

***TMS Transportation Management Centers:
Development Considerations and Constraints***



December 2002

A. Introduction

Transportation Management Centers (TMCs) are used for the efficient and effective management of traffic, and are an integral part of the Department of Transportation's (the Department) approach to congestion management and reduction. TMCs are, fundamentally, buildings that house staff and systems necessary to accomplish day-to-day functions such as incident management, ramp metering, arterial signalization, and emergency support. They are a focal point for control and support of field elements, and monitoring and support of the transportation infrastructure. They are communications hubs between the Department's Operations and Maintenance Divisions, the California Highway Patrol (CHP), Freeway Service Patrol, public and private partners, and information service providers and other media. The Department is legislatively required to support the Statewide Emergency Management System (SEMS), and that support is provided through the TMC. They are centrally important to the Department's ability to implement system management.

System management is a view of managing the state transportation system as a whole, including all agencies, resources, employees, customers, stakeholders and the infrastructure for the various modes (transit, rail, vehicles). It means that all must work cooperatively, with an organic vision of the whole, to increase effectiveness.

In support of the system management approach, and to address on-going concerns of internal and external stakeholders, the Department is committed to the following:

- Every district will have a TMC. The functional complexity, hours of operations, staffing, physical building size, and location will vary, as appropriate, based on demonstrated need
- A system engineering process will be used to justify the need to develop a new TMC or update an existing one
- All TMC development will come after approval of a Feasibility Study Report
- Only real-time operations will be planned into a stand-alone building (see Table 1)
- Planning, research, and maintenance functions will not be designed into the TMC and will not be conducted there except as related to real-time operations or as required for emergency support
- All TMCs must accommodate a CHP presence, regardless of whether the building is an essential services act building. The scope of that presence will vary depending on the need. Generally, CHP presence should fall along the following lines:
 - at TMCs in rural areas, during major emergencies, heavy snow season
 - at TMCs in urban areas during peak periods
 - stand-alone TMCs must have 24-7 communication center

- Formalizing the feasibility assessment process, and employing definitive standards against which projects can be judged, such as the functions defined in Table 1. This will include defining factors that influence TMC needs (such as VMT, population density, vehicle mixes, accident rates, etc).
- As appropriate, TMCs will link to local and regional jurisdictions
- TMC Support Centers are located either in District Offices or satellite locations and will be used for planning and research
- Specific criteria will be defined and applied to determine the need for a stand-alone TMC. Considerations might include vehicle miles traveled, local funding support, CHP support, and the need for updated communication center.
- Continuance of the regional operations model that was implemented in the *1997 TMC Master Plan*
- Improve operations and standardize systems and operations statewide around the improvements

B. Evolution of the TMC

1. History of TMCs

In 1993, the Department and CHP approved the first *TMC Master Plan* to serve as a blueprint for coordination. A 1997 revision of the *TMC Master Plan* provided a common direction for the Department's approach to the use and operation of transportation management systems (TMS). TMS are the business processes and associated tools, field elements and communications systems used to manage traffic. They are essential if we are to get the most of our current system. Effective transportation management focuses around the TMC. This *TMC Development Considerations and Constraints* document supplements the 1997 TMC Master Plan.

The Department and CHP established the first Traffic Operations Center (TOC) in Los Angeles in 1971 to serve as a center for managing highway traffic congestion and providing traveler information. Part of the TMC function was to ensure that field elements supporting traffic control were operating as needed. Field elements include:

- traffic signals at intersections
- ramp meters to control traffic onto the freeways
- detector technologies to monitor traffic speeds and volumes
- changeable message signs, highway advisory radio and extinguishable message signs to inform drivers of specific conditions

As the population of California grew, the number of vehicles increased as well. As the number and technical complexity of elements increased, the Department recognized the need to ensure that the control of these elements and the information these elements provided to inform traffic management required specific physical accommodations and additional TOCs in other major metropolitan areas were developed. The technology that supports traffic management has evolved, and continues to evolve. Information technology costs continue to decrease, and the value that information technology provides in terms of being able to remotely understand and influence traffic congestion increases. With these changes, information sharing between agencies such as the CHP, transit agencies, local police, sheriff and fire departments increased the rapidity and quality of responses to situations. Recognizing the value of this increased coordination, in 1992, the Department and CHP signed a Memorandum of Understanding (MOU) on the development and operation of co-located TOCs.

