DEVELOPMENT OF GUIDELINES FOR TRAFFIC MANAGEMENT IN RESPONSE TO MAJOR FREEWAY INCIDENTS

Task 2: State-of the Practice/Literature Review

by

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PURPOSE

This technical memorandum has been prepared by the Texas Transportation Institute to address the objectives of Task 2 of Research Study No. 2-18-93-1345, "Development of Guidelines for Traffic Management in Response to Major Freeway Incidents". The first objective of Task 2 was to conduct a literature review of recent (10 - 12 years) work directed to major incident response, incident management, and traffic management emphasizing, but not limited to, truck related incidents.

The second objective of Task 2 was to contact and assimilate data from the major urban areas of Texas (and selected smaller cities) to establish current practice and procedures for planning and responding to freeway incidents.

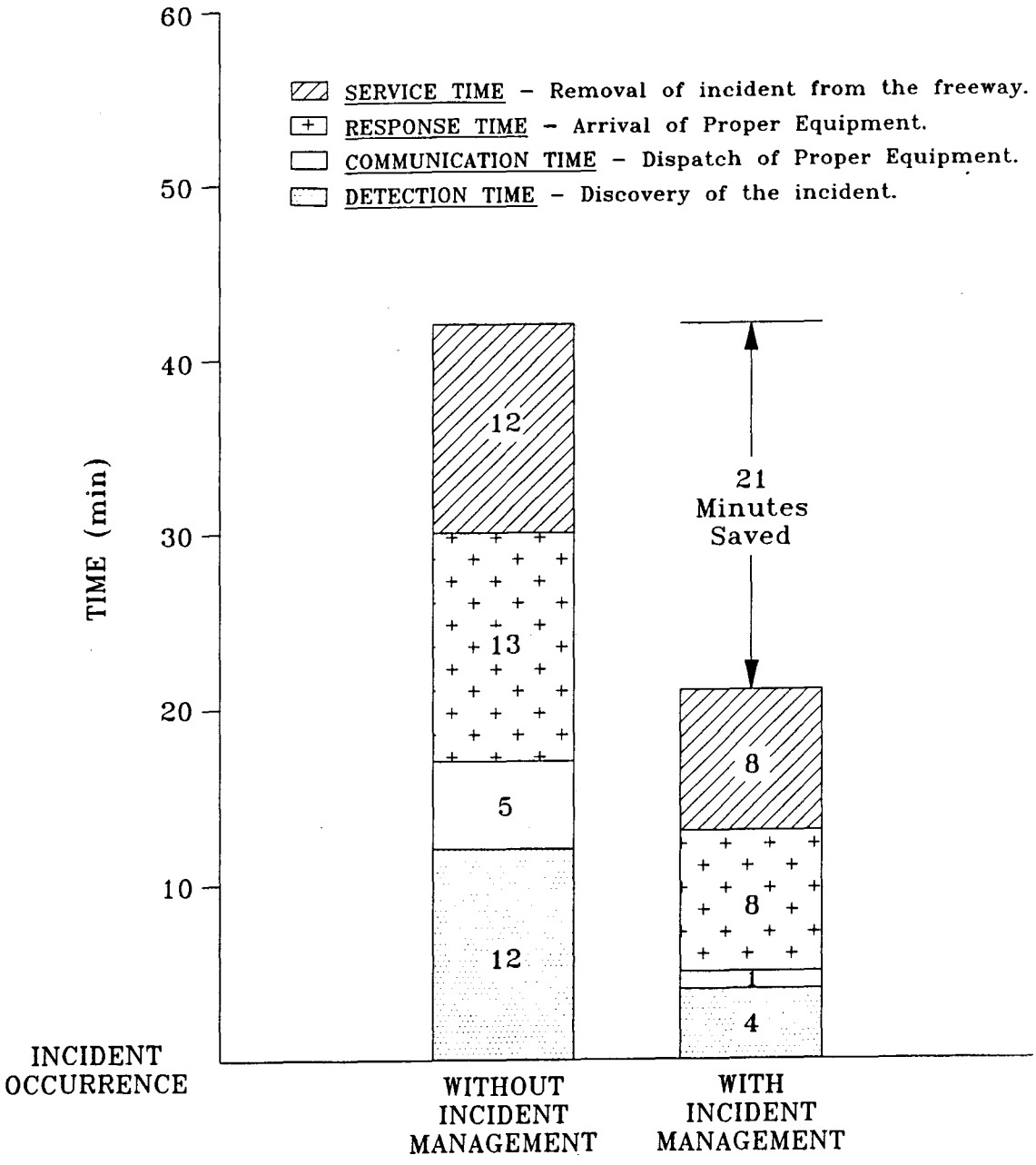
The remainder of this technical memorandum discusses the results of research production to satisfy these objectives.

LITERATURE REVIEW

As early as 1974 (1), transportation and enforcement agencies in California recognized the utility of early detection and response to freeway incidents. The importance of an incident management team was emphasized.

Figure 1 shows the marked reduction in time necessary to detect, communicate, respond, and service freeway incidents with early detection and rapid removal facilitated by effective incident management. Electronic detection proved to be effective in the reduction of incident duration time through its ability to detect most congestion causing incidents (85%) in an average of four minutes after occurrence of the incident. The study also concluded that incident management should function through a centralized communication system with direct contact to all field units.

Figure 1
Early Detection and Rapid Removal
Reduced Incident Duration Time
for Incidents Requiring a Tow Truck

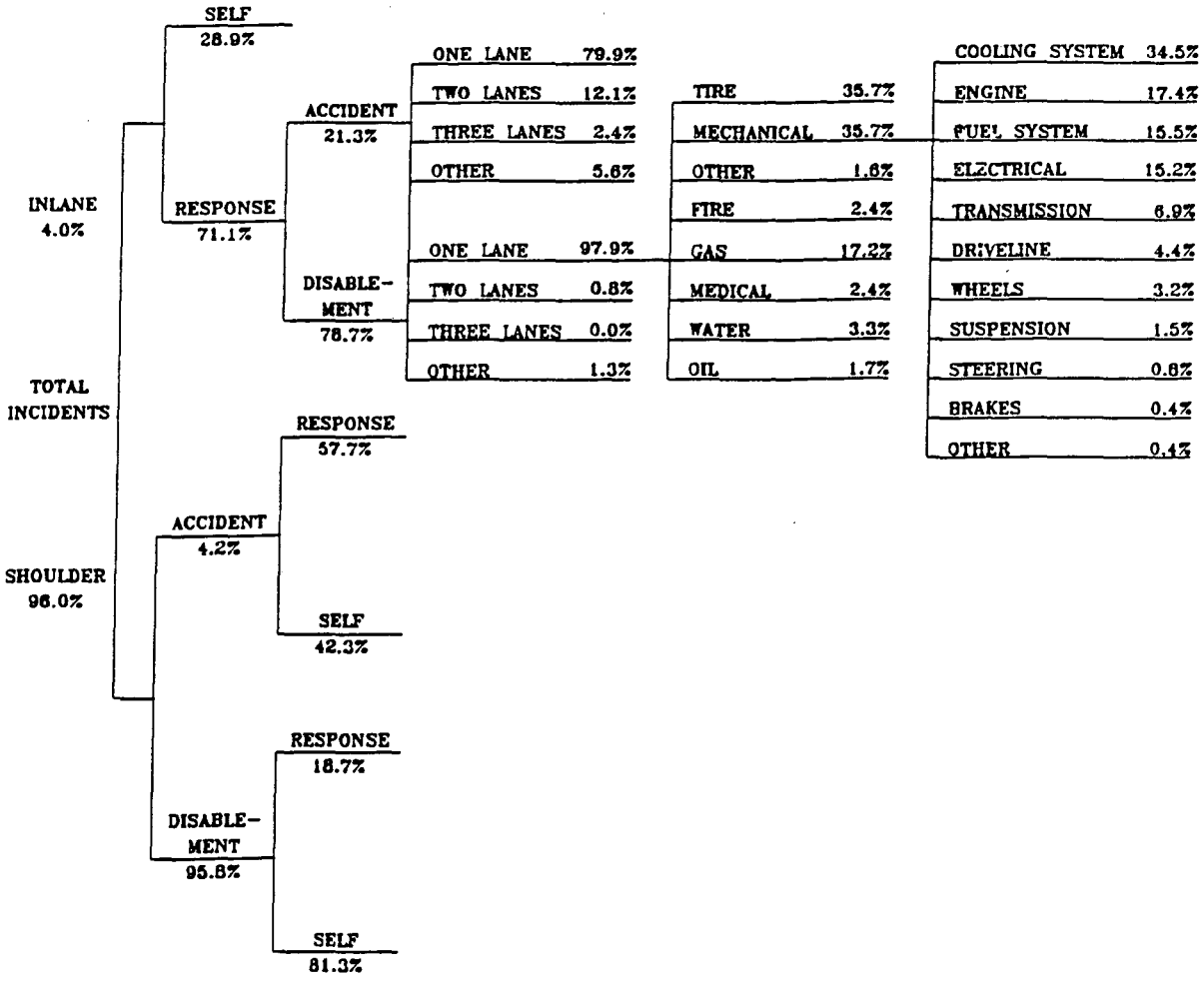


(1)

The Federal Highway Administration focused significant research on freeway incident management in 1978 (2) published in five (5) volumes, this work presented a planning methodology for evaluating incident management, described analytical procedures for estimating delay and congestion, established guidelines for traffic control and incident clearance and provided alternative techniques for incident management implementation.

Figure 2 illustrates a general incident tree categorized by incident location, type of incident, and type of response required. Table 1 indicates typical vehicles and equipment for handling overturned trucks and cargo spills.

Figure 2
General Incident Tree



(2)

In addition, this Situation Analysis should include a forecast of incident conditions whenever possible, Examples of this type of information would be:

* *The possibility of hazards spreading to adjacent structure/areas.*
* *Weather influences affecting the incident.*
* *Projected duration of the incident.*
* *Probable effect of the incident on natural resources (drinking water supplies, etc.)*

Communication of this extremely important information allows for the expeditious dispatch of the proper number and types of Resources that will be needed at the incident scene.

