Fresno County

Congestion Management Process Update

Council of Fresno County Governments

September 2017

Council of Fresno County Governments

Policy Board

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Table of Content

Chapter 1   Introduction

In June 1990, California voters approved legislation that required Congestion Management Plans (CA CMP) be developed in urbanized counties to address congestion on California's highways and roads.   At the federal level, Congestion Management System (CMS) was first introduced in the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991. In 1996, CMS became the Congestion Management Process (CMP) with the Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU).   Fresno COG developed its first Congestion Management Program in November 1991, and it has been updated based on legislative requirements. Assembly Bill 2419 (Bowler) in 1996 allowed counties to "opt out" of the California Congestion Management Program if a majority of local governments elected to exempt themselves from the California CMP.   The Fresno COG Policy Board rescinded the Congestion Management Program on September 25, 1997 at the request of the local member agencies.   The 2009 Fresno County Congestion Management Process (CMP) was designed to meet the federal requirement under 23 CFR 500.109 and 450.320. The 2017 CMP is an update to the 2009 CMP based on emerging transportation planning practices such as the transportation performance measurement required under the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation Act (FAST ACT)

SAFETEA-LU, and the subsequent MAP-21 and FAST Act require that Transportation Management Areas (TMAs) – urban areas with population over 200,000 – "shall address congestion management through a process that provides for safe and effective management and operation, based on a cooperatively developed and implemented metropolitan wide strategy, of new and existing transportation facilities … through the use of travel demand reduction and operation management strategies." It further states that federal funds cannot be programmed in a carbon monoxide and/or ozone non-attainment TMA for any highway project that will result in a significant increase in single occupant vehicle (SOV) capacity, unless the project is vetted through an approved CMP.

Fresno County is designated as a non-attainment TMA for ozone, and was so designated for carbon monoxide, but the Fresno Urbanized Area was reclassified as attainment for carbon monoxide effective on June 1, 1998. However, because of the ozone non-attainment status, Fresno COG is required to comply with such requirements.

The language in 23 CFR 450.320 and 500.109 defines an effective CMP as a systematic and regionally accepted approach for managing congestion. It provides information on transportation system performance and assesses alternative strategies for alleviating congestion and improving mobility for people and goods to levels that meet State and local needs. The congestion management process should include the six elements as specified in 450.320:

- 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;

- a definition of parameters for measuring the extent of congestion and for supporting the evaluation of the effectiveness of congestion reduction and mobility enhancement strategies;

- the 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 congestion management strategies, such as: transportation demand management (TDM) measures, traffic operational improvements, public transportation improvements, Intelligent Transportation Systems (ITS) technologies, and additional system capacity;

- identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy proposed for implementation; 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.

The Fresno County Congestion Management Process should be an integrated part of a Metropolitan Planning Organization (MPO)'s planning process. Based on the guidebook titled "The Congestion Management Process, A Guidebook", which was issued by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), the Fresno County CMP is a systematic process developed with regional approaches, with strategies reflected in and throughout the Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP) process. The following diagram summarizes the major components of the Fresno County CMP and illustrates how the CMP is integrated in Fresno COG's planning process:
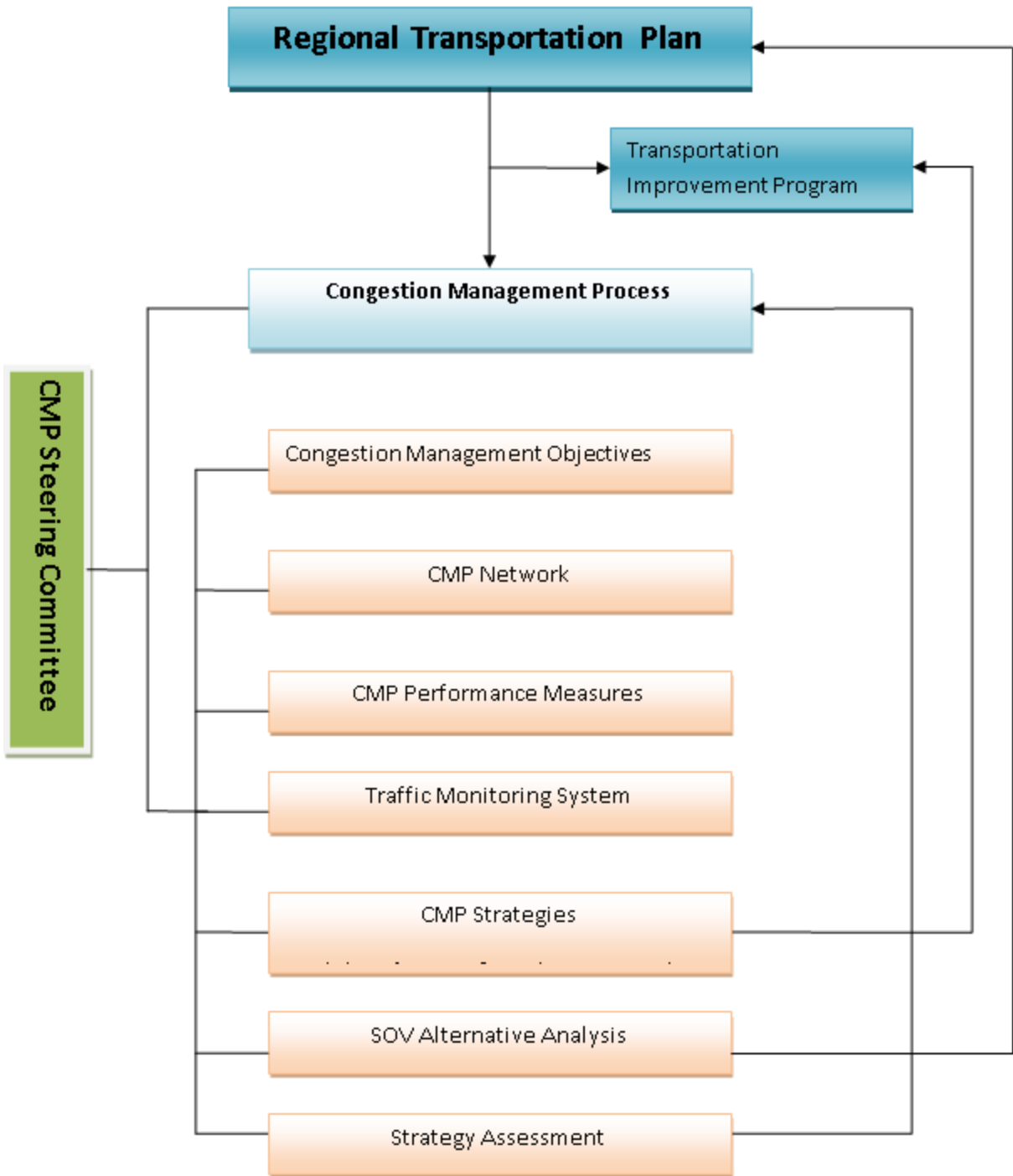
Figure 1

Chapter 2   CMP Steering Committee

The Fresno County CMP Steering Committee was formed in January 2009 and was reconvened in March 2015 for the current update.   The CMP Steering Committee provided guidance for the development of the congestion management process and served as a technical advisory body for the process.   The Committee comprised a broad membership that included engineers and planners from the local governments, representatives from the transit operators, State DOT, bike/pedestrian advocates and other stakeholders. Detailed CMP Steering Committee membership is as follows:

- County of Fresno
- City of Fresno
- City of Clovis
- Caltrans District 6 representatives
- Fresno Cycling Club
- City of Selma
- Fresno County Rural Transit Agency
- Fresno Area Express
- Clovis Transit
- City of Reedley
- City of Coalinga
- California State University, Fresno

COG's programming staff has been involved throughout the entire CMP process to ensure successful integration into the TIP/RTP process.

The CMP Steering Committee is instrumental in establishing CMP objectives and performance measures, selecting alternative strategies, single-occupant vehicle (SOV) alternative analysis and other CMP tasks.   In addition, the Congestion Management Process also provided a forum for the members to discuss regional issues, such as

sustainable development, congestion, transportation and land use planning integration, urban sprawl, active transportation, etc.

Chapter 3   CMP Objectives

The CMP Steering Committee reviewed the 2009 CMP goals and incorporated safety and other emerging technology elements in the update. Economic recovery from the Great Recession in the late 2000s has brought more jobs to the Fresno region, and the region is starting to experience some moderate delays on the urban freeways during peak hours. If not sustainably managed, the congestion would be more widespread, with greater delays expected. The updated objectives focus on operational improvements and management of the transportation facilities, emphasize sustainable land use development role in congestion management and promote the development of an integrated multi-modal transportation system. Four general objectives were established by the CMP Steering Committee:

1. Optimize the transportation facilities through efficient system management
2. Invest in strategies that reduce travel demand, improve system performance, increase safety, and provide effective incident management
3. Reduce vehicle miles traveled (VMT) by encouraging alternative modes of transportation and promotion of sustainable land use development
4. Improve public transit, expand bicycle and pedestrian system, and promote car sharing and bike sharing programs to facilitate the development of an integrated multi-modal transportation system in the Fresno region

Chapter 4 CMP Application Area and CMP Network

Fresno is the most populous county in the San Joaquin Valley, with 979,915 residents as of July 2016. The City of Fresno is the fifth largest city in California with over half a million population. There are over 600,000 people living in the Fresno-Clovis Metropolitan Area. Fresno County is also the second largest county in the San Joaquin Valley, encompassing approximately 6,000 square miles. It is home to 1.88 million acres of the world's most productive farmland, with agricultural operations covering half of the County. Agricultural commodities in Fresno were valued at $7.03 billion in 2014 and the top 10 crops were: almonds, grapes, poultry, milk, cattle & calves, tomatoes, pistachios, garlic, peaches and cotton. Fresno County is a rural county with a large metropolitan urban center. More than 60% of the population lives in the Fresno-Clovis Metropolitan areas, with about 17% in the rural unincorporated areas and the rest residing in the 13 small incorporated cities.

Congestion and its causes are of different magnitudes in the metropolitan areas relative to the rest of the more rural county. The transportation system in the urban area is designed to take people to destinations such as jobs, schools, shopping, doctors' appointments, etc. The rural roads mainly serve to transport agricultural goods. The urban areas experience more recurring congestion during the commute hours on the commute corridors, whereas in the rural areas, non-recurring congestion could take place due to foggy weather, truck traffic or other isolated accidents. The CMP Steering Committee agreed that the congestion management process should be applied countywide and selected different CMP strategies will be implemented where appropriate.

Due to the limitation of resources, the CMP Steering Committee identified and approved a refined CMP network, for which a more focused evaluation is conducted in the current update. Because of the recurring nature of the congestion on the urban freeways during the peak commute hours, the Committee decided that the urban freeways in the Fresno-Clovis Metropolitan Area will be the CMP network where the resources are directed.

The CMP network encompasses SR 41 from the SR 99 interchange to the Madera/Fresno County line, SR 99 from the Madera/Fresno County line to the Jensen Avenue interchange, SR 168 from the SR 180 interchange to the Herndon Avenue interchange and SR 180 from the SR 99 interchange to the SR 168 interchange, as shown in Figure 2 and Table 1. As discussed in Chapter 6, the Congestion Performance Monitoring Dashboard that features a live traffic speed feed for the CMP network. The Single Occupancy Vehicle (SOV) project analysis will be applied to qualified capacity increasing expansion project on the CMP network.
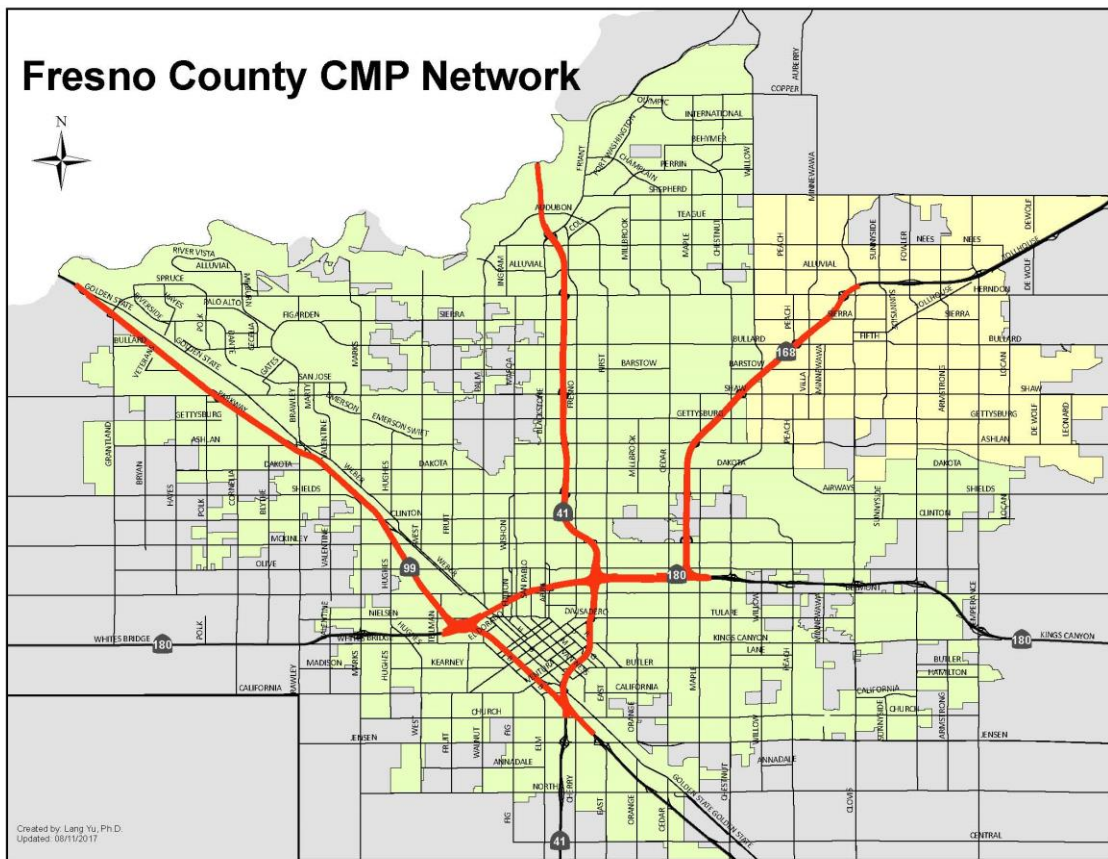

Figure 2

Route	From	To	Length
SR 99	Madera/Fresno County Line	Jensen Avenue Interchange	13 miles
SR 41	SR 99 Interchange	Madera/Fresno County Line	11 miles
SR 168	SR 168/SR 180 Interchange	Herndon Avenue Interchange	7 miles
SR 180	SR 99/SR 180 Interchange	SR 168/SR 180 Interchange	4 miles
Total			35 miles

Table 1

Chapter 5   Performance Measures

Performance measures are used to evaluate and communicate about the system performance issues. The most commonly used measures are speed, travel time, Level of Service (LOS), volume-to-capacity ratio (V/C ratio) and travel delay. Proxies such as LOS and V/C were applied in Fresno COG's 2009 CMP because data for more direct measures such as travel time and speed were not available. Since then, advances in probe data and system detection technologies have significantly reduced data collection costs. The Federal Highway Administration (FHWA) has contracted with HERE North America/Inrix and acquired national travel time dataset for use in the analysis of system performance. The probe data acquired by the FHWA, the National Performance Research Data Set (NPMRDS), has been made available to state Department of Transportations (DOTs) and Metropolitan Planning Organizations (MPOs). The NPMRDS provides a consistent historical profile on the performance of the National Highway System (NHS) for both passenger cars and truck traffic. In addition, cost for the probe data has become much less prohibitive and real-time speed and travel time data are more realistic for purchase for priority corridors.

