Title
Incident Management: Process Analysis And Improvement Phase 1: Review Of Procedures

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Publication Date
1998-12-01

CALIFORNIA PATH PROGRAM
INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

Incident Management: Process Analysis and Improvement Phase 1: *Review of Procedures*

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California PATH Working Paper
UCB-ITS-PWP-98-31

This work was performed as part of the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation; and the United States Department Transportation, Federal Highway Administration.

Report for MOU 354

December 1998

ISSN 1055-1417

INCIDENT MANAGEMENT: PROCESS ANALYSIS AND IMPROVEMENT, PHASE I: REVIEW OF PROCEDURES

November 30, 1998

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ABSTRACT

This working paper examines the process for managing incidents on highways, as it is applied in Los Angeles County. The examination is based on interviews with various agencies, including law enforcement, state highway department, coroners office, and LA County MTA Freeway Service Patrol, along with direct observation through ride-alongs. Follow-up work will quantify the benefits of improved incident management, through analysis of freeway performance and response characteristics during incidents.

EXECUTIVE SUMMARY

Incident management is important due to its direct effect in saving life, property and the environment and due to its indirect effect on the entire highway system, including congestion and travel time. By responding to or clearing incidents more quickly, or maximizing the roadway capacity during incidents, both the economic cost of congestion and the associated aggravation are reduced. The result is more reliable travel, shorter trips, and an ability to accommodate more trips within the existing roadway infrastructure.

The objective of this study is to examine how technology can be used to improve the processes and procedures of incident management. The study is being completed in two parts. The first part (reported herein) has documented processes used in Los Angeles County, California, and identified opportunities for improvement. The second part will quantitatively evaluate the effect of new procedures and technologies on incident related delay.

This paper documents the results of interviews and observations with a range of organizations engaged in incident management:

- California Highway Patrol (CHP)
- California Department of Transportation (Caltrans)
  - Transportation Management Center (TMC)
  - Traffic Management Team (TMT)
  - Maintenance
  - Hazardous Materials (HazMat)
- LA County MTA Freeway Service Patrol (LACMTA FSP)
- Local Fire Departments
- Coroner

Information was collected on the individual agencies through a combination of three methods:

Document Review: Incident procedure manuals, dispatching plans, Internet web pages and other documents were obtained and reviewed.

Interviews: A questionnaire was developed to obtain information on incident response procedures and technologies. Interviews were administered in person, usually on a one-on-one basis.

Observation: Ride-alongs were completed with CHP officers, LACMTA FSP trucks, and Caltrans Maintenance to observe how incidents are handled, and to obtain further

information through interviews. Additional observations were completed at the Caltrans District 7 TMC and CHP Southern Division's Communication Center.

We also examined technologies available for incident management by contacting manufacturers and reviewing articles in transportation and law enforcement publications.

As a general conclusion, we observed that efficient dispatching plays a critical role in effective incident management. This includes being able to dispatch the appropriate crew and equipment, having that appropriate crew and equipment available close to the incident scene, and being able to determine which crew can be dispatched most quickly to the scene. A high level of efficiency depends on having the resources to ensure sufficient staffing, and it depends on the dispatching process itself. The latter might be improved through improved assessment of the incident prior to dispatching crews, and improved awareness of crew locations, which might be achieved through vehicle tracking systems.

In total, the incident management process should be optimized, with respect to the following objectives:

- Minimizing the time from when an incident occurs until appropriate crews arrive on the scene, minimizing the time to clear the incident, and minimizing the follow-up investigation time.

- During the incident, minimizing the disruption to traffic by keeping lanes open, reducing the capacity reduction per lane due to driver distraction and hazardous conditions, and minimizing follow-on collisions.

- Ensuring safety throughout the incident, for the victims, incident response crews, drivers and passengers.

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1. INTRODUCTION

An incident on roadways represents any occurrence that disrupts the ordinary flow of traffic. An incident can range from debris dropped along the side of a roadway up to major collisions involving fatalities or hazardous material spills. Incident management represents the process by which incidents are cleared from the roadway to restore ordinary traffic conditions.

Incident management is important due to its direct effect in saving life, property and the environment and due to its indirect effect on the entire highway system, including congestion and travel time. By responding to or clearing incidents more quickly, or maximizing the roadway capacity during incidents, both the economic cost of congestion and the associated aggravation are reduced. The result is more reliable travel, shorter trips, and an ability to accommodate more trips within the existing roadway infrastructure.

There exists a huge literature on incident management in both academic and non-academic journals. The vast majority of the published research focuses on methodologies for incident detection and surveillance (loop detectors, machine vision, closed-circuit-television, cellular phone calls, probe vehicles, etc.) and traffic management strategies associated with incidents. Relatively little research has been published about managing the incident process as a whole, and the coordination of traffic control with incident clearance. In FHWA sponsored research, Wohlschlaeger and Ullman (1992) and Reiss and Dunn (1991) have produced handbook style documents that provide guidance to emergency management agencies on incident clearance. Wohlschlaeger and Ullman (1992) catalogue techniques used in incident management, and Reiss and Dunn (1991) describe how to develop an incident management program. McCasland (1994) provides an incident response manual for Texas, and outlines how to improve interagency coordination.

From a more analytical perspective, Madanat (1996) modeled and simulated the incident response process to evaluate the effects of decisions made during different stages of the incident. In a series of papers, Nathanail and Zografos (1994, 1995), Zografos and Nathanail (1991) and Zografos et al (1993) have evaluated various aspects of the incident response and clearance process through analytical models, including where to locate response units, which units to dispatch and how to manage the process during clearance. Various authors have developed expert systems to assist transportation management personnel in incident management, including the work of Gupta et al (1992), Hobeika (1996), Suttayamully et al (1995) and Zhang and Ritchie (1992).

A fairly comprehensive model of freeway incident severity and frequency was recently developed by Sullivan (1997). The model classifies incidents as abandoned vehicles,

accidents/fires, debris on highway, disabled vehicles requiring towing, stalled vehicles, tire problems and miscellaneous. The model is divided into four components, which predict (1) incident rates, (2) lane blockage and capacity reduction, (3) incident duration, and (4) demand dependent delays. Other sources of empircal data on incidents include Guiliano (1989), Lari et al (1982) and Recker et al (1988).

Although ramp metering has been studied extensively in the literature, relatively little of the research has been devoted to flow control during and after an incident, along with empirical analysis of flow control strategies. Several authors have investigated combined traffic assignment/metering strategies (Newell, 1977; Yang and Yagar, 1994, Janson, 1998) under non-incident conditions. Janson, for instance, uses the dynamic assignment DYMOD to evaluate effects of ramp meter queues on route diversion and network performance. Whether these models are accurate in the presence of incidents (in which case travel times may not be known to travelers on alternate routes) is questionable. This is also questionable for research targeted specifically at incident conditions (e.g., Ivan and Chen and Chang et al). Other metering research, such as Papageorgiou et al (1990 a and b) does not directly account for the propensity for travelers to divert in response to different metering rates.

In the areas of changeable-message-signs, there has been considerable research on design standards and message formats (Dudek, 1992, 1997, provide reviews), which has become a mature field. Design guidelines are also available for portable message signs (Knoblauch, 1995). The idea of coordinating information dissemination with metering is not new (e.g., Pretty, 1972), and various theoretical models and concepts for diversionary behavior have been developed in recent years (as evident in the Smart Corridor and other projects around the world).

PATH has been very active in research on traffic surveillance methods for the purpose of incident detection. This has included neural network based algorithms for interpreting loop detector data (Ritchie and Cheu, 1993), machine vision based research (Malik and Russell, 1995), vehicle probes (Westerman et al, 1996 and current work by Moore and Hall), and cellular phone calls (current work by Skabardonis). PATH has also completed a major evaluation on the effectiveness of freeway service patrols (Skabardonis et al, 1995). This project also produced an extensive database on the occurrence of incidents along the I-880 corridor through Hayward, including information collected from FSP vehicles and from loop detectors. PATH has also funded a number of projects aimed at evaluating the effects of traveler diversion to alternative routes during incidents, including the work of Al-Deek and May (1989), Khattak et al (1994), Al-Deek and Kanafani (1991), Heydecker (1994) and a series of projects at U.C. Davis (summarized in Kitamura et al, 1995). The work by Heydecker is especially relevant, as it focuses on the effects of incidents on traffic flows and the benefits of diversion strategies. However, Heydecker's work is entirely theoretical with no evaluation of field data. Some work has

been completed on changeable message signs through the YATI project, including studies of traveler awareness of displayed messages.

Perhaps the most similar research to date is the work of Lo and Rybinski (1996), which examined interfaces between transportation management centers and emergency management systems. They examine methods by which emergency agencies receive calls from the public, and how their centers communicate with each other. Morimoto (1996) also describes how global-positioning-systems are being used in Japan to improve the efficiency of dispatching operations, and Harwood (1995) describes a software system used to advise police dispatchers on traffic diversion strategies in the presence of incidents.

1.1 Study Objectives

The objective of this study is to examine how technology can be used to improve the processes and procedures for incident management. The study is being completed in two parts. The first part (reported herein) has documented processes used in Los Angeles (LA) County, California, and identified opportunities for improvement. The second part will quantitatively evaluate the effect of new procedures and technologies on incident related delay.

This paper documents the results of interviews and observations with a range of organizations engaged in incident management:

California Highway Patrol (CHP) The primary law enforcement agency on state highways and the scene commander for incidents.

California Department of Transportation (Caltrans) Caltrans comprises many divisions that are together responsible for the construction, maintenance and operation of the highways, including the following functions:

- Transportation Management Center (TMC): Focal point for monitoring freeway operations through traffic sensors and closed-circuit-television, and for controlling changeable message signs and traffic meters. The TMC also disseminates information through the media, controls dispatch of maintenance equipment and co-locates CHP officers for coordinated incident response.

- Traffic Management Team (TMT): Places portable message signs upstream from major incidents or events to warn traffic.

- Maintenance: Clears debris from the roadway and restores the highway to safe operation after major incidents.

- Hazardous Materials (HazMat): A section within Maintenance that assesses, cleans up and disposes hazardous materials that spill on state highways.

LA County MTA Freeway Service Patrol (LACMTA FSP) Private tow trucks contracted through the Metropolitan Transportation Authority that assist motorists when their vehicles breakdown on highways, at no charge to the motorist.

Local Fire Departments Fighting fires on highways, providing paramedics and ambulance service at accidents and providing environmental and health services in case of hazardous material spills.

Local Police Departments Local police departments respond to and investigate serious crimes that occur on highways (homicides, assaults, etc.), and often provide support in the event of major incidents.

Private Tow Operators Tow operators are responsible for restoring vehicles to operating conditions and removing damaged vehicles from the roadway. Tow operators either specialize in ordinary light-duty vehicles or heavy-duty vehicles, such as trucks or busses.

Cargo Salvage Cargo salvage companies assist trucking companies when they spill their loads on a highway. Their job is to retrieve the cargo, transport it off the highway and salvage what is still usable.

Environmental Environmental agencies such as CalEPA are concerned with the use of correct procedures so as to minimize damage to the environment due to incidents.

Coroner The duties of the County Department of Coroner are to determine the manner, mode and cause of an unnatural death or a natural death in which the deceased was not under medical supervision. Their function is to identify the dead, locate the nearest kin, notify them and return the body to them, after investigation, if any.

1.2 Methodology

Information was collected on the individual agencies through a combination of three methods:

Document Review: Incident procedure manuals, dispatching plans, Internet web pages and other documents were obtained and reviewed.

Interviews: A questionnaire was developed to obtain information on incident management procedures and technologies. Interviews were administered in person, usually on a one-on-one basis. Table 1 lists the persons who participated in interviews.

Observation: Ride-alongs were completed with CHP officers, LACMTA FSP trucks, and Caltrans Maintenance to observe how incidents are handled, and to obtain further information through interviews. Additional observations were completed at the Caltrans Distrcit 7 TMC and CHP Southern Division's Communication Center.

We also examined technologies available for incident management by contacting manufacturers and reviewing articles in transportation and policing publications.

Table 1. Persons Interviewed

Agency	Person Interviewed	Position
Caltrans		
TMC/Operations	Sam Esquenazi	Program Manager
Maintenance	Dave Duncan	Highway Maintenance Supervisor
TMT	Ray Higa	Sr. Transportation Engr.
HazMat	Willie Perales	HazMat Specialist
CHP	Bill Pasley	Lieutenant
LACC	Lynn Diebold Marghi Davidson	Staff Services Manager Communications Manager
LACMTA FSP	Hassan Safari Freddie Guererro	Sr. Transportation Engr. Caltrans Field Supervisor
MTA	Al Martinez	
LASAFE	Ken Coleman Mike Ibay	Administrative intern
Fire Departments		
LA County FD	Gil Herrera	Asst. Fire Chief
City of LA FD	Capt. Tim McDonnell	Captain
LA County HazMat	Gerald Munoz	HazMat Specialist
Coroner	Craig Harvey	Chief Coroner Investigator & Chief of Operations
Tow Operators	Garry Bains	Owner, US Tow

1.3 Document Outline

The remainder of this document presents our findings and recommends topics for in-depth exploration in the quantitative portion of the study. First, the steps of the incident

management process are presented. Next, the functions of individual organizations are described, along with their roles in incident management. This is followed by a review of Intelligent Transportation System technologies used in incident management. Finally, the paper concludes by identifying issues for further quantitative investigation.

2. INCIDENT MANAGEMENT PROCESS

The incident management process is customarily divided into four steps, representing incident detection, incident verification, incident response, and incident clearance.

Incident Detection Incident detection initiates the incident management process. It occurs when something unusual is noticed on a roadway, and can occur in any of the following ways:

- Detection by a patrolling unit (law enforcement officer, FSP truck, Caltrans, etc.)
- Detection by a passing motorist
  - 911 calls
  - Call boxes
- Call by someone involved in an incident
  - 911 calls
  - call boxes
- TMC observation (unusual traffic pattern or closed circuit television)
- Airborne traffic reports

If an incident is seen in the field by Caltrans, CHP, or FSP staff, then it is considered immediately verified, and appropriate incident response procedures are initiated. Most incidents today are detected by patrolling units or 911 calls.

