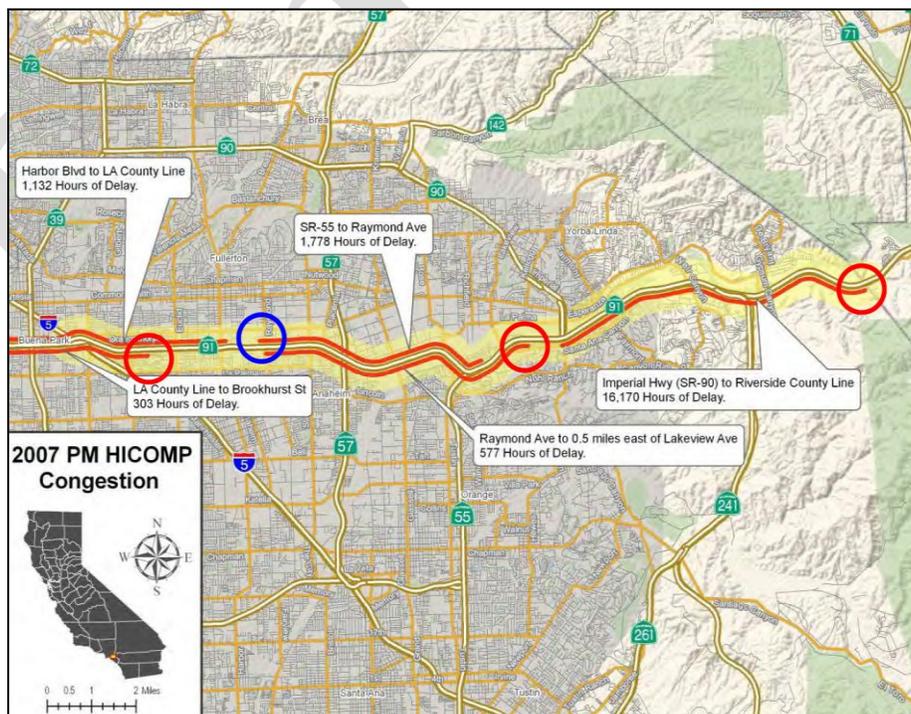


# Corridor System Management Plans

## Findings and Recommendations Initial Discussion Draft



District 12 SR 91 CSMP PM Congestion Map with Potential Bottlenecks (2007)

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This document has been prepared as an initial discussion draft for the purposes of coordinating with the California Transportation Commission regarding the Commission's expectations for a report addressing the development and implementation Corridor System Management Plans (CSMPs) as were initiated by the Commission as part of the Corridor Mobility Improvement Account and State Route 99 Bond Programs under the voter approved 2006 Proposition 1B. This is a discussion draft only and does not represent official findings, recommendations or positions of Caltrans, partner agencies, or the Commission.

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# Corridor System Management Plan (CSMP) Routes

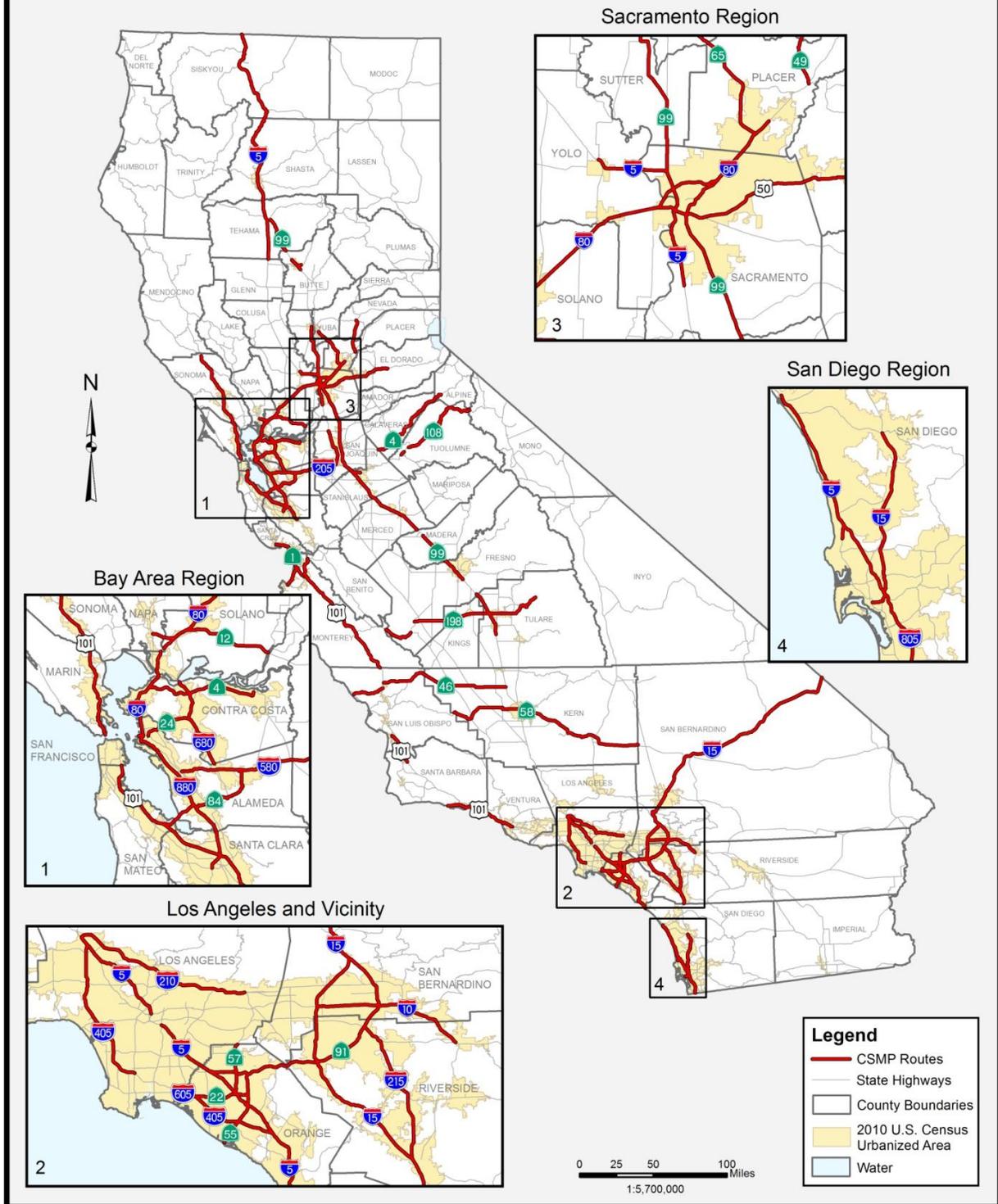


Figure 1: CSMP Routes Map

## 1. FINDINGS

A Corridor System Management Plan (CSMP) was required by the California Transportation Commission (CTC) for each highway project funded under the 2006 Proposition 1B Corridor Mobility Improvement Account (CMIA) and State Route (SR) 99 Bond Programs. The basic intent of requiring a CSMP was to ensure that the mobility gains generated by the Proposition 1B projects would be sustained in the future through the implementation of traffic operations and system management strategies as well as select capital expansion investments based on system monitoring and performance measurement. This was to be undertaken in a partnership environment involving Caltrans, regional transportation planning agencies, and modal operators. The underlying goal was to maximize the multi-modal productivity of the existing transportation system, particularly in heavily congested urban corridors, as efficiently as possible. This report focuses on successes and difficulties of developing and implementing CSMPs, and outlines recommendations for continuing and expanding the CSMP approach. All of the individual CSMPs associated with the CMIA and SR 99 Bond projects can be found at:

<http://www.dot.ca.gov/hq/tpp/corridor-mobility/>

### Findings:

1. Corridor level analysis and the subsequent application of corridor level system management strategies and operations projects are effective means of optimizing the productivity of the existing transportation system at a relatively low cost as compared to traditional highway capacity expansion.
2. A CSMP can be an effective partnership based approach to creating plans that identify and guide improvements on congested urban corridors. The plans are unique in their ability to analyze existing corridor conditions, forecast project corridor performance through scenario testing utilizing complex traffic simulation models on a corridor-wide scope, to recommend consensus-driven long-range implementation strategies.
3. The CSMP development process within Caltrans is most effective when it is a joint effort between the Divisions of Transportation Planning and Traffic Operations.
4. CSMPs require a consensus-driven effort developed in conjunction with partner agencies and stakeholders so that analysis and recommendations therein will be relevant among all jurisdictions and agencies with transportation responsibilities along the corridor and so that a diversity of partnership based funding opportunities are applied to the corridor.
5. Traffic simulation tools, whether microscopic or macroscopic, are essential in supporting CSMP development, particularly in the most congested and complex corridors. For rural and non-complex corridors, traditional analysis tools are generally sufficient.