2. *Today's TMCs*

There are literally tens of thousands of field elements deployed across the State. As technology has evolved, the complexity of these elements has increased, as has the value of and use for the data they collect and transmit. TMCs provide a single point to collect relevant information for a specific geographic region and for use by staff in that locality.

The Department's TMCs operations focus on management of the State-owned system in real-time, responding to incidents in coordination with the California Highway Patrol (CHP) and providing traveler information to drivers. Local City and County TMCs similarly coordinate travel on their transportation networks. While this sounds fairly simple on the

TMC Success Stories

District 7 – Los Angeles

The Freeway Service Patrol is operated by CHP with support from Caltrans. In 1998, the TV show "Good Morning, America" was filming in the Los Angeles area and visited the recently opened interim TMC facility. The staff were intrigued by the use of the incident detection algorithms and CCTV to identify and verify incidents and proposed that they film an incident from detection in the TMC to resolution, using a helicopter to get to the incident site. After some discussion with District staff, they realized that the average time from incident verification to having an FSP truck on the scene was only 7 minutes – not nearly enough time to go from the TMC to the site, even with the helicopter taking off from the roof of the TMC. Instead, in order to film the segment, they followed FSP trucks. TMCs are the coordination point for FSP activity.

Districts 6 & 10 – I-5 Flooding

In 1998, severe flooding washed out a bridge on I-5 and water stood ten feet over the pavement in some places. Despite hard rains and pitch black conditions that night, the TMCs provided the mechanism through which Caltrans districts and CHP could work to close the road by turning on CMS and helping to establish roadblocks. Soon after all traffic was diverted to SR-99, that route also became flooded and traffic was diverted to local roads. The TMC's understanding of where people were and the ability to communicate effectively made efficient deployment of TMT, Maintenance staff, and CHP possible. A major flood that could have been a worse tragedy resulted in the loss of only three or four vehicles.



face of it, provision of real-time data is only possible through the use and analysis of hundreds of thousands of pieces of information on a real-time basis. State TMCs bring together various sources of data from the detection grid, the CHP Computer Aided Dispatch (CAD), and information on planned lane closures and events. A greater emphasis on multi-modal transportation increasingly requires creating partnerships with local entities such as MPOs and transit operators, as well as a broader perspective than just traffic operations.

TMCs also serve as a mechanism for breaking down organizational silos within the Department and provide a framework for increasing synergies between the Department's functional areas, such as maintenance, operations and planning. In addition, they promote greater coordination with CHP and other government and non-government entities by providing a single site for key partners to work in close proximity to each other. TMCs provide the facility to increase coordination among staff who work to prevent and mitigate adverse effects of incidents and congestion.

TMCs provide resources – human resources, system resources, and equipment – to support the California Highway Patrol (CHP) when responding to incidents and emergencies. As emergency resource centers, they also provide human resources, system resources, equipment, and physical space to the CHP, the Governor's Office of Emergency Services, local public safety and emergency response departments, transit agencies, and others in large-scale emergencies, such as earthquakes, floods, hostage situations, bombings, etc. They are the means by which the Department can leverage the full value of the significant investment the State has made in the transportation infrastructure.

The concept of a “virtual” TMC, where all systems are fully accessible to appropriately authorized personnel through web-based applications, is viable in some circumstances. However, in large-scale emergencies, management of the transportation system cannot be completed by numerous individuals scattered across a region. It must be accomplished by staff who are physically located together, making decisions as a team, with access to as much information as possible. In these circumstances, there is little tolerance for error and delay: the right decisions must be made timely.

The 1997 TMC Master Plan proposed specific “development phases” of TMCs – basic, intermediate, and advanced – based on the functions that the TMCs perform, their typical equipment, and roles and staffing levels. However, as noted earlier in this plan, in practice, the variances are a matter of degree of complexity, rather than whether a particular function is performed or not. In fact, despite varying degrees of complexity, each TMC serves the same basic, core functions. Therefore, the development phases approach is not

a particularly useful tool for setting direction for development and operations and should be eliminated.