Incident Verification Incident verification is sometimes needed when the initial report comes from an untrained observer who might exaggerate the severity of an incident or mix up the location of the incident with other details. It is also required when an incident is detected from unusual traffic patterns observed at the TMC. Sometimes, incidents can be verified from closed-circuit-television cameras (CCTV). More likely, someone (such as a CHP officer) must be dispatched to the reported scene to assess the situation. It should be noted that actual incidents might require no other resource than a single CHP officer, so incident verification and incident response are a single step.

Incident Response Incident response represents the deployment of resources to the incident. The process includes generating a response plan, dispatching resources, and response by various organizations. The effectiveness of incident response depends on the speed of communication and decision-making, organizational readiness, placement of resources, and travel time to the scene. For major incidents, incident response can occur

in stages, where different resources are dispatched for different phases of the clearance process.

Incident Clearance Once responding units arrive at the scene, they will be responsible for any or all of the following:

- assisting injured parties,
- controlling hazards and extinguishing fires
- clearing vehicles and debris from the scene,
- controlling traffic and preventing rear end type collisions,
- disseminating information to motorists,
- investigating the cause of the incident
- reporting their findings.

CHP/Caltrans (1991) have defined five classes of incidents, representing their severity:

Stage 1: Up to 2 vehicles on shoulder or center divider
Stage 2: 3 or more vehicles on shoulder or center divider
Stage 3, minor: intrusion of incident into one or more lanes, but not all lanes
Stage 3, major: intrusion of incident into one or more lanes and full closure required for two hours or more
Stage 4: Areawide incident affecting multiple jurisdictions

Simple Stage 1 incidents can often be handled by a single CHP officer, FSP tow truck, or Caltrans maintenance truck. Major Stage 3 or Stage 4 incidents, on the other hand, require a coordinated response from multiple agencies, each serving a unique role in incident clearance. This section describes the role of each agency, based on our observations, document review, and interviews.

A summary of the steps and activities can be found in Figure 1. The following sections describe the roles of individual agencies.

2.1 California Highway Patrol (CHP)

California Highway Patrol (CHP) is the primary law-enforcement agency on California state highways, and are therefore constantly responding to incidents. CHP is organized into eight geographic divisions (Figure 2), each of which is divided into multiple stations. Figure 3 shows the territories served by each station in the Southern Division.

CHP acts as the overall scene commander for incidents on highways. It functions to safely remove people and vehicles as quickly as possible, to control the movement of incident responders in and out of the scene, and to control the incident scene to prevent follow-on incidents. The CHP also serves as the communication hub through use of its

CALIFORNIA'S CURRENT URBAN FREEWAY INCIDENT MANAGEMENT PROGRAM FLOW CHART

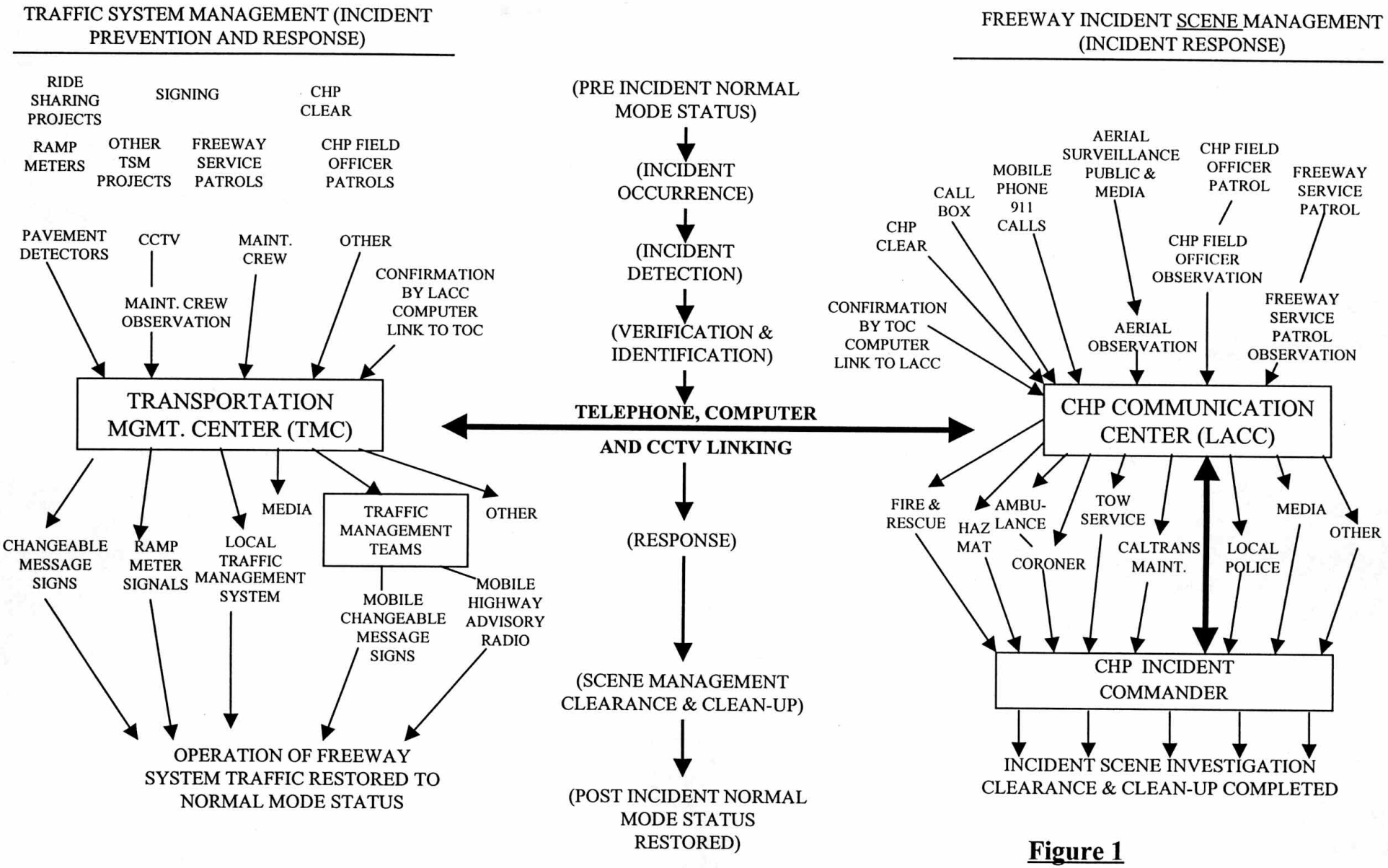


Figure 1

SOURCE: STATEWIDE INCIDENT RESPONSE MANAGEMENT PROGRAM, JAN 1991.

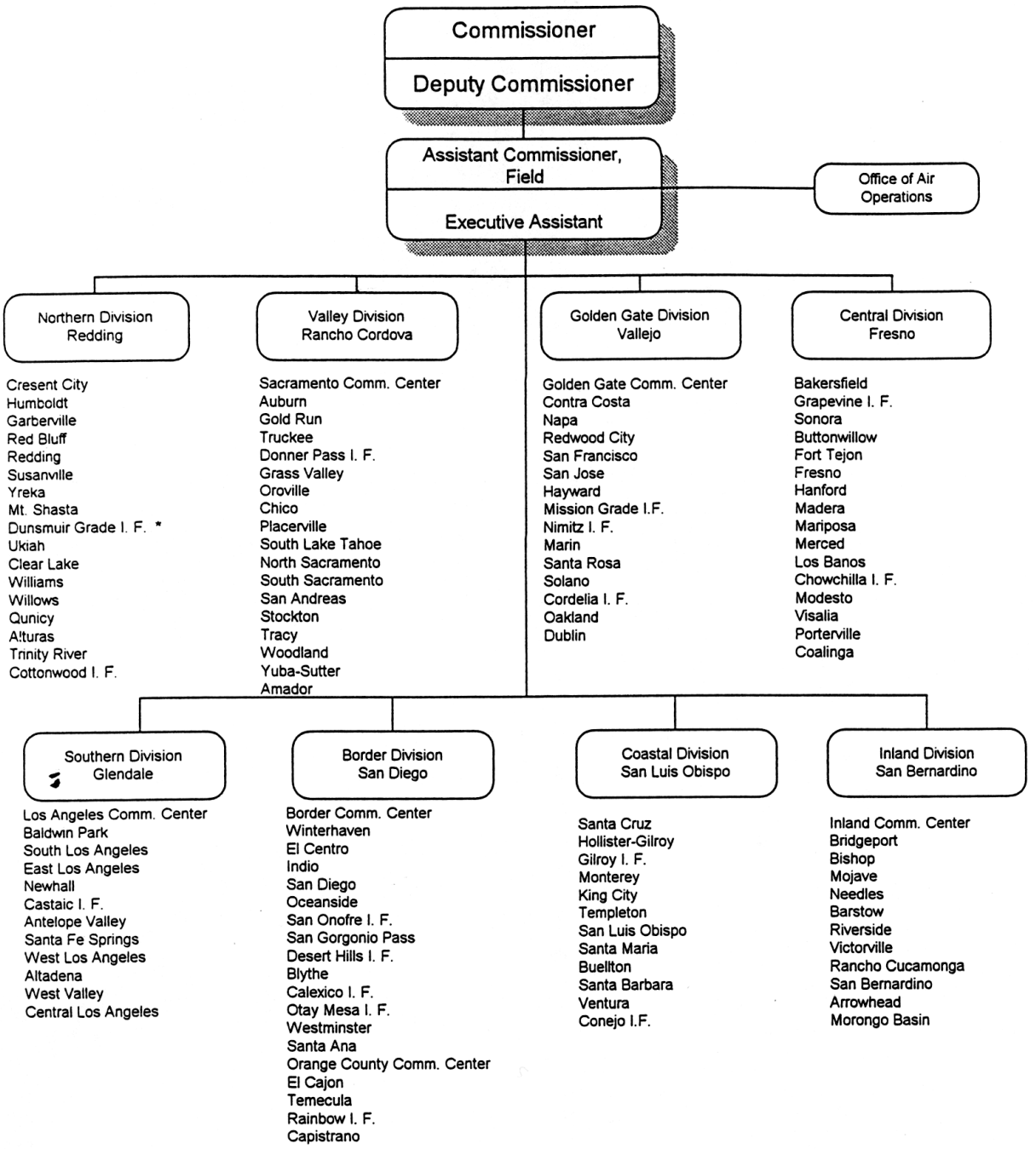
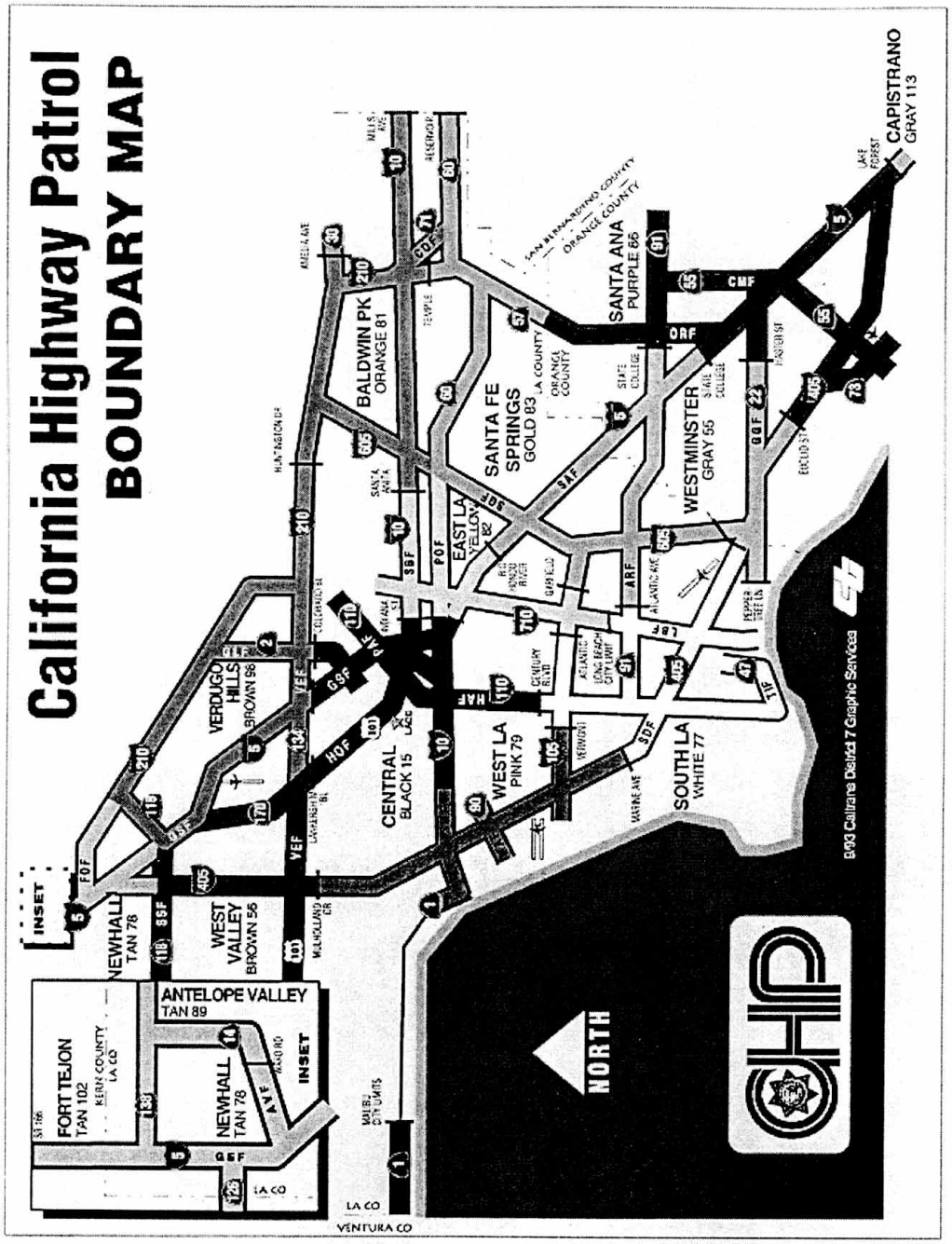


Figure 2 : CHP Organization Chart

Figure 3


California Highway Patrol
BOUNDARY MAP
INSET
FORT TEJON
TAN 102
KERN COUNTY
LA CO
NEWHALL
TAN 78
ANTELOPE VALLEY
TAN 89
NEWHALL
TAN 78
INSET
WEST
VALLEY
BROWN 56
VERDUGO
HILLS
BROWN 86
CENTRAL
BLACK 15
WEST LA
PINK 79
BALDWIN PK
ORANGE 81
SANTA FE
SPRINGS
GOLD 83
EAST LA
YELLOW 82
SOUTH LA
WHITE 77
WESTMINSTER
GRAY 55
SANTA ANA
PURPLE 86
CAPISTRANO
GRAY 113
SAN BERNARDINO COUNTY
ORANGE COUNTY
LA COUNTY
ORANGE COUNTY
LA CO
VENTURA CO
NORTH
CHP
B/93 Caltrans District 7 Graphic Services

Computer Aided Dispatch system, and through its role as the Public Service Answering Point (PSAP) for cellular 911 phone calls.