Furthermore, MAP 21 and the subsequent FAST Act set goals to transition transportation planning into performance and outcome-based programs. One of the goals for the federal aid program is system reliability, that is, to improve the efficiency of the surface transportation system. Transportation Management Areas (TMAs) are encouraged to incorporate reliability measures into the CMP process because travel-time reliability considers both recurring and non-recurring events on delay over time. Traditionally, congestion has been referred to as recurring delays at the commute hours when too many people are trying to get through certain corridors. Non-recurring congestion was typically left out of the analysis.

Given the reduced probe data costs, and the federal system reliability goal, Fresno COG decided to move into travel time-based performance measurement that includes:

- Travel Time (min): Travel time to traverse a defined road segment
- Average Speed (mph): The length of a segment divided by travel time
- Travel Time Index (TTI): Ratio of average speed to the travel time at the reference speed
- Planning Time Index (PTI): Ratio of 95th percentile of the travel time to the reference travel time
- Delay (Total Hours): Delay experienced by all vehicles (measured in hours) measured relative to a nominated reference speed

The CMP Steering Committee approved travel time index and planning time index as the reliability measures in September 2015. The FHWA finalized the system performance measures in January 2017, and here are the final FHWA measures (Freight and Congestion Mitigation Air Quality not included):

- Interstate Travel Time Reliability Measure: Percent of person-miles traveled on the interstate that are reliable, measured by Level of Travel Time Reliability (LOTTR): 80th/50th percentile of all vehicle travel times
- Non-Interstate Travel Time Reliability Measure: Percent of the person-miles traveled on the non-interstate NHS that are reliable
- Peak Hour Excessive Delay (PHED) Measure: Annual Hours of Peak Hour Excessive Delay per capita

In defining performance measures, the Committee also endorsed congestion thresholds in the traffic congestion measures. A travel time segment is considered to have excessive delay if the travel speed is equal to or slower than:

- 35 miles per hour for interstates, freeways, or expressways

- 15 miles per hour for principal arterials and all other NHS roads

Due to the timing of the publishing of the federal system performance measures and the approval of the performance measures by the CMP Steering Committee, both sets of the performance measures are applied in the analysis of system conditions within the Congestion Monitoring Dashboard, which is documented in Appendix A and in Chapter 6.

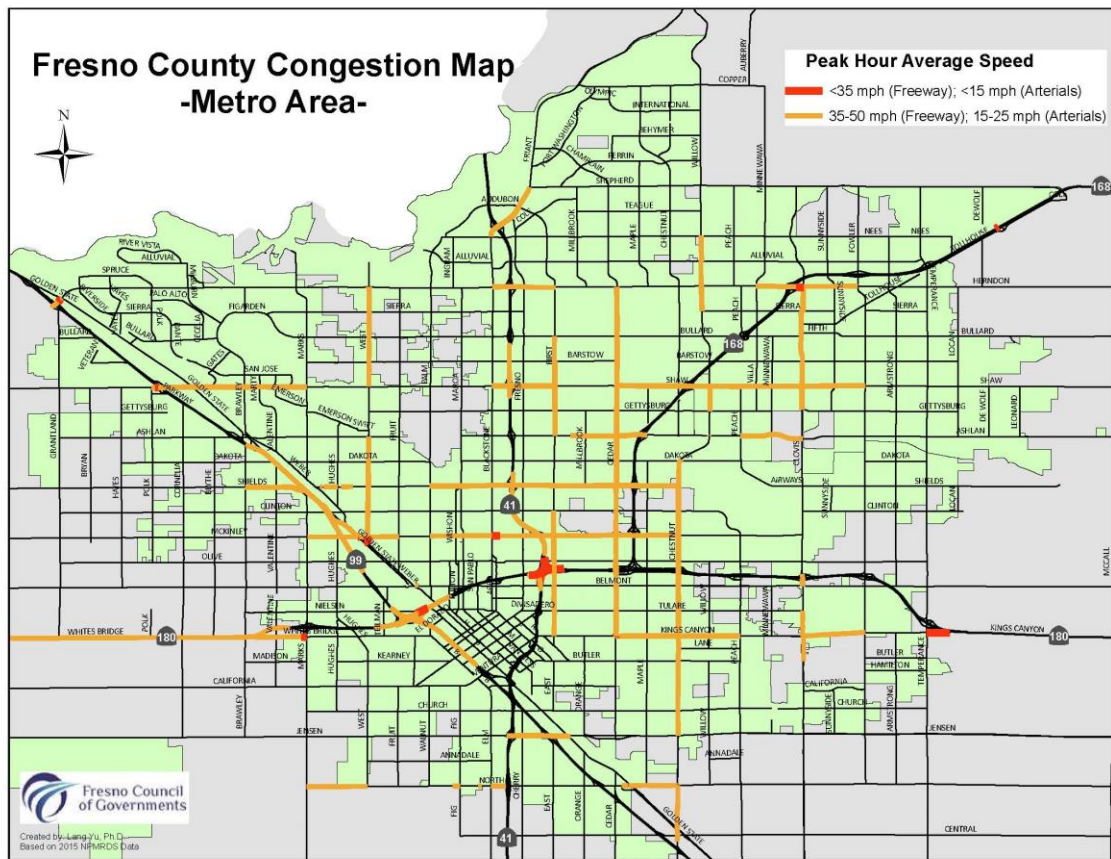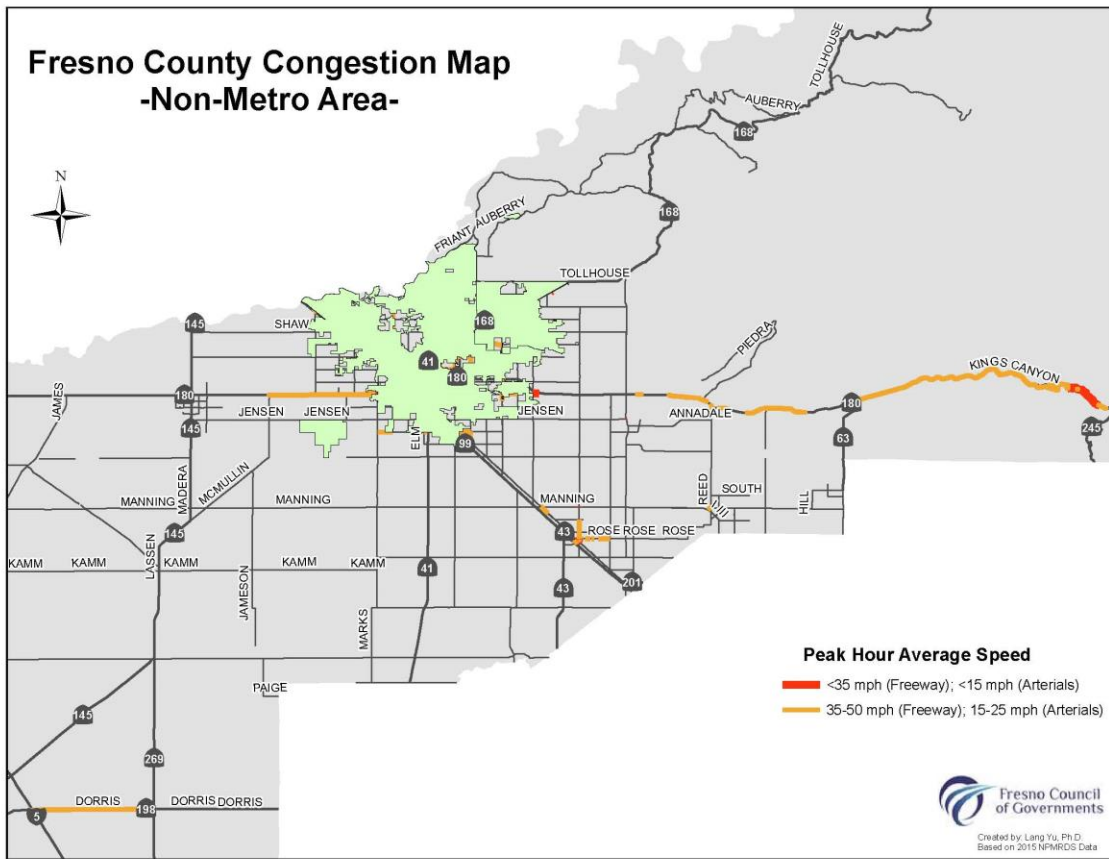Figure 3 & 4 shows the segments in Fresno County that have excessive delays.

Figure 3

Figure 4

Chapter 6 Transportation System Monitoring Programs

I. Traffic Monitoring Program

Fresno COG has operated a Regional Traffic Monitoring Program since 1981. Through this program, the City of Fresno, City of Clovis and County of Fresno receive annual funding from Fresno COG to take traffic counts at COG designated count locations. Hourly counts for 24 hours are taken during typical work days from Tuesday through Thursday. Truck counts are also taken by the Fresno County on county roads. The traffic count data collected through the Monitoring Program is used by private developers, government agencies, and other entities that need traffic counts for different traffic studies. As part of the CMP update, the traffic counts are also being used to calculate total hours of delays. As an input to COG's traffic model, the traffic data is also used to interpret the region's current mobility conditions and to forecast future infrastructure needs. The Fresno COG Regional Traffic Monitoring Program provides a traffic count database that serves COG's traffic model validation and calibration needs.

As part of the current CMP update, Fresno COG underwent a review process for the count location system. The count system was originally developed in the 1980s, and the Fresno region has since grown significantly. More count locations were added in new growth areas and in the small cities. Traffic is counted at 750 locations biannually under the Fresno COG Traffic Monitoring Program. Figure 5 and 6 shows the coverage of the count locations in the region.

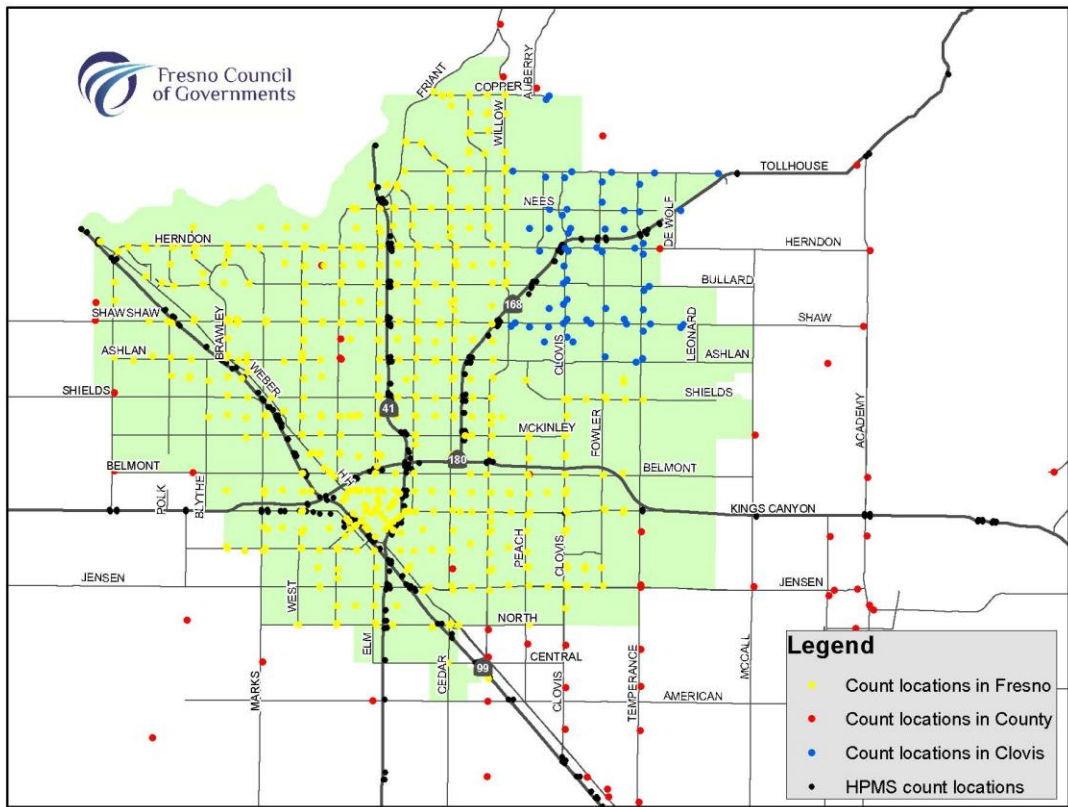# Fresno COG Traffic Monitoring Program
Metro Area

Figure 5

Fresno COG Traffic Monitoring Program
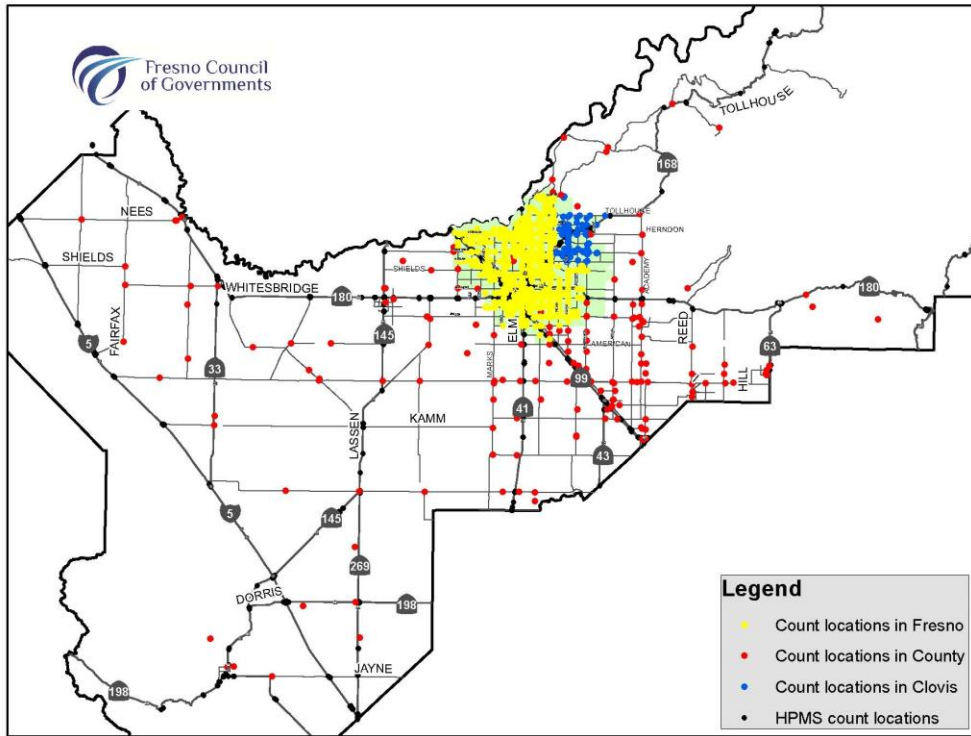## Non-Metro Area

Figure 6

As discussed in Chapter 5, Fresno COG is moving into travel-time and reliability based performance measures for system congestion monitoring. A congestion monitoring dashboard has been developed to monitor the system performance. Probe data from HERE North America has been purchased to provide real time traffic performance information for the identified CMP network. The NPMRDS is used to perform historical system-wide analysis for the NHS network using performance measures developed by the CMP Steering Committee. A third application is being developed on the Dashboard to report the system-wide performance based on the final system performance measures established by the FHWA. Appendix A provides detailed information on the background, dataset, performance measures, methodology and functionality of the congestion monitoring dashboard. The dashboard can be found at: fresnocog.iteris-pems.com. Usage of the dashboard needs to be pre-authorized by Fresno COG.

