. Exp.	55 mph
I-244	60 mph
US-75 North	64 mph

Arterial	Average Speed
121 st St. S.	20 mph
Harvard Ave	22 min
81st St. S.	22 mph
Yale Ave	22 mph
71st St. S.	23 mph
91st St. S.	23 mph
Riverside Drive	23 mph
Sheridan Ave	24 mph
Memorial Drive	24 mph
51st St. S.	24 mph
41st St. S.	25 mph
Mingo Rd.	25 mph
21st St. S.	26 mph
Garnett Rd	27 mph
145th E. Ave	28 mph
101st St. S.	28 mph
161st E. Ave	28 mph

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5.0 CONGESTION MONITORING METHODS

The following methodology will be employed in monitoring congestion on roadway and public transportation networks identified as a part of the CMP.

1. Collecting actual data from both roadway and transit systems: the data collected includes traffic volume counts and travel speeds for roadways and ridership, frequency, and availability of seats per rider for transit

2. Utilizing the adapted methodology suggested by performance measures to analyze the data collected and evaluating the system performance by segment and location

3. Using GIS to develop comprehensive, easy to understand maps of congestion and development of congested region/corridors as applicable for further study and analysis

6.0 COLLECTING DATA AND MONITORING PERFORMANCE

INCOG compiled data on performance measures, to be updated every two years, to refine the CMP.

The data specifically required for the successful implementation of the CMP includes:

1. 24 hour traffic counts
2. Peak period counts/intersection counts, as applicable, or a defined process
3. Transit ridership

The plan specifically identifies facilities, segments of roadways, intersections, and transit routes that are congested.

The above data will enable a more thorough process of addressing congestion in the transportation system. It is also recognized that hourly traffic data and intersection-related data is not easily obtained and not without additional cost to towns and cities. When federal funding is sought for any improvement related to the congested location, it is suggested to include the priority in relation to other submittals for Urbanized Area funds through the TIP.

7.0 COLLECTION OF CONGESTION DATA

The primary purpose of compiling data is to identify recurring congestion and document its magnitude. Traffic counts are compared to capacity and 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. These are most useful in locating “bottlenecks” and causes of congestion.

The method used to measure and monitor travel times and vehicle speeds within the Tulsa TMA for the purpose of determining congestion is called the “floating car” method. A GPS receiver is used to collect real-time travel speed data.

Bottlenecks impeding traffic will be identified based on the travel speed data. Such locations will be targeted for improvements and recommendations will be made.

Products:

- Traffic Counts on segments identified as congested
- Traffic Incident Data on congested roadways identified by the V/C ratio
- Traffic bottlenecks, shorter segments on roadways
- Transit Ridership

8.0 IDENTIFY AND EVALUATE IMPROVEMENTS

The function of this element in the CMP is to translate the congestion information obtained from performance monitoring into specific strategies that can be pursued to address congestion conditions. For INCOG, there are already existing protocols for scoring or ranking projects under the TIP process.

The CMP is also used in the RTP process in identifying specific locations, segments, and strategies that require special attention with respect to congestion management.

The CMP specifically identifies the following agencies to assist in evaluating improvements to the congested transportation system:

- Local Public Works divisions (e.g. City of Tulsa, City of Broken Arrow)
- The Oklahoma Department of Transportation (ODOT) and Oklahoma Transportation Authority
- The Metropolitan Tulsa Transit Authority (MTTA)

Each of the data sources above will be used to collect information related to proposed improvements to the transportation system identified under the CMP. Proposed improvements will be evaluated based on the technical consideration with respect to what it would do to the congestion/performance measure. In addition, the projects proposed to alleviate congestion and the strategies and actions planned will become part of the RTP, the TIP, and their implementation schedules.

Also, all strategies, including those to complete the ultimate transportation system build-out according to the comprehensive plan, to implement alternative transportation systems, and to evaluate priorities and funding mechanism as identified in the RTP, will be considered along with the CMP strategies.

A hierarchy or a menu of tools for mitigating congestion is proposed for local entities to use.

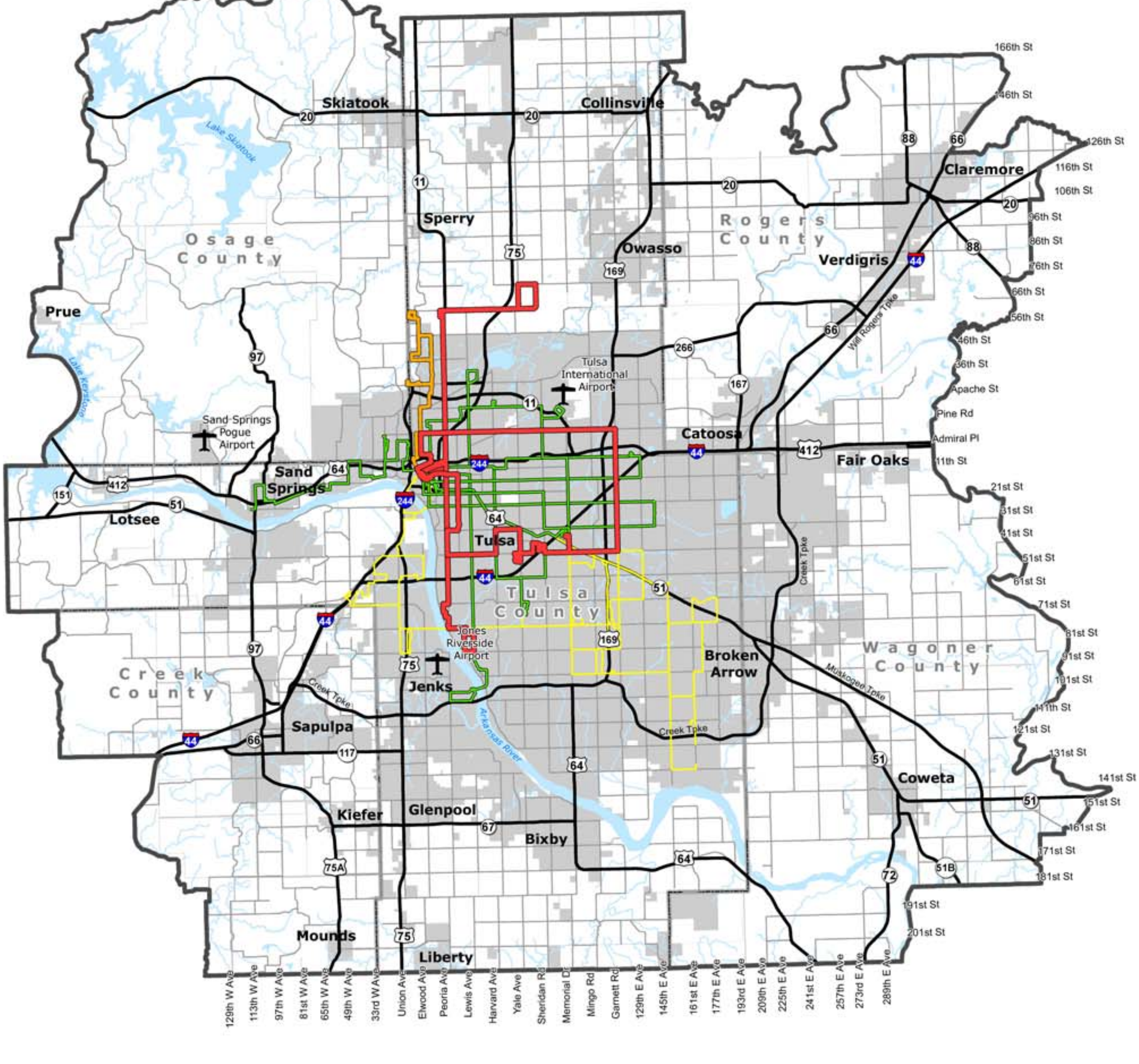
Based on established performance measures, expected benefits will be identified, both qualitatively and quantitatively. To determine overall performance, traditional and non-traditional congestion management strategies will be given importance based on the processes related to transportation system management.