CHP patrol cars are equipped with 2-way radio and (sometimes) a laptop computer connected to a cellular modem. The laptop computer allows officers to receive and send text messages regarding incidents. Officers also carry portable radios, which allows them to communicate with their dispatcher when within a limited range of their car.

CHP's specific roles in incident management are as follows:

Incident Detection Incident detection is processed by CHP most of the time. The phone calls made by the public or from call boxes are all processed by the CHP communication center and then routed to the appropriate agency. CHP officers in the field are constantly patrolling the highways and, therefore, they are often the first to detect an incident. CHP also serves as the communication center for LACMTA FSP trucks, which are also dispatched through the CHP CAD.

Incident Verification Incidents are generally verified by the CHP officers on the site. They verify incidents upon instructions from the CHP dispatch center for incident verification. Depending on the type and severity of incident, the CHP officer will ask the dispatcher to summon other agencies. Upon verifying the incident, the officer takes control of the incident as the incident commander, while staying in touch by radio with the dispatcher.

Incident Response Each day is divided into three watches (1:30 – 10:00 p.m.; 9:30 p.m. – 6:00 a.m.; 5:30 a.m. – 2:00 p.m.) and each highway is divided into beats. A beat is defined by a highway segment and by direction (a different officer may be responsible for each direction). Each officer is assigned to a beat that he or she is responsible for patroling (one officer per car), but in case of a major incident or emergency, the officer might be called to respond on another beat. During the course of his or her watch, an officer will be engaged in various activities, such as patrol, ticketing, roadside assistance, reporting (often in the office) and incident management.

When an incident is reported into the communication center, the dispatcher will first see whether the officer responsible for the section of roadway is "clear" (not otherwise engaged). If the beat officer is clear, then he or she will be dispatched to the incident. Otherwise, the dispatcher will assign the incident to the closest beat for which an officer is clear. However, if the incident has a high priority then he or she may be diverted to it even if not clear.

The speed of response depends on how far the officer is from the incident, the incident's priority and traffic conditions. It also depends on the side of the freeway where the incident is located, and the availability of turn-around ramps when on the opposite side of

the officer's current location. Response time can be reduced by turning on lights and sirens and traveling at a high speed, or by driving on shoulders. This is only merited for major incidents. Otherwise, the patrol car can only respond as quickly as traffic allows.

Incident Clearance CHP serves as the overall incident commander on scene, and remains at the incident site until it is completely cleared and traffic is restored. CHP officers have a "clear the road" policy, whereby the officers can override the owner's wishes and clear the highway. In case of a fire, fire department vehicles will perform delegated responsibilities of the incident to clear it. CHP also plays a crucial role in clearing the road to create fast access for other agencies, when required. CHP also stages agencies on the highway whenever required and protect them from fast-moving traffic. Finally, CHP is responsible for incident investigation and reporting.

The CHP also makes information available to the media and public on incidents through its "Media CAD." Connections are provided to traffic reporting companies, such as Metro Networks and Shadow Traffic. Incident information can also be obtained through the Internet.

CHP officers are also involved in running breaks in traffic to stage various agencies on the scene, and to protect them against fast-moving traffic. CHP officers are involved in enforcement of standards to be followed by LACMTA FSP, their training (including communication), and maintenance of their trucks.

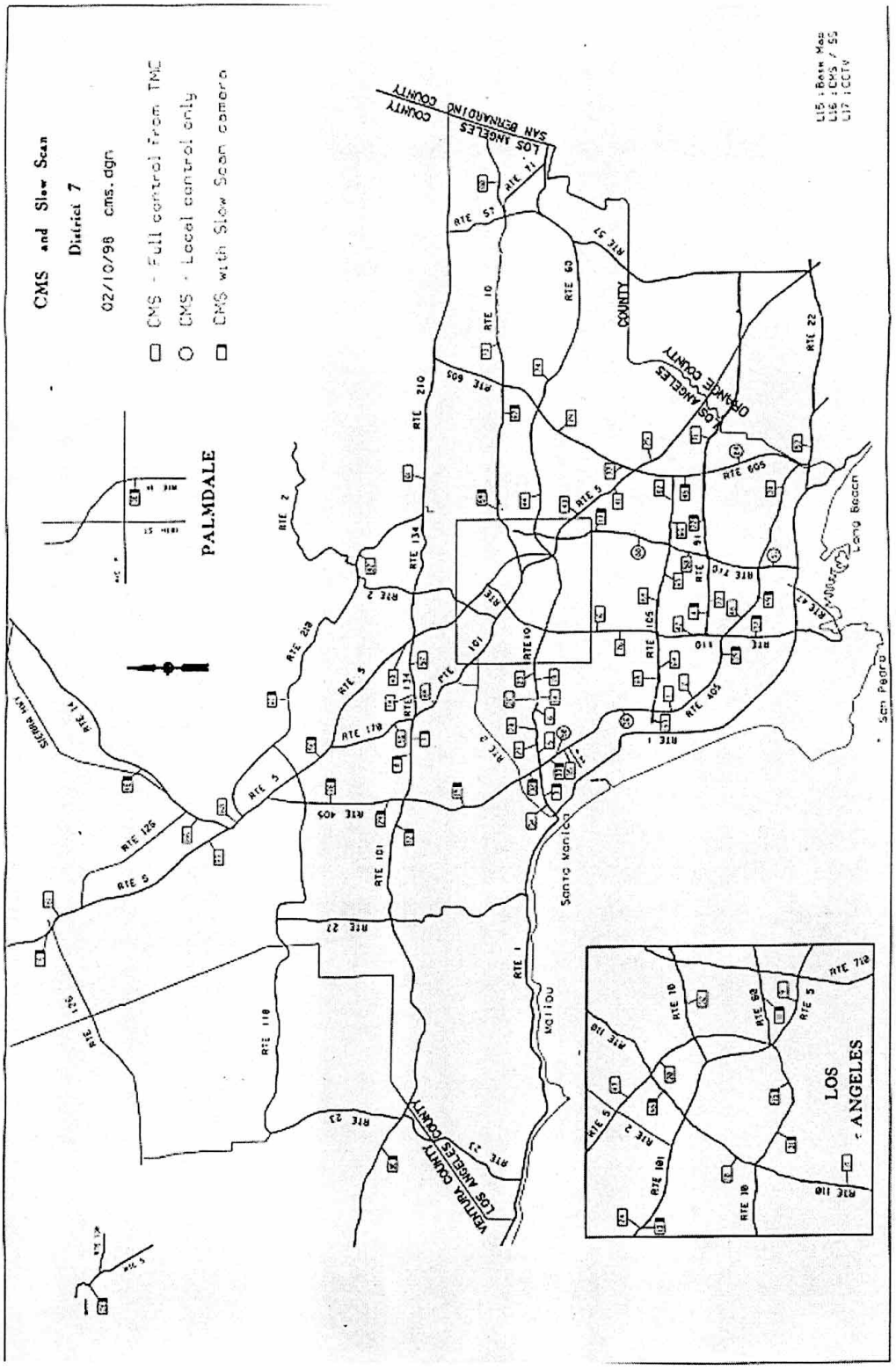
2.2 Caltrans

Caltrans is the State of California's Department of Transportation. Its primary responsibility is construction, maintenance and operation of the state highway system, but it is also engaged in other modal activities such as airport and transit planning and commercial vehicle inspections. Caltrans is organized into 12 districts, each of which is somewhat autonomous. Each district is headed by a district director, and divided into various divisions (planning, operations, maintenance, etc.) headed by division chiefs. Incident management falls within the operations and maintenance divisions, which are sometimes combined into a single division, in the smaller districts.

Transportation Management Center (TMC) The TMC falls under highway operations, and is concerned with maximizing the operational efficiency of the highway system through monitoring traffic conditions, executing control actions and disseminating information to the public. This includes traffic sensors, ramp meters, changeable messages signs (CMS) and closed-circuit television (CCTV; Figure 4).

Occupancy and traffic volumes are measured with magnetic loop detectors and other traffic sensors throughout the highway system. The data are color-coded within the

Figure 4


CMS and Slow Scan
District 7
02/10/98 cms.dgn
CMS - Full control from TMC
CMS - Local control only
CMS with Slow Scan camera
PALMDALE
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
ORANGE COUNTY
VENTURA COUNTY
LOS ANGELES COUNTY
Long Beach
Santa Monica
San Pedro
Malibu
LOS ANGELES
RTE 2
RTE 5
RTE 10
RTE 14
RTE 22
RTE 23
RTE 27
RTE 57
RTE 60
RTE 91
RTE 101
RTE 105
RTE 110
RTE 118
RTE 126
RTE 134
RTE 170
RTE 210
RTE 405
RTE 605
RTE 710
RTE 712

"Freeway Status" map to display calculated speed by highway segment (red, < 20 mph; yellow 20-35 mph; green > 35 mph). This map can be viewed within the TMC, and at remote sites via cable television and Internet. The speed information is most useful in assessing the impacts of incidents, but is also somewhat useful in detecting incidents. Closed-circuit-television cameras are placed at strategic locations, though most of the highway system is uncovered.

Caltrans TMCs exchange information with some city TMCs, such as the City of Los Angeles' ATSAC center. For instance, the Smart Corridor system has been used to coordinate the diversion of traffic onto major arterials in the vicinity of the Santa Monica Freeway. The Smart Corridor treats freeways and surface streets as corridors to move people and goods, instead of separate entities. Therefore, in case of an incident or congestion on the freeway, adjacent city streets act to provide a smooth passage for the freeway traffic, thus relieving congestion on the freeway and reduce effect on other arms of the highway system. It is the policy of Caltrans and CHP to collocate communication center activities in their TMC. In Los Angeles, the CHP communication center is separate from Caltrans' TMC, but CHP has located a public information officer within the CHP TMC. Caltrans and CHP have agreed to joint responsibility for incident detection, incident verification, system incident management, and operational control of the changeable message signs and any highway advisory radio systems. However, Caltrans has primary responsibility for managing freeway corridor systems impacted by incidents and CHP has jurisdiction over freeway incident scene management and scene traffic control.

The TMC Master Plan (Caltrans and CHP, 1997) establishes three regions within the State: Coastal, Valley, and Southern. The existing TMCs located in the San Francisco Bay Area, Sacramento, and Los Angeles include additional regional responsibilities as well as their local urban functions and they are referred to as Regional TMCs. The remaining TMCs retain their local urban functions and are referred to as Urban TMCs.

Within their area, Urban TMCs are responsible for providing a central media point for traffic information, highway communication, managing congestion, and managing transportation systems during emergencies. They coordinate TMT, Maintenance, HazMat, and other agencies, technology projects, and creating synergistic partnerships such as rail, air, or shipping. Beside the urban function, regional TMCs are responsible for round-the-clock coordination and management of statewide coverage, covering areas and functions not covered by Urban TMCs. They facilitate coordination across boundaries and regions and with headquarters.