In addition to the “basic, intermediate and advanced” stratification, the 1997 TMC Master Plan categorized TMCs as “Regional TMCs”, “Urban TMCs”, or “Satellite Operations Centers” (SOC). The regional approach outlined in the TMC Master Plan is an effective way to address the challenges of inter-district communication and cooperation. However, the other distinctions (urban/rural and basic/intermediate/advanced) suggest that there are distinct functions for these different types. It is the degree of complexity, not the core functions, that differs by District. For example, there are areas throughout the state where ramp metering will be used to improve the flow of traffic on the freeway. However, the complexity of ramp metering operations in Fresno will not match the complexity of the operations in Los Angeles. Similarly, in emergency situations such as winter flooding, TMCs in more rural areas will need to be able to accommodate CHP presence, but it is not required 24 hours a day, 365 days a year. This business plan, therefore, eliminates the nomenclature of “basic-intermediate-advance” and “urban”, “rural”, and “SOC”. Rather, this business plan recommends that each of the Department’s 12 districts has a TMC, and that there are three TMC regions and three regional TMCs.

In addition to the regular roles and responsibilities of any TMC, the three regional TMCs – Districts 3, 4, and 7 – have the added role of coordinator for inter-district and inter-region operations. Coordination is critical in areas where freeways cross multiple districts and regions, such as the I-80 corridor in northern California, the I-5 corridor the length of the State, or the various freeways that span multiple districts in southern California. Regional TMC responsibilities include:

- Facilitating inter-district communication and decision making
- Facilitating intra-district communication and decision making
- Emergency operations control of TMCs within the region
- Coordination between TMCs within the region
- Planning special events between regions

TMC Support Centers

In addition to having a TMC – whatever the level of complexity – some districts may require an additional remote facility to promote effective transportation management. A TMC Support Center may be established for a variety of reasons:

- *Seasonal management of snow operations*
- *Seasonal management of recreational traffic*
- *Hazardous weather conditions*
- *Population centers far from the district’s TMC*
- *Research*
- *Executive access to and visibility into TMC activity*

Specific criteria for the establishment of TMC Support Centers will be set, and TMC Support Centers will be established when those criteria are met. TMC Support Centers may be responsible for public outreach and interaction with local agencies.

3. *TMCs of the Future*

The Department's vision is that each District have a TMC capable of performing an array of transportation management functions. Because the needs of each District are driven by the specific needs within the District the degree of sophistication may vary. This is entirely appropriate given the wide range of population concentration, geographies, and weather, among other variables among districts. The TMC may be a stand-alone building or may share the same building as the District headquarters, depending on specific functional requirements. This locational variation is analogous to other functional situations. A hospital may have several rooms devoted to pediatrics or a completely separate building, depending on the functional requirements to meet the service needs.

Using TMS technologies, TMC staff operate to pro-actively manage recurrent and non-recurrent congestion by analyzing data to understand traffic patterns, determine effective ramp metering strategies for freeways, and mitigation of the effects from incidents. In addition, staff will actively manage traffic in conjunction with other transportation modes, which requires a high degree of coordination with local and transit agencies. TMCs are also the coordination point for information distribution for other types of alerts such as AMBER alerts.

TMCs will serve as a single site for collecting real time transportation system related data and disseminating that data to other places. TMCs will deploy, host, and maintain information technology resources that allow for effective management of the system and incident management. Ultimately, center-to-center communication will allow one district to assume control of another district's elements such as changeable message signs and highway advisory radio, viewing of another district's detector information to assist, for example, in wide-spread evacuation efforts, and communication with ramp meter and intersection signals. This is an important step in ensuring the overall safety of the people of the State of California by ensuring continuity of service even if a single TMC is unavailable or unusable.

C. The TMC Facility

1. TMC Services and the Operations Floor

Like many other aspects of system management, the Department's understanding of the role and function of the TMC is evolutionary. As the complexity of TMS increases, and the interdependencies between and among field elements and key players grow, the TMCs themselves become increasingly complex. This evolution is consistent with changes in other building types to accommodate changes in technology designed to increase service levels. Factories have been redesigned to accommodate increased robotics, hospitals designs are different today than they were 20 years ago. Moving forward, the Department believes that the most effective design of a TMC is as a facility shared with some aspects of the CHP. The CHP has been designated as the lead in incident management and must be with the manager of the highway system: the Department. Facilities which are built to also serve as CHP communications centers are designed as essential services buildings, thus creating a greater certainty that the building will be functional in the event of a physical disaster such as an earthquake.

The TMC houses the functions surrounding transportation system management, including an operations floor that brings together detection data, CCTV images, CHP/FSP/Caltrans dispatch functions, and remote operation of field elements. The operations floor includes a video display that shows speeds on the transportation system in the district as well as multiple CCTV images. TMS allow for the remote control of field elements to manage the system and respond to incidents. Table 1 summarizes the functions that occur in the TMC building and indicates those that should occur on the operations floor.