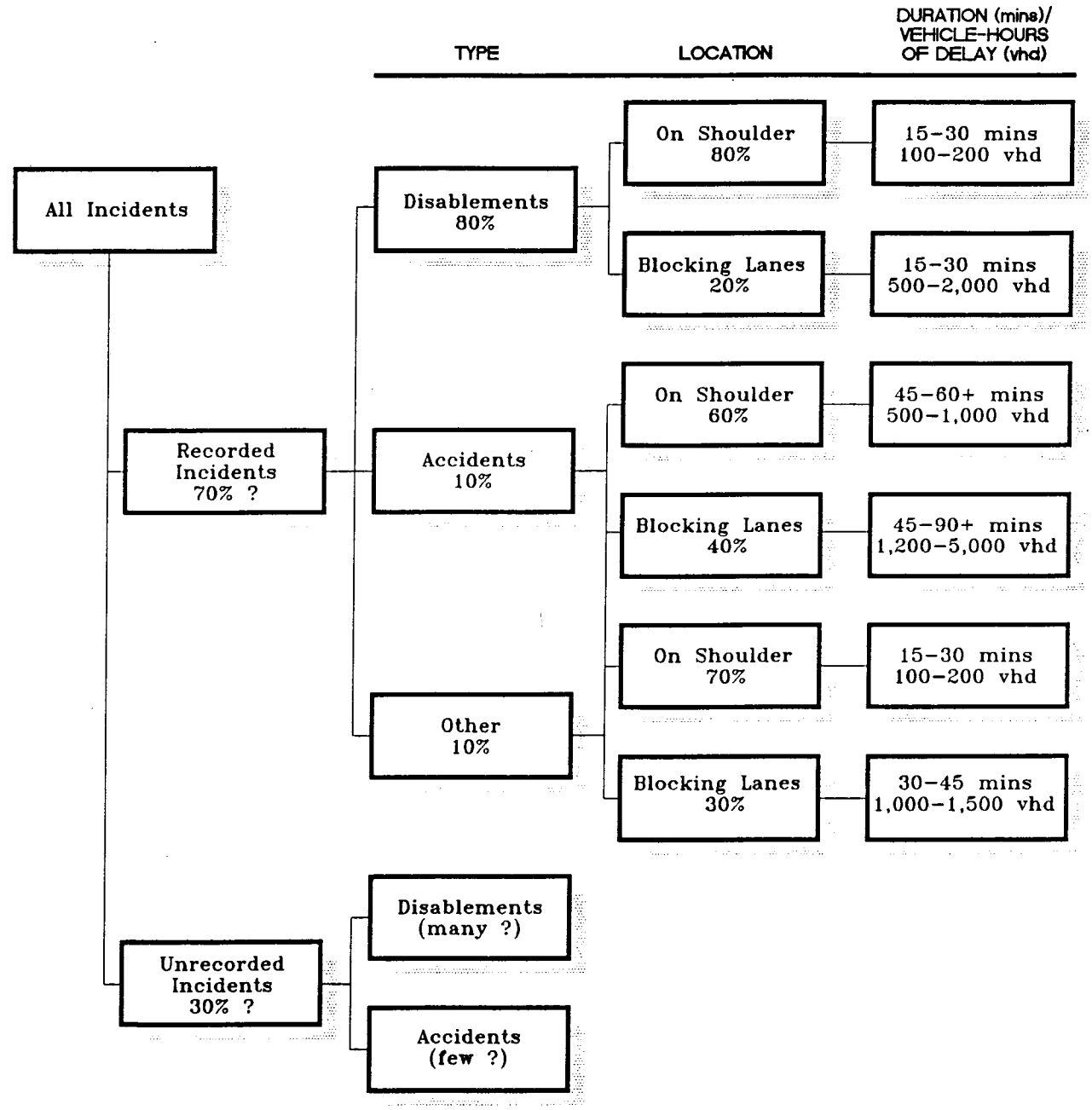
Also in 1990, Cambridge Systematic, Inc. studied what was being done to deal with incident congestion and recommended actions to reduce the time lost to highway incidents (17). The study concluded that the major impediments to development of comprehensive metropolitan incident management programs were organizational and institutional.

The report outlined the following organizational approaches used by successful incident management programs:

1) Traffic management teams;
2) Traffic operations centers;
3) Dedicated service patrols;
4) Incident command systems;
5) Contingency planning;
6) Quick clearance policies;
7) Partnership with commercial radio and television stations; and
8) Strong service organization.

The study recommended that states mandate the development of comprehensive metropolitan incident management programs; assign responsibility for implementation of these programs; and establish clear lines of authority for the management of incidents. Also recommended was the need for states to adopt quick-clearance policies and require uniform annual reporting of incidents. Figure 5 provides composite profiles of incidents by type, location, and duration.

Figure 5
Composite Profile of Reported Incidents



(17)

In late 1990, a survey was conducted among current "active" agencies to determine the state-of-the-art in incident response programs across the nation (18). Much variation was apparent in the number of incidents responded to, type of data recorded, and costs. Unresolved problems were stated as follows:

1) *Interagency radio communication for on-scene responders (nearly 300 municipalities in Chicago)*

2) *Proper tow truck sizes for removal of heavy vehicles.*

3) *Timely response by all the various agencies and companies making traffic decisions rather than incident decisions.*

4) *Not having an active incident response team on duty around the clock.*

5) *Getting the staffing level of the IRT's increased to provide a 24 hr/day program throughout the area.*

6) *Interagency coordination, communication, and response time; upper management support in design and operations.*

7) *Legislation for hazardous waste disposal costs; signing for and use of alternate routes.*

A synthesis of practice report on freeway incident management was also published that same year through the National Cooperative Research Program (19). Table 6 from that study outlines measures for an "ideal" incident management system.

The Department of Transportation Commonwealth of Virginia prepared for agency use the Northern Virginia Freeway Management Team operation manual in 1990 (20). The purpose of this manual was to document an operational plan and certain traffic management procedures for use by agency personnel at the scene of accidents, breakdowns, spills and hazardous materials incidents that occur on the freeway. These included both the major and minor incidents. The manual was intended to inform agency personnel (especially those who are new to the area or to the responsibilities) about interagency policies and procedures so that good coordination and communication can be maintained during freeway incident situations and other emergencies. It is anticipated that these procedures will both help to prevent further loss of life and property and help to minimize the impact of freeway incidents on the flow of traffic in the Northern Virginia area.

Table 6. Measures for an Ideal Incident Management System.

Need	Measures to Address the Need
Detecting and determining the nature of incidents.	Organize existing information sources into a comprehensive network for detection of incidents.
	Design, build, and maintain an electronic surveillance and detection system.
	Place closed-circuit television cameras along critical freeway links and at particularly troublesome locations.
	Use other systems and procedures to gather all available information regarding what is happening on the freeway system.
A focal point for processing data, collecting, and disseminating information.	Establish a traffic operations center, appropriately equipped and staffed.
	Use electronic displays, maps, or other means to visually depict freeway operating conditions.
Active management of major incidents to speed removal of incidents, and to manage traffic to minimize congestion throughout the duration of incidents.	Develop communications systems to receive and dispense information.
	Establish procedures and working relationships to bring about coordinated response efforts by various agencies.
Quick removal of incidents from traffic lanes.	Form incident response teams.
	Use truck-mounted variable message signs and highway advisory radio systems.
Quick removal of major incidents.	Design planned alternative routes.
Provide traffic information to motorists.	Make use of service patrols that operate with vehicles capable of removing relatively lightweight vehicles from the freeway.
	Have heavy service patrol vehicles and/or tow trucks available that are equipped to remove stalled heavy vehicles from traffic lanes.
	Establish tow truck services to provide needed services in a timely manner.
	Use variable message signs located at key locations throughout the freeway system.
	Use portable variable message signs that can be positioned and operated in conjunction with incident management.
Traffic management for construction, maintenance, and special events.	Establish a highway advisory radio system, either ground-mounted or portable.
	Develop a network of commercial radio stations to broadcast information and develop the means to quickly provide information to those radio stations.
	Create systems to provide information about long-term traffic conditions to print media.
	Institute the procedures and recruit the staff to develop traffic management plans for major activities.
	Organize an extensive public information effort for each major event.
	Apply incident management measures throughout the duration of each event.

(19)

The manual includes detailed statements of authority and responsibility, action and equipment checklists, extensive alternative route plan maps, and communication guidelines. It is an excellent example of a major incident response document. A study by the Texas Transportation Institute for the Texas Department of Transportation in 1991 addressed traffic management for major emergencies (21). Table 7 gives a planning framework for major transportation emergencies.

Research by the Pennsylvania Transportation Institute in 1991 developed real-time diversion strategies for incident diversion (22). The user-optional approach reroutes motorists through the shortest alternate paths to their destinations. The system-operational approach attempt is made to effect diversions to optimize the utility of system facility.

Work was also directed to apply expert systems to freeway incident management (23). Research at the University of California in 1991 involved the implementation of an artificial intelligence-based real-time expert system to provide operator decision support in responding to non-recurring (incident) congestion on urban freeways. A decision flow chart and expert system interface with incident detection, verification, and response functions is illustrated in Figures 6 & 7.

Also in Pennsylvania that same year, the Department of Transportation began implementation of a comprehensive state-of-the-art traffic and incident management system for interstate freeways in the Philadelphia area (24). The components of this new system include:

- Loop detection system
- Television surveillance system
- Changeable message sign system
- Radio/media advisory system
- Ramp metering system
- Traffic control center
- Communications system
- Intelligent vehicle highway system
- Accident investigation site system
- Highway patrol
- Emergency high speed crossovers
- Fire service facilities
- Supplemental signs

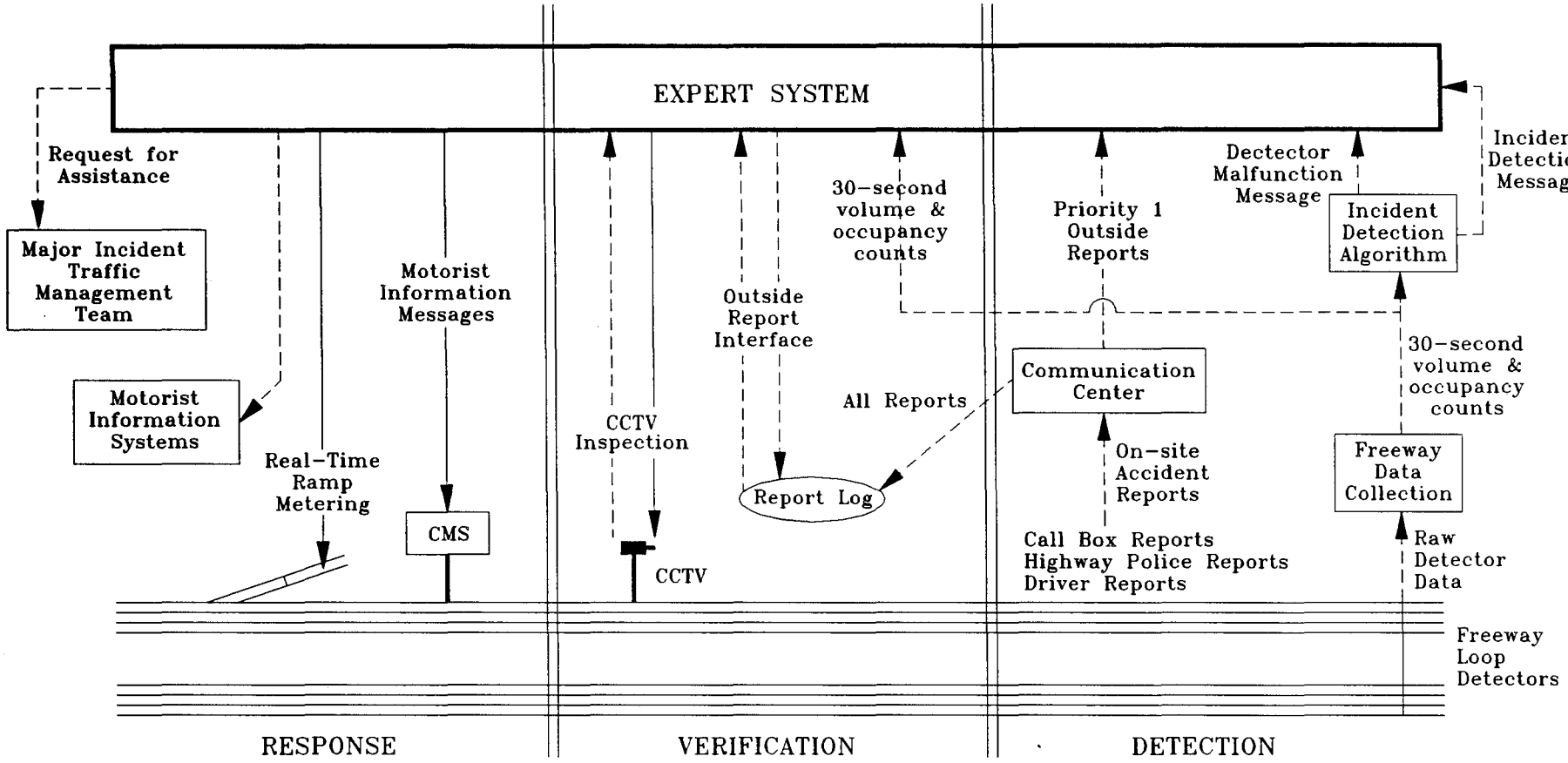
A report completed in March of 1991 documents the impacts of two service patrol demonstrations performed in the Puget Sound metropolitan area during the 1990 Goodwill