Urban and Regional TMCs may contain the following representatives:

- Caltrans Traffic, Maintenance, and Public Affairs
- CHP Communication Center, Media Information, and Air Operations

Caltrans - Transportation Management Center
District 7 - Los Angeles
Organization Chart

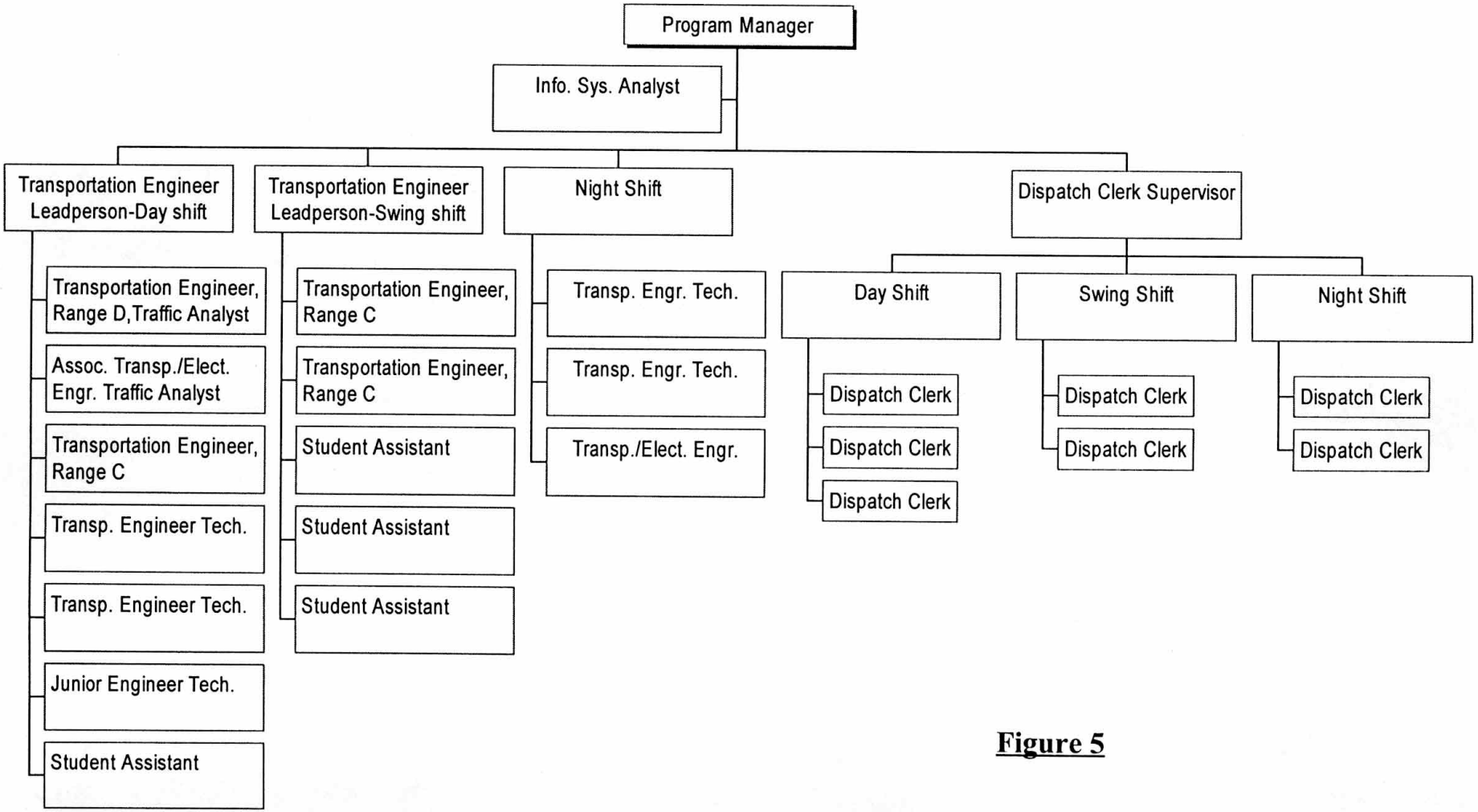


Figure 5

- Local agency staff, media, researchers, and transit authority staff
- Freeway Service Patrol Supervisors

Figure 5 provides an organizational chart for the District 7 TMC. The TMC performs the following functions during incident management:

Incident Detection TMC plays a role in incident detection through its Freeway surveillance system and through its CCTV cameras. Dispatchers in the TMC may also receive information on observed incidents through their field units. Unusual occurrences that require police response are sent to CHP for verification. The usefulness of CCTV as an incident detection tool will increase as more highways are covered with CCTV. TMC staff enters planned road maintenance construction closures into the CHP Media CAD for general dissemination.

Incident Verification The TMC mainly relies on the CHP CAD for the incident verification by a CHP officer on scene. But on its own, the TMC can verify incidents using their CCTV (limited) visually, in case the incident occurred near the location of the camera. They can also indirectly verify an incident through their traffic monitoring system, thus cutting down delay in response.

Incident Response The TMC is directly responsible for dispatch of Traffic Management Teams (described later) and Maintenance personnel.

Incident Clearance Depending on the severity and location of an incident, messages may be displayed on CMS to provide advance warning to motorists. Upon availability of CMS, any incident that has a major impact on the traffic is reported on the CMS. The messages on the CMS provide information on the incident, alternate routes, and warnings of hazards and closures (lanes or freeways). Generally, weather-related warning messages receive lower priority and are displayed only when they pose a significant hazard or delay to the motorists. Information on incidents also reaches the public through CHP's public information officers located in TMCs, who offer information to the media. The traffic control systems will in some cases automatically change ramp meter settings. In the future, ramp meter plans may be changed from the TMC in accordance with the nature of the incident. Finally, TMCs will sometimes work with cities to develop traffic diversion routes and to invoke signal plans on arterials to support diverted traffic.

Traffic Management Team (TMT) The TMT provides equipment and trained personnel to aid in the management of traffic congestion around major incidents and planned events on state highways and freeways. The team's primary goal is to provide advance warning of unexpected congestion, to prevent rear end collisions as vehicles approach slowed traffic. The TMT co-ordinates with the TMC and CHP on managing traffic upstream of the incident. TMT operates 24 hours a day, 7 days a week.

The TMT resources include changeable message signs and a fleet of vehicles that are used to move them. TMT fleet consists of:

1. 3 Full sized sedans
2. 11 Compact station wagons
3. 21 _ ton gasoline pickups
4. 1 _ ton diesel pickups

These equipment are described in Table 2.

Table 2. TMT Equipment

Item	Quantity	Salient Features
Programmable CMS (PCMS)	10	2- line bulb matrix, capable of 9-10 characters per line.
Programmable CMS (PCMS)	2	1-line bulb matrix, capable of 7-8 characters
Fabric Signs	7	Carry a library of pre-stenciled words and alphanumeric characters on vinyl panels. Capable of 5 lines, 9-10 characters per line, externally illuminated for night use.
Trailer mounted PCMS	4	3-line matrix, 7-8 characters per line
Trailer mounted HAR	1	
The sedans are equipped with detour signs, traffic cones and highway flares.		

The TMT Action Plan states that "As a general rule, the Team will respond to the following situations:

1. Major incidents where 2 or more freeway lanes or a major freeway to freeway connector are blocked for 2 or more hours
2. Incidents on high-volume conventional highways (e.g. Pacific Coast Highway) where the congestion is expected to last for a prolonged period of time.

3. Special events which are expected to generate congestion (usually for 2 or more hours) on adjacent freeway routes
4. Planned lane closures for maintenance and construction activities where non-recurrent congestion is expected to last at least 2 hours.
5. During normal work hours, incidents of one hour or more expected duration within approximately 15 minutes driving time from the District office."

The TMT performs the following functions in the incident management process:

Incident detection TMT has no role in incident detection.

Incident Verification TMT has no role in incident verification, however, upon arrival at the scene, TMT provides incident update to the TMC.

Incident Response The TMC notifies the TMT leader when an incident appears to meet the dispatch criteria. Based on the available information and resource availability, the TMT leader decides whether to roll out a team or not and informs the TMC of the decision. The selection of units is dependent on the availability of the nearest unit to the scene and the impact of the incident on congestion. Generally, a minimum of three units respond to an incident. During working hours, the team is located in the district office in Downtown Los Angeles and is rolled out from there. The responders are chosen from the core group. During the non-working hours, TMT personnel (who take their units home) respond from their residence (Figure 6). The call is relayed to the crew member living closest to the scene by phone or pager, upon availability. At night, preference is given to matrix units as they do not require external illumination. The TMT is expected to respond to major incidents within 30 minutes of notification. TMT members check in with the TMC by radio at all times. While enroute to the scene, the team gathers information about the incident from all available sources such as TMC, CHP, Maintenance radio, and commercial radio. Based on the available information, the leader plans the traffic management techniques to be employed, the initial deployment of sign trucks and sedans, and their approach to the scene.

Incident Clearance At the scene, team members need to be aware of the open traffic lanes, hazardous material and working equipment. They determine the traffic management techniques to be employed to minimize the impact of the incident to the motorists on the highway and preventing any further incidents. These techniques include early warning, diversion to other routes or use of median or outside shoulder as a temporary traffic lane. The team continuously observes traffic flow and incident removal operation and ensures that the traffic management plan complements the other agencies. The team leader ensures that the plan and its execution are understood by the members, at the same time relaying pertinent information to TMC and team members. When the incident is over, the leader ensures the safe removal of all equipment. The TMC is then notified that the incident is "closed" (i.e., traffic, equipment and incident cleared) by one of the members.

Maintenance Highway Maintenance is responsible for the preservation, upkeep, and restoration of the roadway structures including toll bridges, as well as the condition in which they are constructed. Maintenance duties also include the operation of highway facilities and services to provide satisfactory and safe highway transportation. The legal definition of maintenance as contained in Section 27 of the Streets and Highway Code includes the following:

- "The preservation and keeping of rights of way, and each type of roadway, structure, safety convenience of device, planting, illumination equipment and other facility, in the safe and usable condition to which it has been improved or constructed, but does not include reconstruction or other improvement."
- "Operation of special safety conveniences and devices, and illuminating equipment."
- "The special or emergency maintenance or repair necessitated by accidents or by storms, or other weather conditions, slides, settlements or other unusual or unexpected damage to a roadway, structure or facility."

Maintenance work requires interagency cooperation with the incident commander, other Caltrans divisions, and County, State and Federal agencies responding to incidents.

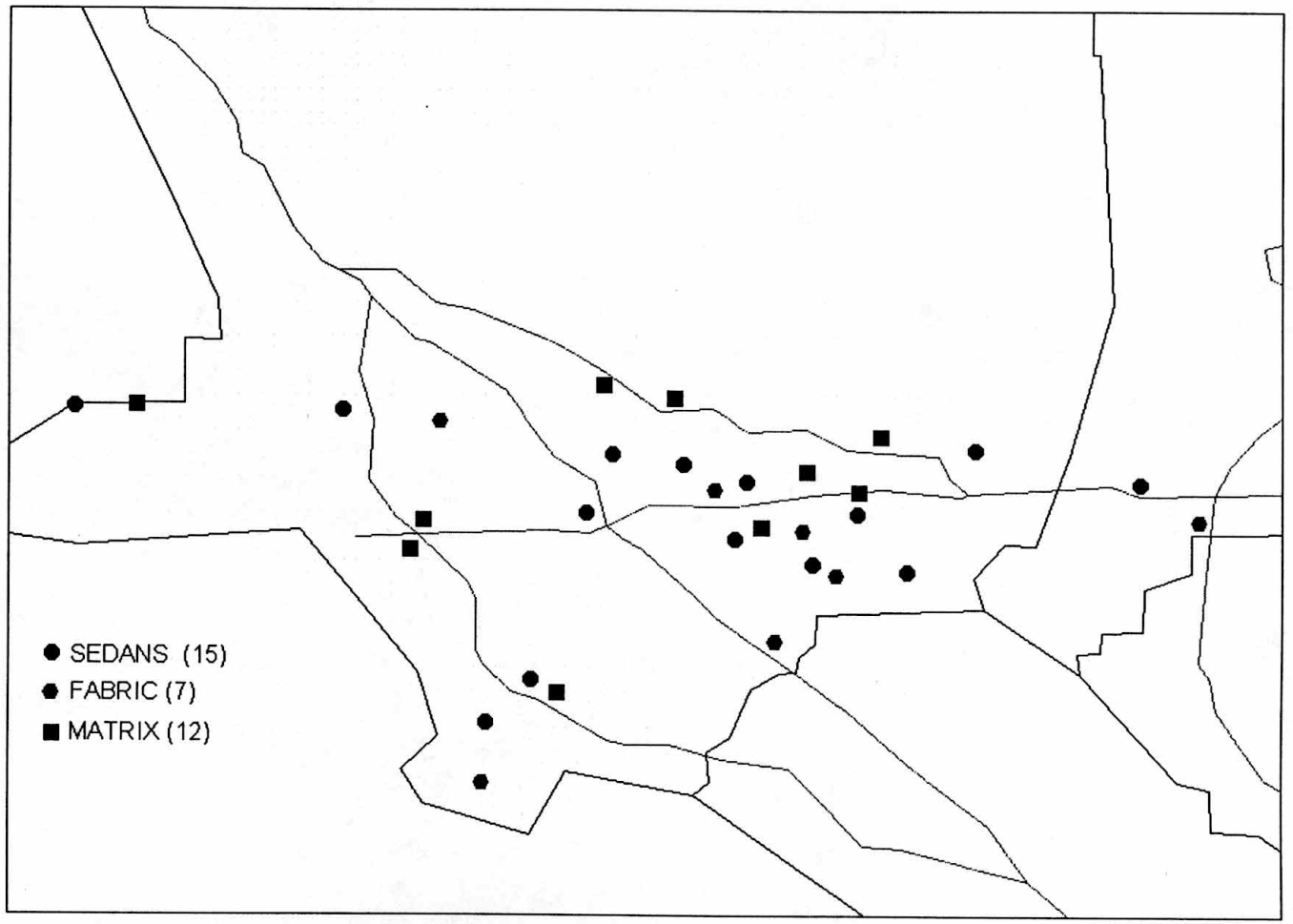
Maintenance activities can be broadly classified as follows:

- Preventive Maintenance of the highways and freeways
- Cleanup of Litter and Debris
- Hazardous materials cleanup
- Weather related maintenance/cleanup
- Repair damaged facility due to accidents

Communication for maintenance is handled through a maintenance communication post within the TMC. They are in constant contact with CHP and, therefore, the TMC is notified by CHP of any incident or hazardous conditions on the highways. Maintenance personnel are trained to handle the closure of freeways, with help from CHP and TMC, by placing signs, cones and flares on the freeway for adequate protection from the fast-moving vehicles. They often require CHP to run breaks in traffic for them to be able to clear the road of litter and debris. For planned incidents such as sweeping the freeways, filling operations on the right of way, and maintenance of ramps, they submit a road closure request one week in advance. In these cases, they stage themselves on the highway, with appropriate CMS and signs. In a moving operation, like sweeping, they have a shadow truck following the sweeper truck to protect it from the fast-moving traffic.