Table 1 TMC Functions

Function	Operations Floor
1. Collection, display and storage of real-time data	✓
2. Control of field elements	✓
3. CHP Communications Center	✓
4. Freeway Service Patrol dispatch	✓
5. Transportation Management Teams dispatch	✓
6. Maintenance dispatch	✓
7. Toll dispatch (in districts where applicable)	✓
8. Caltrans fleet management	✓
9. Dissemination of information to the public and media	✓
10. Monitoring and management of planned and real-time lane closures	✓
11. Ramp Metering operations	✓
12. Signal operations	✓
13. System support (including field elements, other physical hardware, and software support)	✓
14. Planning for special near-term events	
15. Communications support	
16. Media support room	
17. Secondary media outlet	
18. Emergency resource center	
19. Facility security	✓
20. Facility Support	

The functions that are nearer to real-time transportation management must occur on the operations floor. These functions require shared access to the same information and a high degree of trust and coordination for effective response to rapidly changing system conditions. In some districts, staff who perform operational functions may also perform planning functions. For example, the same staff may perform ramp metering operations as ramp metering planning. In those cases, the staff should be permanently located at the TMC or in a nearby building.

These functions are supported by the following staff:

- Operators
- Dispatchers (Caltrans and CHP)



- CHP officers – FSP, TMC & watch officers, media information officer, managers/supervisors
- Traffic analyst
- District Traffic Managers
- Caltrans managers/supervisors
- Support staff – office assistants, office technicians
- Media/public information officer
- Ramp metering engineers
- Signal operations engineers
- CHP IT staff and clerical support
- Caltrans TMC systems engineers
- FSP engineers
- Traffic Management Teams
- Facility manager
- Facility security officer

Table 2 on the following page summarizes the types of activities currently being performed in the Department's twelve TMCs, and provides the number field elements each TMC will support when the currently planned TMS field element implementation is complete.

Table 2: TMC Functional Overview

District	Functions on the Operations Floor*	Other Agencies	Approx. TMC area	Operations Floor area	Centerline Miles (1999)	Total lane miles (1999)	Vehicle miles traveled	Totals at Build Out			
								Detector stations total ^{c,d}	Ramp meters	CMS	CCTV
District 1			230	230	944	2378	1,854,700,000	23	0	29	35
District 2			830	830	1733	4035	2,873,900,000	103	27	101	120
District 3 ^a	1,2,3,4,5,6,9,10	CHP, FSP	34,200	2,000	1508	4450	11,504,300,000	528	307	113	119
District 4	2, 5, 6, 9, 10, 13, 16, 18	CHP, FSP, MTC	10,200	2,400	1428	6280	33,952,600,000	2540	1006	170	800
District 5	2,5,6,9,10,14, 12,18	CHP	1,500	650	1167	3221	7,354,800,000	619	222	25	180
District 6	1,2,5,6,9,10,13, 14,15,18	CHP	2,000	2000	2035	5757	9,964,800,000	358	155	186	111
District 7	1,2,3,4,5,6,9,10, 18	CHP, FSP	60,000	13,000	1153	6413	40,843,200,000	1506	1139	167	501
District 8	1,2,5,6,9,10,13, 14,15,	CHP	8,000	2,000	1899	6608	18,880,400,000	670	398	109	519
District 9 ^b			200	200	739	1754	642,400,000	89	0	12	7
District 10	1,2,5,6,9,10,19	CHP	300	300	1320	3508	6,960,800,000	772	111	130	251
District 11	1,2,3,4,5,6,9, 10,11,12,13,14,15,1 6,18, 19	CHP, FSP, SANDAG	37,720	4,536	1003	4025	15,875,600,000	875	394	61	370
District 12	1,2,3,4,5,6,8,9, 10,13,14, 15	CHP, FSP, OCTA	27,500	2,800	290	1932	12,849,300,000	581	361	80	318

* 1 Collection, display and storage of real-time data; 2 Control of field elements; 3 CHP Communications Center; 4 Freeway Service Patrol dispatch; 5 Transportation Management Teams dispatch; 6 Maintenance dispatch; 7 Toll dispatch (in districts where applicable); 8 Caltrans fleet management; 9 Dissemination of information to the public and media; 10 Monitoring and management of planned and real-time lane closures; 11 Ramp Metering operations; 12 Signal operations; 13 System support (including field elements, other physical hardware, and software support); Planning for special near-term events; 15 Communications support; 16 Media support room; 17 Secondary media outlet; 18 Emergency resource center; 19 Facility security; 20 Facility support

a: District 3 also operates a TMC Support Center at Donner Summit during snow season.