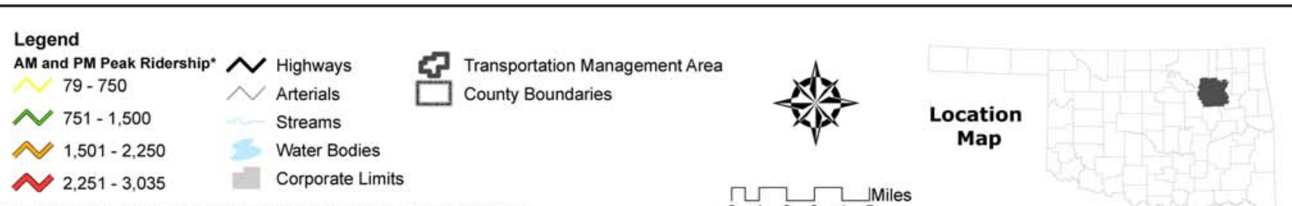
Deliverable Outcome:

- List of improvements
- System performance post-implementation
- Identification of funding for the congestion management strategies
- Documentation of the consultation process and the identified outcome of the process
- A developed menu of tools to mitigate congestion

As a first step, all improvements that are currently funded from cities and ODOT are shown in maps 7 and 8. These maps provide information related to capacity improvements in relation to congestion as identified using performance measures. Prioritizing congestion, as well as addressing it through any funded improvements, is a part of project selection criteria for cities as well as INCOG's TIP process.