Table 7. Planning Framework for Major Transportation Emergencies

Phase of Emergency	Agency Focus of Emergency Responsibilities	Description of Agency Emergency Actions	Preparations to Enhance Agency Actions
Prior to the Emergency	• Move to "alert" emergency response status • Prepare the transportation system to facilitate mobility and endure emergency conditions	• Implement an emergency transportation plan • Monitor status of impending emergency conditions	• Evaluate transportation system and develop action plan • Establish person or agency to designate initiation of emergency response efforts
During the Emergency	• Maintain mobility of the transportation system to the extent possible • Support other agency roles in efforts to minimize loss of property and life	• Identify and respond to problems in the transportation system as they arise • Notify public of transportation problems • Provide personnel, equipment, and supply assistance to other agencies • Manage outlay of equipment and personnel resources	• Establish interagency coordination and mutual-aid agreements • Establish intra-agency and interagency communication networks • Develop and maintain personnel and equipment resource lists • Develop methods of notifying the public of conditions of the transportation system
After the Emergency	• Restore transportation system to pre-emergency conditions • Support region wide clean-up and repair efforts	• Assess damage to transportation system and prioritize repair efforts • Assist other agencies in damage assessments	• Identify protocols and documentation procedures for receiving assistance • Develop mechanism of prioritizing recovery needs in the transportation system

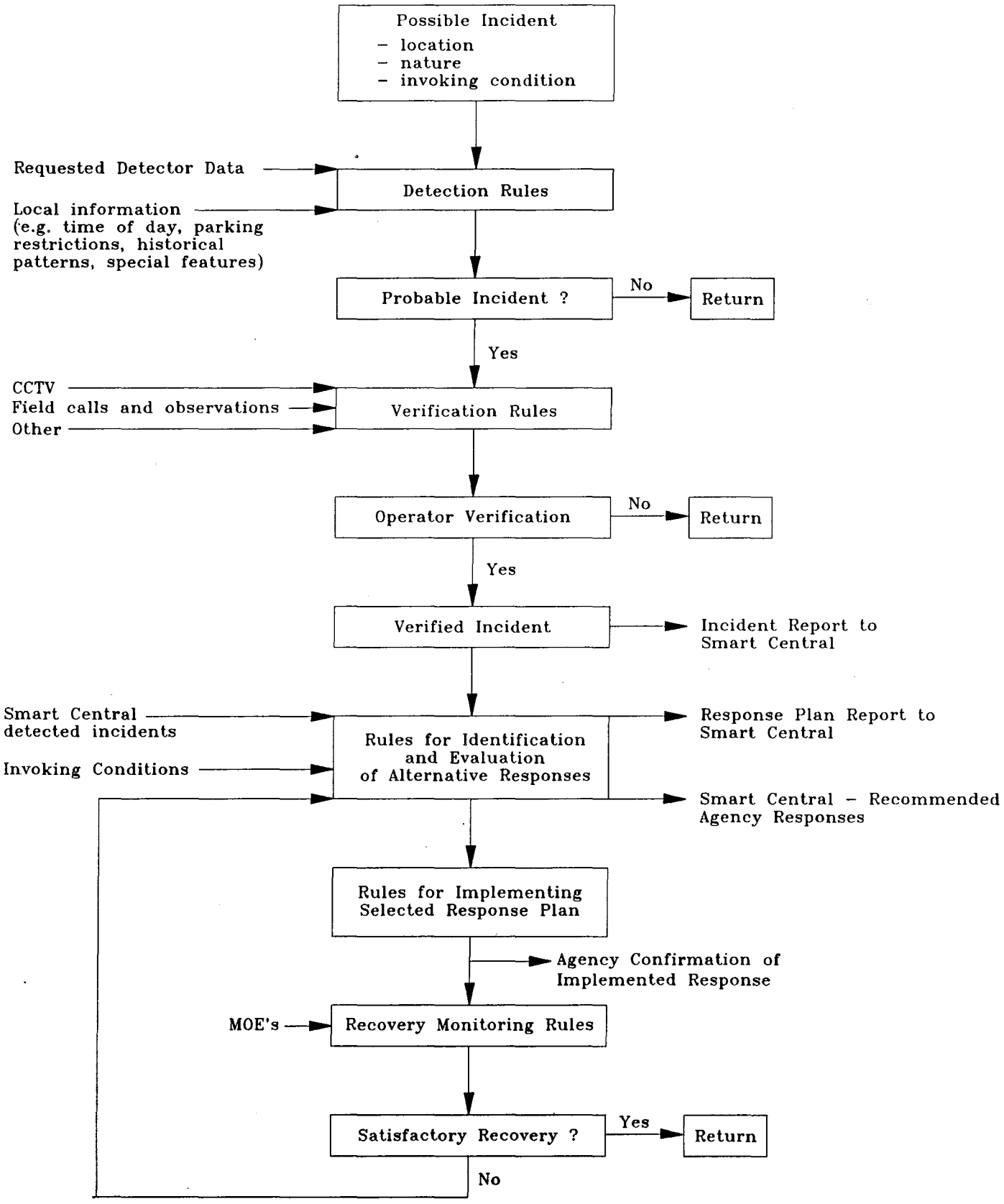
(21)

Figure 7
Expert System Overview



(23)

Figure 6
Major Freeway Incident Flow Chart



(23)

Games (25). As a result of these patrols, substantial decreases in incident duration were measured within the study area during the demonstration. Disabled vehicles were removed more quickly creating less hazard on the roadway.

The Florida Department of Transportation implemented the Major Accident Record System (MARS) in 1991 (26). The system was developed as a database of major accidents, as shown in Table 8. Average delays were calculated for each category. The MARS enables one to quantify the magnitude of the impact of major accidents on users in the study area (Table 9).

Table 8. Major Accident Categories

Accident Category	Description
01	Truck-Hazardous material & fire
02	Truck-Hazardous material
03	Truck-Fire
04	Truck-Fatality
05	Truck-Jackknifed tractor-trailer
06	Truck-Overturned
07	Truck-Injuries
08	Truck-Many vehicles involved
09	Truck-Vehicle disabling
10	Truck-Other
11	Auto-Fire
12	Auto-Fatality
13	Auto-Injury
14	Auto-Many vehicles involved
15	Auto-Simple [minor accident]

(26)

The first incident management conference for the Commonwealth of Massachusetts took place in June, 1991 (27). In reviewing exemplary programs, the following list of five steps to creating a successful incident management program were identified:

1) A clear mandate for managing incidents and the traffic problem they create must be established.

2) An agency or organization must be assigned the responsibility to set up and coordinate an incident management response (includes traffic patrols and a quick clearance policy).

3) Involve the media in the information system.

Table 9. Statewide Impact of Major Incidents

FM TEAM	No. of Incidents	Delay (mill vht)	User Cost (mill $)	Fuel Cost (mill $)	Total Cost (mill $)	Fuel Consumed (mill gal)	Emissions (tons)
TAMPA BAY	558	1.9	14.4	7.7	22.0	7.7	137
Hillsborough	444	1.6	11.7	6.2	17.9	6.2	111
Pinellas	114	0.4	2.7	1.4	4.2	1.4	26
JACKSONVILLE	418	1.5	10.9	5.8	16.8	5.8	104
ORLANDO FMT	240	0.8	5.9	3.1	9.0	3.1	56
Orange	192	0.6	4.8	2.6	7.4	2.6	46
Seminole	48	0.1	1.1	0.6	1.6	0.6	10
BROWARD	545	2.1	15.5	8.3	23.7	8.3	147
DADE	815	2.5	19.0	10.2	29.2	10.2	181
PALM BEACH	390	1.2	8.8	4.7	13.6	4.7	84
TOTAL	2966	9.9	74.6	39.8	114.3	39.8	708

4) Funding should be designated for the incident management program.

5) Incident management records and reports must be kept.

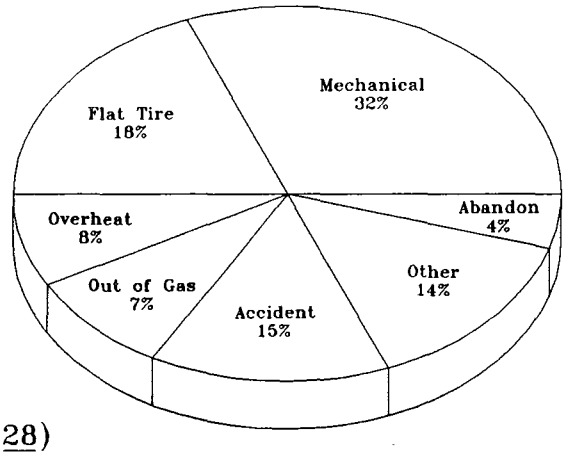
A freeway incident management handbook was published by the Federal Highway Administration in 1991 to serve as a guide for agencies wishing to initiate an effective incident management program (28). It was designed to aid transportation officials with operational responsibility in state and local departments of highways, traffic, or transportation, police, fire, and emergency medical services personnel, environmental protection officials, tow truck operators, and administrators involved with managing roadway incidents.

Figure 8 illustrates incident type distribution. Table 10 from this handbook specifies incident magnitudes while Table 11 outlines incident management measures.

Also in April 1991, the Washington State Transportation Center prepared a report for the Washington State Transportation Commission which established a framework for

Figure 8

Incident Type Distribution (Percent)



(28)

Table 10

Incident Magnitudes

CHARACTERISTIC	MINOR	MAJOR
Duration	<1/2 hour	>1/2 hour
Blockage	Shoulder area only	One or more travelled lanes
Contribution to Overall Incident Caused Delay	65%	35%

(28)

developing incident management systems (29). This document noted that incident management systems encompass five basic tasks. These tasks include:

- Incident detection and verification;
- Incident response;
- Incident site management;
- Incident clearance; and
- Motorist information.

Tables 12 - 16 from this report identify and comment on options to reduce detection/verification time, improve response time, improve site management, reduce clearance time, and improve motorist information.

Because of the number of incidents and the magnitude if their consequences, the Virginia Department of Transportation made a concerted effort to ensure that incident management became a top priority and spearheaded an effort to initiate a state-wide incident management program (30). This program was concerned with preventing incidents and with detecting, responding to, and clearing incidents after they occur. Formal incident management programs in three large urban areas in addition to other efforts by the Virginia Department of Transportation, the Virginia State Police, and Fairfax County are summarized. The documentation contained herein can be used to aid other states in developing incident management programs.