b: District 9 operates its TMC on an as-needed basis

c: Field element numbers are the total elements the Department currently anticipates implementing for each District

d: Each detector station is usually connected to between 2 and 8 detectors



2. Information Systems

Transportation management staff depend on thousands of pieces of data to help inform their decisions. This data, in addition to improving immediate decision-making, is also invaluable as a catalyst for reflection on practices and how they can be improved and as the basis for performance measures. Because the real-time data is used in very close geographic proximity to the field element that is the source of the data, it makes sense to create an information technology infrastructure that can collect and retain the data very near the source of generation.

Additionally, space planning needs to account for the planned district build-out of elements, so that there is adequate and appropriate space for the information systems. This is not to suggest that each TMC will serve as a data center. However, each TMC must be designed to be independently operable, consistent with the concept of an emergency resource center, so that when major services such as power and communication lines are disrupted, the Department is able to continue to work to ensure the safety of Californians. In addition, in order to ensure operational continuity in the event that a TMC becomes physically unavailable through contamination or other circumstances, all systems must be available remotely through TMC Support Centers, mobile TMCs or at District Headquarters offices. Finally, to mitigate the impact of power disruptions, field elements such as CMS and HAR which are critical in the provision of information to the public should be solar-powered or have battery back-up.

D. Benefits of Co-location

Co-location of facilities provides multiple benefits to the Department and its partner agencies. The team environment facilitates communication and inter-jurisdictional coordination, and provides shared access to tools, infrastructure, and resources to promote efficiency and synergies. This is true for all stakeholders who co-locate – the Department, the CHP, local transportation agencies and local emergency response services providers -- but particularly so for the Department and the CHP. The TMC puts the manager of the scene – CHP – and the manager of the system – the Department – in the same place for the same purpose: managing traffic, reducing delay and increasing safety.

The Department is convinced that co-location is cost-effective and that it improves incident response and emergency management. Cost-effectiveness associated with TMCs should not be measured by the number of shared systems or services. Instead, cost-effectiveness should be measured through the consistent provision of quality services to the general public in a way that attempts to minimize the impact on travelers' time. Shared work environments lead to better information and better

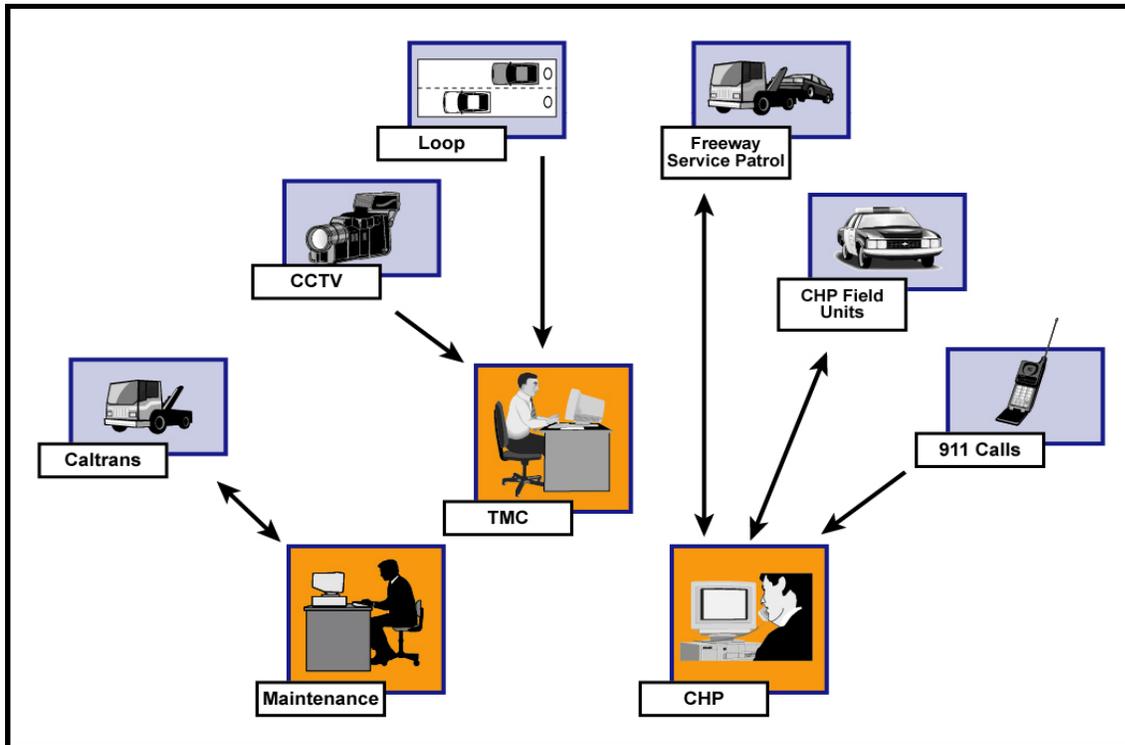
information leads to better system management. The Department is committed to demonstrating that co-location is efficient and effective in improving incident and emergency response but additional research is needed. Therefore, a study of two regions – one with CHP presence in the TMC and one without – is recommended at the conclusion of this report. This study should document observed operational, attitudinal and outcome differences.