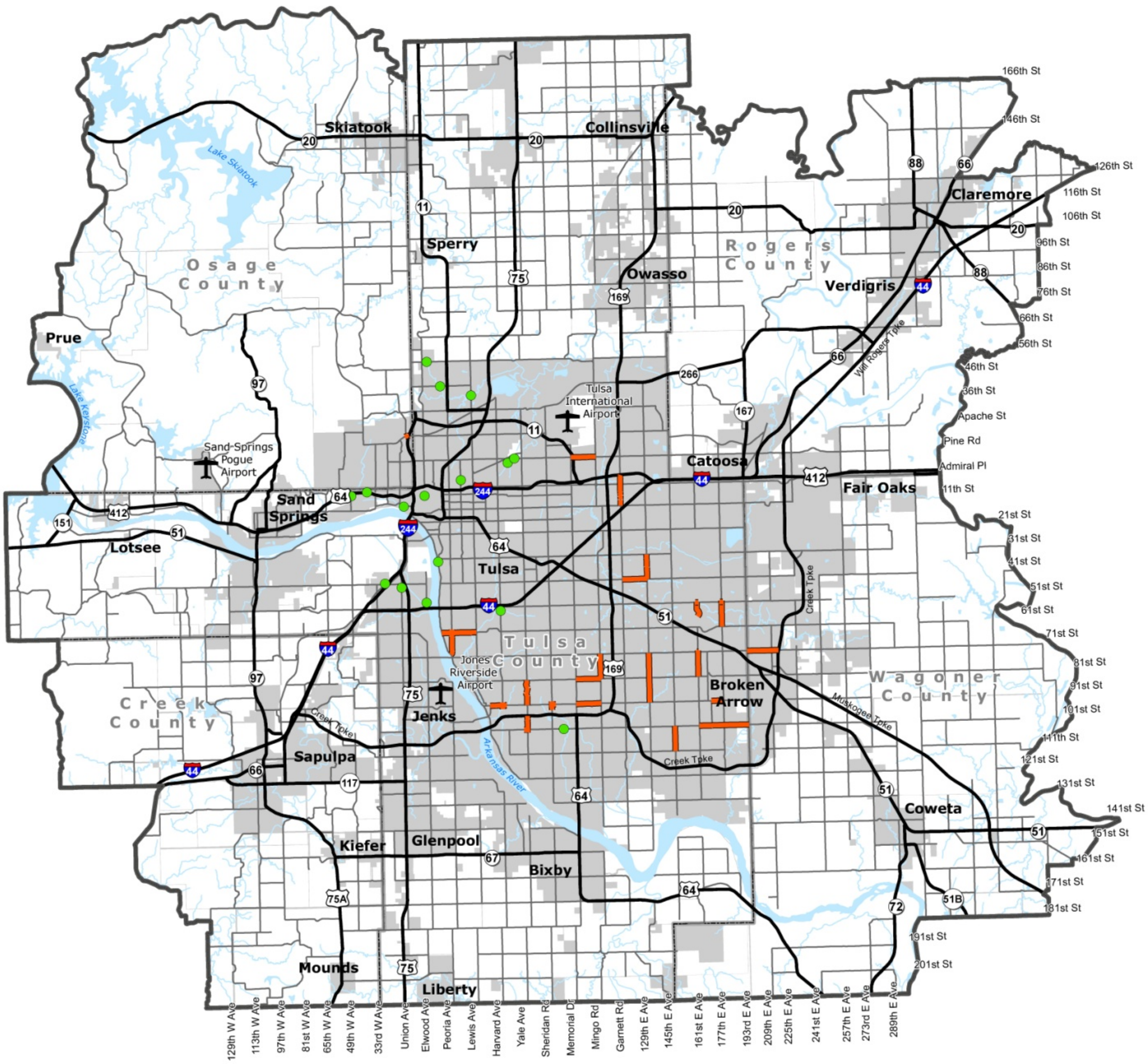
MAP 7: Transit Ridership





*Includes the sum of total ridership for both AM and PM Peak times. AM Peak Ridership time is from 6:00 AM to 9:00 AM, PM Peak Ridership time is from 3:00 PM to 6:00 PM. Source: Metropolitan Tulsa Transit Authority. MTTA Ridership Data for Week of : Nov 10th - Nov 14th 2008

MAP 8: Street & Bridge Projects



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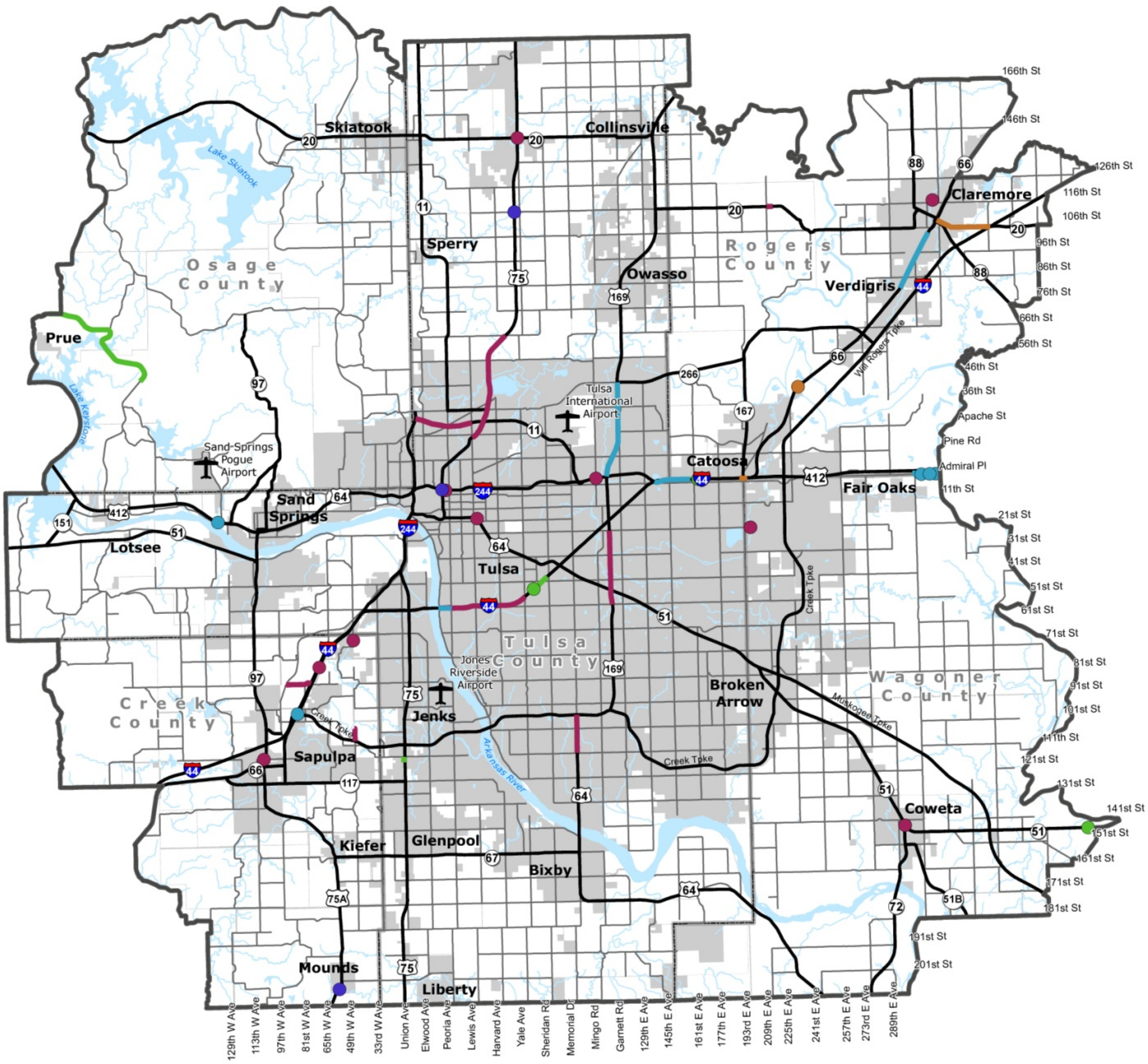
Legend

- Bridge Replacement
- Street and/or Intersection Widening
- Highways
- Arterials
- Streams
- Water Bodies
- Corporate Limits
- Transportation Management Area
- County Boundaries