Table 11. Incident Management Measures

INCIDENT MANAGEMENT					
Reduce Duration			**Restore/Maintain Capacity**	**Reduce Demand**	
Detection	**Verification**	**Response**	**Removal**	**Information to Motorists**	**Traffic Management**
Electronic/computerized detection Enforcement Personnel/patrols Maintenance/ construction /other personnel Service patrols Fixed observers at strategic locations Transit, taxi, trucking organizations Traffic reporters/ commercial traffic information services Aerial surveillance Motorists • Call Boxes • Cellular telephone/ "hot" lines • CB radio	Assimilate information from: • Enforcement personnel/patrols • Courtesy patrols • Service patrols • Closed-circuit TV • Citizens Band Radio • Traffic Reporters • Aerial surveillance • Cellular telephone • Emergency call boxes • Other Display/record information Communicate information to appropriate agencies	Pre-planning Enforcement Agencies Response teams Service Patrols Fire, medical, environment, maintenance, other Inter-agency communication Specialty teams (Haz-mat) Tow truck agreements Commercial Alpha-Numeric Pager Strategic location of materials and equipment	Appropriately equipped response vehicles Training of response personnel Service patrols Off-freeway accident investigation sites Push aside/remove later (push bumpers) Defer removal until off-peak Rapid removal policies	Diversion information • Variable message signs - Permanent - Portable • Highway advisory radio - Permanent - Portable • Commercial Alpha-Numeric Pager • Media outlets - Commercial radio - Cable TV - Print Media - Other media	On-scene traffic management • Lane closures/reopenings • Freeway closures/reopenings Implement pre-planned alternate routes

(28)

Table 1. Typical Vehicles and Equipment for Handling Over-turned Trucks and Spilled Cargoes

Trucks		
refrigerated	dump	tank (dry bulk)
flatbed	platform	concrete mixing
moving van	garbage and refuse collector	tractor-trailer
suction pump	auto transport	steel-carrying
cherry picker	cattlerack (livestock)	heavy duty wrecker
pole and logging	tank (liquid)	lowboy
Equipment		
hoses, pumps	sweeper	portable illumination
defueler	cranebulldozer (earthmoving)	front-end loader
skip loader	portable generator	grader

(2)

In 1979 the Federal Highway Administration further documented "getaway" flow rates associated with clearing freeway incident (3). Rates were calculated based on freeway incidents evaluated from Los Angeles and Washington, D.C. Table 2 gives comparisons of getaway rates by incident type and time of day.

Table 2. Get-away Flow Rates

Getaway flow rates comparison			
		Getaway flow rate	
Incident type	Number of incidents	Average	Standard deviation
		v/l/h	v/l/h
Disabled vehicle	10	1,580	189
Traffic collision:			
Two or less vehicles	5	1,562	251
More than two vehicles	5	1,420	87
Peak versus nonpeak getaway flow rates			
		Getaway flow rate	
Time	Number of incidents	Average	Standard deviation
		v/l/h	v/l/h
Peak	11	1,634	152
Nonpeak	11	1,425	168

(3)

The rates were found to be slightly dependent on incident type and number of vehicles involved and were also dependent on whether or not the incident occurs during the peak period. These getaway flow rates can be used to evaluate various low cost freeway incident management systems.

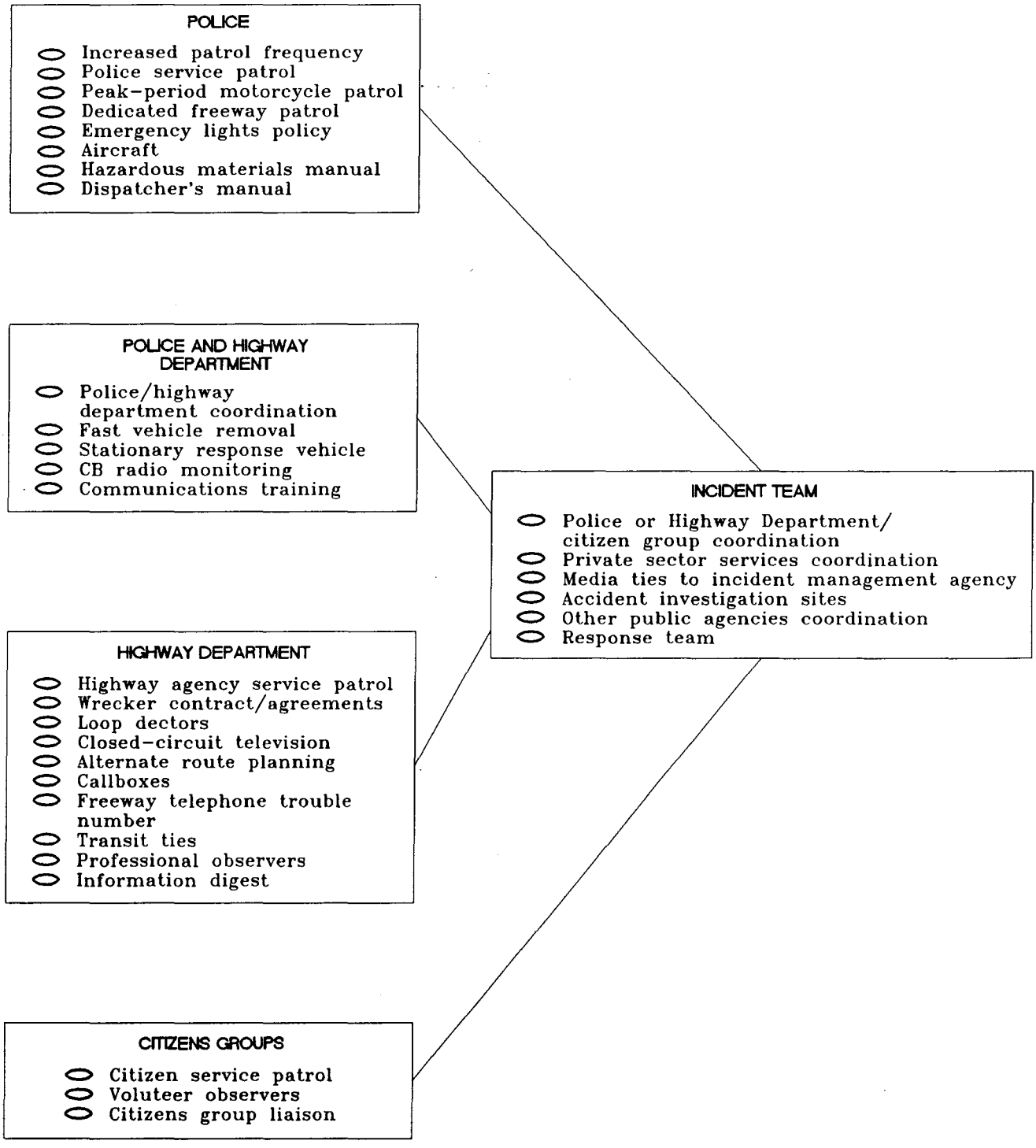
CALTRANS District 07 (Los Angeles) was one of the first agencies to formally establish a major-incident -response (MIR) team (4). The MIR team has been successful with an important key being the use of changeable message sign trucks. Equally important is the immediate identification of alternative routes, which involves considerable pre-planning.

Over 3,000 maps of the applicable counties were developed to show alternate routes, required signing, closures, responsible individuals and telephone numbers, and any special notes unique to the incident area.

In 1983, the Federal Highway Administration sponsored the preparation and publication of a freeway management handbook (5). This document focused on the importance of strategies to minimize the impacts on freeway operations brought on by non-recurring congestion problems (incidents). The magnitude of delay and potential safety degradation from freeway incidents was noted to be dependent on incident type, location, time of day, and clearance duration. The handbook reported effective freeway management of incidents involves enhanced detection with surveillance systems, rapid servicing with patrols and special removal equipment, and motorist information coordinated from a central control center by an incident management team. Three operational incident management systems were noted in Chicago, Los Angeles, and New York.

The handbook considers interagency coordination critical to effective response to freeway incidents. Figure 3 illustrates the multi-disciplinary hierarchy of an incident management team.

Figure 3
Incident Management



(5)

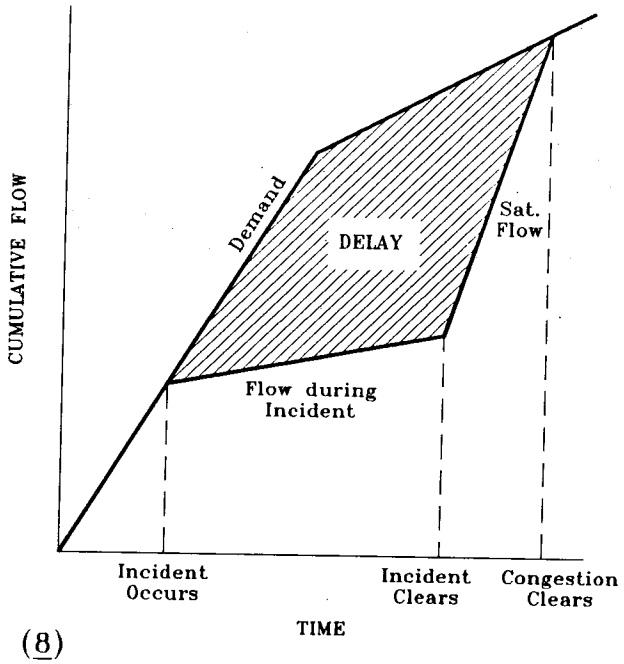
In 1984, truck operations and accidents on urban freeways were examined to determine percent of peak period traffic, lane position of operation, driver violation, and accident frequency and severity (6). This data can be utilized for incident projections and response requirement planning for freeway incident management.

Incident detection and response by the Illinois Department of Transportation on the Chicago freeway system was discussed in a paper given in 1987 (7). The use of electronic surveillance systems for incident detection is outlined. Traffic flow characteristics are measured for each detection point with presence-type detectors measuring lane occupancy. Sampling the flow at points along the freeway gives an estimate of overall system operation. Verification can be accomplished through roadside motorist aid phones, call boxes, citizen's band radio, or cellular phones. Communication must be established between all units involved. Alternate route plans should be ready to implement to minimize motorist delay.

Also published by the Transportation Research Board in 1987 was a paper analyzing recurrent and non-recurrent (incident) delay as related to benefits derived from freeway management incorporating surveillance communication and control systems (8). The paper reports on the installation of a freeway corridor surveillance, communication, and control (SC&C) system in Texas. The model estimated recurrent delay by speed-flow relationships and includes the effects of diversion to the frontage road. Nonrecurrent (incident) delay savings are estimated by using a graphical technique on a plat of time versus cumulative vehicles. Figure 4 depicts this graphical estimation procedure.

Within the last five years, the Texas Department of Transportation has taken several steps in the major metropolitan areas in Texas to formalize major incident response authority and procedures. In Ft. Worth (9), the following policy and procedure statement outline was established for major spills and/or truck turnover closing an arterial on the state highway system.

Figure 4
Nonrecurrent (Incident) Delay



(8)

1. *The immediate use of the freeway by other drivers will be the utmost concern of the Department's personnel on the scene after the injured have received proper care. State law gives the Department the right to clear debris and property from the system as quickly and efficiently as possible under emergency conditions to ensure the safety and well being of other traffic that has the right to use the roadway.*

2. *The department will provide traffic control and/or rerouting of traffic by using its Courtesy patrol and/or maintenance personnel which will include directional arrows, cones, fuses, barricades, etc., throughout duration of closure.*

3. *If the closure is due to a truck turned over but still has its contents intact, measures will be taken to coordinate with wrecker service to provide personnel if available to unload the contents and transfer by that wrecker service to its headquarters; otherwise the Department will provide personnel to accomplish this task.*

4. *If load is damaged to the extent that it is not salvageable, then the Department will remove cargo and cleanup area by means of front-end loader and dump trucks as quickly as possible. Contents will be removed from roadway and stored on State right-of-way or Maintenance yard.*

5. *In cases where liquids are spilled, the department will provide sand to absorb the liquid and the cleanup of such by sweepers, loaders, etc.*

6. *If spill is hazardous, state will attempt to provide all of above upon detection of fire department officials and/or hazardous spill team.*

7. *The department will have final authority in determining when the closed arterials will be opened.*

8. *It is the intent of the department to provide these services to reduce inconvenience of the motoring public by opening a closed major arterials as quickly as possible in a safe manner.*

A similar policy statement by the Houston district was initiated for response to incidents closing a section of the state highway systems. This is given as follows:

1. *State law gives the Department the right to clear debris and property from the State's Highway System as quickly and efficiently as possible under emergency conditions to ensure the safety and well being of other traffic that has the right to use the roadway. After the injured have received proper care (if appropriate), and after the area has been declared safe to the general public by the appropriate hazardous response agencies, the Department's representative on the scene will take appropriate action to clear the roadway for use by other motorists.*