The extent of co-location varies, based on the regional needs. For example, in smaller districts, co-location may consist of a single workstation for CHP to work side by side with the Department staff when circumstances dictate it, such as a major incident on the highway. In larger, urban districts, co-location may extend to the inclusion of a dispatch or communications center in the TMC. Factors that influence these determinations include the number of incidents, the overall traffic volume, vehicle mixes, and facility conditions.

The Federal Highway Administration has reported that when agencies work closely together in an environment like a TMC, responses to a situation are generally more consistent and uniform, making more efficient use of the systems at their disposal. (Federal Highway Administration. *Transportation Management Center Concept of Operations: Implementation Guide*, 1999)

Co-location enhances communication

In routine incident management, communication regarding an incident is accomplished through individual dispatchers, each with his or her own specialized function. The graphic next page depicts the type and sources of information and the individuals to which that information flows. In circumstances where CHP and the Department share an operations floor, when notification of a potential incident is received by the CHP, the dispatcher can request that a TMC operator activate the nearest CCTV, thus allowing the officer to quickly assess the situation and provide that information to the responding officer. The CHP dispatchers who are not located in a TMC do not have access to these images. Duplication of the CCTV systems would be prohibitively expensive. In addition, when information is received by any of the involved operators, that information can be easily relayed to the others for distribution to all responding parties. In a larger, direr situation, such as evacuation of even a part of a city, a TMC that permits all key parties to have access to their own information systems and dispatch systems is crucial. TMCs that are built without the possibility of allowing CHP access to their own systems could jeopardize the safety and security of California travelers.



Trust enhances situational response

The greatest benefits of co-location become apparent in high profile circumstances, such as multi-vehicle, multi-fatality accidents or vehicle pursuits that jeopardize the lives of the responding officers or bystanders. The pressure on all staff in those circumstances is extreme, and tensions run higher. These incidents cannot be predicted and must be responded to immediately. During these incidents, CHP may not only be focused on securing the site or guarding the safety of bystanders, but may also be preserving a crime scene and focusing on the law enforcement aspect of their mission. In these more extreme circumstances, it is precisely the fact that staff have co-operating routines that increases their efficiency and effectiveness of their operations. When an incident or other crisis situation occurs, co-located CHP and Caltrans staff know one another, and have confidence that they can rely on one another to provide the information and support the other needs to be as effective as possible. This level of trust is extremely unlikely to be present if CHP and the Department only interact during crises. Co-location provides the opportunity for CHP and Caltrans staff to learn more about each other's jobs and operating environments than is possible when they are not sharing facilities.

Emergency response improves with co-location

The major benefits of co-location are rooted in emergency response. Managing major changes in ingress and egress routes such as are necessary when fire, flood, earthquake or terrorism mandate major evacuations cannot be done in isolation, and require that the CHP and the Department work side-by-side, clearly understanding

each others' actions and implications of those actions. Large-scale traffic disruptions and complete route closures to allow for investigations, such as those that occurred in the Washington DC area during the search for the individuals responsible for sniper attacks in late 2002, are managed through TMCs. Co-location of Caltrans staff who are be called upon by the CHP to provide support with the CHP is an important element of safely, effectively and efficiently carrying out these activities. TMCs are a critical resource in the event of Standardized Emergency Management System (SEMS) activity as required in the California Emergency Services Act.