II.   Bike/Pedestrian Count Monitoring

Active transportation projects provide air quality and health benefits and have had an increasing role in providing transportation options for the general public, in addition to being used for recreational purposes. Assembly Bill 1358 requires cities and counties to include complete streets policies as part of their general plans so that roadways are designed to safely accommodate all users. The Active Transportation Program (ATP) provides exclusive funding sources for active transportation projects and requires before/after bike/pedestrian counts to support funding applications. In 2015, Fresno COG was selected as one of the 10 MPOs nation-wide to participate in the FHWA Bicycle & Pedestrian Count Technology Pilot Program. Fresno COG received a grant from the Pilot Program to purchase bike and pedestrian counters. Bike and pedestrian counts were taken on trails, bike lanes, sidewalk and pedestrian malls for project funding applications, usage monitoring or bike/pedestrian facility planning. Appendix B is a detailed report on the results of the Bike/Pedestrian Count Technology Pilot Program in the Fresno region.

Although the Pilot Program was completed in 2016, Fresno COG retains the bike/pedestrian counters which are loaned to the local governments and other entities on an as-needed basis. In 2017, additional bike/pedestrian counts were taken at 40 locations close to downtown Fresno, selected high schools and colleges. The bike/pedestrian counts taken in 2016/17 are used in the development of the first bike/pedestrian forecasting system in Fresno COG's Activity-Based Model (ABM). Fresno COG is evaluating a potential regional count system to monitor bike and pedestrian activities and having such counts taken regularly.

Chapter 7   CMP Strategies

SAFETEA-LU and the subsequent MAP 21 & FAST Act mandate that a CMP should identify alternative strategies such as travel demand management (TDM), traffic operational improvements, public transit, Intelligent Transportation System (ITS), and land use strategies, etc. as congestion management strategies. Although such programs have long been in place in Fresno County, the CMP process evaluated and selected alternative strategies considered appropriate and feasible for the Fresno region. This chapter provides an overview of existing CMP programs in Fresno County and summarizes the CMP strategies identified and adopted by the CMP Steering Committee for implementation.

I. Overview of Existing CMP Related Programs

Travel Demand Management

Travel demand management (TDM) programs are designed to reduce automobile usage by changing traveler behavior and encouraging alternative transportation modes besides single occupant vehicle trips. TDMs reduce demand on the system and postpone the need for capacity improvement.

Fresno COG's TDM has been predominately focused on ridesharing. TDM program staff has maintained the Valleyrides Program, which provides ride matching service within Fresno, Kings, Madera and Tulare Counties. In the last 11 years, program staff has worked with more than 1,200 worksites, and provided service/information in the four regions. Valleyrides partnered with California State University Fresno's Parking & Transportation Department and developed an online ride-matching database which has been in operation since 2003.

In 2006, Fresno County voters passed the Measure "C" Extension, a half-cent sales tax measure that programs 0.6% of its revenues to fund carpool and vanpool subsidy programs originating within Fresno County. Launched in 2009, today there are 38 regular vans and 99 farmworker vans sponsored by Measure "C". Annually through 2027, $2 million will be available from Measure "C" to expand farm labor and commuter vanpools

CalVans provides vanpool services to farmworkers and commuters in rural counties, including: Fresno, Kern, Kings, Madera, Merced, Monterey, San Benito, Santa Barbara, Santa Cruz, Tulare, Imperial and Ventura. In 2014/15, vans out of Fresno County traveled 29 million passenger miles; in 2015/16, vans (out of Fresno County) traveled 2.6 million miles with 528,510 passengers and passenger miles reached 28.8 million, which is equivalent to 13,459 metric tons of greenhouse gas emission reduction. Nearly 500 commuter and farm labor vehicles are in service.

Public Transit

Fresno Area Express (FAX) is the transit service provider in the City of Fresno. FAX provides two types of public transportation service: the fixed-route service for the general public and Handy Ride, a demand-responsive service for those who are unable to use the regular fixed-route service because of physical or mental disabilities. With an annual operating budget of $37 million, FAX operates 17 fixed routes in the City of Fresno. The annual boarding was 17.6 million in 2016.

The City of Clovis also operates two types of public transportation service in the FCMA area: Stageline, a general public fixed-route service, and Round-up, a demand-responsive paratransit service for senior and disabled residents. Clovis Transit ridership in 2016 was 154,451 with an annual operating cost at $1.95 million.

Rural Fresno County is served by a combination of public transit providers: common carrier, general public and social service agencies. The Fresno County Rural Transit Agency (FCRTA) and the Fresno County Economic Opportunities Commission (FCEOC) are designated as the Rural Consolidated Transportation Service Agency (CTSA).

About 24% of the Measure "C" extension money, estimated to be about $412 million over 20 years, will be spent on public transit, of which 19.66% ($337 million) will be spent on expanding public transit programs, improving transit service and consolidating services among different transit providers. The remaining 4.34% ($75 million) is intended to enhance alternative transportation services through programs such as the Public Transportation Infrastructure Study (PTIS), carpool/vanpool, and farm worker vanpool programs.

Operational Improvements & ITS

Operational improvements are an effective strategy to reduce traffic delays. Such improvement projects are less costly and can be implemented in a relatively short timeframe. Projects such as signal synchronization significantly reduce wait time at intersections, which also decreases vehicle idling time, bringing considerable air quality benefits to the region. Caltrans and the cities of Fresno and Clovis have been deploying enhanced signal and traffic management strategies to manage congestion. The Fresno County Intelligent Transportation System (ITS) Strategic Deployment Plan has identified traffic operational/management projects as one of its priority strategies to address the transportation problems in the Fresno area. Some of the identified projects are as follows:

- ITS Freeway Crossings
  Traffic Signal Synchronization of Arterials and Freeway Crossings

- ITS Signal Coordination and Improvements/Upgrades
  Installation of ITS equipment (communications, upgraded controllers; cameras, detection, poles, cabinets, and vaults) and signal synchronization

- Ramp metering & communication gap closure
  Deploy additional ramp-metering capabilities along the freeway system within the Fresno County Region to improve freeway throughput and efficiency

The City of Fresno and Caltrans District 6 reached a mutually beneficial shared fiber network agreement to provide fiber connectivity to the SR 41 ramps through the Blackstone corridor segment of the fiber network. Meanwhile, the cities of Fresno and Clovis have been working together on the Fresno/Clovis Metropolitan Area Signal Coordination and Fresno/Clovis Regional ATMS Completion Project. Such ITS projects have been mapped in the cities' plans, with funding aggressively pursued at the federal, state and local levels.

Land use/Growth Management

Segregated land uses and low-density suburban development have contributed to automobile dependency among American families. Both land use planners and transportation planners have realized that congestion needs to be addressed where travel is generated. Mixed-use, compact and transit-oriented development are the neo-traditional land use patterns that encourage transit use, walking and biking. These alternative transportation modes reduce driving, helping relieve congestion. Such land use/growth management strategies have been enacted in the Fresno area as part of ongoing efforts to build sustainable communities.

Fresno COG was a key partner in the San Joaquin Valley Blueprint planning efforts. The Fresno COG Policy Board adopted a preferred scenario with features such as transit

oriented development, urban centers, high intensity transit corridors, mixed uses, etc. Fresno's preferred scenario had a density of eight housing units per acre compared to the existing 3.8 units per acre. The Valley wide preferred scenario, which was stitched together among the eight Valley counties' locally selected scenarios, had an average density of 6.8 units/acre. Under California's SB 375, the Blueprint preferred scenario served as a starting point for developing the 2014 RTP's Sustainable Communities Strategy (SCS).

As mandated by Senate Bill 375, Fresno COG developed its first SCS in the 2014 RTP aimed at reducing greenhouse gas emissions through integrated transportation and land use planning. The SCS contained land use strategies such as higher density, mixed use development, infill, and allocation of growth along transportation corridors. Such land use strategies reduce the growth footprint and encourage alternative modes such as transit, biking and walking. Several cities adopted new general plans with more compact land use and other sustainable transportation strategies. Here are a few examples of the growth management efforts in the new general plans:

- The 2014 Fresno General Plan was adopted in adopted in December 2014. It envisions a balanced city with an appropriate proportion of growth and reinvestment focused in the central core, downtown, established neighborhoods and along BRT corridors. The City set a goal of directing approximately 50% of new growth towards infill areas within existing city limits, and the other half within the existing sphere of influence area by 2035. Around 20% of entire region's housing growth and 36% of new employment by 2035 is planned to take place within ½ mile of BRT corridors inside the City of Fresno. In December 2015, the City of Fresno approved a new Development code/Zoning Ordinance, which is an essential tool to implement the 2014 General Plan.

- The City of Clovis also adopted a new general plan in 2014 right after the
  adoption of the first SCS. Clovis' new general plan also set "goals and policies to
  seek to foster more compact development patterns that can reduce the number,
  length, and duration of auto trips." The Clovis General Plan introduced the
  concept of urban centers that require higher density and more mixed use around
  the community centers. Such density requirements gradually decrease further
  away from the center. The master-planned urban centers are also required to
  provide bike/trail connections within the communities.

The Fresno County Public Transportation Infrastructure Study (PTIS) took an integrated approach in long-range transit planning. The PTIS study identified potential high capacity transit corridors for Bus Rapid Transit (BRT) with the assumption that the land use in those corridors would be intensified. The Study identified transit-supportive land use typology along the BRT corridors and recommended land use strategies and policies for implementation. Such land use recommendations have been incorporated into the City of Fresno's 2035 General Plan; the BRT is under construction at the recommended corridors and will be operating by spring 2018.

II. Adopted **CMP Alternative Strategies**

Based on the adopted CMP objectives, the Steering Committee endorsed a list of alternative strategies that the jurisdictions in Fresno County are encouraged to implement before roadways are widened. Those strategies are categorized as follows:

- Transportation System Management Strategies
- Travel Demand Management Strategies
- ITS Strategies
- Land Use Strategies
- Public Transit Strategies
- Bicycle and Pedestrian Strategies

A Toolbox for Alleviating Traffic Congestion published by the Institute of Transportation Engineers was referenced in developing the list. The ITS strategies were incorporated from the Fresno County Intelligent Transportation System Strategic Deployment Plan.

Table 5. Fresno County CMP Strategies-Transportation System Management
Strategies

Intersection Operational Improvement	Existing Traffic Signals	Equipment update & maintenance
		Timing Plan Improvement
		Interconnected & synchronized signals
		Transit Signal Priority
	Other Traffic Control	Roundabouts
		Traffic Signal Removal
Geometric changes and bottleneck alleviation	Restriping	
	Installation of turning lanes	
	Adding lanes (bottleneck removal only)	
	Realignment of intersecting streets	
Arterial Access management	Left turn restrictions; curb cut and driveway restrictions	
	Reduce conflict points	
	Eliminate parking	
	Consolidate access points	

Table 6. Intelligent Transportation System Strategies

Traffic/Freeway Management Systems	Ramp metering and communication Gap Closure
	Multi-jurisdictional interconnects
	Integrated Smart Corridors (SR41/168/180)
	Railroad/highway interface technology for railroad crossing
	Communications interties
	Integrated Surveillance stations/callbox deployment
	Regional Intersection Safety and enhancement program
Incident Management/Emergency Services	Weather Sensing/ATMS integration
	Variable speed system/smart or intelligent roadway studs
	Remote surveillance and incident scene management
	Computer Aided Dispatch Integration
	Integration of Communications channels
	Incident Management/Response Coordination Task force
Transit System	Form a Regional Transit District
	Transit Operations/Dispatch centers integration
	Transit Information System
	Transit Management System Completion/Expansion
	Implement Regional Farebox System

Table 6. Intelligent Transportation System Strategies –continued

	Regional transportation user information system
Transportation User Information Systems	Regional transit user information system
	Coordination with Valleywide/statewide information system
Regional ITS Configuration Management /Coordination/Planning	Valleywide/statewide communications linkages
	Regional Configuration Management
	Common/Standard regional/county map

Table 7. Public Transit Strategies

	Add new routes
Modify bus routes & service modification	Extend bus and feeder bus routes
	Increase bus frequency
	Limit stop or express bus routes
Provide exclusive bus lanes	
Construct bus shelters & improve passenger amenities	
Improve bicycle routes to transit facilities	
Park & Ride lots for transit & rideshare	
Provide information service for all transits	Build information center for all buses

Table 8. Travel Demand Management Strategies

Ridesharing	Carpool
	Vanpool
Telecommuting	
Alternative Work Hours	
Car sharing	

Table 9. Bicycle & Pedestrian Strategies

Provide walking infrastructure
Improve bicycle facilities at transit stations and other trip destinations
Improve safety of existing bicycle and pedestrian facilities
Provide biking infrastructure to eliminate existing gaps and expand and enhance the existing bicycle network
Link bicycle and pedestrian improvements to schools and retail developments
Road diet program
Bike share programs

Land Use Strategies

The following strategies, individually or in combination, reflect emerging and contemporary planning practices. These practices support sustainable developments that are appropriately-scaled for their environs and can provide transit-compatible densities or mixed land uses. These developments can lower traditional per capita energy demand and reduce distances traveled to work, goods and services and reduce the necessity and attractiveness of private automobile use. Further, when implemented by multiple agencies, these strategies can foster cooperative and sustainable regional policies.

The following strategies are independent of each other. A project that meets **all** the criteria of a strategy shall be considered supportive of the objectives of the Congestion Management Process.

1. Mixed-Use Development

- Projects that provide a mix of land uses -- defined as the practice of allowing more than one type of use in a building or set of buildings -- or that complement existing land uses, and with residential uses within ¼ mile of other land uses.

- Projects that provide pedestrian linkage among different land uses in the mixed use development.

- Projects that provide a range of housing choices, 70% and above of which are planned for attached residential units.

Mixed-use development in this case does not include detached single-family development with stand-alone shopping centers, stand-alone hotels with residential space or stand-alone parking structures with ground floor retail.

2.   Infill and Redevelopment

-       Projects that are located in an existing urban area, defined here as served by urban services and within an existing incorporated boundary.

-       Projects that are located on abandoned, passed-over or underutilized land within an existing urban area as defined above.

-       Projects adjacent to and between currently developed areas.

3.   Transit-Oriented Development

-       Projects within a half mile of a transit stop or other COG-defined transit corridors.

-       Projects that contain a mix of uses such as housing, jobs, shops, restaurants and entertainment.

-       Projects that provide a range of housing choices.

-       Projects that provide a strong sense of community and of place.

-       Projects that increase "location efficiency" so people can walk, bike and take transit.

-       Projects that encourage transit use and minimize traffic impacts.

III. Strategy Implementation

As shown in the Fresno County CMP components flowchart in Figure 1, adopted CMP strategies will be integrated and implemented through the Transportation Improvement Program (TIP) process.