2. *The Department's representative will implement a traffic control plan for rerouting traffic, using an incident response team, the Courtesy Patrol Vehicles, Motorist Aid Program Vehicles, and/or maintenance personnel. As appropriate, the Department will use such forces to supplement the police and fire departments engaged in securing the accident site.*

3. *If the closure is due to a truck turnover, but with its contents intact, the Department will attempt to coordinate removal of the truck and its contents with its owner. If, however, the Department determines that the time to do so is excessive in relation to the traffic demands in the area, or that the accident scene constitutes an immediate danger to the public, the Department will take the steps necessary to accomplish timely removal. The truck and its contents will be removed from the roadway and stored on State right-of-way or at maintenance yards.*

4. *If the closure is due to a truck with spilled cargo, the Department will remove the spilled cargo and clean up the area with state-owned or leased equipment as quickly as possible taking precautions appropriate to site conditions to preserve undamaged cargo which will be removed from the roadway and stored on State right-of-way or at maintenance yards. Removal of the truck and any unspilled cargo will be handled as specified in paragraph 3 above.*

5. *In cases where liquids are spilled, the Department will provide sand to absorb the liquid and will clean up the roadway by sweepers, loaders, etc. The sand will be dispatched to the scene as it is evident that the spillage will require this treatment.*

6. *If the spill is hazardous, the Department will attempt to provide all of the above services upon the directions of Houston Fire Department Hazardous Materials Response Team, or other emergency response agencies.*

7. *Although the Department will have the final authority in determining when the closed roadway will be opened, the on-site representatives for the Department will confer with the other emergency response agencies to ensure that their activities have been completed.*

8. *It is the intent of the Department to provide these services to support the other emergency response agencies, so that the motoring public will not be unduly delayed and that the roadway will be reopened as quickly as possible in a safe manner.*

By this same time (1988), incident management programs were being extensively promoted and implemented nationally. Table 3 gives a summary of incident management system types, locations, detection and verification alternatives, response capabilities, and motorist information communication as reported by the Federal Highway Administration (11).

One particular report (12) by the Federal Highway Administration in 1989 singled out freeway service patrols as an effective element for both incident detection and response. The study compiled data nationally which indicated that 80 percent of all urban freeway incidents are actually minor, with only two percent of all incidents lasting more than 2 hours.

The FHWA study also revealed that about one-third of the total vehicle delay is due to lane blocking accidents, and the other two-thirds is due to minor incidents (those confined mostly to the shoulders and lasting less than 30 minutes).

Services patrols perform a variety of functions, but always with an overriding emphasis to maximize safety and minimize the operational impact of freeway incidents. Some of the typical duties that service patrol operators are assigned and trained to handle include:

Table 3
Incident Management Programs in the United States

X = In-place
P = Planned or Proposed

SYSTEM TYPE AND LOCATION	FIM		DETECTION & VERIFICATION							RESPONSE				MOTORIST INFO				COMMENTS
	Minor	Major	Operation Center	Service Patrol	Electronic Detection	Closed Circuit TV	CB Radio	Call Boxes	Other	Response Team	Wrecker Agreement	Agency Equipment	Other	Alternate Routes	Highway Advisory Radio	Media	Variable Message Signs	
AREAWIDE SYSTEMS																		
Chicago	X	X	X	X	X	X	X					X	X		X	X	X	110 miles of Freeway
Los Angeles	X	X	X	P	X	X	X	X	X	X	X			X	X	X	X	450 miles of Freeway
TRANSCOM – NY/NJ		X	X			P			X					P		X	P	16 Agencies
Seattle	P	P	X		X	X				P	P			P	X	X	X	FAME Project
Minneapolis/St Paul	X	P	X	X	X	X	X	P		P	X				X	X	X	
Detroit	X		X		X	X	X	X			X					X	X	
W Virginia	X	X	X	X	X	X	X				X					X	X	
Baltimore		X	X											X			X	
Phoenix	P	P	P		P	P			P		X			P			P	20 year plan
Ft Worth	X	P	P	X	P	P			P	X	X		P	P	P	X	P	20 yr project over 191 mi of fwy
Houston		P	P	X	P	P				X		X		P		X	P	Current activity on HOV lanes
San Antonio	P	P		X	P	P								P			P	
San Diego	P	X								X								
San Francisco	P	P	P		P	P											P	20 year plan
Norfolk Area, VA	P	P	P		P	P						X		P		X	P	Tie fwy system w/existing bridge
Miami, FL	X	X	P		P	P				X	X			X	P	X	P	Corridor Management Team
Fairfax Co, VA	X	X	X						X		X			P		X		Nonfreeway -- County Police
Massachusetts Fwys	X	X	P				X	X		P			X	P				Oil overcharge funds
Tampa Bay, FL	X	X	P		P	P				X	X			X	P	X	P	2 Corridor Management Teams
Jacksonville, FL	X	X		X						X	X			X		X		Corridor Management Team
CORRIDOR SYSTEMS																		
Long Island Expy	X	X	X		X	P	X			X	X	X		X		X	X	IMIS -- 35 mi x 5 mi Corridor
NJ Turnpike	X	X	X	X	X						X	X		X			X	
Jones Falls, Baltimore			X		X			X										
N Central Expy, Dallas	X	P	P		P	P								P			P	System replaced as part of recon
I-95/495/Maryland		X		X							X	X		X			P	Capital Beltway
US 48/W Maryland		X								X				X				
I-75/Michigan		X								X				X				DOT District 6
I-10/El Paso, Tx	X	P			P	P					X	X	X	X			X	Const oriented -- will be perm
I-10/Los Angeles	P	P	P		P	P			P	P			P	P		P	P	Smart Corridor Demo Project
I-4/Orlando	X	X		X	X			X		X	X			X		X		2 Corridor Management Teams
I-95/Ft Lauderdale	X	X																Corridor Management Team
US 50/Maryland	X	X		X			X			X		X				X		"Beach the Beach" Program
I-95/Rhode Island		X								X				X			X	
NY State Thruway	X	X	X	X		P	X			X	X	X		X	X	X	X	559 miles of Toll Road

(11)

Table 3 cont'd
Incident Management Programs in the United States

X = In-place
P = Planned or Proposed

SYSTEM TYPE AND LOCATION	FIM		DETECTION & VERIFICATION							RESPONSE				MOTORIST INFO				COMMENTS
	Minor	Major	Operation Center	Service Patrol	Electronic Detection	Closed Circuit TV	CB Radio	Call Boxes	Other	Response Team	Wrecker Agreement	Agency Equipment	Other	Alternate Routes	Highway Advisory Radio	Media	Variable Message Signs	
BRIDGES, TUNNELS, AND SPOT LOCATIONS																		
East St Louis, IDOT	X			X			X	X				X			P	X		
Elis River Tunnels Norfolk/Ports VA	X	X	P	X	P	P	X	X	X			X				X	P	
I-64/Hampton Rd Br and Tunnel, VA	X	X	X	X	X	X	X					X			X	X	X	
SR 17/James R Br Newport News, VA	X	X	X	X		X	X	X				X						4 mi of 4-lane divided with no shoulders, ADT = 23,000
Oakland Bay Br (SF)	X	X	X	X	X	X						X					X	
Howard Franklin Br Tampa, FL	X	X	X	X	X	X		X		X	X			X		X	X	
Sunshine Skyway Br Florida	X	X	X			X		X		X	X			X		X	X	
Escambia Bay Br (2) Florida I-10/US 98	X	X	X					X		X	X						X	
I-90/W Idaho			X			X											X	Roadway Conditions
US 95/Lewiston, ID			X			X												6 Escape Ramps on 8 mi downgr
Ft McHenry Tunnel Baltimore	X	X				X						X		X	X	X	X	
Dewey Sq Tnl, Boston															X			HAR override inside tunnel
I-90, Montana																	X	Roadway Conditions
I-93/Franconia Notch New Hampshire															X		X	
Linclon/Holland Tnls NY/NJ	X	X	X	X	X	X					X	X			P		X	
Lehigh Tunnel, PA PA Turnpike	X	X	X	X	X	X		X				X					X	
Tappen Zee Br, NY	X	X	X	X		P	X			X		X		X		X	X	3 mi ling bridge across Hudson
Triborough Bridge & Tunnel Author, NY	X	X	X		P	X		X				X				X	X	7 Bridges, 2 Tunnels

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- *Continuously patrolling a designated area seeking disabled vehicles, stranded motorists, debris in the roadway, spilled loads, accidents, obstructions to traffic, and other potential hazards or abnormal occurrences -- then notifying appropriate highway and enforcement personnel of the location and nature of the situation.*

- *Assisting motorists by towing and/or pushing disabled vehicles out of the roadway, providing gasoline or water, changing tires, providing jump starts with booster cables, performing minor repairs when and if possible, etc.*

- *Notifying enforcement authorities of abandoned vehicles along the roadway -- noting location, make, color, body type, license number, and whether or not the vehicle is impeding traffic. If not impeding traffic, tag the vehicle for removal under local regulations. If it is impeding traffic, notify enforcement personnel that (1) they will remove the vehicle if so authorized, or (2) immediate assistance is required if they are not authorized.*

- *Assisting at freeway accident scenes by providing emergency first aid, notifying enforcement agencies, removing damaged vehicles from the roadway, supplementing or providing traffic control at the scene, assisting in extricating injured motorists, providing and/or coordinating communications at the scene, providing motorist information, traffic reports, etc.*

- *Removing debris from the roadway -- accident or otherwise, or calling for assistance for more complex cleanups.*

- *Assisting in setting up, maintaining, and removing emergency detour routes required because of an incident.*

- *Providing any other assistance as requested by State and/or local enforcement agencies (Highway Patrol, State Police, City Police, Sheriff's Department, etc.).*

- *Maintaining an established service patrol log, completing an entry for each incident encountered and/or handled.*

- *Assisting at major accident scenes and other disasters, providing personnel, equipment, and traffic control support.*

In August of 1989 the Minnesota Department of Transportation, the Minnesota State Patrol, and the City of Minneapolis sponsored an Incident Management Workshop (13). This workshop concentrated on Incident Detection, Response and Removal, Corridor Control, and Motorist Information Systems. In attendance were over one hundred representatives from towing and trucking associations, private businesses, the media, insurance companies, the American Automobile Association (AAA), and the legislature.

The Minnesota Department of Transportation arrived at new directions and innovative solutions to heavy truck incident management. One aim was to support the towing industry's efforts to persuade manufacturers to build into trucks a system to unlock their brakes for towing. Also discussed was the possibility of reducing allowable truck speeds on ramps where truck rollovers are more likely to occur.

A new sense of understanding between agencies involved in incident removal emerged from the workshop and opportunities for cooperation were created. All seemed to call for post-incident reviews to discuss problems and ways to better handle the next similar situation.

Another major concern was the impact of truck incidents on the orderly flow of traffic. In 1989, trucks comprised about 3% of rush-hour traffic and were involved in 11% to 12 % of accidents. On average, it took 50% longer to clear the freeway after a truck incident than after a car accident.

In late 1989, the Federal Highway Administration published the most comprehensive examination of truck accidents on urban freeways to date (14). Table 4 of this report gives a summary of research results on the characteristics of large truck accidents.

Also, accidents occurring from January of 1985 through September of 1988 on 46.5 miles of urban freeway were inspected. A total of 2,221 accidents were verified, by the vehicle identification number and/or the description of the original accident report, as involving a truck over 10,000 lb gross vehicle weight. Information on these accidents were placed into a data base file to provide a homogeneous data base with the required format to address projects needs. A total of 17,962 accidents involving only passenger vehicles were identified as occurring on the same freeway segments and during the same period. The results presented below are based on analyses of these data.

Table 4. Summary of Research Results on the Characteristics of Large Truck Accidents.