6. Where sophisticated analysis tools such as micro-simulation are applied, lengthy corridors should be broken into smaller, more manageable segments in order to minimize costs for data collection, and model validation and calibration. Rather than simulating an entire corridor that may extend in excess of 20 or 30 miles, the more detailed analysis should only be applied to the portions of the corridor where it is necessary. Less complex and more quickly developed macro-models should be applied to the entire corridor.
7. For corridors with micro-simulation models, operations strategies and capital improvements can be analyzed in a scenario testing manner where a menu of options are tested and the best set selected. It also permits an analysis of option phasing so that various improvements can be implemented when needed.
8. Limited data availability for off-highway system roadways, transit facilities, and truck operations make it impractical to adequately model these corridor components. There currently is no widely available off-system operations data that is comparable to what is available for urban freeways.
9. In developing the CSMPs, the micro-simulation modeling capabilities of Caltrans staff, partner agencies, and consultants were stretched beyond their capacity due to the simultaneous development of numerous models and due to the length and complexity of many of the CSMP corridors.
10. In order for Caltrans to sustain the CSMP approach, Caltrans will need to expand staff capacity and expertise to develop, maintain, update and use a wide array of modeling tools. Caltrans will also need to expand technically based partnerships with regional partner agency modeling staff and make more effective and efficient use of consultant services.
11. CSMPs can serve as the Transportation Concept Report (the long-range plan for each route in the State Highway System) for the segments of the route identified within the CSMP.
12. For rural highways that do not experience severe traffic congestion, system management and operations approaches should be incorporated into the System Planning process through utilization of the new Transportation Concept Report guidelines, which include more in-depth analysis, additional performance measures, multi-modal transportation considerations, and an operational concept for the route.
13. While CSMPs are focused on congestion reduction and optimizing system performance, all of the implementation actions must also be relevant in addressing green house gas (GHG) emissions reductions, community impact reductions, and other considerations that are linked to the transportation system.

# Corridor System Management Plan (CSMP) Simulation Modeling Effort

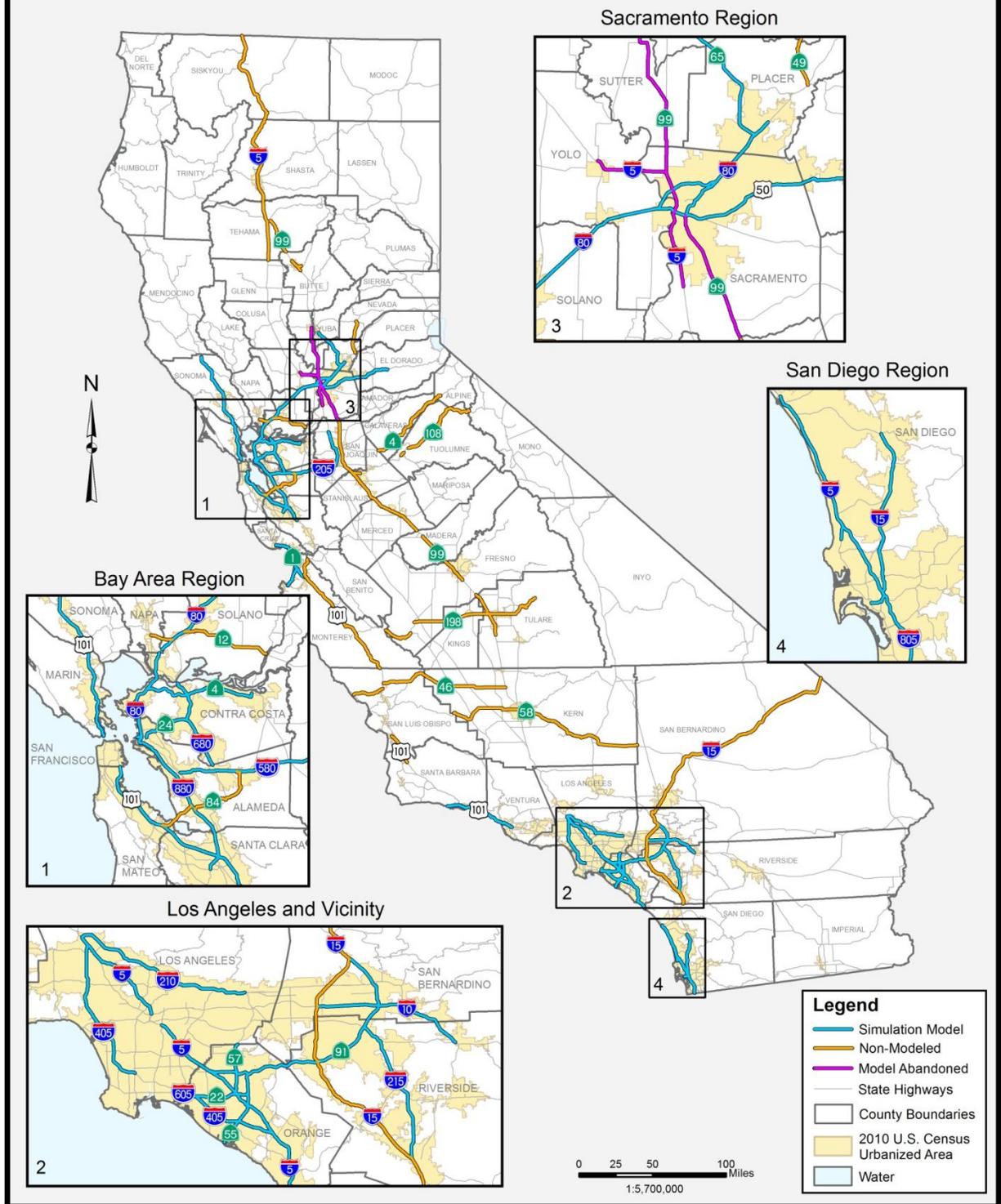


Figure 2: CSMP Simulation Modeling Effort Map

## Corridor System Management Plan (CSMP) Routes

District	MPO / RTPA	County	Corridor	CSMP Limits	CMIA/SR 99 Project(s)
2	TCTC	Tehama	SR 99*	Entire County	#12 - Los Molinos
2	TCTC, SRTA, SCTC	Tehama Shasta Siskiyou	I-5	Entire Counties	#46 - Cottonwood Hills Truck Climbing Lane; #60 - South Redding 6-Lane; and #82 - I-5 Deschutes Rd IC
3	BCAG	Butte	SR 99*	Southgate to Esplanade	#1 - Butte SR 99 Chico Auxiliary Lanes
3	BCAG	Butte	SR 32	SR 99 Ramp to Yosemite Dr.	#61 - But 32 Hwy Widening
3	NCTC, PCTPA	Nevada, Placer	SR 49*	I-80 at Auburn to SR 20 in Grass Valley	#19 - Rte 49 La Barr Meadows Widening
3	SACOG (EDCTC Included)	El Dorado	US 50	From I-80 in West Sacramento to Camino in El Dorado County	#9 - US 50 HOV Lanes - Phase 1 (#73 - US 50 HOV Lanes - Ph 2A Seg 1 combined with #9); #88 - US Route 50 HOV Ln; and #89 - Western Placerville IC Ph 1A
		Sacramento			#30 - Hwy 50 Bus/Carpool Lanes; #31 - White Rock Rd. from Grant Line to Prairie City; and #83 - SR 50 Watt IC
		Yolo			
3	SACOG (PCTPA Included)	Placer Yuba	SR 65	From I-80 in PLA Co. PLA/YUB Co. line PLA/YUB Co. line to SR 70	#25 - Lincoln Bypass (#72 - Lincoln Bypass Ph 2A Seg 1 combined with #25)
3	SACOG (PCTPA Included)	Placer	I-80	From SR 113 in Solano County to Sierra College Blvd. in Placer County	#26 - Pla 80 HOV Phase 2; #27 - Pla 80 HOV Phase 3; and #56 - I-80 HOV Ln – Across the top
		Sacramento			
		Yolo			
		Solano			
		Sacramento	SR 51 (Cap City Fwy.)		No CMIA Project
3	SACOG	Sacramento	SR 99*	SJ/Sac Co. line to SR 51 Jct.	#6 - Add Aux Ln Calvine to N Mack Rd on 99
				Junction I-5 to SAC/SUT Co. line	#7 – SR 99/Elverta Road Interchange
		Sutter		SAC/SUT Co. line to SR 20 Jct.	#10 - SR 99/Riego Road Interchange; #11 - Sutter 99 Segment 2; and #14 - SR 99/SR 113 Interchange
		Sacramento Yolo	I-5	Hood Franklin Blvd to SAC/YOL Co. line SAC/YOL Co. line to SR 113 Junction	No CMIA Project
4	MTC	Alameda	SR 84	I-680 to I-580	#62 - Ala 84 Expressway
4	MTC	Alameda	I-580	I-580/I-205 IC to I-80/I-238 IC in Alameda Co.	#1 - I-580 EB HOV Hacienda to Greenville; #2 - I-580 WB HOV Greenville to Foothill; and #3 - I-580/Isabel IC
4	MTC	Alameda	I-680	Requires Verification**	#95 - Freeway Performance Initiative
4	MTC	Alameda	SR 24	SR 24/I-580/I-980 IC in ALA Co. through Caldecott Tunnel to SR 24/I-680 IC in CC Co.	#5 - Rte 24 Caldecott Tunnel Fourth Bore
		Contra Costa			
4	MTC	Alameda	I-80	SF Oak Bay Bridge Toll Plaza in ALA Co. to Carquinez Bridge in CC Co.	#8 - I-80 Integrated Corridor Mobility Project
		Contra Costa			
4	MTC	Alameda	I-880	I-880/I-280 IC in SCL Co. to I-880/I-580/I-80 IC in ALA Co	#4 - I-880 SB HOV Lane Extension
		Santa Clara			#42 - I-880 Widening (SR 237 to US 101); and #70 - I-880/I-280 Stevens Creek Interchange Improvements