- Preventive Maintenance: Preventive Maintenance includes the maintenance required due to the regular day-to-day wear and tear activities occurring on the highways, and to provide normal replacement cycles for pavements and structures. It includes

Figure 6 : LOCATION OF TMT UNITS



- Cleanup of Litter and Debris: Litter and debris removal is a major activity of the Maintenance Division. Litter and debris in traffic lanes, including dead animals, tire casings, large boxes, and automobile wreckage are removed as soon as possible to ensure the safety of the motorists. Chapter D1 of the Highway Maintenance Manual, Volume One details the policies and procedures for cleanup of litter and debris in detail.

- Hazardous Materials Cleanup: Caltrans and CHP are jointly responsible for clearing spills of unidentified and/or hazardous substances on the State highways. The law enforcement agency is the overall scene manager, with specialized functions resting with the responsible authorities. This forms a specialized part of maintenance operations and involves other responders (to be discussed later).

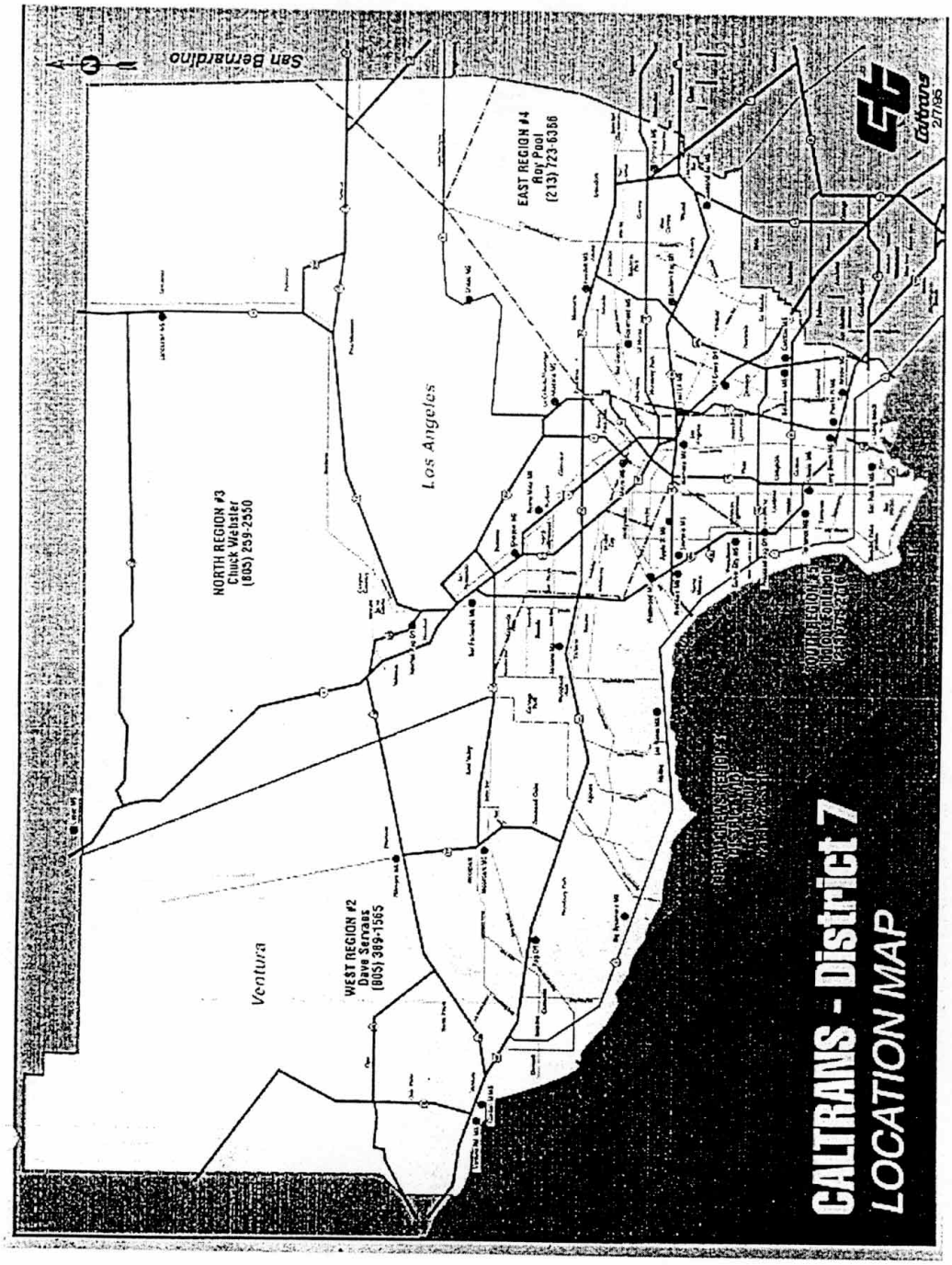
- Weather related maintenance/cleanup: Weather related maintenance/cleanup is required to clear dirt and rocks that slide onto highways, as well as respond to other degrading effects of weather. This includes snow/ice control, storm maintenance and assessment of highway safety due to these weathering effects. The operations include clearance, installation and maintenance of snow fences, snow pole installation and removal, tire chain fabrication and repair, the maintenance and control of chain control locations and avalanche control for snow operations. Storm maintenance includes maintenance to keep damaged facilities operational following major damage caused by storms, earthquakes, slide, tidal waves, spilled loads and other major disasters.

- Accident clearance: Maintenance is involved in clearance of major highway incidents, especially those involving hazardous material spills. Minor incidents are ordinarily cleared by the CHP officer, FSP tow truck or private tow trucks.

Highway maintenance is a 7-day-a-week, 24-hour-a-day operation. Within Los Angeles County, highway maintenance is divided into four zones (Figure 7). Each zone is further divided into territories assigned to specific crews and supervisors. Each crew is composed of two pickup trucks (one for Supervisor), cleanup truck, sweeper truck, shadow truck equipped with crash cushions, compressor truck, vacuum truck (shared between crews) for removal of materials from drains and ditches, and any other equipment needed to meet specific area requirements.

Incident Detection Maintenance personnel are constantly working on the sides of the freeways and city streets and are a valuable source of information on incidents. Incidents reported by Maintenance personnel do not require verification. Maintenance supervisors constantly patrol their areas looking for spills, litter and debris lying on the freeways and shoulders that would be a hazard for the traffic. After detection, supervisors directly contact their teams to roll out to remove the object out of the right of way and sight of motorists.

Figure 7


CALTRANS - District 7
LOCATION MAP
San Bernardino
Los Angeles
Ventura
NORTH REGION #3
Chuck Webster
(805) 259-2550
EAST REGION #4
Ray Pool
(213) 723-6366
WEST REGION #2
Dave Servaas
(805) 389-1565

Incident Verification Maintenance frequently verifies an incident from the standpoint of dispatching specialized clearance equipment and requesting hazardous material crews.

Incident Response District office (TMC) communicates with the other agencies and the public. All calls for maintenance are received by maintenance dispatchers in the TMC, who are responsible for generating the incident report. They determine the regional office responsible for the area where the incident was reported and communicate with the regional offices. The regional offices determine the action plan and roll out maintenance crews to handle the incident with the required equipment. The regional offices communicate with all the maintenance crews in the area via radio. Supervisors are provided with pagers and cell phones for communication. The supervisor determines, based on the information, the types and amount of personnel and equipment required to respond to the incident.

Incident Clearance Maintenance personnel work in crews to accomplish clearance tasks they are assigned. They respond on and around freeways and ramps. Once on scene, they may request assistance from other agencies, as required. The emphasis is to clear the roadways as soon as possible to restore normal traffic. First, they ensure their safety and that of the motorists by controlling traffic on the highways. Afterwards, they clean up the roadways as soon as possible by bagging the material cleared and placing it on the side of the highway, from where it is collected and transported to the yard.

Hazardous Materials Division Caltrans has the overall responsibility for maintaining a safe and usable highway system, which also includes keeping the highway system free from hazardous materials. Thus, Hazardous Materials is a division within Maintenance. Hazardous materials are defined in California Code of Regulations (CCR) Title 22 and the Code of Federal Regulations (CFR) Title 49:

> *A hazardous material is one that poses an unreasonable risk to the health and safety of employees, the public or the environment if it is not properly controlled during handling, storage, manufacture, processing, packaging, use, disposal or transportation.*

The action is initiated to detect, assess, contain spilled material, removal by the spiller, a qualified contractor or Caltrans, and to ensure it is disposed of properly. Every Maintenance employee of Caltrans is trained for awareness concerning hazardous substances. They are given basic training on whom to call, what to do, how to protect themselves and the members of the public from these substances. Supervisors undergo a higher training over and above the awareness training. There are some Hazardous Materials specialists within Caltrans, who undergo extensive HazMat training every year, who determine the action plan for dealing with such incidents.

Caltrans' Maintenance Manual (Volume 2) prescribes the following actions in the event of a spill on a state highway:

- *Provide immediate notification to the dispatch center specified in the District Spill Contingency Plan. The dispatch center will notify the Caltrans Hazardous Materials Manager in the event of any hazardous material incident affecting a state highway.*
- *Dispatch, at the request of the first responder, will make all notifications and reports as required by law and departmental procedures.*
- *Ensure, in cooperation with other public and private agencies, the isolation and containment, identification and hazard assessment, and proper removal and disposal of hazardous materials and restoration of the orderly flow of traffic.*
- *Assist the California Highway Patrol (CHP) or other law enforcement agencies with jurisdiction with traffic control and routing requirements.*
- *Restore contaminated highways and other transportation facilities under its jurisdiction.*

Caltrans is not legally or financially responsible for contamination or cleanup outside the State right-of-way even though the incident begins within the right of way unless it is caused by Caltrans activities.

The law enforcement agency or the incident commander co-ordinates communication and other activities at the scene and is not involved in the specialized functions provided by other agencies. The Maintenance Manual Volume Two states that "During declared emergencies, the incident commander may waive specific Hazardous Waste Control laws to allow Caltrans or its contractors to haul any amount of spilled regulated wastes off the highway to eliminate traffic gridlock and restore public safety."

All the costs incurred in cleanup and disposal of all materials, whether hazardous or not, are borne by the spiller. Caltrans employees generally do not work with hazardous materials, except for some basic ones that require absorption and disposal. All the other materials are cleaned up by contractors or the spiller.

Interagency cooperation during hazardous materials incidents is defined in the California Hazardous Materials Incident Contingency Plan (HMICP) prepared by OES (Office of Emergency Services). HMICP is a broad document covering all aspects of a HazMat Incident including agency responsibilities, command structure, operations, logistics, planning, finance and training. Railroad Accident Prevention And Immediate Deployment Plan (RAPID) prepared by California EPA forms a specialized plan "to provide immediate, onsite technical assistance in an organized and predictable manner to state and local agencies at surface transportation incidents involving a large-scale release of hazardous materials, where the resources of multiple state agencies are needed and/or where multiple state agencies have statutory responsibilities in order to minimize the potential damage to the public health and safety, environment, and property."

Incident Detection Hazardous Materials division generally plays no role in detection.

Incident Verification Hazardous Materials division generally plays a secondary role in verification, assessing whether additional equipment or personnel must be called in to handle an incident. In addition, hazardous materials crews are not ordinarily dispatched until the incident is verified.

Incident Response Hazardous materials division is a part of maintenance, and is subject to its dispatch procedures. Once a hazardous materials specialist is contacted, he determines the level of response and the agencies to be involved in managing the incident.

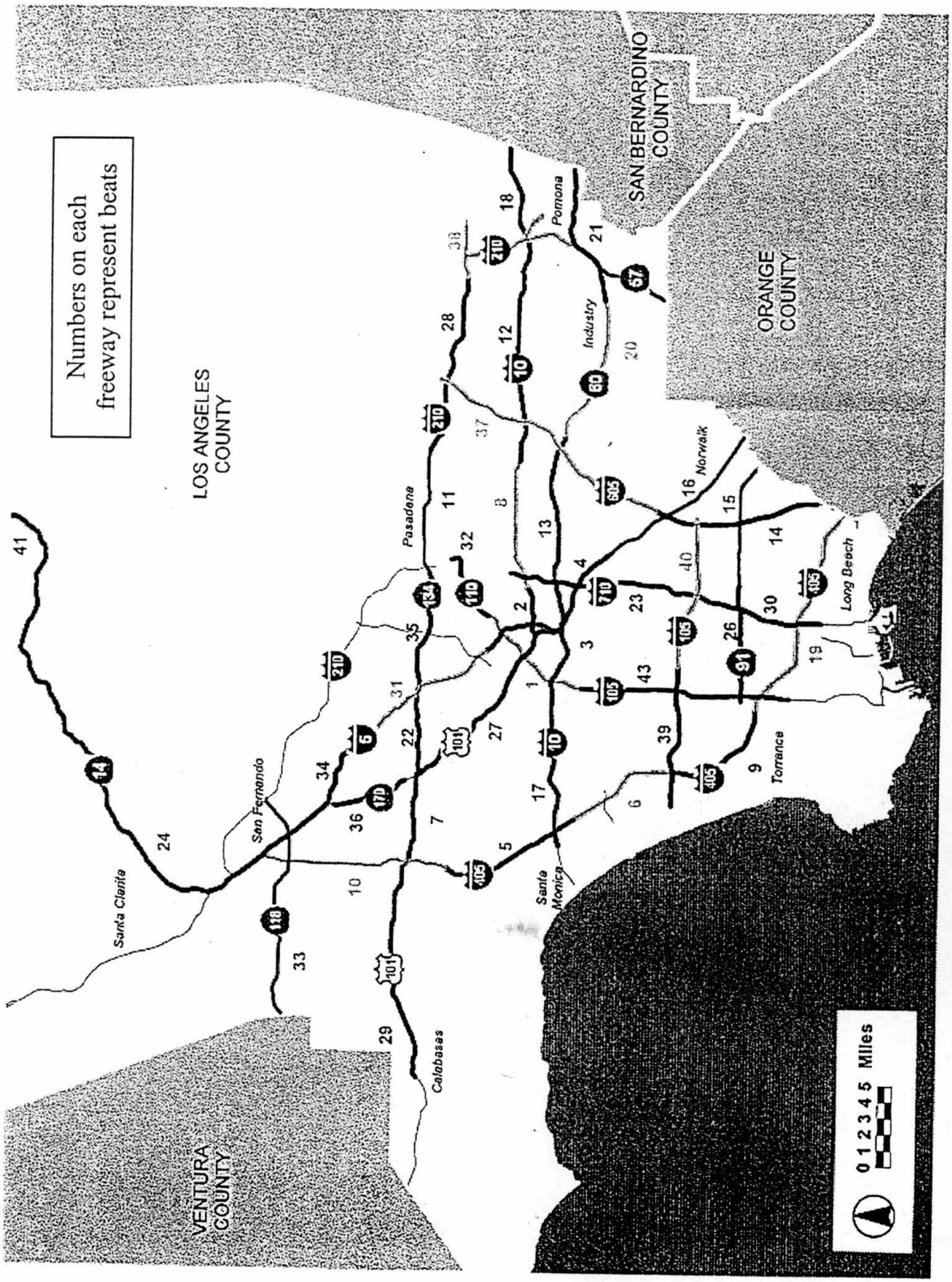
Incident Clearance Most often, Hazardous Materials are not handled by Caltrans Maintenance personnel. They are generally cleaned up by the spiller or by Caltrans contractors. These contractors are approved by Caltrans for various services they provide for hazardous material cleanup. Due to the nature of incidents, many agencies are involved in hazardous materials incident management. Apart from the agencies described above, fire departments, health agencies, environmental agencies, etc. are involved in HazMat incidents. Fire departments offer response in case the material is flammable or if it is to be absorbed in large amounts. Health and environmental agencies ensure complete cleanup, as described in the law as well as correctness of procedures followed so that there is no damage to life, property or environment.