Miles: 0 1 2 3 4 5

Location Map

MAP 9: Completed/Committed Projects



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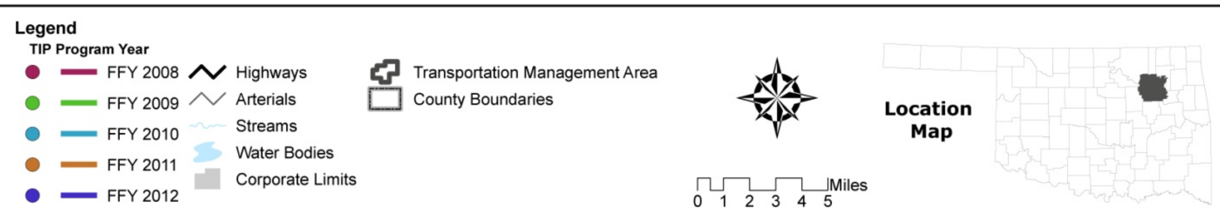
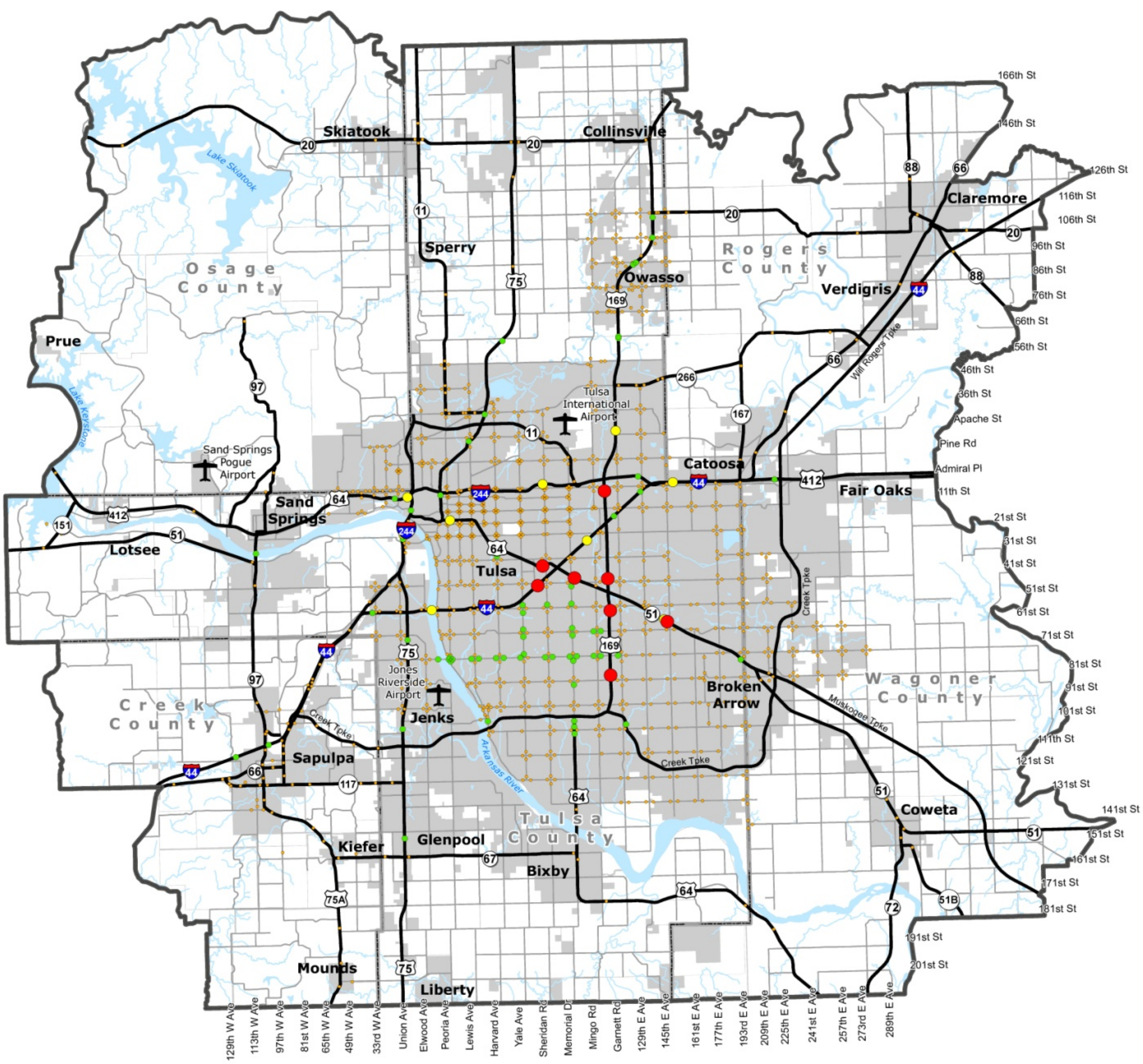


MAP 10: Traffic Volume



USE OF THIS INFORMATION: This map is provided as a public resource for general information only. Although every effort has been made to produce the most current, correct and clearly expressed data possible, all geographic information has limitations due to scale, resolution, date and interpretation of the original source materials. The information on this map is collected from various sources and that can change over time without notice. Therefore, the information provided is not intended to replace any official source. You should not act or refrain from acting based upon information on this map without independently verifying the information and, if necessary, obtaining professional advice. The burden of determining the accuracy, completeness, timeliness of information rests solely on the user.