**Figure 3: CSMP Routes List**

District	MPO / RTPA	County	Corridor	CSMP Limits	CMA/SR 99 Project(s)
4	MTC	Contra Costa	SR 4	SR 4/I-80 IC to SR 160 in CC Co.	#7 - SR 4 E Widening from Somersville Rd to SR 160 (#71 - SR 4 Bypass Fwy Phase 1 & 2 combined with #7)
4	MTC	Contra Costa	I-680	Entire County	No CMA Project
4	MTC	Napa Solano	SR 12	SR 12/SR 29 in NAP Co. to Rio Vista Bridge in SOL Co.	#18 - SR 12 Jameson Canyon – Phase 1
4	MTC	Santa Clara San Mateo	US 101 S*	From SCL Co. SR 85/US 101 south through SM Co. to SM/SF Co. line	#43 - US 101 Aux Lns SR 85 to Embarcadero; #44 - US 101 Improvements (I-280 to Yerba Buena); and #75 - Capitol Exp Yerba Buena IC #41 - Widen US 101 and add Aux Lanes
4	MTC	Solano	I-80	Carquinez Bridge to SR 113 North	#47 - I-80 HOV Lanes Fairfield; and #65 - Freeway Performance Initiative
4	MTC	Sonoma Marin	US 101 N*	Golden Gate Bridge in MRN Co. through SON Co. to Junction with SR 128	#48 - US 101 HOV – Railroad to Rohnert Park; #49 - US 101 HOV Lanes – North Phase A; #50 - US 101 HOV Lanes – Wilfred; #55 - Central Project – Phase B; #69 - North Project – Phase B Airport IC; and #94 - Marin Sonoma Narrows C3 #15 - Hwy 101 Mtn-Son Narrows Project (#74 - MSN Petaluma Riv. Br. combined with #15); #16 - WB I-580 to NB 101 Connector Imprvmnt; #92 - Marin Sonoma Narrows A2; and #93 - Marin Sonoma Narrows A3
5	TAMC, SCCRTC	Monterey Santa Cruz Monterey	SR 1 SR 183	In SCR Co. from the SCR/MON Co. line to 1.7 Miles west of SR 17; and in MON Co. from SCR/MON Co. line to SR 68 West Lincoln Ave to Junction with SR 1	#17 - Salinas Road Interchange #45 - Hwy 1 Soquel to Morissey Aux Lanes No CMA Project
5	SLOCOG	San Luis Obispo	SR 46*	From SR 1/SR 46 Junction to KER/SLO Co. line	#40 - Rte 46 Corridor Imprvmnt (Whitley 1); and #79 - Whitley 2A
5	SLOCOG, SBCAG	San Luis Obispo Santa Barbara	US 101*	Clark Ave. near City of Santa Maria in SLO Co. to Grand Ave. in the City of Arroyo Grande in SB Co.	#58 - Santa Maria Bridge
5	TAMC	Monterey	US 101*	Entire County	#84 - San Juan IC
6	FCOG, MCTC	Fresno Madera	SR 99*	American Ave. in FRE Co. to SR 152 in MAD Co.	#2 - Island Park 6-Lane #3 - Reconstruct Interchange at Ave 12
6	FCOG, KCAG, TCAG	Fresno Kings Tulare	SR 198*	MON Co. line through FRE Co., KIN Co., and TUL Co., ending at the boundary with the Sequoia National Forest	#64 - Plaza Drive Interchange/Auxiliary Lanes
6	KCOG	Kern	SR 46*	Entire County	#10 - Route 46 Expressway – Segment 3
6	KCAG, TCAG	Kings Tulare	SR 198*	Lemoore NAS in KIN Co. to SR 99 in TUL Co.	#11 - Route 198 Expressway
6	TCAG, FCOG	Tulare Fresno	SR 99*	Ave. 184 in City of Tulare to SR 201 in City of Kingsburg	#13 - Goshen to Kingsburg 6-Lane; and #15 - Tulare to Goshen 6-Lane
6	KCOG	Kern	SR 58*	Entire County	No CMA Project
7	SCAG	Los Angeles	I-5	ORA/LA Co. line to I-710	#14 - I-5 Carpool Ln and Mixed Flow Ln

**Figure 3: CSMP Routes List**

District	MPO / RTPA	County	Corridor	CSMP Limits	CMA/SR 99 Project(s)
7	SCAG	Los Angeles	I-5	From I-10 West to I-210	#13 - I-5 Carpool Ln from Rte 134 to Rte 170
7	SCAG	Los Angeles	I-405	From I-110 to I-5	#12 - I-405 Carpool Ln I-10 to US 101
7	SCAG	Los Angeles	I-210	From SR 57 to I-5	No CMA Project
7 & 5	SBCAG, VCTC	Santa Barbara	US 101*	Winchester Canyon Creek in SB Co. to Rice Ave. in VEN Co.	#54 - HOV Lanes Mussell Shoals to Casitas Pass; and #85 - Union Valley Parkway IC
		Ventura			
8	SCAG	Riverside	SR 91	ORA Co. line to I-215/SR 60	#29 - HOV Lane Gap Closure
8	SCAG	Riverside	I-215	From I-15 in RIV Co. to I-15 in SBD Co.	#28 - Add one Mixed Flow Ln in each dir.; and #90 - 215 Widening Scott to Nuevo #33 - I-215 North Segments 1 and 2; #34 - State Route 210/215 Connectors; #35 - I-215 North Segments 5; #66 - I-215 Gap Closure; and #97 - Newport Ave OC
		San Bernardino			
8	SCAG	San Bernardino	I-10	From I-15 in SBD Co. to SR 60 in RIV Co.	#32 - I-10 WB Mixed Flow Lane addition; #36 - Widen exit ramps and add aux lanes; and #86 - I-10 Tippercanoe Ave IC
		Riverside			
8	SCAG	San Bernardino	I-15	From SBD Co./Nevada State line to RIV/SD Co. line	#76 - La Mesa Nisqualli Rd IC; #91 - I-15 Rancho Rd IC; and #96 - Duncan Canyon Rd IC
		Riverside			
10	CCOG, ALTC	Calaveras	SR 4	STA/CAL Co. line to Lake Alpine in ALP Co.	#6 - SR 4 Angels Camp Bypass
		Alpine			
10	MCAG, StanCOG	Merced	SR 99*	From North of SR 152 in MAD Co. to SR 165 in the City of Turlock in STA Co.	#4 - Arboleda Road Freeway; and #5 - Freeway Upgrade & Plainsburg Road IC
		Stanislaus			
10	SJCOG	San Joaquin	I-205	I-205, form ALA/SJ Co. line to I-5; I-5 from I-205 to SR 12 in SJ Co.	#39 - I-205 Auxiliary Lanes #57 - I-5 HOV widening and CRCP
			I-5		
10	SJCOG	San Joaquin	SR 99*	From north of SR 120 W in the City of Manteca in SJ Co. to SJ/STA Co. line	#8 - SR 99 (South Stockton) Widening; and #9 - SR 99 Widening in Manteca & San Joaquin
10	StanCOG	Stanislaus	SR 219	Entire County	#51 - Route 219 Expressway Phase 1; and #52 - Route 219 Expressway Phase 2
10	StanCOG	Stanislaus	SR 99*	In SJ Co. from MER Co. line to SJ Co. line	#17 - SR 99/Kiernan Interchange
10	TCTC	Tuolumne	SR 108	Entire County	#53 - East Sonora Bypass Stage 2
11	SANDAG	San Diego	I-15	On I-15, SR 94 to SR 78; and on SR 94 from I-5 to I-15	#37 - Managed Lanes South Segment; and #59 - Mira Mesa Direct Access Ramp
			SR 94		
11	SANDAG	San Diego	I-5	From La Jolla Village Drive to 1 mile south of Santa Margarita River and on I-805 from Carroll Canyon Rd to Junction with I-5	#38 - I-5 North Coast Corridor - Stage 1A; and #87 - I-5 SR 76 IC
			I-805		
11	SANDAG	San Diego	I-805	Entire route within District 11	#77 - HOV Lns – SR 54 to SR 94; #78 - HOV Lns – Palomar to SR 94; and #81 - 805 Managed Lns North

**Figure 3: CSMP Routes List**

District	MPO / RTPA	County	Corridor	CSMP Limits	CMIA/SR 99 Project(s)
12	SCAG	Orange	SR 22	SR 22 from I-405/I-605 Junction to SR 55; I-405 from I-5 to LA Co. line; and I-605 from I-405 to LA Co. line	#21 - SR 22/I-405/I-605 HOV Conn w/ITS; and #98 - I-405 Widen Ramp for Deceleration Ln
			I-405		
			I-605		
12	SCAG	Orange	SR 57	SR 22/I-5 Interchange to LA Co. line	#23 - Widen NB S Katella to N Lincoln Ave; and #24 - Widen NB N SR 91 to N Lambert Rd
12	SCAG	Orange	I-5	SD Co. Line to LA Co. line	#80 - SR 74/I-5 IC
12	SCAG	Orange	SR 55	Entire route within District 12	No CMIA Project
12	SCAG	Orange	SR 91	From I-5/SR 91 separation in ORA Co. to just east of RIV Co. line	#20 - SR 91 EB Ln – Rte 241 to Rte 71; and #22 - Widen EB/WB SR 91 E 55 Conn E Weir
		Riverside			

\* These routes are identified as Focus Routes within the Interregional Road System (IRRS). The CSMP limits may include only a portion of the Focus Route.