In order to encourage jurisdictions to employ alternative strategies for managing congestion/mobility issues, a point system has been established in the competitive funding program in the TIP process to incentivize CMP projects that will address congestion issues. CMP projects are eligible for up to five points in the TIP scoring system. The point system takes into consideration reoccurring and non-reoccurring delays throughout the region. Recurring delays were analyzed on the National Highway System (NHS) using 2015 NPMRDS data provided by the FHWA. For roadways segments with excessive delays --which are defined as having average travel speed at the peak hour of less than 35 miles per hour (mph) on freeways or less than 15 (mph) on arterials -- the CMP projects will be awarded two points; for segments with moderate delays, -- defined as having average travel speed at peak hour at 35-50 mph on freeways or 15-25 mph on arterials -- the CMP projects will receive one point. Figure 7 shows roadways with excessive and moderate delays.
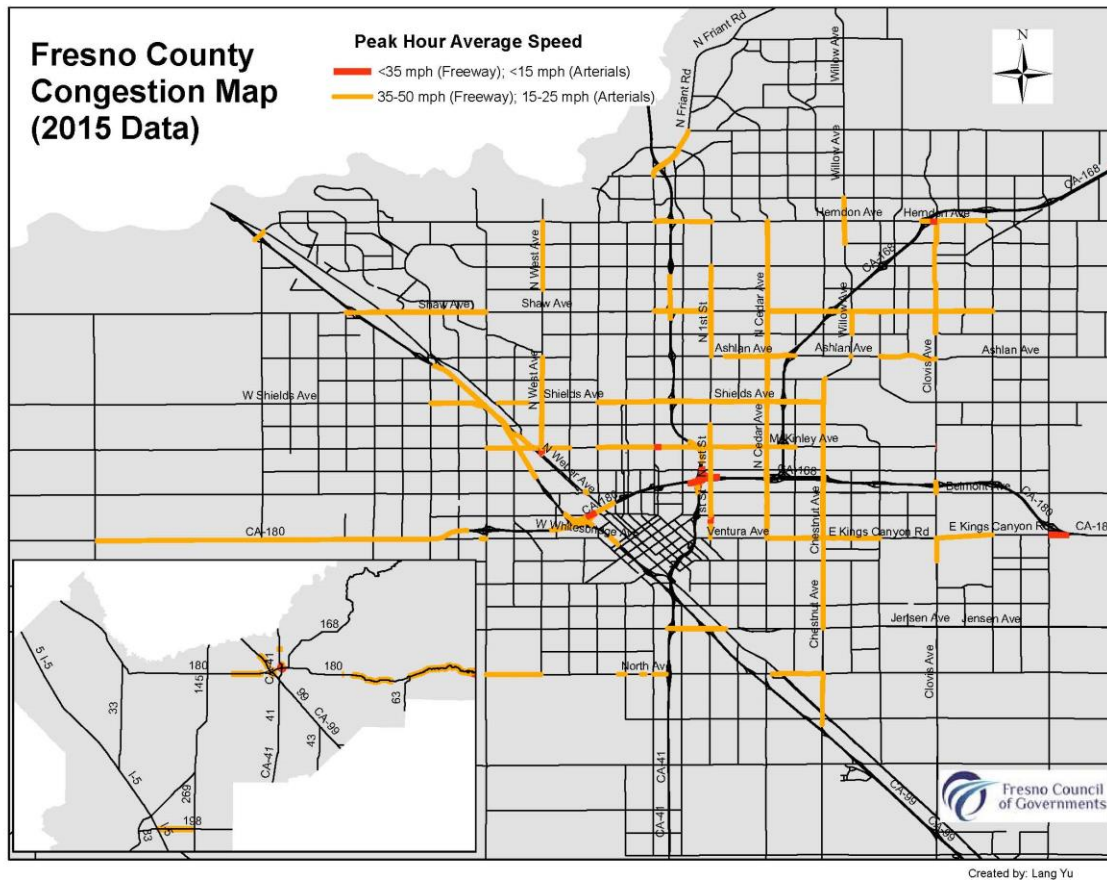
Figure 7

The non-reoccurring congestion is typically caused by traffic accidents, and collisions are used as the proxy for the non-reoccurring delay analysis in this CMP update. Transportation Injury Mapping System (TIMS) data is used in the collision analysis. The TIMS data is based on the California Statewide Integrated Traffic Records System (SWITRS). The collisions are geocoded and mapped statewide with a consistent methodology. The TIMS is housed and maintained by the Safe Transportation Research and Education Center at University of California, Berkeley. The 2009-2013 TIMS data, which was the most recent data available, was applied in Fresno COG's CMP update. CMP projects that address safety issues and fall on the segments that had the top 10th percentile in collision rates -- measured as number of collisions per 10,000 Average Daily

Traffic (ADT) -- will be awarded two points; CMP projects with safety components on locations that ranked among the top 25th percentile in total number of collisions over the analysis timeframe will receive one point. Projects that meet both of the criteria will receive the maximum two points. Figure 8 illustrates the distribution of locations that will receive safety-based points.
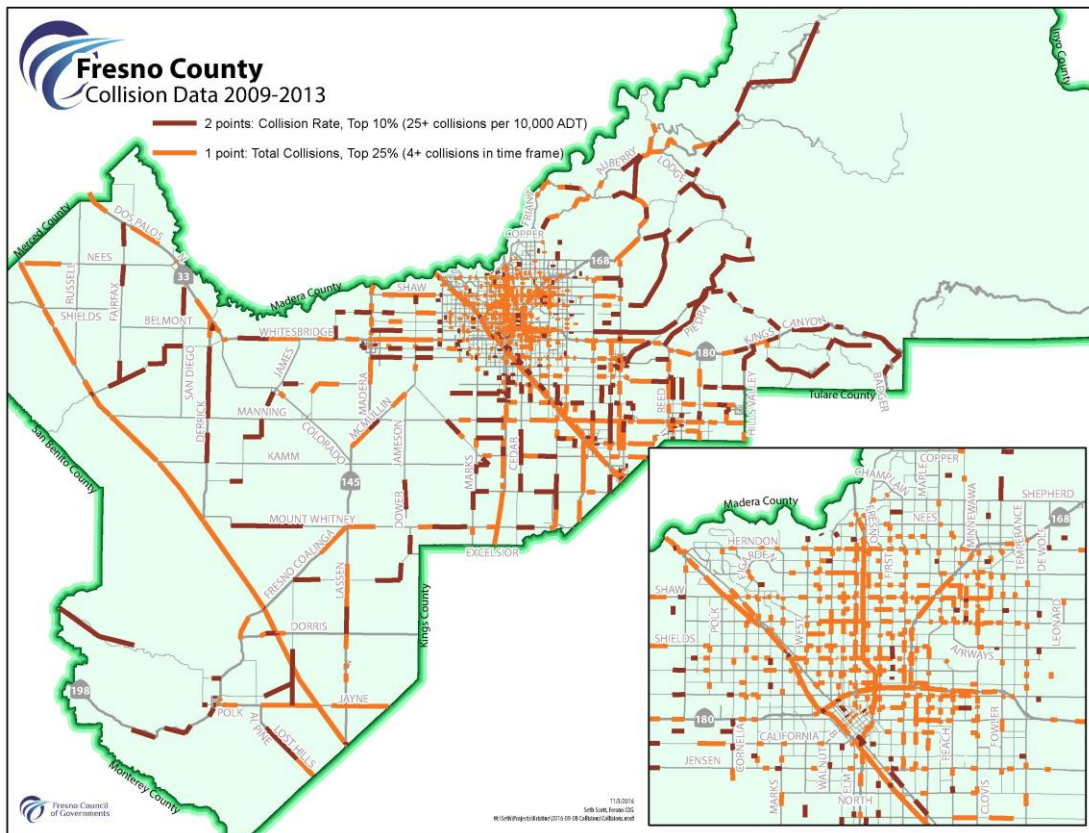

Figure 8

The delay/collision data and mapping analysis will be updated every other year so that the most up-to-date data will be provided to the project scoring process when a TIP call for projects is issued every other year. To encourage submittal of CMP project, the

Steering Committee also decided to grant one point to any CMP project regardless of the location.

CMP strategy implementation system details are documented with the TIP scoring process.

IV. Strategy Assessment

SAFETEA-LU and the subsequent MAP-21 and FAST Act require strategies to be periodically assessed to ensure their effectiveness, efficiency and consistency with the adopted performance measures. FHWA is expected to continue providing the historical NPMRDS data to the MPOs and it will be updated on the Congestion Monitoring Dashboard when it is available. Year-over-year comparisons of system performance can be analyzed on the Dashboard, which provides instant analysis results based on the performance measures.

An application will be developed in the Dashboard to analyze system performance using the final national performance measures. As discussed in the previous session, TIMS data will be updated every other year so that the most up-to-date information can be provided to the TIP process. In the meantime, collision data will be analyzed annually as part of the safety target update process. In addition, as required by the Transportation Performance Management process, system performance will be reported every four years by MPOs in the RTP updates for all the transportation performance measures, including system performance and congestion measures. Furthermore, the effectiveness of the CMP project funding mechanism can be evaluated by the number of CMP projects submitted and funded through the FTIP process. The continuous and consistent nature of this program has provided the region with a great tool to monitor changes of traffic conditions and system performance over time.

Chapter 8   Single Occupancy Vehicle (SOV) Projects Analysis

I. Legislative Requirements

SAFETEA-LU and its subsequent legislation, MAP-21 and the FAST Act, require that "in a TMA designated as a non-attainment area for ozone or carbon monoxide, federal funds may not be programmed for any project that will result in a significant increase in the carrying capacity for single occupancy vehicles (SOVs), (i.e., a new general purpose highway on a new location or adding general purpose lanes, with the exception of safety improvements or the elimination of bottlenecks), unless the project is addressed through a congestion management process."

The legislation further requires that the congestion management process shall provide an appropriate analysis of all reasonable travel demand reduction and operational improvement strategies for the corridor in which a capacity increasing project is proposed. If the analysis demonstrates that travel demand reduction and operational improvement strategies are not able to meet the demand for additional capacity, then the SOV project is warranted. In the meantime, the CMP should identify feasible alternative strategies to manage the corridors efficiently.

Fresno County is designated as a non-attainment area for ozone and is required to develop an SOV project analysis process to ensure that capacity increasing SOV projects are vetted through the CMP before they are accepted into the planning process. Since the CMP Steering Committee decided to limit the CMP network to urban freeways, the SOV analysis will be applied to the SOV projects on the CMP network.

II. Methodology
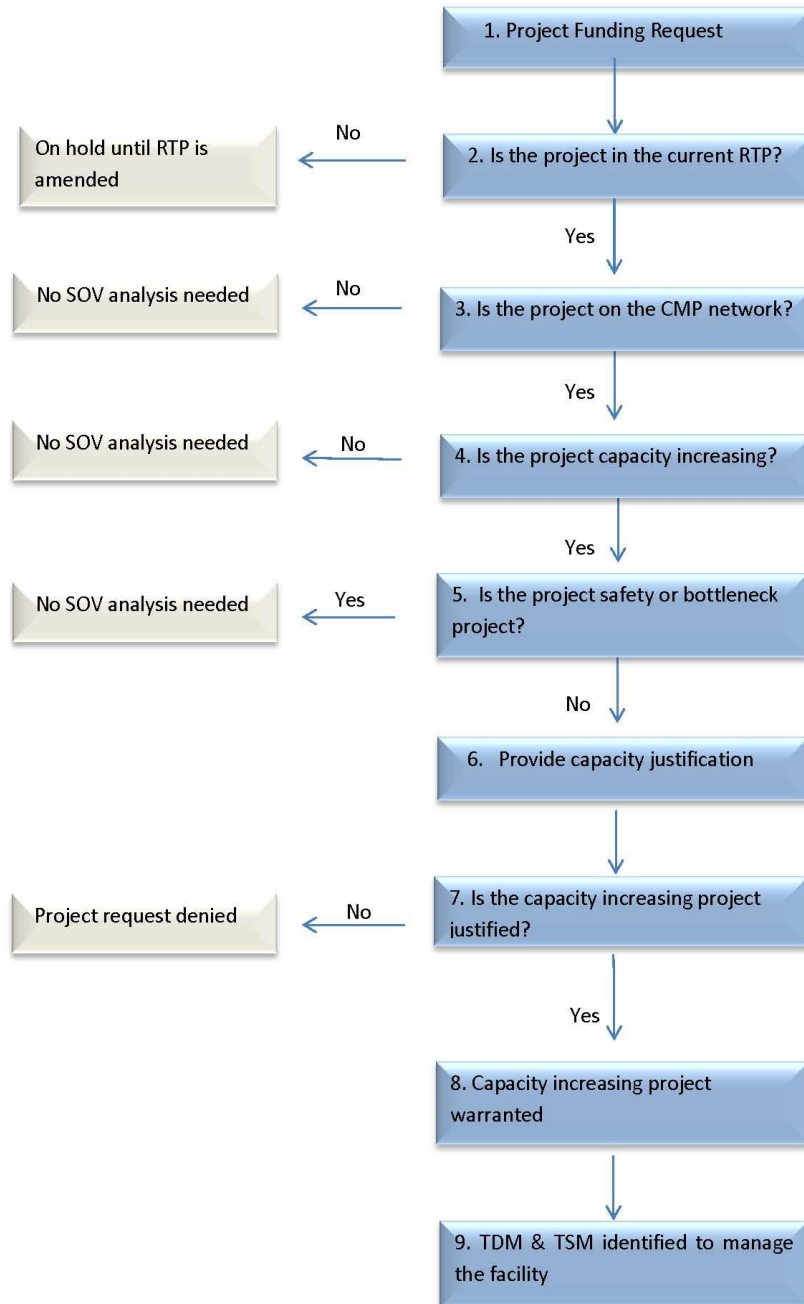
Single Occupancy Vehicle (SOV) Project Analysis

1. Project Funding Request

On hold until RTP is amended ← No — 2. Is the project in the current RTP?

Yes

No SOV analysis needed ← No — 3. Is the project on the CMP network?

Yes

No SOV analysis needed ← No — 4. Is the project capacity increasing?

Yes

No SOV analysis needed ← Yes — 5. Is the project safety or bottleneck project?

No

6. Provide capacity justification

Project request denied ← No — 7. Is the capacity increasing project justified?

Yes

8. Capacity increasing project warranted

9. TDM & TSM identified to manage the facility

Figure 9

The SOV analysis starts with the RTP process as illustrated in Figure 9, when project funding request is initiated. If the project is not in the RTP (step 2), then it is put on hold until it is amended into the RTP. If the project is in the RTP, the project proceeds to the step 3, which determines whether the proposed project is on the CMP network. Any projects outside the CMP network are not subject to the analysis.

If the project falls on the CMP network, then it moves to step 4. At step 4, the project is tested whether it is capacity increasing, i.e. a single occupancy vehicle (SOV) project that will result in a significant increase in the carrying capacities for drive-alone auto trips. A SOV/capacity increasing project is "a new general purpose highway on a new location or adding general purpose lanes, with the exception of safety improvements or the elimination of bottlenecks" 23 CFR 450.322 (e). Auxiliary lanes are not considered capacity increasing considering they are built between interchanges to facilitate speed change, turning, weaving, truck climbing, maneuvering of entering and exiting traffic and other purposes supplemental to through-traffic movement.

Once determined to be a capacity increasing SOV project, it proceeds to step 5 to decide whether it is classified as safety or bottleneck removal. According to the CMP regulation, safety or bottleneck removal projects are exempt from the SOV analysis. A safety project is designed to address a hazardous roadway conditions or to reduce/prevent fatalities and serious injuries on the roadway system. Bottleneck removal projects address recurring localized congestion points where the number of lanes decreases at ramps and interchanges and where there are roadway alignment changes. Typical bottleneck removal projects include: restriping, adding travel lanes for a short section by reducing lane widths and converting shoulders, adding lanes to accommodate entering and exiting traffic, modifying ramps, etc. If the capacity project is not considered as safety or bottleneck removal project, then the sponsoring agency is required to provide analysis to prove that other operational improvements or travel demand reduction strategies can't meet the demand for more capacity.

The capacity justification process begins with a density analysis of the freeway/roadway segment where the capacity project is proposed. Highway Capacity Manual (HCM) methodology is applied through which factors such as volume, ramp, auxiliary lanes, truck volume, enter/exiting volume and types of drivers are included. If the density analysis demonstrates that the roadway is congested and needs extra capacity, alternative strategies such as a parallel route study, ramp metering, carpooling (increased vehicle occupancy rates) are first studied. If such operational improvements or travel demand reduction strategies can meet the demand for extra capacity, then the project is rejected; however, if the analysis shows that the alternative strategies could not solve the congestion problem, the capacity project is justified and accepted into the RTP process. The sponsoring agency then identifies all the reasonable travel demand reduction and operational improvement strategies to manage the SOV facility.

Please contact Kristine Cai at kcai@fresnocog.org or   Kai Han at khan@fresnocog.org if you have any questions regarding the Fresno County Congestion Management Process.