Study Area	Facility Type	Summary of Findings
20 States	urban freeways	The accident rate for trucks rises from 60 per 100 MVMT to over 120 per MVMT in the proximity of interchanges.
California	urban freeways	Left-hand ramps had the highest average accident rate of 10 ramp types.
6 States	urban freeways	Most truck accidents are not related to interchanges or ramps.
(summarized prior studies)	all types	Doubles are involved over three times as often in single-vehicle accidents and over twice as often in all accidents as singles.
Nationwide	all types	Singles have a lower fatal accident rate than doubles.
Nationwide	all types	Doubles are over involved in every major non-collision accident.
Washington	interstate	Truck configuration was the predominant truck characteristic affecting accident rate.
Nationwide	all types	Straight-trucks, flat beds and tanker type tractor-trailers have high fatality and injury rates.
Nationwide	interstate	Truck involved fatal accidents are greatest in July and on Fridays.
Nationwide	all types	Approximately 40 percent of truck involved fatal accidents occur during darkness on roads with no artificial light.
Indiana	toll roads	Truck accident rates are similar for day and night conditions and lower during rainy conditions.

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- *More truck accidents occurred on Friday (468 of the 2,221 truck accidents or 21.1 percent) than any other day for all types of trucks combined. tractor/semitrailers experienced a greater percentage of their accidents on Friday than any other day of the week.*

- *Straight trucks with trailers experienced 32.7 percent (55 of 168 accidents) if their accidents during wet road conditions. This exceeds the wet road surface accident experienced by any other truck-trailer* combination.

- *There were 212 single-vehicle truck accidents. Tractor/semitrailers experienced 74.1 percent (1,190 of 1,605 accidents) of their accidents occur as two-vehicle accidents.*

- *Tractor/semitrailers were involved in 68.9 percent of the 103 accidents with 4 or more vehicles. These accidents involved a total of 326 vehicles with one accident involving 16 vehicles. Straight trucks without trailers accounted for 17.5 percent of all the 4 or more vehicle accidents involving a total of 81 vehicles, the largest accident of which included seven vehicles.*

- *Cargo spillage occurred in 114 of the 2,221 accidents (5.1 percent). Tractor/semitrailers had the greatest incidence (66.7 percent or 76 of 114 accidents) of cargo spillage accidents. Tractor.semitrailers were the greatest contributors to incidents of fuel leakage and vehicle fire, although, both of these occurrences were relatively rare.*

- *Tractor/semitrailers and doubles had 52.5 percent (843 of 1,605 accidents) of their accidents occur as sideswipes. The largest percentage of straight-truck accidents occurred as rear-end accidents (43.0 percent of 211 of 491 accidents).*

- *For the 205 accidents, which occurred in a right-hand merge area, the truck was on the freeway, rather than the ramp, in 90.7 percent of the 205 accidents. Similarly, for those accidents which occurred in a right-hand exit area of the freeway the truck was on the freeway in 73.0 percent or 89 of the 122 accidents. This indicates that the truck was not the vehicle performing the merge maneuver when the merge accident occurred.*

- *Doubles had the highest fatality rate with an average of 21.7 fatalities per 1,000 accidents. Injury rate by straight trucks with trailers exhibited an average injury rate of 494.0 injuries per 1,000 accidents.*

- *Eleven persons were killed in the 2,221 accidents involving at least one truck. This results in an average of 5 persons killed for every 1,000 accidents involving at least one truck. For the 17,962 accidents involving other vehicles 39 persons were killed for an average of 2.2 persons per every 1,000 accidents. Similarly, the 2,221 accidents involving at least one truck injured 866 persons; while the 17,962 accidents involving other vehicles resulted in a total of 9,643 persons being injured. The resultant rates are 389.9 persons injured per 1,000 accidents involving at least one truck and 536.9 persons per 1,000 accidents involving passenger vehicles.*

- *An estimate of the total annual cost of urban freeway accidents was determined to be $634,000 per freeway mile. This cost consisted of accident costs of $182,000, delay costs of $440,000, clean-up costs of $3,000, and operating costs of $9,000 per freeway mile. Expanding this estimate to the 1,937 Interstate and 560 freeway miles with average daily traffic volumes of over 100,000 vehicles results in a nationwide annual cost of 1.6 billion dollars.*

In 1990, the first report in assessment of incident management strategies was prepared and published by the Washington State Department of Transportation (15). Table 5 indicates various incident mitigation strategies and utilization by eight (8) major metropolitan areas nationwide. The advantages and disadvantages of each strategy are discussed in the report.

In 1990, the Massachusetts State Police adopted the Incident Command System (ICS) as part of its overall incident management system (16). The ICS is a documented system that has been successfully used in managing available resources in times of emergency incidents; including simple motor carrier accidents which develop into major incidents requiring drastic emergency response measures.

The ICS is a classic military command and control model. The system provides planning functions in advance of incidents, command and control mechanisms for personnel,facilities, equipment, and communications to insure operational effectiveness and coordination, and on-going training.

Of specific importance, the ICS emphasizes the importance of incident scene evaluation. This is stated as follows:

The initial responsibility of the law enforcement responder is the evaluation (size up) of the incident, and the prompt and accurate relay of information from the scene to the central command and control center. This evaluation must be thorough, and establish priorities for the incident. The type of information communicated from the scene should include the ***Situation Analysis - Present Status,*** *including:*

* The exact location of the incident.
* The severity of damage.
* Existing threats such as fire, explosion, chemical spills, downed electrical wires, structures in danger of collapse, etc.
* The number, types, and severity of injuries.
* The necessity for **evacuation** or the restriction of vehicular or pedestrian traffic.
* The number and locations of trapped victims.
* The nature and number of resources required.

Table 5. Incident Mitigation Strategies and System Utilization

Administrative Options	Chicago	Houston	Detroit	Los Angeles	Seattle	Toronto	Minneapolis	Cincinnati
Vehicle Removal	X	X	X	X	O	X	X	O
Dedicated Patrol	X	X	X	X	X	X	X	X
Emergency Lights/Screens	X	O	O	X	X	O	O	O
Accident Investigation Sites	O	O	O	O	O	O	O	O
Equipment Storage Site	O	O	O	O	O	O	O	O
Removal Crane	X	X	O	O	O	O	O	O
Patrol Car Push Bumpers	X	X	X	X	X	X	X	X
Organizational Options	**Chicago**	**Houston**	**Detroit**	**Los Angeles**	**Seattle**	**Toronto**	**Minneapolis**	**Cincinnati**
Interagency Agreements	X	X	X	X	O	O	O	O
Traffic Management Teams	X	X	O	X	X	O	O	O
Incident Phone Number	O	O	O	O	X	X	X	X
Variable Message Signs	X	X	X	X	X	X	X	X
Media Ties	X	X	X	X	X	O	O	O
Transit Radio	O	O	X	X	O	O	O	O
Incident Response Teams	X	X	O	X				
Preplanning for Incidents	**Chicago**	**Houston**	**Detroit**	**Los Angeles**	**Seattle**	**Toronto**	**Minneapolis**	**Cincinnati**
Alternate routes	X	X	X	X	X	O	O	O
Emergency Vehicle Access	X	X	X	X	X	X	X	X
SURVEILLANCE/CONTROL*								
	Chicago	**Houston**	**Detroit**	**Los Angeles**	**Seattle**	**Toronto**	**Minneapolis**	**Cincinnati**
Police Patrol	X	X	X	X	X	X	X	X
Motorcycle Patrol	O	O	O	O	X	O	O	O
Tow Truck Patrol	X	X	X	X	X	O	X	X
Aircraft	X	X	X	X	X	O	X	X
CB Monitoring	X	X	X	X	X	O	X	X
Cellular Phone	X	X	X	X	X	O	X	O
Call Boxes	O	X	X	X	X	O	X	O
Highway Advisory Radio	X	X	X	X	X	X	X	X
Volunteer Watch	O	O	O	O	O	O	O	O
Loop Detection	X	X	X	X	X	X	X	X
Video and CCTV	X	X	X	X	X	X	X	X

*(X--In Use, O--Not in Use)

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Table 12. Options for Reducing Detection and Verification Time

Type of Program	Potential Benefits	Potential Costs	Comments
Peak Period Motorcycle Patrols	▪▪▪▪	$$▸$$$	Roving motorcycle patrols can provide added surveillance along high incident segments of freeway.
Dedicated Freeway/Service Patrols	▪▪▸▪▪▪▪	$$▸$$$$	Roving patrols along high incident segments of the freeway can service to reduce incident detection times.
Motorist Aid Call Boxes/Telephones	▪▪	$$$	May incur added costs or complications because of required utility work.
Incident Phone Lines	▪	$$	Requires an initial publicity effort and continued cooperation with media agencies.
Cellular Telephones	▪▪▪▪	$	Information should be distributed to cellular phone users describing proper incident reporting techniques.
Citizen Band (CB) Radio Monitoring	▪▪	$	Information should be distributed to CB radio operators describing proper incident reporting techniques.
Volunteer Watch	▪	$	Training efforts may be wasted on short-term or non-dedicated volunteers.
Ties with Transit/Taxi Companies	▪▪▪	$	Can be expensive to cover all routes or limited to only those who travel on the freeway or other high incident areas.
Aircraft Patrol	▪▸▪▪▪▪	$▸$$$	May be limited by noise or density restrictions.
Electronic Loop Detection	▪▪	$$$	Can also serve other operations functions, but may give false calls in incident detection.
Video and Closed Circuit TV	▪▪▪▪	$$$	Can also serve many other operations functions such as volume, speed, and vehicle classification data collection.
Central Information Processing and Control Site	▪▪▪	$$$	Centralization of information allows for better verification of incidents.

▪ = Minor benefits
▪▪ = Moderate benefits
▪▪▪ = Substantial benefits
▪▪▪▪ = Very substantial benefits
▸ = Indicates a range of benefit/cost level

$ = Minor costs
$$ = Moderate costs
$$$ = Substantial costs
$$$$ = Very substantial costs

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Table 13. Options for Improving Response Time

Type of Program	Potential Benefits	Potential Costs	Comments
Personnel Resource List	☛☛☛	$	Can save time in locating specially trained personnel if list is comprehensive (involving all responding agencies) and frequently updated.
Equipment and Materials Resource List	☛☛☛	$	Can save time in locating special equipment or personnel if list is comprehensive (involving all responding agencies) and frequently updated.
Peak Period Motorcycle Patrols	☛☛☛☛	$$▸$$$	Motorcycle patrols can provide a direct communications link to request additional response assistance.
Dedicated Freeway/Service Patrols	☛☛▸☛☛☛☛	$$▸$$$$	Roving patrols can reduce the response times required by response vehicles departing from the freeway.
Personnel Training Program	☛☛☛	$$	An emphasis on personnel training through knowledge and repetition of tasks can reduce required response times.
Tow Truck/Removal Crane Contracts	☛☛	$	Provides faster access to equipment, but may create dissention with other capable private agencies.
Improved Interagency Radio Communication	☛☛☛	$▸$$	Adequate communication between the various responding agencies, can help to insure that the closest response vehicle is called to the incident scene.
Ordinances Governing Travel on Shoulder	☛	$	Can provide additional travel lane for response vehicles during emergencies but may be severely limited by space constrains.
Emergency Vehicle Access	☛☛	$$	Requires identification of those freeway links which suffer from poor access.
Alternative Route Planning	☛☛	$	If properly planned can allow quicker access to incident site by response vehicles.
Equipment Storage Sites	☛☛	$▸$$	Provides faster access to equipment or materials.
Administrative Traffic Management Teams	☛	$	Provides a forum to discuss and provide funding for area incident management programs aimed at improving response times.
Public Education Program	☛☛☛	$	Can educate drivers regarding disabled vehicle removal policies and can resolve many incidents without the need for an actual response.
Central Information Processing and Control Site	☛☛☛	$$$	Provides a single location for monitoring incidents, so that data from multiple sources can be used to more quickly determine the appropriate response action.
Closely Spaced Milepost Markers	☛☛	$	Always fast, accurate, easy location, of incidents, which improves the speed with which response actions can be brought to bear.