\*\*The CSMP limits need verification, therefore the CSMP is not mapped on the corresponding CSMP Routes Map

\*\*\* SR 99 projects are highlighted in orange.

\*\*\*\*SR 99 project #16 is utilizing the SR 99 Business Plan. Project is listed as #1B on the SR 99 Business Plan Category 2 list of projects.

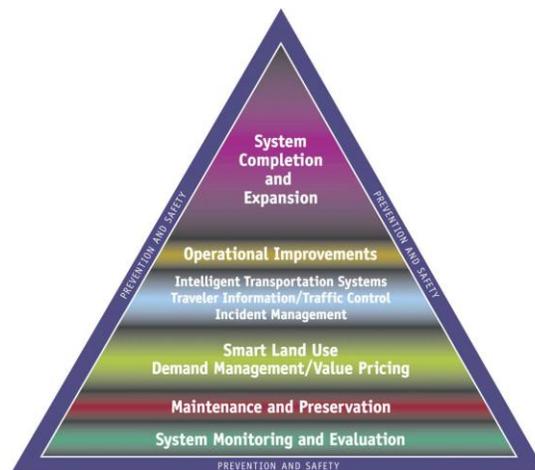
**Figure 3: CSMP Routes List**

## 2. BACKGROUND

Corridor System Management Plans (CSMPs) were envisioned to be a mechanism for monitoring corridor system performance to help identify opportunities to improve efficiency and productivity within our most congested urban corridors in the face of increasing travel demand and limited transportation funding. “CSMPs are different from traditional traffic management strategies in that they seek to manage the various components within a transportation corridor as a system rather than as independent elements” (DynusDion, 2012).

In 2006, California voters approved Proposition 1B (Prop 1B) which enacted the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act authorizing \$19.925 billion of state general obligation bonds aimed at, among other things, highway congestion reduction. Prop 1B created both the Corridor Mobility Improvement Account (CMIA) and the State Route 99 Corridor Account (SR 99). The CMIA and SR 99 programs funded projects that provided congestion relief, operational enhancements, enhanced mobility, improved safety, and improved connectivity throughout the state, particularly in urban areas. The California Transportation Commission (CTC) gave priority to projects funded through the CMIA where a CSMP was in place, or there was a documented regional and local commitment to develop and implement a CSMP (CTC, 2006).

Projects funded through the SR 99 program had to be consistent with the requirements outlined in the CMIA program. CSMPs were intended to report on performance measures within a corridor to determine if the proposed CMIA and SR 99 funded projects were improving mobility, and to preserve and enhance those mobility gains by introducing system and congestion management strategies to the corridor, such as system monitoring and evaluation, Intelligent Transportation Systems (ITS), and operational improvements. These strategies are reflected within the Mobility Pyramid, which was the cornerstone of GoCalifornia, the transportation element of the 2006 Strategic Growth Plan (Figure 4, below).



**Figure 4: The Mobility Pyramid**

Initially, 67 projects throughout the state were awarded CMIA or SR 99 Bond funding. Projects included capacity increasing capital investments such as new traffic lanes, auxiliary lanes, High Occupancy Vehicle (HOV) lanes and HOV connectors, interchange improvements, truck climbing lanes, and auxiliary lanes. Integrated system management strategies included incident reduction, reversible traffic lanes, and evaluation of pricing programs for goods movement/freight operations. Operational improvements included traffic signal synchronization, ramp metering, and other ITS components (DynusDion 2012).

In many cases, the CMIA or SR 99 Bond projects were proximate to each other on the same route or proximate to each other but located on an adjacent or adjoining route. Some Caltrans Districts elected to create CSMPs that included multiple CMIA or SR 99 Bond projects and in some cases multiple routes. For all of the urban CSMPs, traffic detection that provided detailed, accurate data was an essential enabling element that made CSMPs possible. The current status of the CMIA and SR 99 programs is outlined in the most recent Quarter Report for the CMIA and SR 99 Bond Program (see Appendix A).

For the initial set of CMIA and SR 99 Bond funded projects, 43 CSMPs were developed. Since the initial set, 11 new CSMPs have been completed and/or initiated, and updates to existing CSMPs are also being developed. This includes CSMPs that do not include projects receiving CMIA or SR 99 Bond funds and are not required to report to the Proposition 1B Delivery Council. Most of the new CSMPs are associated with additional projects that were amended into the CMIA and SR 99 programs utilizing the remaining available Bond program funds and/or savings from Bond funded projects.

Many CSMPs on urbanized corridors utilize complex traffic simulation models (simulation models), which had not previously been widely used for corridor scale scope and analysis. CSMPs that do not include simulation modeling are identified as Non-Modeled CSMPs for the purposes of this report. Figure 5 provides a map of the types of CSMPs (Modeled, Non-Modeled, or Model Abandoned). Throughout the CSMP effort, District staff, consultant staff, and external stakeholders gained critical knowledge about assessing bottlenecks and their causalities, freeway performance measurement, and methods to mitigate congestion with limited transportation funds and within a multi-jurisdictional consensus driven framework.

### 3. RECOMMENDATIONS

This section examines the feasibility of continuing the CSMP effort and makes recommendations on how to incorporate corridor planning as a permanent and sustainable Caltrans practice. It will cover the future role that system management and corridor planning will play in the Caltrans Planning and Traffic Operations functions, the funding and staffing constraints Caltrans will likely have to work within, and recommendations for continued incorporation of CSMPs into the core System Planning practices.

#### Future Role of System Management

Since “building our way out of congestion” is not a viable option, widely implemented system management and strategic system improvements will be essential to optimizing the existing transportation system to maintain mobility and improve multi-modal integration. Integrated system management at the corridor level is being investigated in several places throughout the country, such as the Integrated Corridor Management Initiative pilot study on I-15 in San Diego County (Balducci, et al., 2011). It has been demonstrated that ITS and operational improvements when applied in conjunction with strategically placed capacity increasing capital projects preserves and improves corridor throughput. For example, studies have shown that ITS has a benefit to cost ratio (B/C) of 10.1 to 1, Operational Improvements has a B/C of 8.3 to 1, while system expansion projects have a B/C of 3 to 1. (Operations, 2000).

Caltrans should continue to work in partnership to implement corridor-wide analysis and system management strategies. Before 1995, Caltrans was essentially the sole planner, manager and operator of the State Highway System. In 1995, Senate Bill 45 provided significant responsibility for planning and financing the urbanized portions of the State Highway System to Regional and Metropolitan planning agencies. Since Caltrans retains “Owner Operator” responsibilities and has state-wide, interregional responsibilities for maintaining mobility throughout the entire state, it is essential that Caltrans be closely involved with developing and implementing CSMPs in the urban areas even where much of the planning and funding of those CSMPs are provided by Regional agencies and local transportation sales tax measures.

With the recently enacted Federal Transportation Bill, Moving Ahead for Progress in the 21<sup>st</sup> Century Act (MAP-21) including a strong focus on performance-based approaches to system operation, improvement and funding, CSMPs and the role of Caltrans in developing and implementing them becomes more important. CSMPs can be a performance tracking tool and a performance improvement tool. While the specific performance measures and performance targets that will be required by MAP-21 have not yet been established, it is anticipated that many, if not all, of the performance measures identified within the legislation will be consistent with those that are currently identified through the corridor and system management strategies utilized during the CSMP effort.

State legislation that promotes system management strategies include the Strategic Growth Plan, which was funded through Propositions 1A, 1B, 1C, 1D, 1E, and 84, passed by California voters in 2006. The transportation element of the Strategic Growth Plan, called “GoCalifornia,” was a 10-year \$100 Billion plan to reduce congestion by 2016 to levels below 2006 through investments in each of the

strategies within the Mobility Pyramid. Proposition 1B created the CMIA and SR 99 Bond accounts. The CMIA and SR 99 Guidelines required CSMPs for all projects funded through those accounts. In addition, California laws related to GHG emission reduction such as AB32, SB375, and SB391 all compel Caltrans to investigate and implement methods, such as system management, to reduce congestion and thus emissions associated with the SHS.

Internally, Caltrans has adopted several directives and programs that directly or indirectly promote system management. DOTP administrates the Blueprint program, which awards grants to MPOs to create regional plans that promote sustainable land use development through achieving a number of goals, including:

- Improve mobility through a combination of strategies and investments to accommodate growth in transportation demand and reductions in current levels of congestion,
- Reduction of single occupancy vehicle trips,
- Enable opportunities for bicycling and walking,
- Providing a diverse and sufficient housing supply for projected growth,
- Protect farmland and wildlife habitats, and
- Improve energy efficiency. (DOTP, 2006)

Looking beyond the SHS simply serving motor vehicle travel, the inclusion and interconnectivity of non-motorized modes into System Planning is articulated by Deputy Directive 64 - Complete Streets - Integrating the Transportation System (DD-64). DD-64 requires the Department to provide for the safety and needs for all types of travelers on the SHS by including infrastructure for transit, bicyclists, and pedestrians early in the Planning process and continuing through project delivery, maintenance, and operations (Caltrans, 2008).