2.3 LA County MTA Freeway Service Patrol (LACMTA FSP)

LA County MTA Freeway Service Patrol (LACMTA FSP) is a joint program provided and financed by the MTA, Caltrans and CHP. It is a special team of tow trucks and service technicians who reduce highway congestion by helping stranded highway motorists during rush hour at no charge. LACMTA FSP is also involved in collection and analysis of information about incidents on the highways.

Under the LACMTA FSP program, Los Angeles has 43 beats, with 2-6 tow trucks per beat (Figure 8). Beats are generally staffed during the rush hours (6am – 10am and 3pm – 7pm). Some beats, especially the ones in the downtown Los Angeles area work during the mid-day period between these periods also. FSP also has a weekend service (10am –6pm) on approximately 15 beats. FSP trucks constantly patrol the beat they are assigned for incidents such as accidents, breakdowns, and disabled vehicles. They generate over 75% of the calls themselves by helping the motorist before the incident is detected or reported by any other agency. They contribute to incident management by eliminating traffic congestion due to minor incidents and at the same time, remove the incident away from public vision. Their services include providing gas, water, diesel (up to 1 gallon each), inflating or changing tires, towing the vehicle if disabled to a point of

Figure 8


Numbers on each freeway represent beats
LOS ANGELES COUNTY
VENTURA COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
Santa Clarita
San Fernando
Calabasas
Santa Monica
Pasadena
Pomona
Industry
Norwalk
Long Beach
Torrance
0 1 2 3 4 5 Miles

safety outside the highway (specific drop-off locations) where assistance is available. They also minimize the risk of accidents by removing the debris from the freeways.

Incident Detection Most incidents handled by FSP trucks are detected by FSP. They stop to help vehicles parked on shoulders or stuck in traffic lanes.

Incident Verification Minor incidents are handled in their entirety by the FSP driver, so no verification is needed. In the case of major incidents, the FSP driver acts as the verifier, requesting appropriate assistance through the FSP dispatcher.

Incident Response FSP drive on set beats, serving incidents as they see them. When dispatching is required, the FSP operator closest to the incident site on the beat is sent to the incident. FSP trucks are outfitted with GPS systems that give the location of each truck to the dispatcher, facilitating the decision-making and pin-pointing of the closest truck to the incident. The tow truck operators are not allowed to leave their assigned beats, (except for breaks or replenishing supplies) unless they detect an incident within one exit away from their beat on the same freeway. If the incident has occurred farther than that, they must inform the dispatch center via radio.

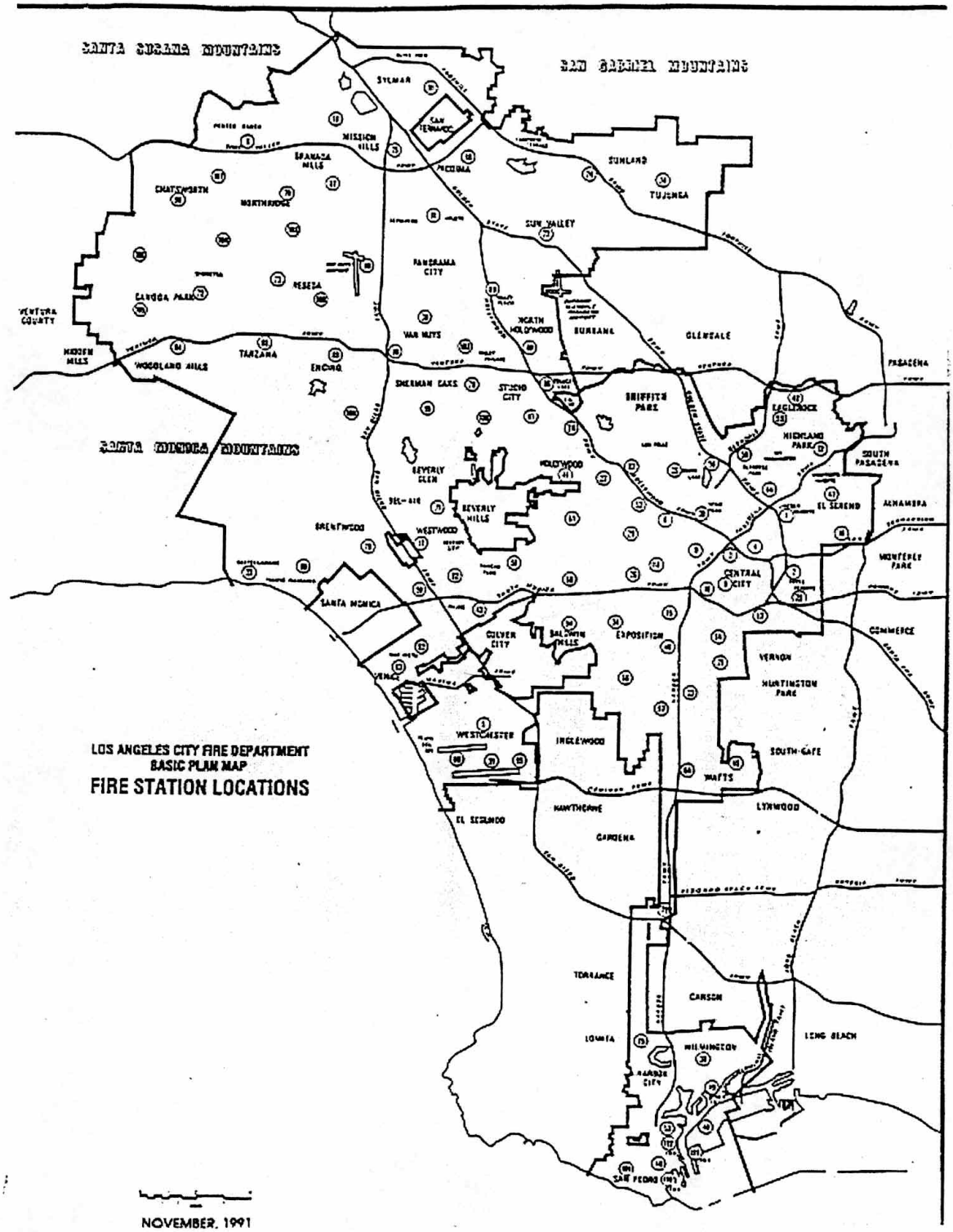
Incident Clearance FSP trucks are equipped with all the basic tools that may be required for incident management and clearance, including water, gas, sand, various tools for cutting, tearing, etc. They also have equipment for jump-start, changing the tires, compressed air for flat tires, etc. If the vehicle is larger than can be handled by the FSP tow truck, the CHP is informed or services from the nearest tow truck operator are offered to the owner. FSP operators are trained to provide quality services on the highway and to remove the vehicle from the highway either by putting it back in operation or towing it away. There are specified drop points where the operator can drop off the motorists, in case he needs to be towed, from where he can call his private tow operator. After the vehicle is helped, the tow truck operator fills out a machine-scanable form, which has two parts. The operator fills out one part, called Motorist Assist Form, giving details on the assist – type, problem, location, time, motorist information, etc. The other part, which is a survey on FSP service, has to be filled out and mailed by the motorist later. These forms generate data on the assists as well as the usefulness and perceived value of FSP to the public.

2.4 Fire Departments:

Fire departments are responsible for incident management on highways in two ways:

- Fire: Fire on the highway (usually a vehicle), fires on the side of the highway (usually a brush fire), or spill of a flammable material that might cause a fire.
- Emergency: Medical emergencies or fatalities.

Figure 9


SANTA SUSANA MOUNTAINS
SAN GABRIEL MOUNTAINS
SANTA MONICA MOUNTAINS
VENTURA COUNTY
SYLMAR
SAN FERNANDO
MISSION HILLS
GRANADA HILLS
PACOIMA
SUNLAND
TUJUNGA
CHATSWORTH
NORTHRIDGE
SUN VALLEY
RANCHO PARK
RESEDA
PANORAMA CITY
HIDDEN HILLS
TARZANA
ENCINO
VAN NUYS
NORTH HOLLYWOOD
BURBANK
GLENDALE
PASADENA
WOODLAND HILLS
SHERMAN OAKS
STUDIO CITY
GRIFFITH PARK
EAGLE ROCK
HIGHLAND PARK
SOUTH PASADENA
BEVERLY GLEN
HOLLYWOOD
BEVERLY HILLS
EL SERENO
ALHAMBRA
BRENTWOOD
WESTWOOD
MONTEREY PARK
CENTRAL CITY
SANTA MONICA
CULVER CITY
BALDWIN HILLS
EXPOSITION
COMMERCE
VERNON
HUNTINGTON PARK
WESTCHESTER
INGLEWOOD
SOUTH GATE
WATTS
EL SEGUNDO
HAWTHORNE
LYNWOOD
GARDENA
TORRANCE
CARSON
LOMITA
WILMINGTON
LONG BEACH
HARBOR CITY
SAN PEDRO
LOS ANGELES CITY FIRE DEPARTMENT
BASIC PLAN MAP
FIRE STATION LOCATIONS
NOVEMBER, 1991

Unlike law enforcement, different fire departments serve on the same highway. Fire Protection services are provided by local departments, operated by cities or the county. Fire stations are spread all over the county and some of them are located especially close to the highway so that they can provide quick response to incidents on the highway.

Incident Detection Fire departments are usually not involved in incident detection. They get calls from the public directed through the CHP for any fire or paramedic response required on the freeways.

Incident Verification Fire departments are usually not involved in incident verification, as they are rarely the only agency to respond to an incident. Due to the critical nature of the incidents handled by fire departments, they respond without incident verification (any reported fire or medical emergency will trigger a response).

Incident Response: The fire department dispatch center is connected to the CHP, the sheriff's department, and 911 trunk facility connecting them to the local PD. After CHP identifies a fire, HazMat or rescue operation, they automatically contact the appropriate fire department. From this point, the FD dispatcher works with the police to gather information about the incident and send appropriate resources. The LA county fire dispatch center handles all dispatch operations through its own CAD, which is completely digital. All responses are computer-generated and sent electronically to the fire stations (Figure 9) over mobile data terminals. The selection of equipment available is made based on the proximity and availability from 50 best choices available to the system. Medical calls receive top priority but all calls are handled within seconds of detection.
The county fire department sends out two engines in the opposite direction on the highway to minimize the response time. Different local Fire departments generally have similar equipment. This includes Fire Engine that carries water, foam, and tools, Fire trucks with ladder, Paramedic Squad, and Support vehicle carrying two personnel. These are located at various locations in the cities and county Fire stations. There is an automatic and mutual aid agreement between Fire departments that share common boundaries or require mutual co-operation in some areas. Paramedic squads are private-AMR units all over the county, except Pomona (Cole-Shaefer) and Hawthorne (McCormick Ambulance).

Incident Clearance The fire department takes joint command at the scene with CHP for highway fires. Their roles in incident management are different: CHP evacuates the highway or the adjoining area if required (with help from local PD), and the fire department carries out its operation on extinguishing the fire. The entire operation of fire departments is based on Automatic Aid agreements and Mutual Aid agreements between the various adjoining city fire departments. The California Master Mutual Aid Agreement covers a broad state-wide mutual aid agreement for the various fire

departments to respond to a major incident requiring resources beyond the means of a single city or county fire Department. (e.g. for the Malibu Brush Fires, teams of fire fighters from Northern California assisted.) Automatic Aid agreements between cities cover areas adjoining the cities and border areas to avoid duplication of resources and at the same time, ensuring prompt services. It also makes available scarce resources, such as helicopters, to smaller cities adjoining larger cities.

The County fire department also has a HazMat division, based in the City of Commerce. The division works with other local and state HazMat agencies and is responsible for the county of Los Angeles.

For Emergency Medical Services (EMS), fire departments are assisted by CHP to function on the highway until the patient is deemed fit to be transported to the nearest hospital. Most of the calls received require the paramedic squad to roll out due to human life threatening situations or just as a precautionary measure. EMS paramedics assess the situation, examine the patient, provide first aid and stabilize his or her health condition before transporting the patient to the nearest hospital to receive full medical treatment.