☛ = Minor benefits
☛☛ = Moderate benefits
☛☛☛ = Substantial benefits
☛☛☛☛ = Very substantial benefits
▸ = Indicates a range of benefit/cost level

$ = Minor costs
$$ = Moderate costs
$$$ = Substantial costs
$$$$ = Very substantial costs

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Table 14. Options for Improving Site Management

Type of Program	Potential Benefits	Potential Costs	Comments
Incident Response Teams	☛☛▸☛☛☛	$▸$$$	Highly trained, coordinated response teams can greatly reduce site management delays and can reduce interagency conflicts.
Personnel Training Programs	☛☛☛	$$	Highly trained personnel can speed the management process as well as reduce the number of interagency conflicts that may arise.
Peak Period Motorcycle Patrols	☛☛☛☛	$$▸$$$	Motorcycle patrols have more maneuverability in highly congested areas and can access and carry out tasks vital to the incident management process (i.e. traffic control).
Improved Interagency Radio Communication	☛☛☛	$▸$$	Direct communication between the various responding agencies can reduce repetitious commands and improve interagency relationships.
Command Posts	☛☛	$	Allows information and instruction to disseminate from a single, central location, improving efficiency and reliability of information.
Identification Arm Bands	☛	$	Allows quick differentiation between respondents and public or media personnel who may also be present.
Properly Defined Traffic Control Techniques	☛☛☛	$	Provides greater safety for motoring public, as well as improving the safety of the respondents
Properly Defined Parking for Response Vehicles	☛☛	$	Ensures that excess lanes are not blocked by response vehicles and smooth operation of incident management processes are not impeded.
Flashing Lights Policy	☛	$	Need to consider safety of respondents, liability and impacts on normal traffic flow.
Administrative Traffic Management Teams	☛	$	Provides a forum to discuss and provide funding for area incident management programs aimed at improving site management efforts.
Central Information Processing and Control Site	☛☛☛	$$$	Central collection and analysis of incident information allows for more coordinated responses to incidents.
Alternative Route Planning	☛☛	$	Serves to improve both response and clearance efforts.
Incident Response Manual	☛☛☛	$	Predetermined chain of command and responses can facilitate decision-making, communications, and site management.

☛ = Minor benefits
☛☛ = Moderate benefits
☛☛☛ = Substantial benefits
☛☛☛☛ = Very substantial benefits
▸ = Indicates a range of benefit/cost level

$ = Minor costs
$$ = Moderate costs
$$$ = Substantial costs
$$$$ = Very substantial costs

(29)

Table 15. Options for Reducing Clearance Time

Type of Program	Potential Benefits	Potential Costs	Comments
Policy Requiring Fast Vehicle Removal	▬▬▬▬	$	Serves to quickly restore the capacity of the roadway, but may require passage of an ordinance to be used.
Accident Investigation Sites	▬▬	$$▸$$$	Serves to improve the safety of the motoring public, as well as improving the safety of the respondents, by removing the incident from the roadway.
Dedicated Freeway/Service Patrol	▬▬▸▬▬▬▬	$$▸$$$$	Specially equipped freeway/service patrol vehicles can clear most minor incidents without the assistance of other response vehicles.
Push Bumpers	▬▬	$	Allows minor incidents to be cleared quickly.
Inflatable Air Bag Systems	▬▬	$$	Improves clearance times for incidents usually involving overturned trucks; however, use is severely limited by the truck trailer type involved.
Responsive Traffic Control Systems	▬▬	$$$$	Can improve clearance efforts by limiting congestion in the immediate area.
Variable Lane Closure	▬▬	$	Can speed clearance efforts by allowing the interruption of flowing traffic but may require a change in existing policy.
Ordinances Governing Shoulder Travel	▬	$	Can provide additional travel lane for removing disabled vehicles but may be severely limited by space constraints.
Emergency Vehicle Access	▬▬	$$	Requires identification of those freeway links which suffer from poor access.
Alternative Route Planning	▬▬	$	If implemented simultaneously with motorist information programs, can serve to reduce congestion and improve mobility at the incident site by rerouting uninvolved vehicles.
Identification of Fire Hydrant Locations	▬▬	$	Can greatly speed clearance efforts by allowing the quick location of utilities in incidents involving fire.
Incidents Response Teams	▬▬▸▬▬▬▬	$▸$$$	Coordinated response teams should be trained in a variety of equipment use to provide greatest clearance capabilities.
Personnel Training Programs	▬▬▬	$$	An emphasis on personnel training through knowledge and repetition of tasks can reduce required clearance times.
Incident Response Manual	▬▬▬	$	Once developed, should be included in regular training procedures to further clearance efforts.
Hazardous Materials Manual	▬▬▬	$	Once developed, should be included in regular training procedures to further benefit clearance efforts.
Administrative Traffic Management Teams	▬	$	Provides a forum to discuss and provide funding for area incident management programs aimed at improving clearance times.
Public Education Program	▬▬▬	$	Can educate drivers regarding disabled vehicle removal policies and can result in the immediate clearance of disabled vehicles off the freeway.
Total Station Surveying Equipment	▬▬▬▬	$	Can reduce the time required for accident investigation by nearly half.

▬ = Minor benefits
▬▬ = Moderate benefits
▬▬▬ = Substantial benefits
▬▬▬▬ = Very substantial benefits
$ = Minor costs
$$ = Moderate costs
$$$ = Substantial costs
$$$$ = Very substantial costs
▸ = Indicates a range of benefit/cost level
(29)

Table 16. Options for Improving Motorist Information

Type of Program	Potential Benefits	Potential Costs	Comments
Improved Media Ties	☛☛	$	Information disseminated by the media must be effective and accurate and must therefore come from a single and central dissemination point.
Highway Advisory Radio	☛▸☛☛	$▸$$	Variations include mobile and truck mounted, but in each case must be kept current and accurate to be utilized by the motoring public.
Variable Message Signs	☛☛	$▸$$	Variations include flap, matrix, drum, permanent and portable, but in each case must be kept current and accurate to be utilized by the motoring public.
Radio Data Systems (RDS)	☛☛☛	$$$$	Provides information to motorists when they want it, but is still in the early implementation stage.
Externally Linked Route Guidance (ELRG) Systems	☛☛☛☛	$$$$	Provides the most comprehensive information concerning traffic situations, but is still in development stage.
Central Information Processing and Control Site	☛☛☛	$$$	A central location which can collect data from multiple sources will be able to provide a more accurate picture of existing traffic conditions.

☛ = Minor benefits
☛☛ = Moderate benefits
☛☛☛ = Substantial benefits
☛☛☛☛ = Very substantial benefits
▸ = Indicates a range of benefit/cost level

$ = Minor costs
$$ = Moderate costs
$$$ = Substantial costs
$$$$ = Very substantial costs

(29)

In 1992, a synthesis of practice report by the National Cooperative Highway Research Program on Freeway Corridor Management was published (31). Chapter 13 of this document addresses traffic management for incidents.

The Institute of Transportation Engineers dedicated a special journal issue solely to the topic on incident management (32). Included articles were as follows:

1) *The National Incident Management Coalition*
2) *The True Costs of Highway Congestion*
3) *Managing Traffic During Nonrecurring Congestion*
4) *Three Decades of Progress: Freeway Traffic Management in Illinois*
5) *Maryland's CHART Program: A New Model for Advanced Traffic Management Systems*
6) *Seattle Area Incident Management Program*
7) *Reflections on Traffic Management Experience in Minnesota*
8) *Personnel: The Critical Element in Successful Incident Management*
9) *Intelligent Vehicle-Highway Systems and Incident Management*
10) *Incident Management: The key to successful Traffic Management in Toronto*

Also in 1992, the Federal Highway Administration sponsored workshops focusing on relieving traffic congestion through incident management (33).

In a 1992 report by the Texas Transportation Institute for the Federal Highway Administration on Truck Accident Countermeasures on Urban Freeways (34), incident response management was specifically designated as of critical importance. This document emphasizes that the two primary issues involved in incident response for large trucks is providing a heavy-duty tow truck in a timely manner and clearing the roadway immediately of vehicles and/or spilled loads.

In late 1992, a draft guide of emergency response for highway maintenance managers was available from the Washington State Transportation Center (35). This document was prepared for implementation of Washington State Department of Transportation emergency management procedures. This guide describes how agency personnel should respond to and manage emergencies resulting from natural disasters and technological incidents that impact the transportation system and associated physical plants. The guide further describes the organizational roles and responsibilities of agency management in response to disasters and incidents.

State-of-Practice (Texas)

The vast majority of recorded incidents nationwide (80 percent) are the result of disabled vehicles. This includes cars and trucks that have run out of gas, had a flat tire, or been abandoned by their drivers. Nationwide, it has been found that 80 percent of all disabled vehicles end up on the shoulders of the roadway for an average of 15 to 30 minutes. During periods of high traffic, the presence of a disabled car on the shoulder can slow traffic in the adjacent travel lanes, causing 100 to 200 vehicle-hours of delay to other motorists. The other 20 percent of disabled vehicles can be found blocking one or more lanes of traffic for an average of 15 to 30 minutes. During peak periods, these disabled vehicles can cause between 500 and 2,000 vehicle hours of delay. More recent studies done by the Texas Transportation Institute have found a similar distribution of incidents on the

Houston freeways. Of all of the incidents responded to by the Houston Motorist Assistance Patrol (MAP), 75 percent involve vehicles on the shoulders of freeways while 19 percent are found on the mainlanes. The location of the other 6 percent could not be determined from analyzing the incident report forms.

Accidents account for only 10 percent of recorded incidents across the nation (5). In the city of Houston, 9 percent of the incidents responded to by MAP were the result of major or minor accidents. Approximately 40 percent of all accidents block one or occasionally two lanes of traffic. Each such incident typically lasts for 45 to 90 minutes and causes between 1,200 and 2,500 vehicle hours of delay (5). Accidents that include fatalities are especially time consuming.

The time saved by an incident management program (IMP) depends upon how well the four stages of an incident (detection, response, clearance, and recovery) are managed.

The four stages of an incident are sequential. First, a response will not be initiated until an incident is detected. Secondly, an agency cannot begin to clear an incident until it can respond. Finally, although all incidents are eventually cleared, clearance time may be unnecessarily extended if the appropriate agency does not respond in a timely manner.

Response is the activation, coordination, and management of the appropriate personnel and equipment necessary to clear an incident. Incident response time can be considered to be the sum of three time elements: (1) the time required to determine the appropriate emergency equipment and personnel needed to remove the incident, (2) the time needed to report these needs to the appropriate agencies, and (3) the travel time of the emergency vehicles and personnel to the incident site.