In 2010, DOTP published the "Smart Mobility Framework," or SMF. The SMF will help guide and assess how well plans, programs, and projects meet a definition of "smart mobility" through the application of 17 performance measures, each of which is directly tied to the strategies presented in the Mobility Pyramid. This assessment will provide a "scorecard," which will inform decision makers of how well proposed plans and projects meet "smart mobility" principles and criteria. Ideally, the SMF should be able to be applied to various levels of plans, programs, or projects (e.g., Regional Transportation and Blueprint Plans, General Plans, corridor plans, specific development proposals, etc.) in all parts of the state (i.e., urban, suburban, and rural). The SMF will be the action element of the 2035 California Transportation Plan, and will be a component of the overall strategy by DOTP to comply with AB32, SB 375, and SB391 (DOTP, 2010). A SMF pilot project to incorporate place types and performance measures into the CSMP process is currently under development and is being integrated into a recently initiated CSMP effort in the San Francisco Bay Area.

## Continuing the CSMP Effort

As demonstrated by many of the CSMPs in California, corridor level planning and system management are viable and valuable practices, and Caltrans must continue to have a leadership role in this effort. However, now that Prop 1B funding as associated special funding for the development of associated simulation model development have been exhausted, corridor planning and system management are subject to the constraints of on-going Caltrans operating and personnel resources within a tight fiscal environment. The performance based corridor approach needs to be normalized within Caltrans practices rather than being a demonstration or test case basis that is specially funded. Caltrans corridor planning and system management efforts must also continue to be consensus driven and include the participation of internal and external stakeholders.

## CSMP Integration into System Planning

CSMPs should continue to be standalone documents and should be prepared for urban segments of the State Highway System (SHS) that are experiencing severe congestion including bottlenecks and severe delay. These documents are unique in their ability to analyze existing corridor conditions; project corridor performance through the inclusion of proposed capacity increasing capital investments and integrated system management strategies, including operation and ITS improvements; utilize complex traffic simulation models for a corridor-wide scope; and recommend consensus-driven long-range implementation strategies. The production of CSMPs is envisioned for all urban corridors which experience severe congestion and delay. The definition of “severe congestion” should be up to the discretion of the Districts. One definition of recurrent congestion found in the Highway Congestion Monitoring Program (HICOMP) is “15 minutes or longer when travel demand exceeds freeway capacity and vehicular speeds are 35 miles per hour (mph) or less during peak commute periods on a typical incident-free weekday” (Operations, 2008).

One District is producing an annual State of the Corridor Report which “maintains the momentum started by the completion of the first CSMP by reporting on the ongoing implementation of CSMP strategies and movement towards true integrated multimodal corridor system management, as well as anticipated corridor mobility challenges, and impediments to CSMP implementation” (D3, 2010). The Report also outlines the status of the Proposition 1B projects associated with the CMIA and SR 99 bond programs, other major corridor accomplishments including status of other non-Bond projects and operational improvements, and addresses the opportunities and challenges as system management is implemented along the corridor. The Reports are potentially very effective at documenting and communicating corridor performance in an easily understood, yet rigorous manner. Caltrans will consider if these reports can be widely produced using existing resources while also continuing to meet other obligations funded by those resources.

Another viable way to integrate enhanced corridor-wide analysis and system management is through the Transportation Concept Report (TCR). The TCR is a System Planning document created for every route on the SHS which describes current conditions within a SHS route and recommends a “concept” facility and concept operations strategy that will accommodate future travel needs. Districts are required to report the physical attributes of the route, such as number of lanes, for existing,

conceptual (within 20 years), and long-range (beyond 20 years) facilities. Districts are also encouraged to report several performance measures for each segment, including Level of Service (LOS), Average Annual Daily Trips (AADT), and peak hour volumes. TCR guidance has recently been updated to include more robust system performance and operational information, including an operational concept for each route. This update ensures that future TCRs or “enhanced TCRs” will meet the informational needs of Caltrans, partner agencies, and the public. CSMPs should serve as the TCR for the segments of the route identified within the CSMP, while maintaining consistency with the TCR for the remaining portion of the route.

### Stakeholder Roles

CSMPs are a collaborative consensus driven product developed among Divisions within Caltrans (most notably Planning and Traffic Operations), regional and local transportation partners, internal and external stakeholders, interest groups and consultants. These internal and external relationships will need to be maintained and strengthened as further CSMPs are developed and as TCRs incorporate system management strategies and operational concepts into their long range 20-25 year facility visions.

### *Partner and Stakeholder Participation*

Districts endeavored to involve transportation partners and stakeholders throughout the CSMP development process to ensure consensus, stakeholder buy-in, and plan implementation. Stakeholder participation will continue to be a critical factor in developing and implementing CSMPs. This will ensure that the documents continue to be consensus driven so that local jurisdictions, regional agencies, and modal operators along the corridor can support the effort and help guide corridor development, operation, and investments. This will also help ensure that the CSMPs represent the mutual interests of all parties involved. The recently revised and updated TCR guidelines encourage that enhanced TCRs incorporate a higher level of stakeholder participation than what has historically been conducted for most TCRs. In an effort to increase implementation of the 1962 Federal Highway Act 3C’s of transportation planning (Continuing, Cooperative, and Comprehensive), it is in the best interest of Caltrans (with its regional partners) to engage stakeholder and interest groups while creating system planning and regional planning documents. Ultimately, the relevancy of Planning products is dependent upon the level of involvement and consensus achieved with all stakeholders within the corridor.

### Corridor Scope

CSMPs include infrastructure and analysis that is not part of the SHS, including nearby arterial roads, park and ride lots, rail, and bicycle and pedestrian pathways. The reason for analyzing such a broad scope along the corridor is to investigate how non-SHS infrastructure is performing, to identify gaps in intermodal connectivity, and improve overall “person throughput.” CSMPs should expand efforts to include existing, planned, and conceptual infrastructure for transit, bicycles, and pedestrians within the corridor. They should attempt to identify gaps and opportunities for each mode, and provide recommendations for greater intermodal connectivity, which may in turn improve productivity on the larger corridor. Districts should continue to work closely with stakeholders to incorporate non-SHS information, to ensure information accuracy and to strengthen stakeholder buy-in with the recommendations of the CSMP. Districts should also coordinate with other Districts to ensure inter-District consensus and interregional connectivity.

### Performance Measures

Performance measures should be aligned with the new measures and targets that will be issued by MAP-21. It is anticipated that several of the performance measures related to mobility, reliability, productivity, and safety within the corridor will be relevant to MAP-21. For those measures that do not appear to have substantial utility, they should be considered for deletion from the CSMPs so that the CSMPs move in the direction of providing actionable information and not needlessly reporting all information that is available. While the goal of the CSMPs is to maximize the efficient use of the existing transportation system, the goal of the CSMP development process should be similarly focused on efficiency and making the best use of existing resources.

### Information Sources

CSMPs should use readily available information sources such as the PeMS tool to the maximum extend possible, which should streamline the time needed to gather performance measurement data. The incorporation of information from studies such as traffic impact studies, environmental documents, and Regional Transportation Plans should be encouraged, especially when in-house analysis methods of data gathering are inadequate. Multimodal information may be acquired from regional planning agencies, cities and counties, transit agencies, and bicycle and pedestrian advocacy groups.

### Modeling/Scenario Testing

Short and long range scenario testing will remain a vital component of corridor planning, so that the best mix of strategies are identified to mitigate existing and future bottlenecks. Many of the simulation models accomplished this in the initial CSMP effort; however, as previously discussed, simulation modeling can be prohibitively expensive and resource intensive for lengthy corridors. There are several innovative tools being developed that may be capable of scenario testing at a lower cost and would require less staff modeling expertise. As these new tools become available, they should be considered for their applicability to CSMPs.

For future CSMPs, and possibly TCRs, Districts should have discretion on what kinds of technical analysis methods they will use, and where to apply it within the corridor. Rather than analyzing the entire route with one massive simulation model, similar to what has been done in existing CSMPs, Districts should consider using “spot analysis” by looking at the most complex areas or proposed projects of the route with more advanced methods where applicable. Examples could be a specific location, such as a planned interchange, an auxiliary lane, or an advanced ramp metering system. Detailed analysis should target the most complex parts of the route, so that unnecessary analysis is avoided and Caltrans staff and contracting resources are conserved.

### Simulation Models

The simulation models created during the CSMP development process will need to be maintained and updated by Caltrans. This will require a substantial resource commitment by Caltrans and the need to expand staff skills and retain staff with the specialized skills to work with the models. Caltrans has not yet determined how to accomplish this in a sustainable manner. There are varying levels of in-house modeling expertise at the District level. It is envisioned that Districts will continue to

use the simulation models for scenario testing, either by in-house staff or through the utilization of consultants. “Based on the demonstrated benefits, it is strongly recommended that traffic simulation tools, whether microscopic or macroscopic, continue to be used to support CSMP evaluations” (DynusDion, 2012). Districts will need fiscal support in order to fund the use and maintenance of simulation models for CSMP evaluations and Headquarters will need to provide training and technical assistance to Districts, as well as perhaps have a core modeling team that can work with all of the CSMP models.

### *Regional and Statewide Models*

For long-range planning, Caltrans should continue to incorporate the use of regional models maintained by regional and metropolitan planning organizations. Regional models are becoming increasingly sophisticated and can project traffic flow rates many years into the future, and these flow rates can be imputed into programs such as Synchro and HCS to test different improvement scenarios. A prerequisite to using regional models is to continue the strong collaboration between Caltrans Districts and the regions. Metropolitan agencies and their models cover 90% of the population of the state, including all urbanized areas, which makes the models very helpful to Caltrans. Some regional models are capable of simulating how land use, transportation, and economic factors are related. However, regional models do not address individual facilities and how they are configured and operate at the level needed for active corridor management.