Appendix I

FINAL TECHNICAL REPORT:
CONGESTION MONITORING TOOL FOR FRESNO COG

Table of Contents

INTRODUCTION

Fresno COG first developed its Congestion Management Program (CMP) based on legislative requirements. The CMP network included Regionally Significant Roads that "maintain and improve access between cities, accommodate a high level-of-service access to and within the Fresno-Clovis Metro Area, and to link regionally significant commercial, education, industrial and recreational facilities."   Similar to other counties at the time, the 2009 CMP was presented in an extensive electronic (PDF) report and published on the Fresno COG website for review by the communities.

In 2015, an update was initiated to the federally mandated CMP for Fresno County. Through a collaborative process with the local and federal agencies, Fresno COG led the following tasks to:

- **Redefine the CMP network:** The new CMP network consists of major freeways in the metropolitan areas in Fresno County, which are all part of the National Highway System (NHS). The new network allows for congestion monitoring where traffic congestion tends to be highest in the County.
- **Identify congestion performance measures:** using travel time and speed-based methods.
- **Gain agreement to use Big Data sources for the congestion analysis**.

This project builds upon the outcomes of the 2015 efforts and implements a Congestion Monitoring Tool.   At a high level, the congestion monitoring tool has two main components:

1. Real Time Data on the CMP Network;
2. Historical data from the National Performance Management Research Data Set (NPMRDS) on the National Highway System (NHS).

This report records the goals of the congestion monitoring tool, a description of its features and assumptions made.

OBJECTIVES

The goal of the congestion monitoring tool is to provide a web-based portal that allows Fresno COG (and member agencies) to monitor the performance of the:

1. CMP network; and
2. NHS network.

OVERVIEW OF THE FUNCTIONALITY

Fresno COG has indicated that the Congestion Monitoring Tool should do the following:

- Provide real time traffic performance information for the identified CMP network.
- Develop traffic performance analysis for the National Highway System (NHS) network and each of Traffic Message Channel (TMC) segment.
- Perform system-wide analysis for NHS network using travel time index, planning time index and delay developed by the CMP Steering Committee.

The tool is broken into two sections. The first section provides access to real time speed data on the CMP network. The second section provides access to historical NPMRDS data on the National Highway Network. A high level summary is provided in Table 1.

Table 1: High Level Summary

	Section 1: Real time data on the CMP network (TrafficML®*)	Section 2: Historical data on the NHS network (NPMRDS)
Description of Tasks:	Real time monitoring on the CMP network	Historical monitoring on the NHS network, both on a TMC basis and an area-wide basis.
Description of Data:	TrafficML® Data provided by HERE	NPMRDS Data provided by FHWA
Procured by:	Iteris on behalf of Fresno COG	Federal Highway Administration (FHWA) and provided free of charge to state departments of transportation and metropolitan planning organizations.
Applicable road segments	Fresno COG CMP Network	NHS in Fresno County
Real Time or Historical	Real time data which is stored so that users can look back at this data over time.	Historical data provided monthly and uploaded
Ingested into iPeMS by:	Connecting to a real time feed.	Provided through the FHWA Vendor Download Center on a monthly basis.
Screenshot		

* TrafficML is a registered trademark of HERE, North America LLC. HERE offers real-time speed and travel time data via their TrafficML® data feed.

BACKGROUND

SUMMARY OF RELEVANT LEGISLATION

Federal CMP legislation is applicable to this CMP effort and federal requirements are codified in the Code of Federal Regulations (CFR) Section 450.320. This section summarizes relevant parts from this document:

- The congestion management process shall include the methods of monitoring the Fresno CMP network, identify the causes of recurring and non-recurring congestion and measure the extent of congestion.
- The performance measures shall be tailored to the specific needs of the affected MPO.

THE MONITORING NETWORK

As part of this project, performance monitoring is conducted on two distinct networks of roads including:

1. The CMP Network
2. The NHS Network

Further details about each network are provided below.

Fresno CMP Network

In 2015, Fresno COG, in conjunction with the CMP Steering Committee, redefined the CMP network. It now consists of four freeway including SR 99, SR 41, SR 168 and SR 180. Refer to Table 2 and Figure 1.   This network applies to the monitoring in Section 1 of the Congistion Monitoring Tool.

Table 2: Fresno CMP Network

Route	From	To	Length (miles)
SR 99	Madera/Fresno County Line	Jensen Avenue Interchange	13
SR 41	SR 99 Interchange	Madera/Fresno County Line	11
SR 168	SR 168/SR 180 Interchange	Herndon Avenue Interchange	7
SR 180	SR 99/SR 180 Interchange	SR 168/SR 180 Interchange	4
Total			35

State Route 41 from
SR 99 Interchange to
Madera/Fresno
County Line

State Route 168 from
SR 180 Interchange to
Herndon Avenue
Interchange

State Route 99 from
Madera/Fresno
County Line to Jensen
Avenue Interchange

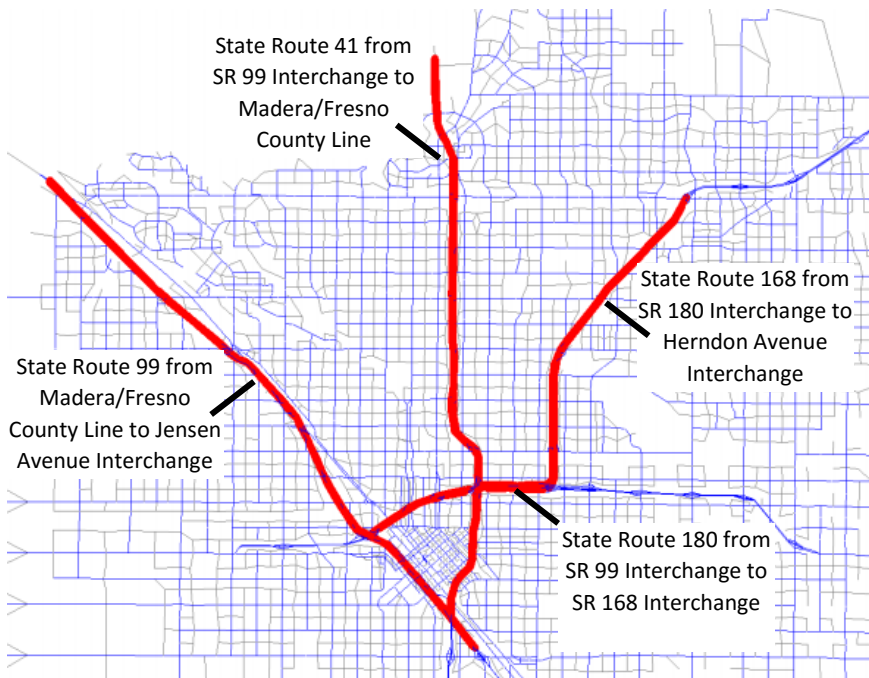State Route 180 from
SR 99 Interchange to
SR 168 Interchange

Figure 1: Fresno COG CMP Network

National Highway System (NHS) in Fresno County

FHWA has defined a network of roads that have national significance and provide the backbone transportation network for the country. Nationwide it consists of 160,000 miles, which is equivalent to approximately four percent of the nation's roads; yet it carries 40 percent of all highway traffic, 75 percent of heavy truck traffic and 90 percent of tourist traffic[1]. This network of roads applies to the monitoring in Section 2 of the Congestion Monitoring Tool.

The NHS is comprised of the following road networks:

- Interstates: The Eisenhower Interstate System of highways retains its separate identity within the NHS.
- Map-21 Principal Arterials: These are highways in rural and urban areas which provide access between an arterial and a major port, airport, public transportation facility, or other intermodal transportation facility.
- Strategic Highway Network (STRAHNET): This is a network of highways which are important to the United States' strategic defense policy and which provide defense access, continuity and emergency capabilities for defense purposes.
- Major Strategic Highway Network Connectors: These are highways which provide access between major military installations and highways which are part of the Strategic Highway Network.
- Intermodal Connectors: These highways provide access between major intermodal facilities and the other four subsystems making up the National Highway System.

For this project, additional monitoring is undertaken on the NHS within Fresno County. Refer to Figure 2.

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[1] Slater (1996) The National Highway System: A Commitment to America's Future
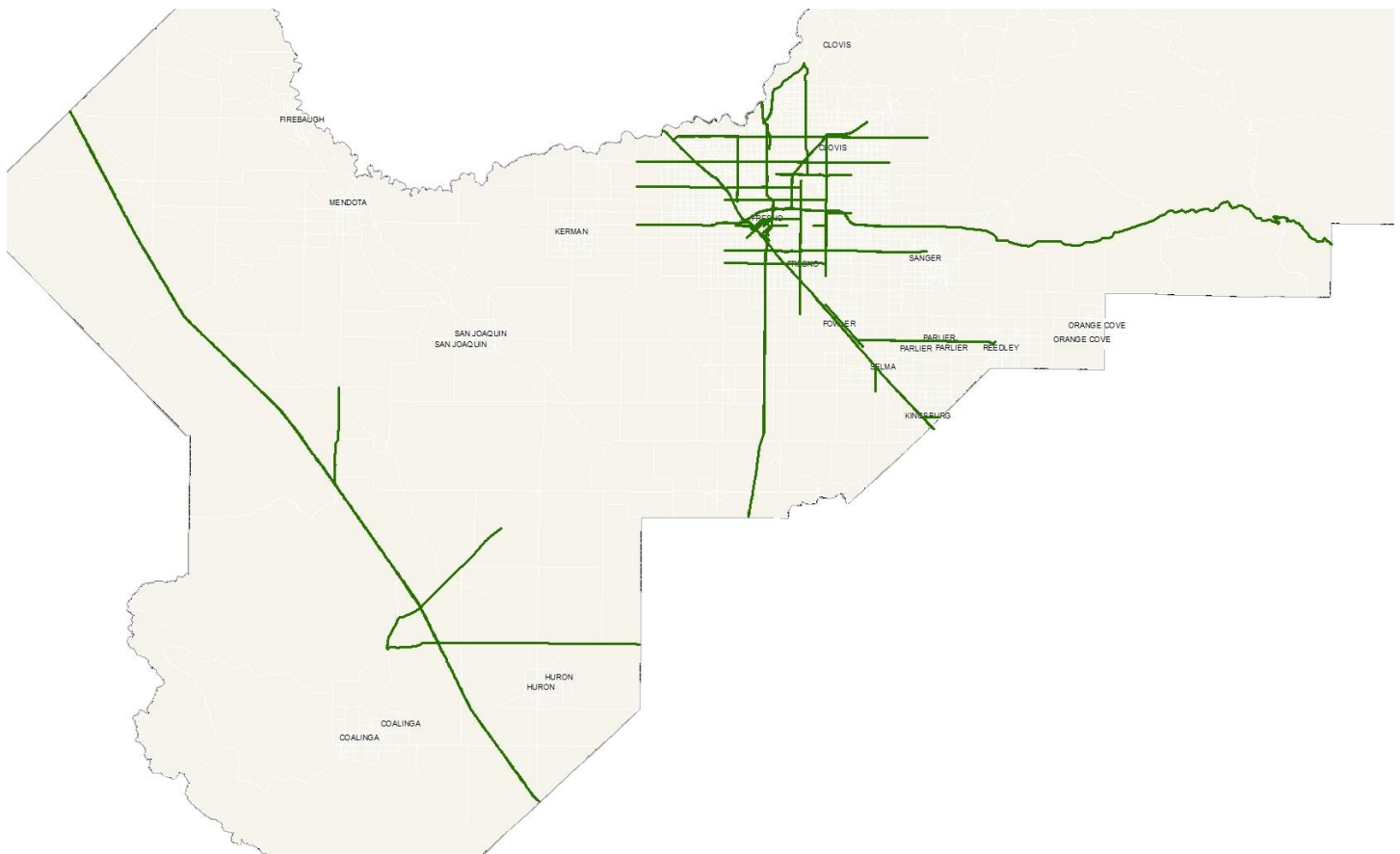http://www.fhwa.dot.gov/publications/publicroads/96spring/p96sp2.cfm

Figure 2: NHS in Fresno County

OTHER TERMINOLOGY

Third Party Data – Average speed and travel time data that is collected using vehicle probes that is provided by third party vendors like HERE, TomTom, or INRIX. Third party data may also be called probe data, commercial speed data or referred to by the vendor name i.e. HERE data, TomTom data or INRIX data.

NPMRDS – The National Performance Management Research Data Set (NPMRDS) is a third party dataset procured by the Federal Highway Administration (FHWA) and provided by HERE and INRIX.

Link – A small length of roadway reference to by third party data vendors when assigning traffic data.

- For HERE, this may also be called a Traffic Message Channel (TMC)
- For INRIX, this may also be called an XD segment or TMC

Route - A user defined directional path between two points containing one or more links.

Real time data – Data collected and/or presented as it occurs in the (or close to) actual time.

Historical data – Archived data of past conditions.

Report – This term is used in iPeMS to talk about graphs, maps or tabulated exports of performance data.

For descriptions of the performance measures used, refer to the Performance Measures section.

DATASETS

The project uses third party probe data from two sources:
- HERE TrafficML® Data – Sourced from HERE, this real time data is used on this project to provide performance monitoring on the CMP Network. Iteris procures this data directly from HERE.
- NPMRDS Data – The NPMRDS dataset is also sourced by HERE and provided to the project by Federal Highway Administration (FHWA). This historical dataset provides performance monitoring on the National Highway System (NHS).

This section describes the datasets in more detail.

HERE TRAFFICML DATA

HERE offers real-time speed and travel time data via their TrafficML® data feed. The system connects to the TrafficML® data feed to download the updated traffic information on each TMC for each minute. This data is then stored in the cloud. This data is used in Section 1 of the Congestion Monitoring Tool.

Under this arrangement, the data obtained includes the average speed and travel time of all sampled vehicles for a link of roadway for the given time period. It is not the average speed of each individual vehicle passing over the roadway; and transportation professionals should bear this in mind while using the data.

While there are no absolute conventions, typically:
- Freeways begin and end at interchange ramps. This means that there is generally a link on the freeway within the interchange and another link between interchanges;
- Arterials begin and end at major intersections;
- Rural roads begin and end at major cross roads; and
- Interchange ramps begin and end at the endpoints of each ramp. Where there are major merges and diverges within a ramp, i.e. commonly encountered on system interchanges, new links may start at these points as well.

It is noted that HERE links do not cover all roadways particularly as the roadways get smaller and less traveled. Where link codes do not exist, data from commercial speed providers is missing.

For Fresno COG's iPeMS instance, data is provided on four freeways as discussed in the Section titled Fresno CMP Network on page 3.

Important Points from the HERE TrafficML Data Sharing License Agreement

On behalf of Fresno COG, Iteris accesses the HERE data to use in the iPeMS tool. Refer to the Hosted Service Agreement in the contract. Access to this portion of the tool is provided to:

- Fresno COG employees;
- Fresno COG member agencies as designated by Fresno COG.

NPMRDS DATA

NPMRDS is produced for the Federal Highway Administration (FHWA) as a source for assessing mobility performance measures. FHWA makes the dataset available to State Departments of Transportation and Metropolitan Planning Organizations (MPOs) on a monthly basis to use for performance management activities. Data is also aggregated at a TMC level; similar to the TrafficML® data.

NPMRDS is an unmolded data set that only contains data if there was an actual observation, resulting in the prevalence of gaps. The system translates the raw NPMRDS into information that can be used for meaningful traffic performance analysis for Fresno County. Since the NPMRDS contains separate data for passenger cars and truck traffic, the Congestion Monitoring Tool evaluates these metrics for all traffic, passenger cars only, and truck traffic only.

This data is used in Section 2 of the Congestion Monitoring Tool.