Legend

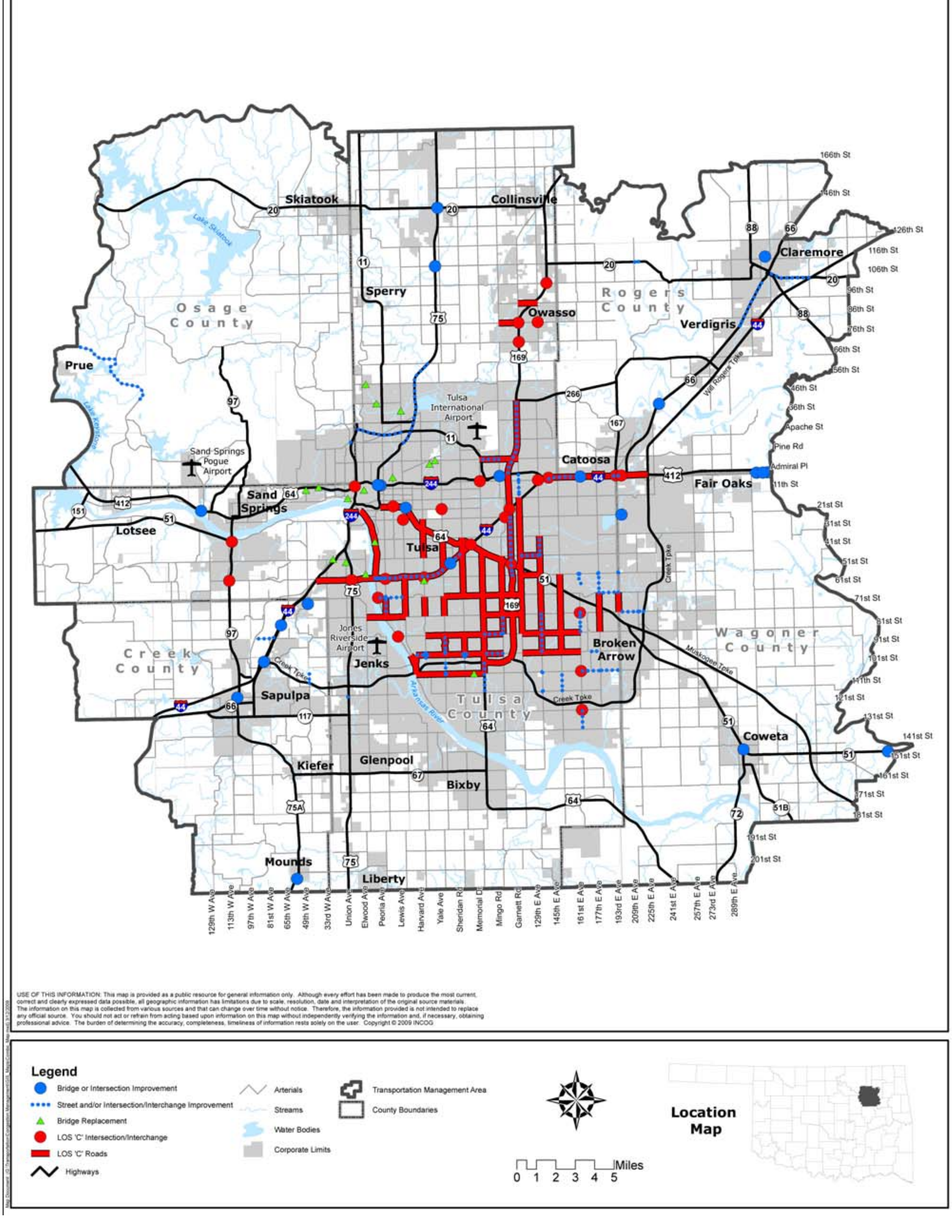
Average Daily Traffic Volume
- 45 - 30,000
- 30,001 - 55,000
- 55,001 - 80,000
- 80,001 - 108,600

- Highways
- Arterials
- Streams
- Water Bodies
- Corporate Limits
- Transportation Management Area
- County Boundaries

0 1 2 3 4 5 Miles

Location Map

MAP 11: Committed Improvements and LOS 'C'



9.0 CONGESTION MANAGEMENT STRATEGIES: NON-RECURRING CONGESTION

9.1 Role of Incident Management Program as a Congestion Management Strategy

Every day, traffic incidents obstruct roadways, impeding mobility and disrupting traffic. Incidents such as spilled loads, stalled vehicles, and accidents reduce the traffic carrying capacity of a highway. When they occur during peak hours, they cause serious congestion, usually far out of proportion to their degree of severity. Secondary incidents are also a concern. All incidents are responsible for over 60% of the congestion delay in the Tulsa TMA and can substantially impact peak period travel on urban freeways. Delays related to incidents increase at a faster pace with the growth of traffic volumes, and it is estimated that in 2005 incidents caused over 70% of freeway congestion.

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. It primarily applies some of the same resources that are already being used to respond to incidents; the difference is that these resources are used more effectively. Time is essential since four minutes is needed to unblock a road for each minute an incident obstructs any portion of it.

Incident Types

Predictable	Unpredictable
Maintenance Activities	Accident
Construction	Stalled Vehicle
Special Events (ball games, fairs, parades, etc.)	Weather (rain, fog, ice, snow)
	Spilled Load

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

About two-thirds of all incident-caused delay is a result of minor incidents. Exceptions to the criteria shown below can occur.

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 that responders and motorists are exposed to traffic hazards and “secondary incidents.” Simultaneous incidents can severely compromise agencies’ abilities to respond effectively.

9.2 Strategies to Reduce Incident Duration

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 is a procedure that relays incidents to 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, cell phones, and visual observation. Dispatchers should be trained to obtain precise information on the location and magnitude, verifying if it is an incident or a stall, if it is blocking the traffic, and if there are injuries. Dispatchers should also note the type and number of vehicles and any other issues that may help the response team.

- Coordinate Incident Management Teams with understanding and training across the disciplines
- Develop a routine toward an annual active incident management workshop for various stakeholders in the region
- Coordinate all major construction activity involving major foreseeable disruptions to traffic with the implementing agency

10.0 CONGESTION MANAGEMENT STRATEGIES: RECURRING CONGESTION & TRANSPORTATION CONTROL MEASURES

Travel Demand Management (TDM) and Transportation System Management (TSM) alternatives encourage the use of alternative transportation, promote staggered work hours, and seek efficient public transportation systems. TDM & TSM efforts are being implemented in urban areas across the country in order to reduce traffic congestion and air pollution, and to increase efficiency of the transportation system.

The CMP will only be complete with an effective TDM element. The table on page 37 identifies several strategies for implementation in the Tulsa TMA. The strategies include implementing a trip sharing-program, a vanpooling program, an improvised bus/transit option along with mass transportation alternatives such as passenger rail, and cycling facilities.

Unlike most other transportation programs, TDM programs are not "centralized" and can be implemented relatively easily by public or private sector groups. In fact, this is one of the great strengths of TDM programs. A significant component of this element is the adoption and implementation by local governments of a voluntary trip-reduction program. INCOG will continue to explore TDM and TSM options for effective transportation system management in the Unified Planning Work Program, the transportation planning process, and through the promotion of alternative transportation modes.

10.1 Transportation Demand Management (TDM) Measures

TDM strategies are designed to maximize the people-moving capability of the transportation network and support more efficient use of the existing transportation systems by influencing the time, route, or mode selected for a given trip. To accomplish these types of changes, TDM programs often rely on incentives to make these shifts in behavior attractive. Incentives associated with TDM strategies include preferential parking for persons using carpools, vanpools, or bicycles; transportation allowances for transit; subsidies for transit operators; and guaranteed ride home programs. Programs generally work best where land use is mixed and fairly dense, urban design is integrated with transportation systems, and multiple travel choices are available. The following are some of the widely implemented TDM alternatives that are recommended for the Tulsa TMA.