As part of the California Interregional Blueprint and California Transportation Plan, a Statewide Travel Demand Model (STDM) is being created that will simulate future travel demand. Though the STDM will not have the capability to evaluate corridor level performance, it will simulate future interregional travel patterns, which will inform the larger System Planning process that links urban and interregional travel needs. Caltrans is working with UC Irvine to develop a statewide commodities flow model that will inform the pending California Freight Mobility Plan and the California Transportation Plan.

### *Caltrans Staff Resources/Expertise*

Districts did not receive extra staff resources to complete CSMPs. Rather, staff resources were redirected from other closely related Planning functions to support the development of CSMPs. Going forward, if CSMPs remain a stand-alone document and continue to utilize simulation modeling analysis, the need for staff resources must be resolved. Special funding, that is not anticipated to be provided again, was provided to fund the large set of consultant contracts used to develop most of the micro-simulation models.

### *Urban Versus Rural CSMPs*

Existing and projected urban congestion established the need for the entire CSMP effort. It is envisioned that CSMPs will be created for every urban corridor on the SHS to improve and preserve corridor performance in the face of increasing demand for travel. However, the CMIA and SR99 Bond programs awarded funds to projects that were in both urban and rural areas. This was to encourage equity, and to avoid the entire state from subsidizing just the urban areas. To preserve the mobility

benefits of rural CMIA and SR99 Bond projects, CSMPs were required for rural corridors that contained these projects. This section will briefly describe the differences between Urban and Rural CSMPs.

### Urban CSMPs

Urban corridors are relatively complex due to the multiple modes, different types of infrastructure, and multiple jurisdictions and agencies involved. Due to this complexity, it was believed that urban corridors would require extensive analysis involving simulation models at the corridor level. The simulation models could provide a more accurate depiction of individual vehicle operation, for existing and future conditions. Simulation models were envisioned to test numerous proposed system improvements and system management and operational strategies. The results from simulation modeling and scenario testing would be used to create a phased implementation plan of strategies and projects to alleviate existing and future bottlenecks, providing a high benefit/cost value. In practice this approach has generally been a success. The urban CSMPs provide a thorough performance assessment, causality analysis, and a phased implementation plan. However, due to unforeseen challenges in the modeling effort many of the early urban CSMPs experienced significant delays in their development.

### Rural CSMPs

Proposition 1B included allocation of funds to nominated improvements within rural corridors. Per the CMIA program guidelines, a CSMP had to be created for any corridor that included projects seeking CMIA/SR99 Bond funds. However, due to the difference in relative complexity between rural and urban corridors, the same level of technical analysis was not required for rural CSMPs. For this reason, CSMPs created for rural corridors were excluded from the more rigorous technical analysis required for urban corridors. Instead of creating a new report, Districts with a project on a rural corridor used existing TCRs as a baseline to build upon. These were built upon by including the CMIA or SR99 project(s), and projects from local RTIPs and the ITSP. Then Traffic Ops conducted analysis with conventional methodologies such as those established in the Highway Capacity Manual (HCM). These rural CSMPs, or “Non-Modeled” CSMPs, satisfied the CMIA requirements by providing a CSMP that contained a plan to preserve and improve corridor performance.

### Incorporation of Alternative Modes

Analysis of alternative modes of transportation is strongly recommended in the CSMP guidelines, since one of the intentions of CSMPs is to improve multimodal connectivity within the corridor under study. Districts are encouraged to incorporate Rail (Light, Commuter, Passenger, and High Speed), Transit, Bicycle, and Pedestrian modes of travel within their scope of analysis. Also, Districts are encouraged to include agencies and advocacy organizations that represented alternative modes within corridor stakeholder groups.

Incorporating other modes besides automobiles to the simulation models adds additional complexity to an already complex model and can be cost prohibitive, so they have generally not been included in the initial CSMPs modeling analysis. For the most part, the alternative modes represented through simulation modeling are motorized vehicles such as transit and rail; however, this was the exception, not the rule. Simulating bicycling and walking was not within the scope or technically feasible

for the simulation modeling analysis. To compensate for the lack of simulation modeling, CSMPs provide static analyses and narratives of existing conditions as well as future deficiencies and needs for alternative modes. Many CSMPs emphasize the importance of multi-modal evaluation and suggest that future CSMPs need to incorporate additional analysis related to alternative modes and multimodal connectivity.

A recently initiated CSMP has taken the consideration of alternative modes one step further by incorporating a Complete Streets Analysis which includes the arterials with freeway interchanges, non-interchange crossings, parallel arterials, and nearby shared use paths. This will help ensure that the corridor management strategies and the identified projects are designed and operate for the benefit of all users as articulated by Deputy Directive 64 - Complete Streets - Integrating the Transportation System (DD-64) which requires Caltrans to provide for the safety and needs for all types of travelers on the SHS by including infrastructure for transit, bicyclists, and pedestrians early in System Planning and continuing through project delivery, maintenance, and operations (Caltrans, 2008).

### **Goods Movement**

Some districts elected to include Goods Movement analysis within the CSMP, although it was not outlined in the CSMP guidelines. Analysis of goods movement was incorporated into corridors that experienced significant truck traffic and where goods movement was essential to the area's economic vitality. Truck counts were obtained from Traffic Ops - Traffic Data Branch, or from on-site traffic counts. These truck counts were incorporated into the modeling analysis, which also helped inform Greenhouse Gas (GHG) emission estimations. Generally, CSMPs included a narrative on the way goods movement affects the corridor and any projects or future trends that would result in significant changes to corridor conditions. Trade Corridor Improvement Fund (TCIF) projects, another Prop 1B program for freight related projects, located within the corridor were also discussed within the CSMP goods movement analysis, and these discussions often referenced the Goods Movement Action Plan (GMAP) which addressed the state's goods movement-related congestion, environmental and community impacts, port security, and economic issues.

### **Land Use/Demographics**

CSMPs describe existing land use patterns and major trip generators within the corridor. CSMPs also list major future trip generators, such as planned schools, hospitals, event centers, and residential development. Many CSMPs identify the need to further integrate land use with the transportation network in subsequent CSMPs. Some Districts anticipate using the Sustainable Community Strategies (SCS) from Metropolitan and Regional Transportation Plans (MTPs and RTPs) to model future land use patterns.

Population and Employment datasets are also utilized for CSMP development. This information is important for understanding current and projected demographic and economic conditions within the corridor, and is incorporated into simulation models. However, CSMPs have not always been consistent in terms of where the demographic data is obtained. Some CSMPs derive demographic data from regional travel demand models used by MPOs and RTPAs, others use demographic data the California Department of Finance or the US Census.

## Environment/Air Quality

CSMPs themselves are not considered a “project” under CEQA/NEPA statutes. Thus they do not require an accompanying environmental document. However, many of the projects analyzed and recommended in the CSMPs do require environmental review during the Project Approval & Environmental Document (PA&ED) phase. CSMPs are instrumental in providing information and alternatives analysis for environmental analysis, as a Traffic Impact Study (TIS) does for a proposed local development. Although not required in the CSMP guidelines, or by CEQA/NEPA, some CSMPs incorporate an environmental scan. Many include a narrative about the environmental issues the corridor currently faces, and the foreseeable impacts the phased implementation plan of CSMP-derived projects could have. A few Districts incorporate a GHG emission analysis for tested scenarios. This shows the difference in GHG emission output between scenarios and improvements in emissions identified within the phased implementation plan presented in the CSMP. The GHG analysis is conducted using the Caltrans Benefit/Cost (Cal B/C) model with the 2007 Emission Factors (EMFAC) module created by the California Air Resources Board.

#### 4. CSMP DEVELOPMENT PROCESS

This section evaluates the multiple aspects of the CSMP effort, which includes a general description of the CSMP Development Framework, an evaluation of partners and stakeholders involved, data sources utilized, the simulation modeling effort, incorporation of land use, inclusion of alternative modes of transportation, and environmental considerations.

##### Development Framework

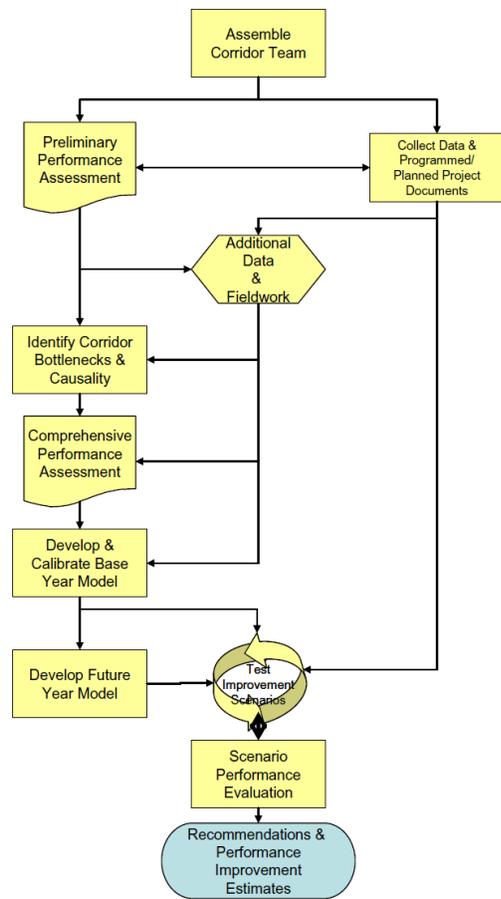
Districts were given a great amount of latitude on how to approach the CSMP process. There were no existing mandates related to the content within a CSMP. Districts were compelled to complete a CSMP for corridors that needed CMIA/SR 99 funding for proposed projects per the CMIA and SR 99 program guidelines developed by the CTC (CTC, 2006). To assist Districts in completing CSMPs, Caltrans Headquarters (HQ) created a guidance document called “CSMPs: Guidelines for Creating CSMP Milestones” (OASP, 2006). The document provides guidance on how to complete the eight steps, or milestones, within CSMPs, which are:

1. Define Corridor
2. Assemble Corridor Team
3. Develop Preliminary Performance Assessment
4. Ensure Adequate Corridor Detection
5. Comprehensive Corridor Performance Assessment
6. Identify Causality of Corridor Performance Degradation
7. Develop Corridor Micro Simulation Model and Test Improvement Scenarios
8. Develop Corridor System Management Plan

However, the guidelines were designed to be intentionally broad enough to allow Districts leeway in the content and format of the report as well as the level and frequency of stakeholder participation.