Important Points from the NPMRDS Data Sharing License Agreement

The NPMRDS data agreement between FHWA and HERE® expired in February 2017 and the new contract between FHWA and INRIX® started in July 2017. FHWA is currently rolling out access to the new dataset and as of writing this report we do not yet have access to it. Our expectation is that that FHWA will continue to provide a comparable dataset available for performance monitoring purposes.

The data license agreement contains text specifying the permitted users of the dataset and the purposes in which they may use it. The following text is extracted from the NPMRDS Data Sharing License Agreement:

> *"Agency warrants that it is a State Department of Transportation or Metropolitan Planning Organization receiving federal transportation funds and is authorized by the US Federal Highway Administration to receive Data."*
>
> *"AGENCY may use Data:*
>
> - *to support performance management activities such as creating performance indicators, measures and evaluations;*
> - *to disseminate summaries of the Data to the public consistent with the organizations' transportation planning, programming, management and operations responsibilities as they pertain to performance management activities;*
> - *in transportation planning and operational analyses, service and data quality validation analyses; and*
> - *in applications for Agency's internal business.*
> - *to provide a copy of a spreadsheet of the data used in developing a plan or capital program based in part or on performance measurement if requested for validation of decisional materials.*
>
> *AGENCY may not use Data to make data sets or aggregated average travel time databases publicly available. For avoidance of doubt, the intent of this license is to enable AGENCY to provide summaries and statistics based on the Data but not to provide the Data in a form that would enable unlicensed parties to build databases of the Data."*
>
> *"Contractors. Agency may grant contractors the right to use Data for work performed for Agency under the Purpose defined in this Agreement."*
>
> NPMRDS Data Sharing License Agreement

In response to these requirements, the Congestion Monitoring Tool must be adapted to ensure that any raw NPMRDS data or aggregated NPMRDS travel time data is only available to:

- Staff at State Departments of Transportation i.e. Caltrans and Metropolitan Planning Organizations i.e. Fresno COG; and

- Contractors when they are carrying out work on behalf of an agency. Fresno COG shall grant Iteris the right to use the NPMRDS data for work under the purpose to support performance management activities. Iteris will hold in confidence and not disclose any confidential information of Fresno COG.

Summaries and statistics are provided to all users.

PERFORMANCE MEASURES

The congestion monitoring tool calculates a number of different performance measures on the data provided for both the CMP network and the NHS network. The resulting output can be used to meet the requirements of the CMP legislation and to support Fresno COG planning efforts. This section documents each performance metric and the calculation methods.

Figure 3 defines the performance metrics used in the monitoring tool. Table 3 presents information on which part of the dashboard implements a given performance measure. It also provides information on which road segments a particular performance measure is applicable to. For example, average speed is calculated on both a TMC basis and an area-wide basis under the NPMRDS section of the tool.

Average Travel Time (min)	Average amount of time to traverse a defined road segment
Average Speed (mph)	The length of a CMP segment divided by the travel time
Travel Time Index (TTI)	Ratio of average speed to the travel time at the reference speed, which is useful for comparing travel times across different segments
Planning Time Index (PTI)	Ratio of 95th percentile of the travel time to the reference travel time
Total hours of delay for all traffic	Delay experienced by all vehicles (measured in hours) measured relative to a nominated reference speed

Figure 3: Summary of Performance Measures

Table 3: Performance Measures and their applicability to each section of the Congestion Monitoring Tool

Performance Measure	Section 1: Real time TrafficML data on the CMP network		Section 2: Historical NPMRDS data on the NHS network	
	Spatial Unit	Vehicles	Spatial Unit	Vehicles
Travel Time	TMC or User Defined Route	Auto	-	-
Average Speed	TMC or User Defined Route	Auto	TMC † Area-wide	Auto, Freight, Both
Travel Time Index	TMC or User Defined Route	Auto	TMC † Area-wide	Auto, Freight, Both
Planning Time Index	TMC or User Defined Route	Auto	TMC † Area-wide	Auto, Freight, Both
Total Hours of Delay for all Traffic *	-	-	Area-wide	Auto, Freight, Both

* Incorporates volumes from Fresno COG, Caltrans PeMS and from other local traffic counts
† Access provided to those permitted under NPMRDS license agreement

The following sections provide additional details on each of the performance measures.

TRAVEL TIME (MINS)

Commercial speed data provides the average speed and travel time on lengths of road called links or Traffic Message Channel (TMC) links.

In Section 1 of the Congestion Monitoring Tool, individual links will be grouped together in order to report the travel time on user defined routes. In order to aggregate the travel time information, links in the correct direction are identified and the corresponding travel times are summed together. The travel time will also be available for any individual link.

Other performance measures are calculated from the travel time.

AVERAGE SPEED (MPH)

The average speed is a performance measure commonly used in congestion analyses. It is easy for the community to understand as they can equate it to their own driving experience.

The following equation is used to calculate the average speed based on the travel time and length.

$$Link\ Speed\ (mph) = \frac{Link\ Length\ (mi) \times 60}{Travel\ Time\ (min)}$$

TRAVEL TIME INDEX (TTI)

The travel time index is the ratio of the actual travel time (typically during a peak period) to a free-flow travel time. For example, if it takes 3 minutes to traverse a segment in peak hour and the free-flow travel time is 2 minutes, then the travel time index is 1.5. This metric allows for a comparison of travel time performance across many segments; it assesses the severity of congestion levels.

In the Congestion Monitoring Tool, the TTI is available on the same spatial segments and for the same vehicles as for the speed performance measure; except that for Section 2 of the Congestion Monitoring Tool, the TTI is also available to calculate area-wide performance measures on the NHS network.

PLANNING TIME INDEX (PTI)

The planning time index is the ratio of the 95th percentile travel time as compared to the free-flow travel time. This index is a measure of travel reliability. This measure represents how much total time a traveler should allow beyond the free-flow travel time to ensure on-time arrival in 95% of trips.

The PTI is presented similarly to the TTI for both sections of the dashboard.

TOTAL HOURS OF DELAY FOR ALL TRAFFIC

The total hours of delay for all traffic, is a measure of delay experienced by all vehicles relative to a nominated reference travel time. For this project, it will be calculated as an area-wide performance metric across the NHS network in Section 2 of the Congestion Monitoring Tool. It is calculated using the following information:
- Actual travel time experience for a specified time period;
- Reference travel time; and
- Volume of vehicles traversing over the segment.

Firstly, the excessive delay is calculated by subtracting the reference travel time from the actual travel time. Where a positive number remains, excessive delay is indicated. Next, the excessive delay is multiplied by the volume of vehicles on the segment to estimate the total delay experienced by all vehicles.

The reference travel time be calculated using a speed of:
- 35 mph for Interstates, freeways, or expressways
- 15 mph for principal arterials and all other NHS roads

Since NPMRDS does not provide volume information, the total hours of delay is calculated using average hourly traffic volumes for each day of the week using data provided by Fresno COG. They provided several spreadsheets containing hourly volumes for several county locations throughout Fresno County. Hourly volume data from the City of Fresno, City of Clovis, Fresno County, and Caltrans were also used. It should also be noted that the Fresno COG Travel Model was used in determining the annual growth rate for Fresno County (2% per year), and this was also used in developing the hourly volumes.

TOOL FUNCTIONALITY

Development of the tool revolves around three main efforts, as follows:

- Hosting operations
- Development of Section 1 of the Congestion Monitoring Tool: Real Time TrafficML® Data on the CMP Network
- Development of Section 2 of the Congestion Monitoring Tool: Historical NPMRDS data on the NHS network

These efforts are described below as they relate to both Section 1 and 2 of the Congestion Monitoring Tool.

HOSTING OPERATIONS

The Congestion Monitoring Tool uses the established iPEMS architecture developed for the Fresno COG (http://fresnocog.iteris-pems.com) and provide customization as discussed below. HERE TrafficML® data and NPMRDS data is stored in the cloud on an Amazon Web Service. The hosting operations is similar for both Sections 1 and 2 of the Congestion Monitoring Tool.

SECTION 1: REAL TIME TRAFFICML DATA ON THE CMP NETWORK

The purpose of Section 1 of the Congestion Monitoring Tool is to display real time and detailed information on Fresno COG's CMP network. The goals of the tool are to:

- Display trends on the CMP Network on a real time basis to allow users to examine the severity and reliability of congestion levels.
- Allow for creating and searching for customized routes.
- Calculate the performance measures on a CMP route or individual link.
- Visualize performance on graphs and tables.
- To allow users to export extracts of data or visuals for further analysis in tools such as Microsoft Excel.
- View and export the performance of all Fresno COG CMP routes.
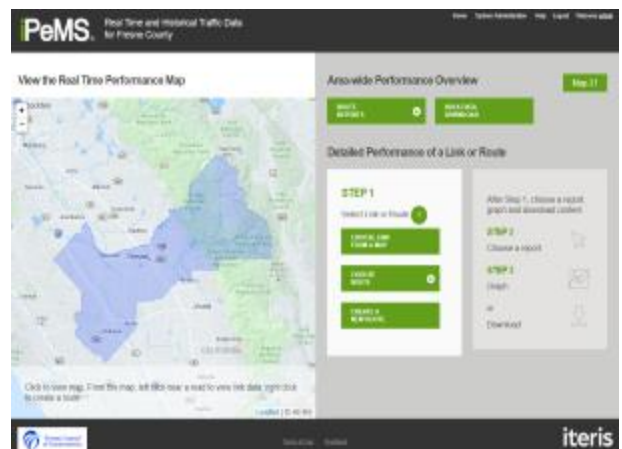
Real Time Map

Section 1 of the Fresno COG Congestion Monitoring Tool displays congestion information in a map format, allowing users to observe traffic conditions at a high level. As is widely used in the industry, traffic conditions are displayed using red/yellow/green lines correlating with the amount of congestion. In Figure 4, for any colored congestion line appearing on the map, the user is able to bring up a performance report comparing today's performance to the normal range. In addition to the speed layer, uses are able to view speed anomalies, data quality and the functional class (as designated by HERE).

> HERE TrafficML® data for four freeways (SR 99, SR 41, SR 168, SR 180) in the CMP network is displayed on a map
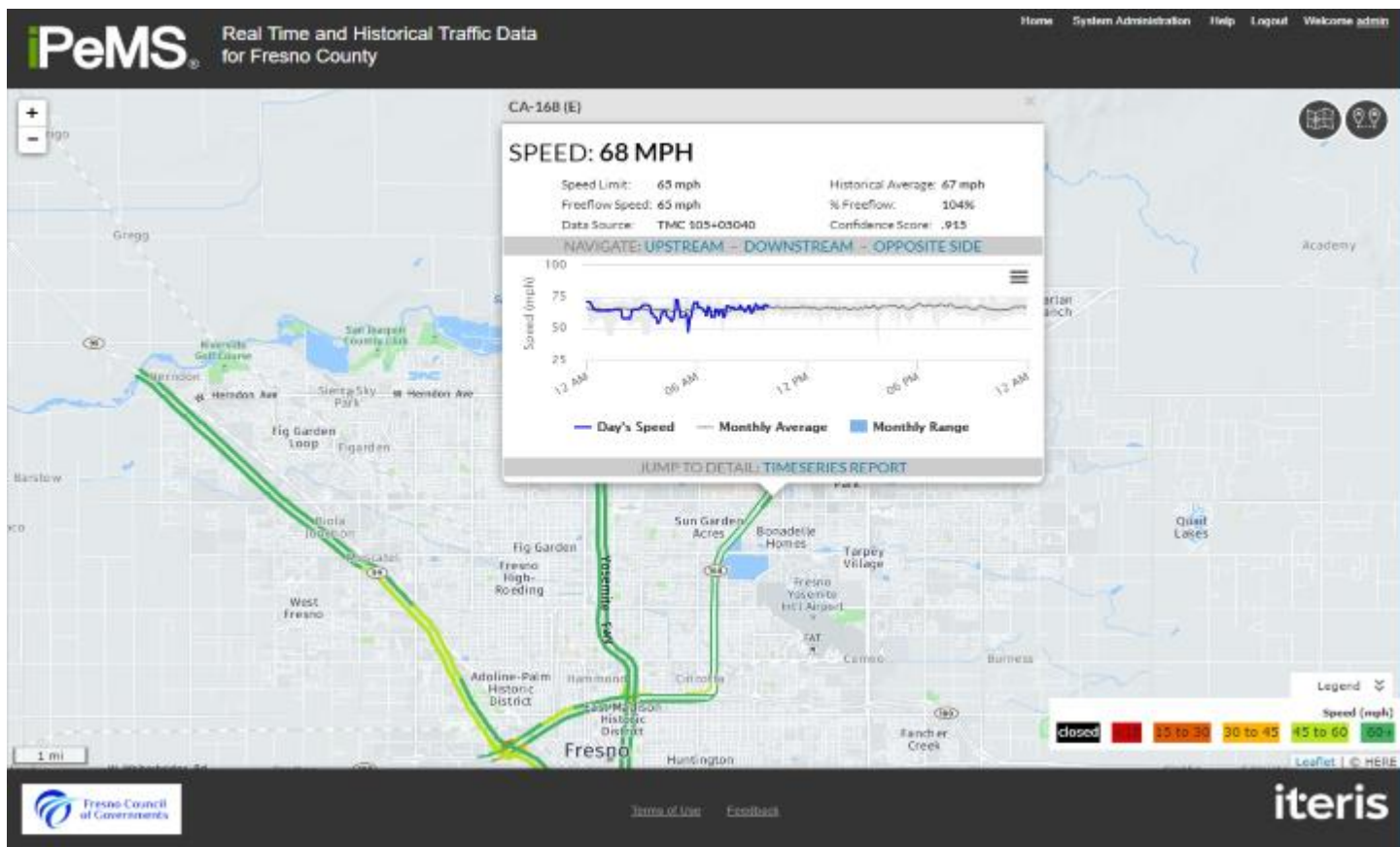
Figure 4: Example iPeMS Real-Time Congestion Map using HERE Data

Link Data

After finding a specific link from the real time map and clicking on the link to display the popup, the user is presented with an option to jump to the Timeseries report (Refer to Figure 4). At this point, users have the option to extract data using three reports, as follows:

- Timeseries: Shows variables over time.
- Time of Day: Shows averages of variables by the time of day; and
- Day of Week: Shows averages of variables by the day of week.
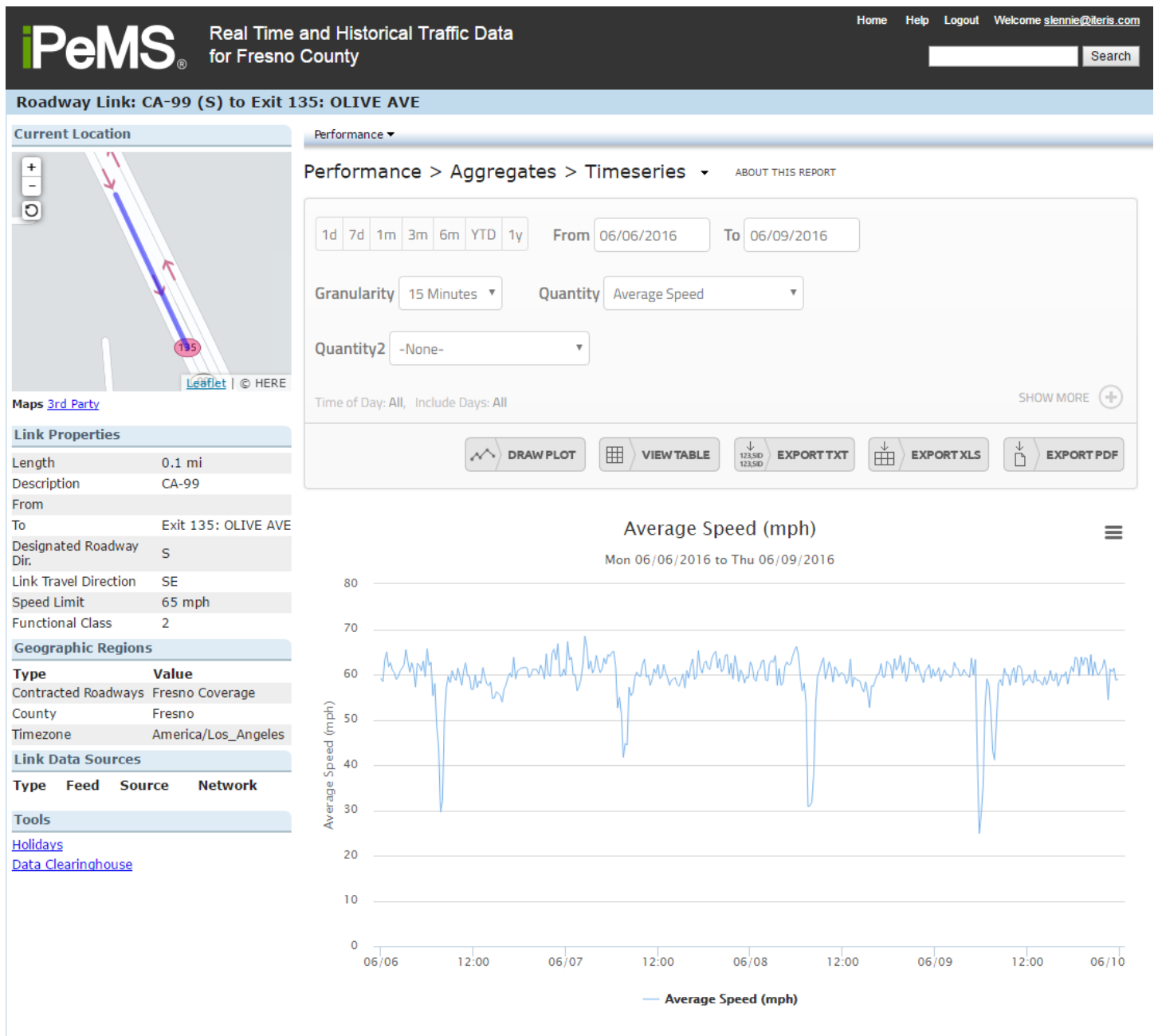
Figure 5: Example Timeseries Report

Route Data

A route is a user defined directional path between two points. Data is aggregated from multiple links by summing together the travel times. The tool provides functionality to search for existing routes, create new routes, obtain the performance of all routes in a single report and get detailed data for a specific route (Figure 6). An example route report is presented in Figure 7. The user are able to export these reports as an Excel compatible file and PDF file.

1. Searching for a Route

- Users are able to search for a Route using text searching.

2. Creating a Route

- Using a map, users are able to create a route by specifying the start and end locations of their route.

3. Area-wide Route Reports

- Users are able to extract the performance of all routes for a given time and date range. This report is useful for meeting legislative requirements. In addition, there is another report that can compare the performance from two different time periods.

4. Detailed Data

- In addition to the timeseries, time of day and day of week reports, users are able to review congestion visually in a contour or heat map.

Figure 6: Summary of Route Functionality

Figure 7: Example Daily Contour Plot showing average speeds along a route throughout the day

Analysis of CMP Segments

To meet CMP legislative requirements, it is recommended that the tool's route functionality should be utilized. The 'Create new route' function can be used to define each CMP segment on Fresno COG's CMP network. While the definition of the start / end points of each segment are completely at the discretion of Fresno COG and its stakeholders, it is recommended that new CMP segments be defined at:

- Major Interchanges on Freeways;
- Major changes in performance, such as at a bottleneck; and / or
- Major changes in land use on Arterials (not applicable for the current CMP effort, but a consideration if the CMP network is expanded in future monitoring cycles).

We recommend using a consistent description syntax to ensure that the routes are easily identifiable in later monitoring cycles. For example:

- CMP ID: ROAD NAME from START to END
- F3: CA-168 from E McKinley Ave to Shaw Ave.

Table 4: Syntax for defining CMP segments

CMP Text Description	Example	Comment
CMP ID	F3	It is recommended that each CMP segment be assigned an ID. Where multiples classes of road network are proposed, it is recommend that a letter be placed in front of the ID to designate the class of road eg F – Freeway, A – Arterial, R-Rural Highway. While Fresno COG's current CMP only contain one class of CMP segment, it is recommended that a letter be used in case future cycles expand the network to other classes of road. However, it is acceptable to use a simple ID numbering i.e. 1, 2, 3, 4 and so on.
Road Name	CA168	The road name and any potential cosigning alternatives or names.
Start	E McKinley Ave	The intersecting road at the beginning of the CMP segment or other placemark such as a County Line, culvert / bridge, major access point etc. It is recommended the consistent abbreviations be used for street suffixes eg St, Ave, Blvd, Rd.
End	Shaw Ave	Similar to the start point.

In addition to the description field, it is recommended that a tag 'Fresno COG CMP Network' be included. Refer to Figure 8.

Figure 8: Text used to define the CMP network

Once the CMP routes are defined, the iPeMS system begins to aggregate the data from that point in time. It is for this reason, that we recommend defining the routes early in the monitoring project. Next, the area-wide reports can be used to extract the performance of all CMP segments for the nominated monitoring period(s) (Figure 9). The nominated monitoring should be defined with consultation from the CMP steering committee. It typically includes a 6-8 week period in the fall or spring when school is in session. It is also typical to define the monitoring peaks and we recommend 7-9 am and 4-6 pm. Other off-peak or weekend monitoring periods may be defined as well.

Figure 9: Route Performance Report can be used to Extract CMP Network Results

SECTION 2: HISTORICAL NPMRDS DATA ON THE NHS NETWORK

The purpose of Section 2 of the Congestion Monitoring Tool is to display *aggregated* performance measures using the NPMRDS dataset from FHWA. The NPMRDS dataset contains average speed data for links on the National Highway System (NHS) for cars, trucks and all vehicles. The goals of the dashboard are:

- Display trends on the National Highway Network on a monthly basis to allow users to examine the severity and reliability of congestion levels.
- Calculate the performance measures on an area-wide basis.
- Visualize performance across the network in map and graph / table based formats.
- To allow users to export extracts of data or visuals for further analysis.
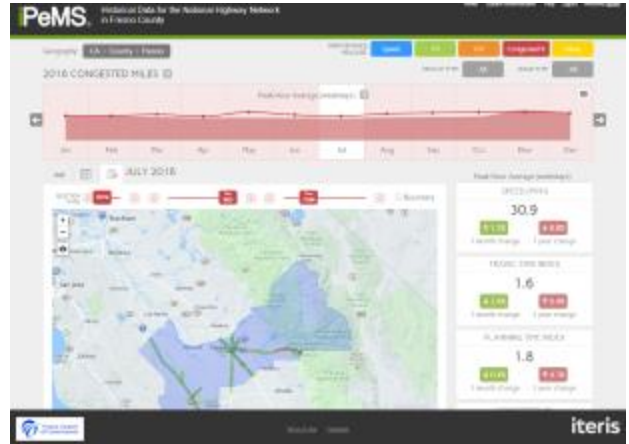
At a high level, the tool connects to the NPMRDS feed and ingest the data on a monthly basis. Since the NPMRDS data contains only observed data points, when there is no observation, there will be a gap in the dataset. Therefore, algorithms are applied to backfill the data. Once the dataset is ready, the system allows users to filter the data in order to isolate the relevant data. The system then aggregates the data and output the results. This process is summarized in Figure 10.

Figure 10: High Level Process for Building the Dashboard's Capability

As shown in Figure 11 the dashboard is split into two sections. The first section includes the MAP-21 performance reporting and the second section includes more traditional measures that display high level trends of the data. For Fresno COG, the team delivers the second section which displays high levels trends in the data (including travel time, average speed, travel time index, planning time index and delay). This part of the dashboard is useful for planners who want a more traditional approach to aggregating the data and more conventional performance measures; rather than the specific, and somewhat unusual requirements by MAP-21. For the MAP-21 part of the dashboard, Iteris undertook its development once the rulemaking is finalized, and Iteris have made this part of the dashboard available to Fresno COG as well.
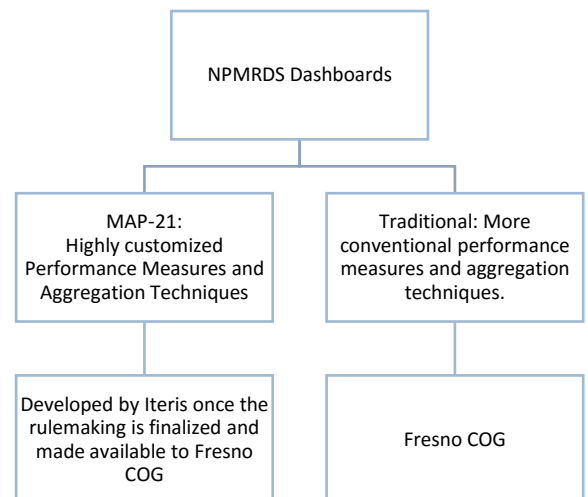

Figure 11: High level summary of Congestion Monitoring Tool Dashboards

The remaining sections in this document expand the effort needed to get the traditional dashboard implemented.

1. Ingesting the data

This task is to set up a process that collects NPMRDS data that is provided monthly from the NPMRDS login site hosted by HERE. Next, the team stores the data into a cloud hosted database.

There are a few considerations for this task, as follows:

- First, the NPMRDS data is provided monthly as a file that contains observed data points for each 5-minute period when data was collected. The system contains an automated process to load this file once per month.
- Second, Section 1 of the Congestion Monitoring Tool also currently processes data from real-time HERE data collected on the CMP network. Since the data overlaps for the two data sources, the design stores the NPMRDS and the aggregated HERE data separately. This means that the aggregation of the MAP-21 measures are based solely on the NPMRDS data.

At the end of this task, as is currently designed, the NPMRDS data is enabled into tables. A method is written to process the NPMRDS data monthly as it becomes available.

2. Backfilling the data

The NPMRDS only provides travel times on a link if there are actual observed probes during the 5-minute period. There are links where no data is provided for certain periods of the day. In order to produce meaningful performance measures from the NPMRDS, these gaps where no data is provided must be filled in through a data imputation process.

Using long standing practices from Caltrans PeMS, the gaps in the NPMRDS data are imputed using a series of imputation routines including temporal median, spatial link profiles, corridor profiles and corridor medians (Figure 11).
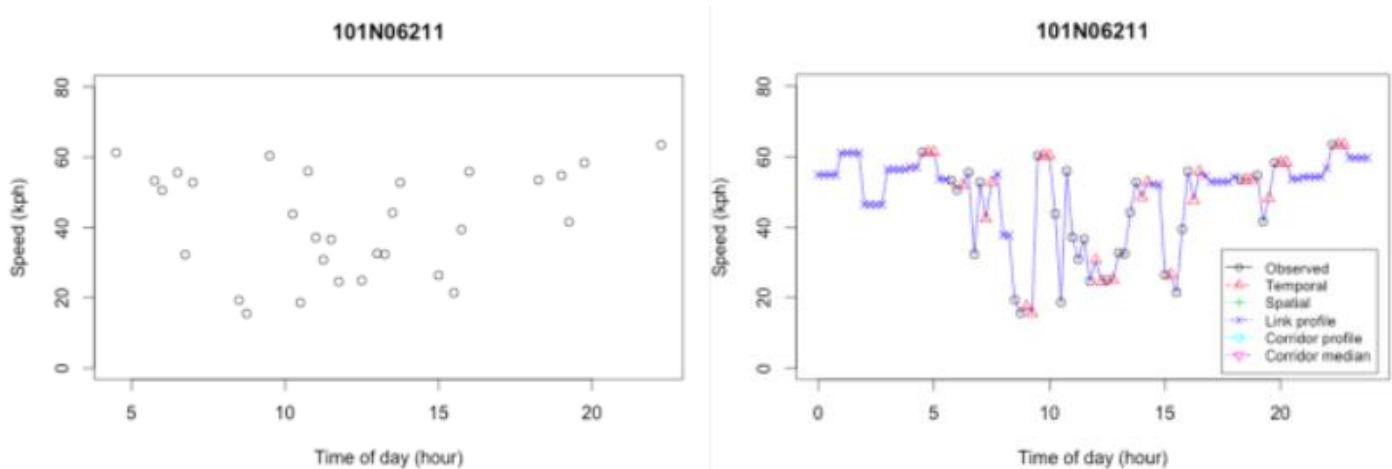

Figure 11: Imputation Processes a) Raw NPMRDS data before processing b) Processed data that fills in the data holes

3. Filtering the dataset

The NPMRDS dataset is a large dataset which provides data across a number of different dimensions, including:

- Cars, trucks, all vehicles
- Varying times of the day
- Different days of the week
- Different performance measures including the average speed, travel time, levels of congestion, TTI, PTI and delay

- Interstate and non-interstate routes across many routes
- The ability to display the data in different formats

In order for the tool to accommodate all these dimensions, careful consideration is needed to layout the various choices to users. The dashboard provides access to data on these varying dimensions as follows:

Select Vehicle Type

At the upper level of the dashboards, users can update their analysis to include freight vehicles only, passenger vehicles only or all vehicles.
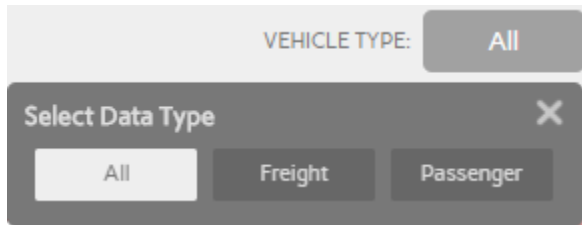
Select the Time of the Day / Day of the Week

In order to specify the time of day, users have an option to input the hour of the day in which they want to conduct the analysis for. Users have a further option to define the day of week to include.

Select the Performance Measure

As defined above, the user has the ability to select the performance measures including Average Speed, Travel Time Index, Planning Time Index, Congestion Percentage, and Delay.

Select Type of Road

The area-wide performance measures runs separately for interstate and non-interstate sections of the NHS network.
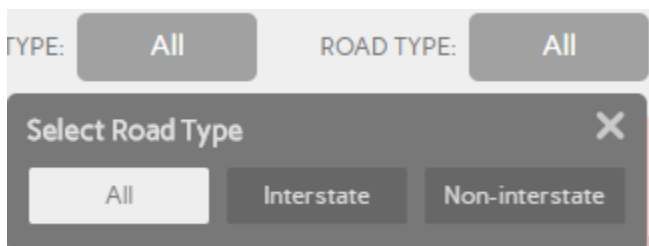

4. Aggregate

Using the backfilled NPMRDS data stored in the database and the inputs specified by the user, the system aggregates the data and calculate the performance measures. This is a backend process and the results are displayed as specified in the following section.

5a. Output Area-wide Results

The last task for the system is to display and export the results. Knowing that different audiences seek the results in different formats, the system provides options to report values, display the results on a map, display on a graph / table, and export the results in a variety of formats.