Trip Sharing
Carpools and vanpools are typically arranged by employers. Trip sharing will reduce Single-Occupant Vehicle (SOV) trips and Vehicle Miles Traveled (VMT) in the region, and can be especially helpful in corridors with large employment centers. Implementation costs involve parking space and administration, although participants usually realize savings. INCOG currently funds and administers the Green Traveler initiative (www.green-traveler.org), a web-based travel matching program. The timeframe for implementation is usually short-term (1-5 years).

Telecommuting
This option allows employees to work from home or from a regional telecommute center, which helps to reduce SOV trips, and most importantly, the amount of traffic during peak travel times. Employer costs tend to decline after initial investments, and the timeframe for implementation is usually short-term (1-5 years).

Alternative Work Hour Programs
Alternative hours allow workers to arrive and leave work outside the traditional commute period. It may be accomplished through Compressed Work Weeks, in which employees work a full week in fewer than the typical five days, or a Flexible Work Schedule, in which the start and end is timed with off-peak hours. Employer implementation costs vary and the timeframe for implementation is usually short-term (1-5 years).

Public Transit
Existing bus transit and future rail transit can be promoted as a TDM strategy when there is a demand for transit service and other TDM strategies are not able to alleviate congestion. Reducing fares (replaced by operational subsidies), increasing route coverage or frequencies, and implementing park and ride lots all have short-term to medium-term (0-10 years) implementation timeframes. Costs include capital, operational, and possibly structural outlays.

Enhanced Transit Service should be pursued in the short- and long-term to improve commuting options for travelers in the Tulsa region. Transit service improvements depend on operational requirements and funding. The CMP should provide adequate balance for transit-related enhancements in order to compete for funding.

Non-motorized Improvements
Bicycling and walking are important travel options, especially in mixed-use development areas, and aid in reducing congestion and air pollution. New sidewalks and designated bicycle lanes increase mobility and access. Exclusive non-motorized rights-of-way for medium-to-long distance trails improve safety and reduce travel times for pedestrians, cyclists, and users of other wheeled non-motorized vehicles. Providing access in developments and at transit facilities provide incentives to walk and use bicycles. Implementation cost can be part of design and construction costs, as well as education, encouragement, enforcement, and evaluation. Costs for new facilities can vary widely. The timeframe for implementation of most strategies is short-term to medium-term (1-5 years).

10.2 Transportation System Management (TSM)

The TSM approach to congestion mitigation seeks to identify improvements of an operational nature to enhance the capacity of the existing system. Through better management and operation of existing transportation facilities, these techniques are designed to improve traffic flow, air quality, and movement of vehicles and goods, as well as enhance system accessibility and safety.

Intersection and Lane Improvements
Congestion and travel time can be improved by installing traffic control devices and designs for the smooth and safe passage of both pedestrians and vehicles. The devices and designs used could be signs, turning lanes, auxiliary lanes, traffic islands, traffic channels, and other appropriate geometric designs to help reduce congestion and improve the safety and ease of travel. Implementation costs vary but are usually moderate to high, and the timeframe for implementation of most strategies is short- term to medium-term (1-10 years).

Traffic Signal Improvements
Studies have shown that changes in a signal's physical equipment and timing optimization can help significantly in congestion mitigation. Traffic flow could be improved by equipment updates, timing plan improvements, interconnected signals, traffic signal removal, or as-needed traffic

signal maintenance. Implementation costs vary and the timeframe for implementation is usually short-term (1-5 years). Intelligent Transportation System (ITS) technology, such as Advanced Traveler Information Systems, has been a great help in relieving congestion where other solutions have failed. These intelligent transportation systems include computers, communications, and displays. Implementation costs vary and the timeframe for implementation is usually medium-term (1-10 years).

Incident Detection and Management Systems
To alleviate non-recurring congestion, systems typically include video monitoring, dispatch systems, and sometimes service patrol vehicles. The prompt removal of disabled vehicles from travel lanes reduces travel time and accident delay. Capital costs are variable, as are annual operating and maintenance costs. The timeframe for implementation is usually medium-term (1-10 years).

10.3 Land use Management

Aside from TDM and TSM strategies, a variety of tools that deal with land use and access may be used to mitigate congestion. Some of these strategies and techniques are employed to some degree in the Tulsa TMA already, but not as part of a coordinated congestion management effort.

Land Use Strategies
Land-use techniques and urban design can be used to mitigate congestion by integrating land-use planning (e.g. zoning), site planning, innovative development styles, and landscaping within a transportation system. Mixed-Use Development, Infill and Densification, Traditional Neighborhood Design, and Transit-Oriented Development all support a reduction of SOV travel and VMT. Some of these strategies involve public costs in creating ordinances, and all involve economic incentives to encourage developer buy-in. The timeframe for implementation is usually long-term (10+ years).

These strategies include Smart Growth initiatives:

- Mixed Use Development
- In-fill Development
- Nontraditional Modes

Access Management
Access management consists of controlling the space and design of driveways and other curb cuts, medians, and median openings, intersections, traffic signals, and freeway interchanges. Appropriate access control can decrease the number of accidents and congestion. To have a successful access management plan, both transportation planners and land-use planners have to work cooperatively. The benefits of access management are decreased conflict points, accidents, and travel times, as well as increased mobility and capacity. Implementation costs can be part of design and construction costs, but new signage, striping, and other facility costs can vary widely. The timeframe for implementation of most strategies is short-term to medium-term (1-10 years).

Roadway Improvement Strategies
The traditional way to deal with congestion has been to widen highways and add lanes, but lanes can be added without widening the highway. Geometric design improvements (as described under *Intersection and Lane Improvements*), can serve to improve mobility, reduce congestion, and improve safety. Also, a coordinated approach toward implementing “complete streets” to

include the interaction of expressways with major arterials and signalized intersections increases capacity and mobility. Implementation costs can be part of design and construction costs, but new facility costs can vary widely. Also, there is potential for significant environmental and community impacts. The timeframe for implementation of most strategies is short-term to long-term (1-10+ years).