Each District and their respective partners approached the CSMP effort in different ways. A general approach can be seen in Figure 4 (left). In most cases, Caltrans was the lead agency, and in many cases led the efforts of organizing the report as well as involving and informing stakeholders. For most of the CSMPs that involved simulation modeling, project management was done in concert with a consultant team, who collected

pertinent data and conducted the technical analysis, including the simulation modeling. Caltrans staff endeavored to involve stakeholders through Technical Advisory Committees (TAC) and management/policy group teams. Caltrans staff and its consultant partners briefed stakeholders at critical milestones and sought consensus over proposed improvements and timing. The outreach effort



**Figure 5: General CSMP Development Framework Approach (DOTP, 2010)**

was to ensure buy-in from stakeholders so that the suggested phased implementation plans were carried through and the value obtained from the CSMP would be preserved.

### Partners and Stakeholders

CSMPs identify corridor and system management strategies that are consensus driven and that the local jurisdictions, regional agencies, and modal operators along the corridor can support to help guide corridor development, operation, and investments from all sources. Districts invite all relevant internal and external entities to participate, so that solutions presented in the plan represent the mutual interests of all parties. Ultimately, the number of stakeholders involved in the report is dependent upon the scope and complexity of the corridor. Stakeholders that are involved can generally be put into three categories: Intradepartmental, External Stakeholders, and Consultants.

### Intradepartmental

The CSMP effort requires coordination and resources between several Divisions within Caltrans (Divisions). It provides an opportunity for tighter coordination between Caltrans planning and operations staff, which is critical to the success of the system management approach. The CSMP process is principally a joint effort between the Divisions of Transportation Planning (DOTP) and Traffic Operations (Traffic Ops). Other Caltrans Divisions, such as Programming, Mass Transportation (Mass Trans), Rail, Design, Environmental Analysis, and Transportation System Information (TSI) play supporting roles by providing critical information associated with that Divisions expertise.

Programming staff provides detailed lists of projects within current and future State Transportation Improvement Program (STIP) cycles to inform modeling teams on which programmed projects (projects that already have funding support for some phase of the project) should be included in scenario development and testing. Mass Trans and Rail staff provides statistics and data related to transit and rail activities within the corridor and identify Caltrans properties such as park and ride lots. Design staff provides “as-built” plans for model calibration to ensure that models accurately reflect existing and future highway geometrics. Design staff also adjusts projects under development based upon performance issues discovered during the CSMP process. Environmental Analysis staff, in some cases, provides resources for conducting an environmental scan, or preliminary analysis, of the existing environmental conditions within the corridor to inform the Preliminary Environmental Analysis Report (PEAR) during the Project Initiation (PID) phase and provide information for National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) processes.

### Planning

DOTP, and specifically District staff within the System Planning branch, act as the project managers for CSMPs led by Caltrans. System planners manage and coordinate the effort with consultants, stakeholders, other Divisions, and HQ. When a consultant is not involved in the process, especially for Non-Modeled CSMPs, the system planners are the project managers and write the CSMP document with assistance from Traffic Ops staff for the technical analysis.

System planners are heavily involved in stakeholder outreach. When the CSMP effort was initiated, system planners made presentations to Metropolitan Planning Organizations (MPOs), Regional

Transportation Planning Agencies (RTPAs), and County Transportation Commissions to educate and inform them of the CMIA and SR 99 Bond requirements, and to involve them in the CSMP process. Stakeholders participate in Corridor Teams which are organized with different responsibilities (pgs. 6-7), and these teams coordinate, inform, and work to reach consensus on the content and recommendations within the CSMP documents.

System planners ensure that the CSMPs will be compatible with and complement existing Caltrans System Planning documents, such as Transportation Concept Reports (TCR), the District System Management Plan (DSMP), the Interregional Transportation Strategic Plan (ITSP), regional documents such as the Regional Transportation Plan (RTP) and Metropolitan Transportation Plan (MTP), and City and County General Plans. Also, system planners ensure that existing, conceptual, as well as ultimate facilities previously envisioned for the corridor are incorporated into the CSMP process. Many of the CMIA and SR 99 projects included in the CSMPs are located on routes identified as “Focus Routes” within the ITSP. These Focus routes are a selected subset of the Interregional Road System (IRRS) which represent the 10 most critical interregional route corridors and are the State’s highest priority for its Interregional Transportation Improvement Program (ITIP). CSMPs are developed in accordance with regional blueprint efforts funded through the California Regional Blueprint Planning Program (DOTP, 2006). Also, system planners advocate the inclusion of CSMP-derived capital projects into the RTPs and MTPs.

Initially, HQ system planners worked with Traffic Ops staff to create the CSMP guidelines document, and held periodic videoconferences with the Districts to discuss the status of the CSMP efforts and CSMP milestone accomplishments. HQ system planners continue to provide advice and guidance for District staff throughout the CSMP process.

### *Traffic Operations*

Traffic Ops is the principal Division for providing operational data, reviewing modeling work from consultants, and conducting operational analysis when modeling is not used or available. Traffic Ops staff provides operational data from several sources: Performance Measurement System (PeMS), HOV Reports, probe runs, and the Highway Congestion and Monitoring Report (HICOMP). Data from these sources are compiled to report on existing conditions within the corridors under study. Average Annual Daily Traffic counts (AADTs), peak volumes, truck volumes, and terrain types are some of the data Traffic Operations provides that is reported in the CSMPs. This data is also used for creating the simulation models for urban CSMPs. The models are calibrated until they provided a reasonable goodness of fit to existing volumes within the corridor.

Traffic Operations is also the lead in matters related to operational improvements and modeling review, and their staff works with system planners, consultant teams, and stakeholders to determine the correct mix of scenario testing, recommending and prioritizing operational improvements, and developing phased implementation of improvements for the CMIA and SR 99 bond and non-bond funded projects. The recommendation of operational improvements is an iterative process. Planned and programmed projects from existing plans are included in the future scenario analyses, and new

improvements are recommended based upon corridor deficiencies identified through the modeling process. Operational benefits derived from simulations were used to help determine the most effective projects and provide recommendations on the timing of specific project implementation. Projects producing the highest benefit/cost ratio with potential to reduce queuing and congestion were the most highly recommended (DynusDion, 2012). As a quality control measure, Traffic Operations staff from both Districts and HQ reviews both the constructed models and model results submitted by the consultants.

Not all CSMPs use simulation modeling to examine future scenarios. This is because the corridor does not warrant modeling analysis, such as in rural corridors. For these CSMPs, Traffic Operations staff conducted operational analysis using in-house methods (such as Highway Capacity Manual, or HCM) to determine performance measures for future scenarios, including those for the proposed CMIA and SR 99 bond projects.

### Stakeholders

The CSMP Guidelines provided direction on which external stakeholders to involve in the process: the regional MPOs and RTPAs, Cities and Counties, Transit Agencies, Business Communities (e.g. Chambers of Commerce), and nonprofits such as bicycle and pedestrian advocacy organizations. However, there is no set method on which stakeholders to invite onto the corridor teams, or how to involve everyone in the effort. The guidelines suggest creating two Corridor Teams: a TAC, and a management/policy team. The TAC would be made up of members involved in conducting technical analysis, such as planners, transportation engineers, and modelers. The TAC would provide results and recommendations to the management/policy team, which would act as the decision making body by commenting on and approving items submitted to them. Either team could include members from Caltrans and a variety of external stakeholders.

The Districts were given great latitude when forming their committees and deciding the level of stakeholder participation. Districts often relied upon existing relationships that were already established from the production of previous System Planning products, such as TCRs. Districts met with stakeholders as often as was deemed necessary: some on a quarterly basis, others during the completion of each of the eight milestones. The specifics of who would be involved, what each team's responsibilities were, and the frequency of participation was outlined in the CSMP charter, which was the end product from the second milestone (Assemble Corridor Team). In many cases, Districts created a signatory page at the front of each report that contained signatures from the executive management from both the District and the MPO/RTPA. Some corridor teams also achieved consensus on an overarching phrase regarding the CSMP, usually posted on the signatory page. Examples include:

- "I accept this Corridor System Management Plan for the State Route 99 and Interstate 5 Corridor as a document informing the regional transportation planning process" (D3 & SACOG, 2009).
- "I approve this Corridor System Management Plan as the overall Policy Statement and Strategic Plan that will guide transportation decisions, investments, and system management of the I-205 and I-5 Corridor within San Joaquin County" (D10 & SJCOG, 2010).