Report Dashboard Values

Using a display similar to the figure below, high-level values are displayed for each of the performance measures. It is noted however, that the results are displayed separately for interstate and non-interstate roadways.
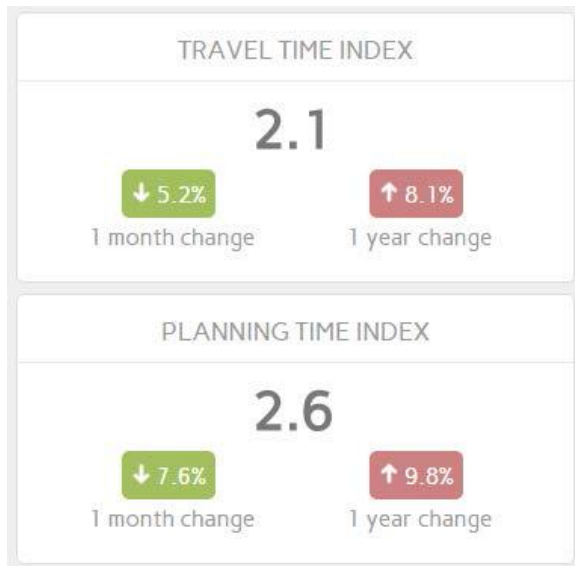
Visualize on a Map

The map-based output is used for two purposes:

Firstly, colored lines are displayed that correspond to the performance of that particular road segment for the given filters. The colors can be cross referenced to a legend to understand the cut off points for each color. Separate cut-off points and legends are used for interstate routes and non-interstate routes as the flow characteristics are different on uninterrupted flow routes such as freeways compared to interrupted flow routes such as arterials. For example, if the user has selected the Travel Time Index performance measure, the cut off for the 'green' category may be <= 1.0 for interstate routes, but 1.2 for non-interstate routes. The exact thresholds for each of the categories have been reviewed during the development of the map and shown as legends on the dashboard.

Secondly, the map is made clickable so that users can select a single link and review traffic data associated with the link for the given filters. Refer to 5b. Select and Output Link Results below for more details.

Visualize on a Table / Graph

Alternatively to viewing on a map, the data may be viewed on a graph or displayed on a table. The data is displayed on an area-wide basis such that the performance is summarized over the entire selected region. Graphs and tables are displayed separately for interstate and non-interstate links.

Table 5: Day of Week Table showing the average performance for different days of the week.

Days of Week	This Month	Previous Month	Previous Year
SUNDAY	1.3	1.2	1.2
MONDAY	1.9	2.0	1.8
TUESDAY	2.3	2.2	2.0
WEDNESDAY	2.3	2.2	2.0
THURSDAY	2.3	2.1	2.2
FRIDAY	2.2	2.0	2.1
SATURDAY	1.4	1.4	1.3

Export Results

Once, filtered and aggregated, the results can be exported in a variety of formats including:

- Comma Separated File (.csv)
- Microsoft Excel Format (.xlsx)
- PDF
- Copied to a clipboard
- Printed

5b. Select and Output Link Results

Similar to Section 1 of the Congestion Monitoring Tool, users are able to select a link from the map. After clicking on the map, a pop-up appears that confirms the name, length, direction, and ID. A graph is displayed showing the historical performance of autos, freight and all vehicles for the given day. To investigate further and extract more data for the link, the user can click the report link. Users can then extract the average performance by the time of day, or day of week using an interface similar to the link reports in Section 1 of the Congestion Monitoring Tool.
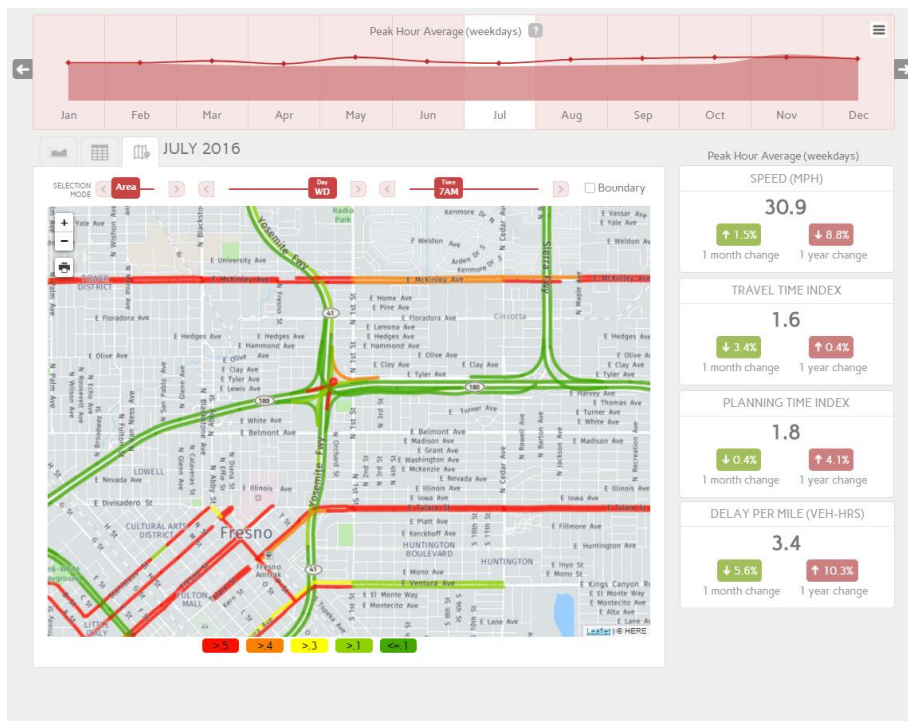
Appendix II

Fresno Council of Governments

Bicycle and Pedestrian Count Technology Deployment Pilot Project

Final Report

May, 2016

1.   Introduction

Fresno Council of Governments (Fresno COG) embarked on the Bicycle and Pedestrian Count Technology Deployment Pilot Project in April 2015, when Fresno COG was selected by the Federal Highway Administration (FWHA) as one of the ten Metropolitan Planning Organizations (MPOs) nationwide to receive $20,000 for the Bicycle and Pedestrian Count Technology Pilot Program. To strengthen the project funding, Fresno COG subsequently matched $7,000 in cash for this project.

The Pilot Project kicked off in May 2015 and was effectively managed through Fresno COG's Congestion Management Process (CMP). The CMP Steering Committee has meetings regularly to discuss project-related planning and technical issues.

Over the past year, we received guidance and technical support from FHWA and the technical team FHWA assembled together for this pilot program. The pilot project was well-received by local agencies and higher education institutes. Five local agencies (cities and county) and Fresno State University participated in the program. In addition, the vendor, Eco-counters, provided excellent technical and customer support.

Collectively by May 2016, the agencies and university have collected four months' worth of bike and pedestrian data covering 23 locations ranging from suburban multi-use trails, and university campus to downtown pedestrian mall.

After the one-year pilot project phase, Fresno COG and local agencies will continue the count data collection utilizing the equipment acquired during the project. This document is to summarize the progress of pilot program up to May 2016, and give an overview of the data collected and report on lessons learned. The raw data is summarized in this report, and is available upon request.

2.   Regional Settings

Fresno is the fifth largest city in California, and 34th in the nation, by population. Together with City of Clovis, the Fresno/Clovis Metropolitan Area forms the major urban core of the Fresno County. The population of the entire Fresno County has reached 1,000,000 according to the California Department of Finance (DOF) projection.

Located in the center of the California's San Joaquin Valley, Fresno has been challenged with a series of issues such as high poverty, air pollution and health related issues such as high asthma rate. A survey by the California Environmental Protection Agency (Cal-EPA) showed that several communities in Fresno are listed as the most disadvantaged communities in the State when measured against 19 environmental, economic and health factors. The region needs any help possible to promote alternative

transportation so that people will drive less, and walk and bike more, which can lead to better air quality and improved public health.

As MPO, Fresno COG is responsible for transportation planning for the Fresno region. Currently, through our Needs Assessment program, Fresno COG is conducting an inventory of existing and planned bike and pedestrian facilities in the region. Collection of bike/ped counts will complement the inventorying efforts and provide the communities with first-hand information about the usage of these facilities. Such bike/ped counts and infrastructure inventory will also be very usefully in developing bike/ped trip assignment for Fresno COG's regional travel demand model, which will be a huge step forward in quantifying the benefits of investment in bike/ped facilities.

Fresno COG's 2014 RTP/SCS proposed to invest $112 million in bike and pedestrian facilities by 2040. Development of a non-motorized count program will help the region monitor the progress of such investment, and help evaluate the effectiveness of the investment. The bike/pedestrian count program will be a nice addition to Fresno COG's 2015 CMP update, which proposes to monitor traditional traffic counts, speed/hours of delay, and also safety, travel cost, transit ridership, vehicle miles traveled, etc. The combination of the CMP and other transportation monitoring efforts will serve as a report card to our communities on the effectiveness of transportation investment in Fresno region.

In addition, Fresno COG is in the process of developing an Alternative Transportation Plan (ATP), which will help the small cities and communities in Fresno County develop their bike and pedestrian plans. The bigger cities such as City of Fresno and Clovis, and the County of Fresno have had such bike/ped master plans in place and have been actively seeking funding to implement them. The bike and pedestrian count program will help communities implement the ATP and provide solid data support for bike/ped project funding applications. Furthermore, with the adoption of Complete Street Policy in more and more local general plans, the local governments are eager to gather bike/ped data and set up guidelines for such Complete Street Policies. Engineers and planners from many jurisdictions in Fresno region have expressed strong interest in such non-motorized counts to Fresno COG staff. It will be a very popular program if implemented in Fresno region.

3.   Bike and Pedestrian Counting in Fresno Region

Conducting bike and pedestrian counts is new to this region. Before the pilot project, there is no historical bike and pedestrian data readily available. This pilot program provides a unique opportunity for local agencies and transportation planning community to get familiar with the state-of-the-art technologies and engage in the active transportation field with more accountable data.

The local agencies and university showed strong interest in the pilot program. Although the counter technologies are new to this region, the agencies are fortunate to have staff with ample experience of conducting vehicular counts, which is proven valuable. The following local agencies and university participated in the pilot project:

- City of Clovis
- City of Fresno
- County of Fresno
- City of Reedley
- City of Selma
- California State University, Fresno

4. Counter Technology Selection

As part of the pilot project, FHWA developed additional support and guidance for bicycle and pedestrian counting. Technical webinars sponsored by FHWA provided much information about best practices and state-of-art technologies in the fields of bike and pedestrian counting. The project steering committee used this information, with local conditions and project goals and objectives in mind, determined the selection criteria for appropriate technologies to adopt.

The criteria that were agreed upon require the counter technologies to be mobile, providing temporal coverage of continuous counting of at least two weeks, and capable of counting both bikes and pedestrians in a variety of environment including urban street, pedestrian malls, suburban trails, and rural/residential streets. Budget constrain is also a consideration as it affects the number of counters that can be deployed at the same time.

Based on the criteria, the steering committee looked into a host of vendors and their respective products. The counter technologies that were considered include:

- various People Counters from We Count People LLC, CountWise, to SenSource and Axper, and
- the following ruggedized traffic counters which were deemed more suitable for the intended outdoor environment:
  - MetroCount
  - Jamar
  - Iteris

3

- o Eco-Counter
- o Miovision
- o Chambers Electronics

After extensive consultation with local agencies and counter manufacturers, Fresno COG decided on a combination of PYRO Box counters and pneumatic TUBES counters from Eco-Counter based on the following considerations:

1. These counters are widely used throughout North America, having clients in 42 States.
2. Working together, the two types of counters will meet the needs for counting bike and pedestrian at various locations.
3. The one-year complimentary automatic data transfer plan will save agencies data retrieving efforts (after the one-year free period, agencies still have the option to manually download the data).
4. Having two counter types from the same manufacturer will simplify data processing.

Given the limited budget for the pilot program, Fresno COG purchased four pairs of PYRO Box and TUBES counters from Eco-counter, one pair being capable of directional counts and the rest non-directional.

The vendor, Eco-counters, provided very good professional and technical support. In addition, the local agency staff has a lot of field experience. The installation process turned out to be very smooth. The local university originally wanted to use their students to install the counters, but eventually decided to use a traffic counting firm to do that.

Since all the counters are all equipped with cellular upload units, all count data is automatically uploaded to Eco-counter's server. We have set up data management accounts for the agencies to monitor and analyze the data. Automated data retrieval also facilitated the field operations where agency staff is in short supply. It is worth noting, that one of the PYRO Box counter was out-of-spec due to insufficient range. The manufacturer promptly diagnosed the issue and provided a loaner unit while the affected unit was repaired.

5.   Count Location Selection and Scheduling

Five local agencies and one university eagerly participated in the pilot program. Each participating agency had multiple count locations proposed. The steering committee had to limit the location candidates to three per agency to balance the demand and the limited number of equipment available, while maintain good temporal coverage at each count locations.

Following the recommendation of the FHWA technical support team, the pilot program tried to allocate at least two weeks for each count location in order to capture enough temporal data to help determine the traffic pattern at a later time. COG staff tried their best to give each agency at least two-week of count time plus the transition period between agencies, while fitting the count schedule into the project's tight timeframe, which was further shortened by weather related factors, such as hot summer, wet winter, and holiday seasons. A copy of the scheduling spreadsheet can be found in Appendix A.

By May 2016, the program has gone through five agencies and one university. Each agency captured at least two-week's worth of data. In case of the university and City of Reedley, one month's of data were obtained by taking advantage of the holiday season and spring break.

6.   Data Reporting

An added benefit for using Eco-Counter technology is the capability of managing all the count data from a single centralized database. The agencies can access their data through a web interface called Eco-Visio. Eco-Visio platform is the data portal provided by Eco-counters for users to handle the backend activities of the count program, such as keeping inventory, managing counter locations, processing count data, conducting analyses, and generating reports. With technical support from Eco-Counter, COG staff was able to set up individual sub users for each respective agency. Agencies have full control to their own count data, which they can view and modify. In the meantime, a group user with viewer-only rights gives them the capability of sharing data among the agencies under the umbrella of Fresno COG.

Count reports can be automatically generated within Eco-Visio, which greatly facilitates the data analyses and data processing. Count reports for all the counts collected up to May 2016 under the pilot program at 23 locations in five jurisdictions within Fresno County can be found in Appendix B.

7.   Data Analyses

Students from California State University, Fresno, Department of Civil and Geomatics Engineering incorporated pedestrian and bike counts conducted by the University around its campus into their Transportation Planning and Design class project, and produced a report titled "Campus West Active Transportation Planning Pedestrian Survey and Non-Motorized Traffic Count". The report presented their analyses of the count data in conjunction with survey information and manual counts. A copy of the report can be found in Appendix C.

During early February 2016, City of Clovis conducted an interesting comparison of the data collected by the counters with video footage recorded by camera. The counting and video recording were conducted simultaneously at two locations on the city's Old Town Trail. They found the accuracies of the counts range from 16% under counting to 19% over counting. The factors affecting accuracy of bike/ped count include: trail users stopping in front of the PYRO counter, multiple trail users crossing the counters simultaneously, groups of trail users, strollers, and bike trailers. Detailed reports of the comparison can be found in Appendix D.

8.   Final Thoughts

The overall experience of the pilot project was positive. It generated a lot of interest among the local agencies with regard to counting pedestrians and bicycles. A number of agencies already express interest in performing additional counts at more locations in the future, or conduct before and after analysis for the reopening of pedestrian mall to vehicular traffic.

No doubt the collection of bike/ped count data will enhance the multi modal aspect of Fresno COG's and agencies' transportation planning process. The pilot project also provided a rare opportunity for Fresno COG and local agencies to access the state-of-the-art technologies and acquire valuable experience in the field. Lessons learned from the pilot project will benefit Fresno COG and local agencies in the future deployment of the technologies. Some of these considerations include:

- Selecting the count site requires careful planning, as suitable poles are hard to come by in rural settings. And sometimes, trees within the sensor range can generate false counts when certain combination of temperature and movement of the tree from blowing wind.
- In a trail setting, the pole that counters attached to can be attractive for people using it for stretching exercise, hence generating disproportionally large counts in a short amount of time.
- Smaller gauge tubes (Greenway tubes) present less tripping hazards for pedestrians, which is especially beneficial to trail counting. Since there is a strong interest among the local agencies to count the trails, the count program can benefit from further investment in purchasing more Greenway tubes.

Appendices

The Appendices and complete report can be found at http://www.fresnocog.org/congestion-management