2.5 Coroner

The duties of the County Department of Coroner are to determine the manner, mode and cause of death in certain cases prescribed in the law. Their function is to identify the dead, locate the nearest kin, notify them and return the body to them, after investigation, if any. Generally, the Coroner's Department is responsible for investigating any death due to unnatural causes, such as homicides, suicides, fatalities due to accidents, and deaths due to use of drugs or alcohol. All deaths that are not certified by medical practitioners are also to be handled by the coroner and investigated, depending on the case. On the freeways, CHP is the law investigator whereas the coroner functions as the death investigator. On the freeways, their primary role is to determine the cause of death.

The Coroner's department has a central location in Los Angeles, with three other offices located in the rest of the county. They serve 24 hours a day, 7 days a week from these offices. Each office is fitted with CME (case management system) and JDIC (Justice Data interface controller), which belongs to the sheriff's department and can be used to check license plates, people, missing people, wants and warrants. The dispatch is handled centrally from the Los Angeles office by phones, pager, and cellular phones.

Incident Detection No role in incident detection.

Incident Verification No role in verification.

Incident Response The Coroner's department has access to CHP CAD, which they monitor for fatalities. The LACC also makes a call to follow-up to make certain the

fatality on the freeway has been noted. A new communication system called FIRST will help them get much more information in the future. In general, they get their calls from police, fire, hospital, mortuaries, and members of the public. The coroner's dispatch staff determines whether the case on hand is a coroners' case and the action plan. If the death occurred on the highway or surface street, the investigator responds to the scene. If the death occurred in a hospital, the body is brought into the department by the transportation unit, and the investigation is carried out in the department. The freeway investigations take precedence over other investigations.

Incident Clearance Until the Investigator arrives at the scene, it is the duty of the law enforcement agency (CHP) to protect the scene. If the case is simple with eyewitnesses, and other evidence, the body can be moved to the shoulder with Coroner's permission to clear the freeways. If the case is complicated, with uncertainty over the cause of death, the CHP will protect the scene until the investigator completes his report. Generally, the coroner's unit gets on scene in less than one hour. The investigator reports various bodily injuries, and other evidence that can be collected from the scene, including photographs of the scene. He also tries to get some evidence of the closest kin to the deceased. After the investigation is completed, and the evidence collected and tagged, the transportation vehicle transports the body to the department for a detailed physical examination and investigation. The investigator tries to identify and notify the closest relatives of the deceased. After the body is taken away from the scene, the roadways can be opened for traffic.

At the department, the body is undressed, evidence such as hair, nails, blood sample, urine samples, etc. are collected and tagged. The physical examination takes place the next day by the medical examiners of the department. The examination may be witnessed by the law enforcement if he so wishes.

2.6 Private Tow Operators and Clearance Companies

The role of the Private Tow Operators and clearance companies is mainly in the incident clearance area, although they also play a critical role in other areas of incident management system. The role of the Tow operators in clearance can be summarized in the "5Ps" (Towing & Recovery Association of America, 1996):

1. **Park:** The first thing that the driver should do upon arrival at the scene is to park the tow truck safely, out of the way of the traffic and turn on the beacons or flashing lights to warn oncoming traffic. The driver should ensure his safety so that he can safely and quickly reach the incident.

2. **Protect:** The tow truck operator has to protect the scene for the investigators, hazards and environment. He has to ensure that warning devices such as fuses, flares or cones are in place (if there are flammable materials in range, use of flares would not

be appropriate). The operator should protect himself by wearing a bright colored reflective vest for the personal safety, especially at night.

3. **Police:** This function involves assessing the incident scene by checking the conditions and area for obstacles to recovery. As soon as the tow operator has parked safely and secured the area, he/she should report to the officer in charge of the incident.

4. **Plan:** The tow truck operator has to plan his approach and evaluate the estimation looking for bills of lading and any other things that might directly influence the recovery and towing process.

5. **Pull:** This refers to towing the vehicle away from the scene. The tow operator should do this after ascertaining that there is no danger to life, property and environment. Apart from these, he has to ascertain the impact of his actions on the traffic.

6. **Pictures:** Pictures are not included in the 5Ps formula but are gaining prominence as an aid to reconstruct the scene and for billing and training purposes.

Other important factors which the tow truck operator must familiarize himself with are the communication technology and the local laws concerning cleanup. Some jurisdictions require the tow operators to clean up debris, spills, etc. whereas others assign this responsibility to the local DOTs. The operator should always check these with the officer in charge.

Tow operators can be called to the scene by the CHP officer or, in some cases, by the driver (e.g., through use of a cellular phone). CHP follows a rotation policy when it calls in a tow operator, unless the driver has requested a particular operator (e.g., AAA). Operators are divided into four classes (A, B, C, D), based on the gross-vehicle-weight-rating of vehicles that they are capable of towing. To participate in rotation towing, operators must pre-enroll according to CHP's Tow Service Agreement, and demonstrate that they are capable of providing required service.

Area Commanders are responsible for defining the geographic area covered by tow districts. When a tow operator is needed for a given class of vehicle in a given district, the dispatcher calls the operator at the top of the rotation tow list. That operator then moves to the bottom of the list, and all other operators move up one step. The exact location of the operator relative to the incident plays no part in the process, other than the requirement that the operator is qualified to serve the tow district as a whole.

The field officer/incident commander has a number of responsibilities in the process, including conveying information about the accident to the communications center, ensuring safety, determining whether the operator's equipment is adequate, monitoring response times and reporting any violations of the Tow Service Agreement.

2.7 Health, Environmental and Safety

Apart from the first responders, other Health, Environment and Safety agencies play important roles in incident management. Their involvement is typically limited to hazardous materials spills, which may endanger the environment, workers or the general public. They are involved from the standpoint of setting standards for incident clearance and occasionally from the standpoint of inspecting to ensure that standards have been satisfied.

Federal

1. **Environmental Protection Agency (EPA):** Identifies and sets standards for hazardous materials and hazardous wastes, which are usually applied and enforced by states. The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) program of EPA locates, assesses and cleans up potentially hazardous waste sites.

2. **U.S. Department of Labor, Federal Occupational Safety and Health Administration (OSHA)**: Sets and enforces health and safety standards for workers in the work place.

3. **U.S. Coast Guard, Marine Environmental Protection**: The Federal Department of Transportation (DOT) regulates the transportation of hazardous materials and hazardous waste on any or all of land, air, and water. Within the DOT, the U.S. Coast Guard is responsible for the response and investigation of release of oil and hazardous substances that enter U.S. waters. It also has the authority to enforce the federal pollution laws and to arrange for removal of hazardous substances.

State: (California)

1. **The California Occupational Safety and Health Administration (Cal OSHA):** Enforces chemical and other hazardous material exposure standards designed to assure the protection of workers' health and safety.

2. **Department of Fish and Game:** Protect the fish and wildlife from chemical contaminants in all state waterways located forty miles inland.

3. **The California Environmental Protection Agency (Cal EPA):** Provide and enforces the standards on environment protection and provides funds, if necessary, for major incidents threatening environment.

4. **Department of Health Services, Toxic Substances**: Sets statewide standards for hazardous waste facilities and enforces both State and federal EPA standards.

5. **Health and Welfare Agency:** Implements Proposition 65 and provides information related to its implementation including information about the governor's list of carcinogens.

6. **Air Resources Board:** Sets standards for the protection and preservation of air quality. It is responsible for controlling mobile sources of emission and oversees the management of the local air quality management districts.

Local: (Los Angeles County)

1. **L.A. County Agricultural Commission:** Maintains a countywide pesticides sampling program of wells and run-off water and to investigate complaints and incidents involving pesticides and their misapplication, and obtains and analyzes soil samples, if necessary.

2. **Forester and Fire Warden:** Responds to hazardous materials releases and regulates the storage of flammable, explosive and water reactive materials in industrial facilities through its Fire Prevention Program.

3. **Department of Health Services, Toxic Epidemiology Program:** To investigate human illness cases resulting from environmental exposure to hazardous materials.

4. **Department of Public Works, Waste Management**: Provides construction plan check, issues permits and regulates waste discharge to sewers. In addition, it works to regulate industrial waste storage facilities, issues permits and regulates underground storage tanks for hazardous materials or wastes within unincorporated areas or cities without a local regulatory body.

Apart from these, incorporated cities operate programs for health, environment and safety within local agencies such as fire department, police, or sheriff's departments.

3. TECHNOLOGIES IN INCIDENT MANAGEMENT

Technologies are used to expedite the incident management process, to provide for safety and to protect property. Our focus here is on the ITS related technologies being deployed in incident management, and the types of technologies that are becoming available.

3.1 Technologies Currently Being Used

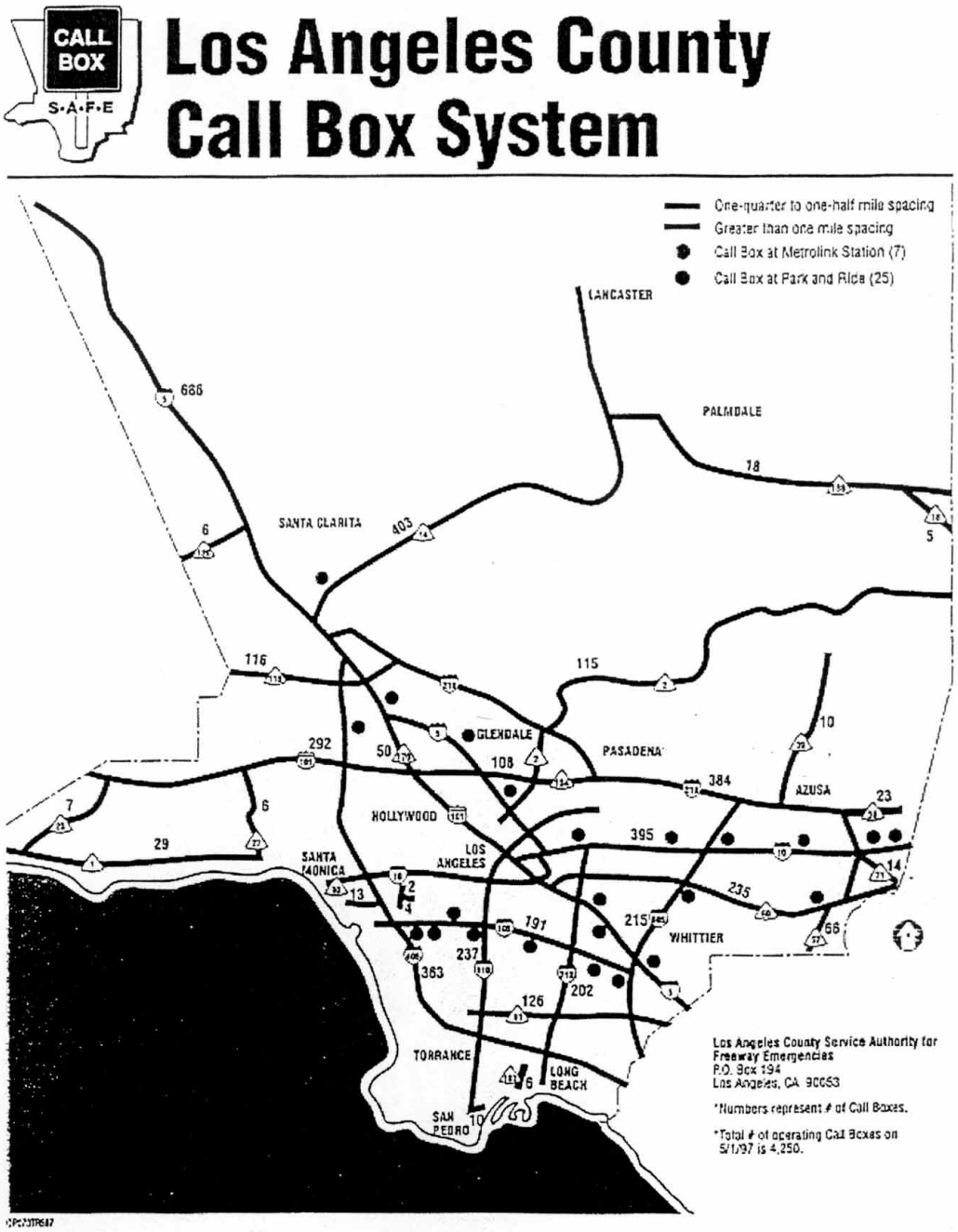
CHP Communications Center The primary mission of CHP's LA Communications Center (LACC) is to provide the necessary communication, services and informational support for Field and Administrative CHP units; and to insure safety, security and service to the public and allied agencies. LACC is the largest Computer Aided CHP dispatch center. Its areas of responsibility include:

- 11 CHP Field Commands within Southern division
- Communications with Division Motor Carrier Safety Unit, Vehicle Theft Unit, Protective Services Unit, MAIT operations, and the Traffic Operations Center
- Primary communications relay point for units affiliated with the US Border Patrol, LA, Ventura, and Kern County Sheriff's Department and Caltrans units assigned to remote areas of the County
- Communication with FSP tow truck units and sergeants
- During non-business hours, it also provides communications services for Department of Justice, as well as a myriad of other national, state and local agencies who have CHP radio capabilities and call upon them for reporting emergencies or relaying pertinent information

The entire dispatch and operational information are handled by a Computer Aided Dispatch (CAD) System. Information is routinely checked for accuracy and updated as changes or discrepancies occur. Although they operate a state-of-the-art technology, the majority of their information is received from citizens involved in or passing by an incident. While every attempt is made to confirm complete information, their operators can only document information as it's received. In addition the Communication Center does not have equipment for tracking officer locations, to assist in dispatch.

The FSP dispatcher, after confirmation of the incident, locates the nearest tow truck to the incident (by distance) facilitated by the Automatic Vehicle Locators (AVL) on every truck and then communicates with the truck over radio. The status of each truck (available, on call, logged off, etc.) is also available on the same system. A desired additional is the status of freeway congestion, which would allow location of the nearest tow truck to the incident by travel time. LACC also houses training equipment set for FSP tow truck operators for these communication devices. LACC also uses Teletrak for vehicle theft prevention and location.