Stakeholders that actively participated brought invaluable expertise and value to the process. Districts reported that feedback from the stakeholders helped to solidify the findings of the performance assessment, bottleneck identification, and causality analysis given their intimate knowledge of local conditions.

#### *MPOs/RTPAs/County Transportation Commissions*

For all CSMPs, Metropolitan and Regional planning agencies were involved from the beginning, and were involved in the technical and stakeholder committees. MPO and RTPA buy-in and participation was important for several reasons. Their regional models provided land use and trip generation projection data that was imputed into future scenarios in the simulation models, and projects listed in the Metropolitan Transportation Improvement Plan (MTIP) and Regional Transportation Improvement Plan (RTIP) were included in modeling scenarios. Also, when CSMPs identified a needed project that wasn't identified in the MTIP or RTIP, or if the CSMP recommended a different timeframe to implement a certain project, MPOs and RTPAs are instrumental in programming the project for funding.

In terms of how MPOs and RTPAs use CSMPs, the 2010 Regional Transportation Plan Guidelines state RTPs should incorporate the strategies, actions and improvements identified in the adopted CSMP that are needed to restore capacity (ORIP, 2010). RTPs are recommended (but not mandated) to:

- Identify urban freeway corridors with current and projected recurrent daily vehicle hours of delay that are a priority for preparing CSMPs.
- Include by corridor all strategies, actions and improvements identified in the adopted CSMP that are needed to restore capacity, taking into consideration statewide and regional objectives which can include but are not limited to: multi-modal mobility, accessibility, environmental protection, and greenhouse gas reduction.
- Describe how the corridor will be managed across jurisdictions and modes to preserve corridor productivity based upon performance measurement.
- Include a reasonable time-line for each urban freeway corridor to be restored to full capacity and identify actions to preserve capacity restoration recognizing the need for each region to consider multiple objectives regarding corridor mobility.
- Identify funding by corridor to implement the CSMP.
- Describe roles and relationships among units of local government and modal agencies.
- Caltrans and related agencies for managing the corridor for highest mobility benefits and for measuring and evaluating performance.

#### *Cities/Counties*

Many CSMP corridors go through multiple cities and counties, and recommend near-term and long term projects within their jurisdictions. For many CSMPs, Districts held several stakeholder meetings where planners and public works representatives from local jurisdictions through which the corridors passed through were able to input directly into the process.

### *Transit Agencies*

In general, Transit agencies expressed concerns that CSMPs would suggest transit actions that are not outlined or would run counter to their own transit plans. Transit agencies were also concerned that CSMPs would induce more demand for their systems, which would increase capital costs to accommodate increased demands, even though there is often excess capacity on their systems. However, when the MPO acted as the transit authority, they were usually more willing to incorporate transit analysis. As simulation modeling capabilities improve and more transit data is incorporated into the scope of the CSMP evaluations, transit operators may be more inclined to increase their level of interest and participation in the CSMP process.

### *Consultants*

For less complex corridors in rural areas, consultants are generally not utilized and the CSMP reports are created entirely in-house by System Planning staff, with input and technical support by other Divisions, in the Districts. Where a consultant is used, the level of their involvement varies between each District. In some Districts, the consultant team is responsible for all aspects of the CSMP, including stakeholder outreach, performance assessment, simulation modeling and scenario testing, recommending corridor strategies, and writing the final document. In other Districts, consultant involvement is limited to the simulation modeling and data gathering work, while District staff writes the document. Consultants were critical to the CSMP development process for urban corridors. Caltrans did not have the in-house resources to conduct the simulation modeling analysis. Ultimately, consultants conducted the simulation modeling for all but a few of the CMPS. The CSMP effort, particularly in the earliest stages, occupied much of the consultant field specializing in simulation modeling and corridor-wide transportation analysis.

### *Staff Resources and Expertise*

#### *Staff Training*

Training opportunities have been provided to Caltrans staff focused on CSMP preparation. In 2009 Caltrans partnered with the consultant System Metrics Group (SMG) to conduct a CSMP overview course designed for everyone involved in preparing the reports. This included System Planning and Traffic Operations staff, staff from other Divisions, and staff from other external partner agencies. This course covered the system management approach, purpose of CSMPs, how to complete each CSMP milestone, and how to write the final report incorporating a recommended phased implementation plan.

In 2010, there was an introductory and advanced Performance Measurement System (PeMS) course offered to Caltrans staff and a select group of staff from regional and local agencies. This course was taught by SMG and Berkeley Transportation Systems (BTS), and was meant to familiarize staff on how to use PeMS for not only CSMPs but for any project that required freeway performance measurement.

## Modeling Expertise

Caltrans has few simulation modeling specialists within its staff, so the model construction, calibration, and scenario testing for the urban CSMPs was generally outsourced to consultant firms. The CSMP effort occupied many of the available simulation modeling professionals from the private sector for a number of years. Peer review teams made up of both Caltrans staff and consultant firms not involved in the CSMP effort reviewed and commented on the models submitted. Also, base year models were sent to Traffic Operations staff in Caltrans HQ for review. The CSMP simulation modeling effort was a learning opportunity, and the knowledge, skills, and expertise of Caltrans staff significantly improved from it. In most cases, Caltrans still lacks the simulation modeling staff to support future in-house CSMP simulation modeling efforts.

## Data Review

CSMPs are a data-driven analysis of a corridor so that any recommendations in the plan will be backed by quantitative evidence. This means that CSMPs require vast amounts of data from numerous sources.

## Data Needs

The collection of data needed to build the simulation models is a challenge for many reasons. Due to the multi-jurisdictional nature of large corridors, there is not a single source where all the needed data can be accessed. Instead data is collected on an ad hoc, piecemeal basis. Another challenge is the sheer amount of data required, which consumes personnel resources. The TAC from each CSMP collects data from a wide variety of sources, including:

- Caltrans Highway Congestion Monitoring Program (HICOMP) report and data files (2004 to 2008)
- Truck Volumes and AADT from Caltrans Traffic Volumes on California Highways
- Manually collected information to complement existing data (Traffic Counts)
- Classification Counts
- Performance Measurement System (PeMS)
- Caltrans probe vehicle runs (electronic tachometer runs)
- Caltrans Traffic Accident Surveillance and Analysis System (TASAS)
- Aerial photographs and Caltrans photologs
- Caltrans System Planning documents (TCRs, DSMPs, TSDPs, ITSP)
- Statewide, regional, and local models
- RTPs and MTPs
- County and City General Plans
- Traffic impact studies and other special studies

## Performance Measurement

Performance Measurement for the State Highway System (SHS) is a vital component to completion of CSMPs, and is a system management strategy identified in the Mobility Pyramid (Figure 1, pg. 1), which was the basis of GoCalifornia and represents the overarching philosophy of how Caltrans will maintain and operate the SHS. Districts use existing detection equipment, probe runs, existing

studies, or the PeMS detection system to measure performance of the SHS. The need for detection was first identified in Traffic Operations Strategies (TOPs), which identified Intelligent Performance Evaluation as a vital component in the overall strategy to reduce congestion (Operations, 2000). The need was further emphasized in the Transportation Management System Master plan (TMS), and was identified as a key system management strategy in the TMS System Management Framework pyramid (Operations, 2004). Real-time performance measurement is vital to understanding how a corridor performs, and to identify where TMS strategies should be implemented.

### *Performance Measurement System (PeMS)*

PeMS is an innovative tool used for corridor analysis. PeMS has been implemented and refined over the past decade as a way to monitor and report performance measures on the most congested portions of the SHS. It has been installed and utilized for urbanized freeways located in corridors identified during the CSMP effort, and is being expanded to urbanized portions of the SHS in support of the TMS Master Plan. PeMS incorporates a network of loop detectors installed within the pavement, and data collected from these detectors is relayed to roadside monitors, which is then sent to servers where the data is analyzed and compiled. This data is reported to the PeMS website, which is accessible to a variety of transportation professionals.

PeMS allows users to look at performance measurement data since 2000 for many urbanized portions of the SHS. The purpose for this was to use performance measurement data to identify existing conditions as a baseline for corridor analysis. PeMS has many capabilities, and is continuing to grow in terms of its reporting abilities. For the CSMP effort, PeMS is one tool for measuring existing and historical performance measures, such as Average Speed, Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), Delay, Reliability, and Productivity. PeMS is also instrumental in identifying where, when, and for how long bottleneck locations were forming within CSMP corridors. This critical information informs the CSMP TACs on what strategies to investigate in the scenario testing phase.

There are a few drawbacks in using PeMS. In many cases, adequate detection coverage was not installed in time to provide the optimum level of information for early CSMPs. In certain areas, the loopback detectors installed in the pavement have a high failure rate, exacerbated by the theft of the copper wiring which is used for the loop detectors. On average at any given moment, approximately 70% of detectors are operational on the SHS. This impedes District's efforts to collect more accurate real-time performance measurement data, and some Districts have to incorporate more traditional sources such as probe runs to be used in conjunction with PeMS, or used instead of PeMS. Another drawback is that PeMS does not have coverage of parallel arterials or transit. However, it is the intention of the Caltrans to expand PeMS detection to arterials and transit in the future.

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