Parking Management
Many communities have adopted parking policies to induce transportation mode shifts, increase peak-period capacity, promote access preservation, and improve environmental quality. Parking management strategies include: On-street Parking and Standing Restrictions; Employer/Landlord Parking Agreements; Location-Specific Parking Ordinances; and Preferential/Free Parking for Trip-sharing. Implementation costs vary and the timeframe for implementation of most strategies is usually short-term (1-5 years).

The following table summarizes the short-listed strategies along with the linkages to the TIP and RTP for Tulsa TMA.

Implementation Strategy Summary	Implementation Term	Effectiveness	Funding Through TIP	Regional Plan Activity
Promote Trip Sharing	1-5 Years	Very Effective	Yes	Yes
Enable Telecommuting	1-5 Years	Effective	Yes	Yes
Promote Alternative Work Hours	1-5 Years	Very Effective	No	Yes
Enhanced Public Transit	5-10 Years	Very Effective	Yes	Yes
Non-Motorized Transportation Improvements	1-5 Years	Effective	Yes	Yes
Intersection Lane Improvements	1-10 Years	Very Effective	Yes	Yes
Traffic Signal Improvements	1-10 Years	Very Effective	Yes	Yes
Incident Detection and Management	1-10 Years	Very Effective	Yes	Yes
Land Use Strategies	1-10 Years	Effective	No	Yes
Access Management	1-10 Years	Effective	No	Yes
Roadway Improvement Strategies	1-10 Years	Effective	Yes	Yes
Parking Management	1-5 Years	Effective	No	Yes

11.0 MONITOR STRATEGY EFFECTIVENESS

The CMP includes provisions to monitor the performance of strategies implemented to address congestion. Regulations require “a process for periodic assessment of the efficiency and effectiveness of implemented strategies, in terms of the area’s established performance measures.”

The CMP will evaluate the effectiveness of each strategy based on the congestion monitoring program that is tied to the performance of the system as discussed in the document.

The sub-committee for the CMP will continue to evaluate other appropriate alternatives with respect to methods and performance of the transportation system. In addition, the sub-committee will track implemented actions as they relate to the CMP.

The sub-committee continues to provide results of the evaluation of the implemented actions to the TTC and the TPC for incorporation in the overall transportation planning process.

The standing sub-committee that reviews application and progress of congestion strategies also would review the TIP project selection process as it relates to alleviating congestion.

12.0 DOCUMENTING CMP ACTIVITIES

Every two years, INCOG will produce a document identifying the revisions to any performance measures, strategies, and funding of congested corridors identified along with a list of improvements funded through local and statewide initiatives. This user-friendly document will be made available to the public and to stakeholders through the INCOG website. It will also be available in hard-copy or other formats upon request.

Appendix A: List of Projects

Based on 2005-06 Traffic Count Data

For all actions identified below the implementation timeline is defined as follows:

Long term: 10 Plus Years
Medium term: 5-10 Years
Near term: 0-5 Years

Expressways

Location	Criteria	Strategy	Agency Responsible	Funding Identified
Broken Arrow Expressway (Downtown to Garnett) **Long term**	V/C Ratio	Alternative Analysis	ODOT	None
I-44 (West Segment) in TMA (I-44/I244 Interchange to SH-51) **Near - Medium term**	V/C Ratio	Capacity Expansion	ODOT	Partial
I-44 (East Segment) in TMA(I-44/I244 Interchange to Creek East) **Medium term**	V/C Ratio	Capacity Expansion	ODOT	Partial
US-169 North (I-244 to SH-266) **Medium term**	V/C Ratio	Capacity Expansion	ODOT	Partial
US-169 South (I-244 to Memorial Dr) **Long term**	V/C Ratio	Alternative Analysis/ Capacity Expansion	ODOT	None

Highway to Highway Interchanges

Location	Criteria	Strategy	Agency Responsible	Funding Identified
I-44 & BA Expressway **Medium term**	Travel Speed/Volume	Reconstruction	ODOT	Partial
I-44 & US-169 S. **Medium term**	Travel Speed/Volume	Reconstruction	ODOT	Partial
I-44 East Segment & I-244 **Medium term**	Travel Speed/Volume	Reconstruction	ODOT	Partial
I-44 & US-75 South **Medium term**	Travel Speed/Volume	Reconstruction	ODOT	None
I-44 & SH-167 **Medium term**	Travel Speed/Volume	Reconstruction	ODOT	Partial
I-44 East segment & SH-66 **Medium term**	Travel Speed/Volume	Reconstruction	ODOT	None
North West segment of IDL **Long term**	Travel Speed/Volume	Reconstruction	ODOT	None
BA Expressway & US-169 S **Medium term**	Travel Speed/Volume	Reconstruction	ODOT	Partial

Arterials – Short term (based on LOS ‘D’)

All roadway segments include arterial street intersections associated with those segments

Location	Criteria	Strategy	Agency Responsible	Funding Identified
Yale Rd. (61st to 71st Street)	V/C Ratio/Speed	Capacity/Traffic Improvements*	City of Tulsa	Partially Funded
Yale Rd. (81st to 91st Street)	V/C Ratio/Speed	Capacity/Traffic Improvements*	City of Tulsa	Partially Funded
Sheridan Rd. (81st St S to 91st St S)	V/C Ratio/Speed	Capacity/Traffic Improvements*	City of Tulsa	Partially Complete
Memorial Ave(BA Expressway to 81st St S)	V/C Ratio/Speed	Capacity/Traffic Improvements*	City of Tulsa/ODOT	None
Mingo Rd. (71st St S to 91st St. S)	V/C Ratio/Speed	Capacity/Traffic Improvements*	City of Tulsa	Partially Complete
Garnett Rd. (61st St S to 71st St S & 81st St S to 101st St S)	V/C Ratio	Capacity/Traffic Improvements*	Tulsa County	Partially Complete
129th E Ave. (31st St S. to 61st St S.)	V/C Ratio	Capacity/Traffic Improvements*	COT/Broken Arrow	None
81st St. (Harvard to Mingo Road)	V/C Ratio/Speed	Capacity Expansion	City of Tulsa	Partially Funded
91st St. (Delaware to Mingo Road)	V/C Ratio/Speed	Capacity Expansion	City of Tulsa	Partially Funded
101st St. (Sheridan to Memorial Drive)	V/C Ratio	Capacity Expansion	Tulsa County	None