Figure 10


CALL BOX
S•A•F•E
Los Angeles County
Call Box System
One-quarter to one-half mile spacing
Greater than one mile spacing
Call Box at Metrolink Station (7)
Call Box at Park and Ride (25)
LANCASTER
PALMDALE
SANTA CLARITA
GLENDALE
PASADENA
AZUSA
HOLLYWOOD
LOS ANGELES
SANTA MONICA
WHITTIER
TORRANCE
LONG BEACH
SAN PEDRO
Los Angeles County Service Authority for Freeway Emergencies
P.O. Box 194
Los Angeles, CA 90053
*Numbers represent # of Call Boxes.
*Total # of operating Call Boxes on 5/1/97 is 4,250.

CHP Patrol Cars In addition to a conventional 2-way voice radio, most CHP patrol cars are equipped with a mounted laptop computer along with a wireless modem. The computer is used to display computer-aided-dispatch data, which is useful in keeping track of an incident's exact location and characteristics. It also provides back-up information to verify data communicated over the voice channel. Officers carry a variety of safety-related equipment such as flares and cones to mark off accident scenes, a first-aid kit, and lights, and measurement tools for use in accident investigation.

Call Box system The local SAFEs (Service Authority for Freeways and Expressways) operate the user-funded, locally managed motorist aid programs in California on a county-elective basis. Funding for the California call box program is provided by a $1 per year surcharge on every vehicle registered, which provides installation, maintenance, and operation of the system. Each call box is battery-powered , solar charged cellular telephone fitted with a microprocessor. There are over 4000 call boxes in LA County alone and the entire system, when complete, is expected to have 5000 call boxes in the county (Figure 10).

Call boxes are located along all major freeways in California at a minimum distance of one-quarter mile to over a mile depending on the average daily traffic handled by the freeway. All call boxes are answered by the CHP (Communications Center) who will either contact the appropriate agency for response or redirect the call to appropriate private agencies.

All California call boxes are installed keeping in mind the general guidelines for ADA (Americans with Disabilities Act) compliance. These include units equipped with a teletypewriter for the deaf (TTY), viewing messages on the screen, and communicating through a combination of screen and written messages.

The communication center dispatcher can initiate a call back to the motorist if the line is disconnected for any reason. The dispatcher can also get the location of the call box by the Number Identification feature available in all call boxes. This helps the dispatcher in case the motorist is unaware of his exact location or mistakenly gives an incorrect location. Call boxes are supported by the FSP program, where the dispatcher can roll out FSP units for responding to the incident. Various ITS projects also complement the call box system by using the system for providing information

Caltrans The Department of Transportation operates or has access to several types of communication facilities:

- Telephone/Calnet System
- Operational Area Satellite Information System (OASIS)
- Caltrans Statewide Land Mobile Radio Communication System
- State Microwave Telephone System (Green Phones)

- Mobile Scan Receivers (Scanners)
- Management Information Systems (MIS-Teletype)
- Facsimile System (Faxes)
- District communication with CHP, both radio and computer aided dispatch (CAD)
- Military Communications
- CALCORD
- State Communication (STACOM) Radio System
- Computer Systems (E-mail)
- Amateur Radio communications
- Cellular phones
- Pagers

Currently, Caltrans has telephone communications with all other state agencies. However, this service may become limited or non-existent during a major catastrophic event. The EOC will be furnished with "Priority Lines" that will be the first service restored in cases of telephone outage.

Oasis The Headquarters and Districts 4 and 7 also have OASIS. The primary purpose of OASIS is to connect County Emergency Operations Centers with the OES and other other agencies mainly during emergencies, although day-to-day usage is also permitted.

Caltrans Land-Mobile Radio Communication Each of Caltrans geographical Districts has their own land-mobile radio system, which is controlled by District Headquarters. It is used for dispatching personnel to routine and emergency maintenance activities. The radio systems are to be used extensively to co-ordinate traffic control and clean-up activities necessary to prevent loss of life and property damage in cases of emergency.

Caltrans Headquarters Highway Communications Section has the capability of dispatching on selected mountain-top base stations in each District. This feature provides communication link from the headquarters to every District Communications Center as well as to most field personnel in vehicles equipped with mobile radios.

State Microwave Telephone System (Green Phones) Microwave stations, or hubs, are located in several locations statewide connecting various state agencies including Caltrans, CHP, California Department of Forestry (CDF) and OES.

Mobile Scan Receivers (Scanners) Caltrans also has some mobile receivers (scanners) that permit the monitoring of frequencies with CHP and other public safety agencies.

Management Information System (MIS/Teletype) is an independent computer controlled teletype system owned by CHP and shared by Caltrans. This system has a terminal in Caltrans Headquarters Highway Communications Section and all District Office Communications Centers.

Military Communications An interagency emergency transportation committee has been developed for responding to transportation needs within the REOC, which is managed by the OES. This committee, the State Emergency Transportation Committee (SETCO), is staffed primary by Caltrans, CHP, and the California National Guard (CNG). Once the State Co-ordination center is set up, the CNG would provide emergency back-up communications for Caltrans and the CHP for transportation response efforts.

CALCORD System for Interagency Communication CALCORD is a new emergency radio system established by the State (OES) that provides a single frequency, which can be used in mobile and portable units at the emergency incident scene requiring co-ordinated action by more than one agency.

State Communication (STACOM) Radio System connects almost all Caltrans Districts (excluding 1,6, and 12), the CDF and OES. The system is owned, operated and maintained by OES.

Amateur Radio Operators OES has a statewide emergency response network of amateur radio operators called Radio Amateur Civil Engineering Services (RACES). RACES was organized to provide amateur radio resources for the State and local governments. They provide as a back-up communication services in the event of the loss of current statewide radio system.

Transportation Management Center The TMC handles traffic-related and operations information for the freeway. Their system consists of the following (Table 3):

- CHP CAD
- Loop Detectors
- Changeable Message Signs
- Radio links to the field units
- Closed Circuit Television Cameras
- Smart Corridor work station

Table 3. Caltrans Transportation Management Center Resources: District 7

Resource	Quantity
Closed Circuit TV cameras	
Full motion	150
Slow scan	30
Planned	450
CMS: Existing	81
CMS: Planned	105
Metered Connectors	21
Ramp Meter with HOV Bypass	340
TMT Teams	7
Portable CMS Trailer	26
Fabric truck	7
Matrix truck	15
Portable HAR (trailer)	1
Loop Detector Surveillance Sites	748

The TMC system gets information on incidents from the CHP CAD or calls routed through LACC. Currently, these systems exist as separate units. Loop detector information is collected by the mainframe system and displayed on the vertical display screen as well as on Internet and kiosks. The messages on CMS are changed by a PC-based interface, where you click on the CMS to be changed and enter the new message. Closed Circuit TV exists as a separate unit, providing information on traffic flow on some of the congested freeways and interchanges that they cover.

The TMC is in the process of installing a new system for its operations that is expected to be operational by late 1998 or early 1999. In the new system, all these subsystems will be integrated into a single system. The CHP CAD will be available on the same terminal where the loop detector information can be retrieved by a GUI system. The CCTV output will also be directed to the terminal so that the operator can choose to view any particular freeway. Based on these inputs, a plan will be generated by the computer (including the message shown on each CMS unit). The operator has to confirm the plan and the signs will be automatically changed. The operator can also choose to change the message or display the message on other CMS. The advantage of this system is that it makes all TOC information available on the same terminal, reducing response time of the operator and at the same time, generating an action plan, thus standardizing response.

LACMTA FSP Each LACMTA FSP tow truck, including the required back-up trucks, is equipped with FSP radios, Mobile Digital Terminals (MDT) and Automatic Vehicle Locators (AVL) to enable the Operator to communicate with LACC. Programmable

scanners capable of scanning frequencies used by Caltrans and CHP are installed in each FSP tow truck, including back-ups. Thus, each FSP truck operator can communicate with Caltrans and CHP units in the field. Additionally, they are also equipped with shop radios enabling the operator to communicate with the applicable home office. This is required for some of their procedural communication. The tow trucks are equipped with an external speaker and public address system. The speaker and public address system should have the capability for the Operator to hear transmissions outside the cab of the tow truck.

Fire Department Fire Departments have their own dispatch centers. They have a connection to the CHP, the sheriff's department and 911 trunk facility connecting them to the local PDs. The county FD has a state-of-the-art fully digital center that is capable of handling dispatch within seconds. The CAD is all digital and the calls are digitally transmitted to the mobile data terminal of a unit at a specific location. Each FD unit has a Mobile Data Terminal which can receive and send out messages to the dispatcher. The entire dispatch is computerized and takes place within seconds of receipt of call from the public.

3.2 Other Available Technologies

A great many other technologies are used in incident management, covering dispatching, communication, clearance and investigation activities. This section provides a few examples.

LifeLink In an application of ITS technology, San Antonio is installing an innovative wireless LAN for Emergency Medical Services (EMS). This system was developed as part of Texas DOT's ITS Model Deployment Initiative (MDI) by system integrator Southwest Research Institute (*Traffic Technology International*, 1998). The LifeLink system will connect ambulance crews with emergency medical centers through the TransGuide traffic management center so that the physicians in the medical centers will be able to view and receive data on the patient being transported, at the same time providing advice to the ambulance crews. At any time, only one center will be able to talk to the crew but more than one center can consult to the patient by viewing with a full motion video camera, and talk to each other over various media.

The equipment will consist of a laptop configured for a LAN-based video teleconferencing application. The cameras will be mounted in the ceiling of the patient area of the ambulance so that the patient is in the view and another one on top of the ambulance outside so that the accident scene or work going on near the ambulance can be viewed. The system will use a wireless link between an ambulance and the nearest TransGuide camera location, spaced not more than one mile apart along the city's freeway system. It will also be equipped with a line-of-sight radio link that will connect

the ambulance to the nearest camera location, and seek a new connection as the old one begins to fade, thus providing continuous communication along the freeway.

ALERT **A**dvanced **L**aw **E**nforcement & **R**esponse **T**echnology is a law enforcement and incident response technology developed by the US Department of Transportation (US DOT) and Texas Transportation Institute (TTI) designed to reduce the time taken for the law enforcement officers on the incident scene. The system consists of a host computer in the officers' car trunk, a touch-screen display and a hand-held remote unit (Smith, 1997). The system can run checks on drivers (including criminal records) and cars, store forms for officers' ready use, thus saving time and reducing discrepancies by not relying on the dispatcher for the information. This does away with a lot of paperwork for various incidents and provides an open platform to collect data from various sources.

ALERT's open architecture allows the addition of other types of incident forms. Another unique feature of ALERT is the use of digital images from either digital or video camera to add to the paperwork directly and electronically to help reconstruct the incident scene without losing valuable information. The same technology can connect law enforcement, TMC, and Emergency Medical Services and Fire in a LAN to the incident site.

Operation Respond This program provides access to information on clearing chemical skills. Several of the major hazardous materials carriers (trucks and railroads) are participating, providing a centralized database for accessing data on specific shipments. Law enforcement and fire agencies can access data through workstations in the event of a spill.

PIC-PAC **Portable Incident Command Package** is a portable communication package to provide communication between the LACC and responding resources via various devices such as the laptop and six cellular phones. The unit also houses a fax, scanner, color printer, copier for various other communication purposes. The PICPAC aims to reduce incident management time through improved communication among the field units and with the Communications Center. The laptop will have various applications to run checks, forms (which can be filled on-line) and other information required on scene.

Signal Preemption Most preemption systems are decentralized, allowing emergency vehicles to communicate their ID to a receiver mounted close to an intersection, which can then interrupt the signal pattern to provide priority (Johnson, 1998). Different systems for communicating from vehicle to receiver, and some institute green waves across multiple intersections to clear traffic in advance of an approaching emergency vehicle.

4. AREAS FOR FURTHER INVESTIGATION

As a general conclusion, we observed that efficient dispatching plays a critical role in effective incident management. This includes being able to dispatch the appropriate crew and equipment, having that appropriate crew and equipment available close to the incident scene, and being able to determine which crew can be dispatched most quickly to the scene. A high level of efficiency depends on having the resources to ensure sufficient staffing, and it depends on the dispatching process itself. The latter might be improved through improved assessment of the incident prior to dispatching crews, and improved awareness of crew locations. It also depends on making most effective use of available resources, especially in determining whether an incident should be handled by a CHP officer, an FSP truck, or both. These might be accomplished through implementation of two recommendations in the 1991 report of CHP/Caltrans to the State legislature:

> "Augment CHP communication center staffing and equipment to speed dispatching of incident response resources."
>
> "Promote the utilization of Automatic Vehicle Location (AVL) technology by the towing industry and emergency responders to enable them to deploy on the basis of the nearest available unit and fastest response."

In the second phase of research, we will examine the effectiveness of technologies that could improve the dispatching process. This would include vehicle tracking systems, and improved incident assessment methods.

Other areas where incident management might be improved include:

- Technologies that provide for remote assessment of incident severity prior to dispatching crews, such as closed-circuit television cameras.
- Automated incident investigation tools, such electronic measurement devices and hand-held computers that automate accident recording.
- Access to data, and provision of equipment, that allow officers to determine the nature of substances spilled on highways, and to assess the need for hazardous material response.
- Portable communication devices that make it easier for personnel on the scene to communicate with each other.

In total, the incident management process should be optimized, with respect to the following objectives:

- Minimizing the time from when an incident occurs until appropriate crews arrive on the scene, minimizing the time to clear the incident, and minimizing the follow-up investigation time.

- During the incident, minimizing the disruption to traffic by keeping lanes open, reducing the capacity reduction per lane due to driver distraction and hazardous conditions, and minimizing follow-on collisions.

- Ensuring safety throughout the incident, for the victims, incident response crews, drivers and passengers.

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