TMCs support the TMS in increasing safety and security, and reducing incidents; the TMS save lives. Incident management – both response and prevention – is a critical function of TMCs. Quick decisions require thorough information as well as a high level of confidence in all the players' ability to perform their role well. Co-location also greatly enhances the ability of the departments to plan for events and devise new transportation management strategies based on past experience.

E. Building TMCs

The San Bernardino/Riverside region is actively pursuing the development of a new TMC. This district, which has approximately 18,000,000,000 vehicle miles traveled (VMT) annually, currently has CHP support for co-location, a commitment for local funding support (33%) and is in the process of developing an FSR. The TMC that supports the Bay Area has recently been redesigned and will provide a solid base of operations for the next few years. However, the Bay Area has approximately 33,000,000,000 VMT and the TMC is currently located in a non-essential services building in an area that is at very high risk of earthquakes. An analysis to determine if a stand-alone essential services building is the best long-term solution for this region should be initiated in the next couple years. The Fresno and Stockton region operations are currently located in facilities that were not intended to provide permanent housing for TMC services and may pursue new co-located facilities within the next ten years.

To facilitate the decision-making process for determining need, and to support the planning and development effort if need is demonstrated, there are a number of evaluations that the Department should undertake. The first study should be undertaken immediately in support of the San Bernardino region's TMC effort. The other two studies should be undertaken within a year.

1. Develop space standards for each TMC function

The functions performed at a TMC are varied and space needs have been hard to determine in a justifiable manner due to the lack of accepted standards for each function. A study of standards used in other states for their TMCs and of other emergency operations environments should be conducted to determine

what standards are used, how similar they are to the Department's processes and functions, and if those standards that could be applied to future TMCs. This study should include human factors that influence space planning, adequate consideration for projecting space needs along a 15 year planning horizon, and a discussion of how to plan for including other agencies such as local transportation authorities, the CHP and other emergency service providers.

2. *An evaluation of the impact co-location has on long-term operating environment.*

This study should be a comparison of at least two Department TMCs within California, one with a CHP presence and one without. The study should explore the full spectrum of the operational implications of co-location, including incident response time, staff attitudes, costs, training, overall outcomes. The study should also determine, based on the outcomes, what specific considerations and conditions that determine the extent of co-location, and what triggers that decision now; what complement of CHP staff and functions demand an essential services building and how are those determinations made; and how costs should be shared between the agencies.

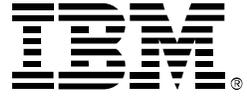
3. *An evaluation of the current TMC organizational and staffing design*

This study should evaluate the current organizational structures in place in each TMC and determine if better structures would result in better performance. This study should also include an assessment of the current classification of Caltrans TMC staff and a determination of whether that classification structure is best to support the TMCs in the future. This evaluation should include all Caltrans staff in the TMCs, regardless of organizational alignment. In addition, the study should evaluate the feasibility of establishing a single point of accountability for each TMC. To be most effective, this study should include the CHP staff as well, since they are an integral part of many TMCs. The study should also explore the feasibility of using interagency agreements to share support services such as information technology and clerical staff between agencies.

In addition to these specific studies, the Department should develop a specific list of questions to be used as a guide to formalize the decision-making process related to TMCs and ensure that the selected approach is a cost-effective solution that delivers the highest value to the people of the State of California.

Minimally, using a systems engineering approach to guide the evaluation, the following questions, including the risks and benefits of the proposed solution, should be addressed:

- Based on the list of functions above in Table 1, how many staff will be located at the TMC? Staffing determination is limited to the functions defined in Table 1.
- Will the CHP use the facility as a communications center? If so, how many CHP from the applicable region will be located in the TMC?
- If the facility is being proposed as new, stand-alone construction, what functional requirements demand a stand-alone facility?
- If the facility is being proposed as an essential services building, what functional requirements demand an essential services building?
- Is the TMC defined in the Facilities Plan? What is the 15 year vision for the TMC with specific regard to how local jurisdictions (including transit agencies) will integrate into the building? Will staff be co-located? What are the functional requirements to support this?
- Are there other existing facilities that could be used in lieu of building a new facility? For example, are there other State facilities that could be remodeled? Is there a local jurisdiction which has an existing TMC that could be shared? What are the costs of such an alternative site?
- If the facility is to be shared with other agencies, what financial approach is being taken to share the development costs? How are routine operating costs being shared?



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