Arterial Intersections - Near term

Location	Criteria	Strategy	Agency Responsible	Funding Identified
US-169 & 106th Street	Level of Service	Traffic Engineering	Owasso	None
US-169 & 96th Street	Level of Service	Traffic Engineering	Owasso	None
US-169 & 86th Street	Level of Service	Traffic Engineering	Owasso	None
71st & Riverside	Level of Service	Traffic Engineering	City of Tulsa	None
81st & Riverside	Level of Service	Traffic Engineering	City of Tulsa	None
51st /Skelly Drive & Peoria	Level of Service	Reconstruction	ODOT	Funded
51st /Skelly Drive & Lewis	Level of Service	Reconstruction	ODOT	Funded
51st /Skelly Drive & Harvard	Level of Service	Reconstruction	ODOT	Funded
61st & Harvard	Level of Service	Traffic Engineering	City of Tulsa	None
41st & Garnett	Level of Service	Traffic Engineering	Tulsa County	None
51st & Garnett	Level of Service	Traffic Engineering	Tulsa County	None

Location	Criteria	Strategy	Agency Responsible	Funding Identified
81st & Garnett	Level of Service	Traffic Engineering	Tulsa County	None
91st & Garnett	Level of Service	Traffic Engineering	Tulsa County	None
91st & Garnett	Level of Service	Traffic Engineering	City of Tulsa/ Broken Arrow/ Tulsa County	None
71st & 145th E Ave.	Level of Service	Traffic Engineering	City of Broken Arrow	None
91st & 145th E Ave.	Level of Service	Traffic Engineering	City of Broken Arrow	None

Appendix B: Sources of Funding

The following are the Sources of Funding for transportation system improvements in the Tulsa TMA, where agency responsible is identified

- Sales Tax - specifically from citywide initiatives oriented toward maintenance, reconstruction, and capacity expansion projects including roadways and trails, as well as transit capital

- General Obligation Bonds - specifically from citywide initiatives oriented toward maintenance, reconstruction, and management of the transportation system and capacity expansion

- State transportation - funding for improvements to the state highway system

- County Sales Tax - for capital improvements to county roadways, specifically for capacity expansion and maintenance

- Federal Highway Administration - funding for Interstate and other highway maintenance and expansion

- Federal Transit Administration - funding for capital transit improvements

Appendix C: Tulsa Transit Route-Based Analysis

MTTA has the operational responsibility and may be requested to perform a congestion analysis based on the route and ridership.

Ridership per seat information is not immediately available from MTTA in a given segment of the transit route. Therefore, the following two phases of analysis is presented:

Phase 1

Identification of Top Tier routes - Top FIVE routes carrying the most passengers during the Peak Periods: Routes 101, 105, 112, 221, and 222CI & CC.

Phase 2

Top Tier Routes with greater than 20 Minute headway during peak periods - Routes 101, 105, 112, 221, 222CI & CC.

Most Recent MTTA Transit Ridership Data

MTTA Ridership Week of November 10 – 14, 2008

Route #	Combined Peak Ridership	AM Peak Time (6 to 9 a.m.) Ridership	PM Peak Time (3 to 6 p.m.) Ridership	Headway (minutes)	# of buses on route
100	1056	431	625	40	2
101	1847	960	887	20	4
105	3035	1293	1742	30	6
111	856	431	425	45	2
112	1484	744	740	52	3
114	936	439	497	75	2
117	621	329	292	45	2
118	495	228	267	55	2
203	823	447	376	60	2
210	1288	579	709	45	3
215	797	369	428	35	2
221	1255	626	629	45	3
222 CI & CC	2311	1127	1184	45	6
251	1079	538	541	25	2
306	371	249	122	60	1
318	675	288	387	45	2
471	365	125	240	50	2
508	79	65	14	67	2
902	688	310	378	26	2
909	156	71	85	N/A	1
	Total: 20217	Total: 9649	Total: 10568		

Appendix D: Methodology for Intersection Evaluation

Key Terminology per Highway Capacity Manual:

ADT = Average Daily Traffic

Peak Hour Traffic, TOD Factor = 7%, 10% or 15% of ADT (Scenarios)

Peak Hour Green Time = 40%, 50% or 60%

Capacity of Signalized Intersection Flowrate= 1800 pcphgpl (passenger cars per hour of green time per lane).

Assumptions for Intersection Analysis:

A peak hour intersection traffic flow of 10% of average daily traffic; AND at 60% of green time available per lane;

A signalized intersection processes approximately 1,080 vehicles per hour per lane with no congestion. That is assumed to be the LOS A for a given intersection.

All the Tulsa TMA traffic counts are processed at a threshold rate of 1,400 passenger cars per lane to match the examples developed by the City of Tulsa as well Highway Capacity Manual to arrive at the LOS ‘D’ Criteria for the same signalized intersection. {1,080 / 1,400 = 77%}.

Please see the validation exercise from City of Tulsa (next page).

ESTIMATED TMC

Intersection: 71st Street & Memorial Drive

	NB			SB			EB			WB		
ADT	29,800			27,800			35,700			26,500		
Street:	Memorial Drive			Memorial Drive			71st Street			71st Street		
Direction:	NB			SB			EB			WB		
Movement:	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Percent Entering	55			31			50			55		
TOD % Factor	7											
TM % Factor	28	58	14	20	58	22	24	64	12	15	73	12
AM Peak	321	665	161	121	350	133	300	800	150	153	745	122
Total	1,147			603			1,250			1,020		
Percent Entering	50			50			46			50		
TOD % Factor	10											
TM % Factor	24	51	25	32	48	20	28	51	21	22	57	21
Noon Peak	358	760	373	445	667	278	460	838	345	292	755	278
Total	1,490			1,390			1,642			1,325		
Percent Entering	28			50			70			42		
TOD % Factor	15											
TM % Factor	24	50	26	27	53	20	27	56	17	31	58	11
PM Peak	300	626	325	563	1,105	417	1,012	2,099	637	518	968	184
Total	1,252			2,085			3,749			1,670		
Total Actual	1241			2140			3710			1715		