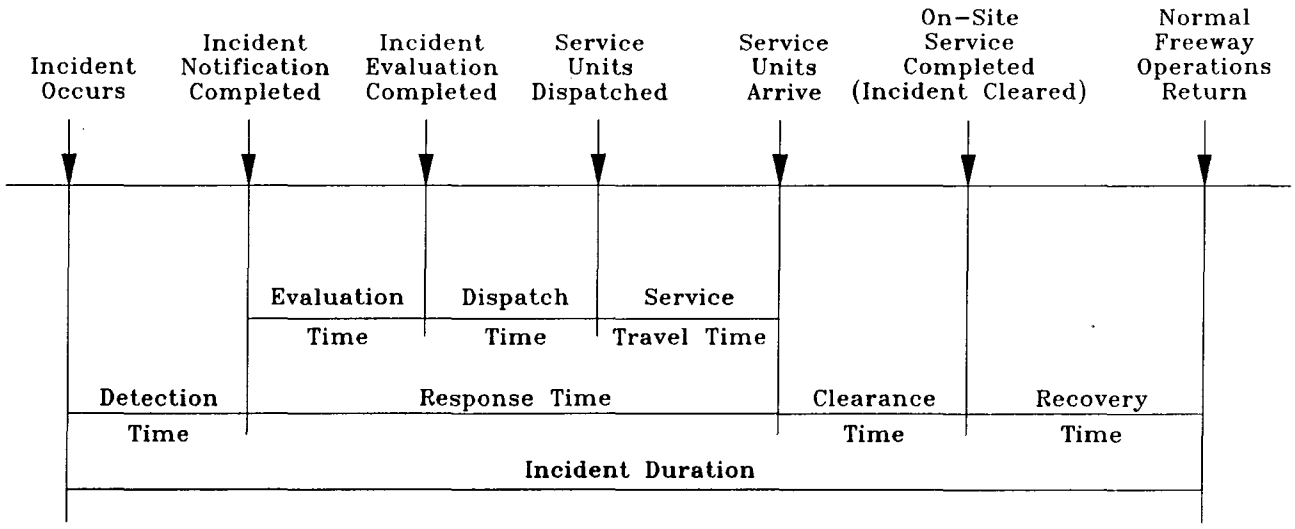
Clearance is the safe and timely removal of the incident in order to facilitate restoration of the roadway to its full capacity. Incident clearance time is affected by a number of factors including: the severity of the incident, the response provided, the

surrounding traffic conditions, and the coordination of response personnel and equipment at the incident site.

The contributions of the response and clearance stages of an incident to the total incident duration can be seen in Figure 9. Incident response and clearance procedures are implemented by agencies with the intent of reducing the incident duration. This can have a dramatic effect on the congestion (and also total delay) caused by incidents which occur during periods when traffic volumes are at or near capacity.

By introducing the proper procedures, an agency can also reduce the magnitude and severity of adverse impacts such as vehicle emissions and secondary accidents. In Texas, four procedures which TxDOT has worked most diligently towards are (1) freeway corridor surveillance and control systems, (2) traffic and incident management teams, (3) fast removal policies, and (4) motorist assistance patrols.

Figure 9
Components of Incident Duration



Freeway corridor surveillance and control systems focus on managing the traffic in the travel lanes surrounding or adjacent to an incident as well as on incident detection and verification. They are designed and operated to monitor traffic conditions, detect the occurrence of incidents, monitor and report on the status of traffic control hardware, provide information for traffic controls, and operate those controls. They are able to reduce response and clearance time by shortening the time it takes to verify that an incident has occurred and to initiate the appropriate response. They also have the potential to reduce the adverse impacts of an incident by providing the ability to discourage the use of the facility upstream of an incident or by directing motorists more efficiently through an incident site.

PEGASUS (PEople, Goods, and Services Urban System) is the acronym for the freeway corridor. There are many components of this type of system. Elements of the control phase of PEGASUS - ramp meters, changeable message signs (CMS), and lane control signals are most pertinent to the response and clearance stages of an incident and are used in conjunction with the surveillance systems to expedite incident response and clearance. Ramp meters can be used to restrict the influx of traffic upstream of an incident. The CMS's could be used to provide advanced notice of an incident and to inform motorists of an alternative route around the incident location. Lane control signals can be used to indicate which lanes are blocked by an incident. This allows motorists to move into an unimpeded lane upstream of an incident, reducing the potential for erratic maneuvers (i.e, hard braking, last minute lane changes, swerving, etc.) and increasing the efficiency of traffic flow past the incident site.

Coordination and cooperation among various state and local agencies are the keys to successful incident response and clearance. Both traffic management teams (TMT) and incident management teams (IMT) are excellent methods to facilitate communication between the various agencies involved in incident response and clearance. Table 17 indicates the multi-jurisdictions and agencies represented on major metropolitan traffic management teams in Texas.

Table 17. Agencies Represented on Teams in Texas

JURISDICTION	AGENCY	BEAUMONT	CORPUS CHRISTI	FORT WORTH	SAN ANTONIO	HOUSTON
STATE	Traffic	•	•	•	•	•
	Design			•		
	Maintenance		•	•		
	Highway Patrol	•	•			•
COUNTY	Engineer		•		•	•
	Sheriff				•	•
CITY	Traffic	•	•	•	•	•
	Police	•	•	•	•	•
	Fire	•				•
	Transit				•	•
OTHER	Naval Air Station		•			
	Traffic Safety Assoc.				•	
	Railroad				•	

The TMT and IMT bring together professionals from the various transportation related agencies in an area and help them to work together to solve the area's traffic and incident problems. They aid in the development of mutual respect among members, help members to view problems from another agency's point of view, and more importantly, they help to promote effective communication.

There are two variations of fast vehicle removal policies. In the first, emphasis is placed on educating the public on the need for them to remove their vehicles from the roadway as soon as possible after they are involved in an accident (22). The "MOVE IT" public awareness campaign initiated by TxDOT is an example of this type of fast removal policy.

The "MOVE IT" campaign, which originated in Dallas, is an effort by TxDOT to inform motorists of Article IV, Section 39 of the Texas Motor Vehicles Laws Uniform Act 1981-82. Simple observance of the law by motorists will lessen the impacts of many incidents on the freeway system. This will result in safer more efficient roadways for everyone.

In the second variation of fast vehicle removal policy, the public agency takes the initiative in removing disabled, abandoned, or damaged vehicles. The position of TxDOT was strengthened in this area when the Texas Legislature passed Senate Bill 312. This bill gives TxDOT the authority to remove cargo or personal property from the roadway without owner consent and without the threat of liability for damages or claims of damages, given that the removal or disposal was not carried out in a reckless or grossly negligent manner. This can be done anytime cargo or property is blocking the roadway or otherwise considered to endanger public safety.

Both of these developments, the "MOVE IT" campaign and Senate Bill 312, have helped TxDOT provide more effective and expedient incident response and clearance. By quickly removing spilled cargo and/or disabled vehicles from the roadway, incident duration is decreased and the possibility of secondary accidents is diminished. Senate Bill 312 has also decreased incident clearance time by providing a clearer understanding of TxDOT liability and authority for restoring roadways to normal operating conditions after an incident.

Motorist assistance patrols are particularly well suited for incident response and clearance. Their primary advantage is that they are active in nature, that is they directly affect the impact of an incident at the incident site. Eighty-six percent of the incidents responded to by the Houston motorist assistance patrol (MAP) were detected by the sheriff's deputies which man the vehicles. Not only do they identify incidents, they also stop and offer assistance, and provide directions to lost motorists. Motorist assistance patrols are able to reduce the time of all four stages of an incident and thereby have the potential to dramatically decrease total incident duration.

All four of the incident response and clearance procedures identified can provide positive benefits to the motoring public as well as to the transportation agency. Motorist assistance patrols, freeway corridor surveillance and control systems, TMT's and IMT's offer the most favorable atmospheres for TxDOT influence and oversight. Of the three, freeway corridor surveillance and control systems are by far the most expensive. Fast vehicle

removal policies require, and have gained, the support of the state legislature. To be effective though, they also require a concerted effort on behalf of the transportation agencies to educate both motorists and their own employees of the existing legislation. The incident response and clearance strategy pursued depends greatly upon the existing problem. For example, if stranded motorists cause an excessive amount of congestion on the roadway network, development of a motorist assistance patrol should be considered.

The remainder of this section of the technical memorandum details staff contacts by Texas Transportation Institute with city/state transportation agencies, emergency medical service agencies, fire departments, and hazardous material teams regarding major incidents on freeways and data record documentation of response actions.

Ft. Worth:

Mr. Howard Hill of TxDOT - District 2 was contacted by telephone and asked about information which he might have on major freeway incidents. He stated that the best source of information would be his Courtesy Patrol logs. He offered to allow TTI to use the information contained on the log sheets. A meeting was scheduled on December 3, 1992 to determine the usefulness of these logs. Upon meeting Mr. Hill and discussing the project with him in greater detail, he allowed TTI to look through a stack of Courtesy Patrol log sheets which represented a time period of three months. Information contained in these log sheets was not sufficient for our purposes. There were some useful details on the sheets such as services rendered, the amount of time needed to render the service, and notes pertaining to additional maintenance needs. However, the Courtesy Patrol does not remain at the scene of an incident for its duration. Mr. Hill stated that when the TxDOT Courtesy Patrol is the first unit to arrive at an incident, they set up whatever is necessary to make the accident site as safe as possible. If fire or police are already there, the Courtesy Patrol does not stop unless TxDOT needs to make repairs to the roadway.

Mr. Hill suggested contacting the Ft. Worth Police Department, specifically Captain Grady Judd. Mr. Hill stated that the police officers have work sheets for incidents they have

worked which should provide some of the needed information. On December 8, 1992 Captain Grady Judd of the Ft. Worth Police Department was contacted and asked whether any records are kept on major freeway incidents. He stated that no statistics are kept on freeway lane closures, but stated that he would check with the TRASER software people in the police department to determine if they had any information. He said he would call if he located this information. He did not call back.

On January 20, 1993 several persons at the Ft. Worth Fire Department were contacted. Ms. Dorothy Milton in the records section stated that a request must be initiate through Ms. Martha Chambers. She stated that perhaps Mr. Jim Marks of EMS would provide the best source of information. Alternates would be Naomi Cassidy or Greg Dawson of the Fire Department. Mr. Marks' assistant stated that they can retrieve information on incidents from their mainframe computer database, but it would be very time consuming. She went on to say that their EMS reports are not very detailed. They would provide information on the patient, the time EMS was notified, and the time they arrived at the scene, but it would not provide information on lane closures or cause of the incident or accident. She was informed that TTI had gotten useful information from other cities through their EMS/Fire Departments. She responded that for those cities the police departments might be located in the same building or in close proximity with EMS.

Later, Ms. Naomi Cassidy of Tarrant County EMS called to discuss their data availability. The data they have on file is for EMS calls on city streets only, with the exception of a few freeways. According to Ms. Cassidy, they do not keep records for an extended period of time unless a claim was filed against the city. To get this information, we must know an exact location. When asked if she knew what, if any, additional information the Fire Department might have, she stated that they would not have additional information. She was confident about that because EMS and the Fire Department are located within the same building. She mentioned one additional possibility; Mr. Bart Garner of the TxDOT Claims Department. Mr. Garner was ont contacted because of the limited amount of information within a claim. Captain Grady Judd was contacted again to follow-up on the previous conversation. The TRASER personnel at Ft. Worth do not have

the information we need for this study. When asked about his officers' work sheets, Capt. Judd stated that these are 8 ½ by 11 inch sheets which are completed by the officers for each shift and they are not computerized. They would contain the time an officer was dispatched to an incident; however, officers who initially respond might have been relieved by another officer before the incident was cleared. Captain Judd concluded by saying that their worksheets "would not be accurate in many cases." The other considerations with using their worksheets are that any evaluation using them would be extremely time consuming and they are only kept on file for a period of 60 to 90 days. Captain Judd also commented about hazardous materials personnel, and said that they are located within the Fire Department.

Corpus Christi:

The first contact in Corpus Christi was Mr. Ray Mims, TxDOT Division of Transportation Operations. He stated that incidents are usually reported by law enforcement officers, but information might be available from TxDOT Maintenance Supervisors. He suggested contacting two Maintenance Supervisors, Mr. Robert Bedolla and Mr. Jimmy Harrod.

Mr. Bedolla stated that no records are kept on how long a closure remains. He also stated that he does not think the district keeps records on closures related to incidents. However, he told me that most Maintenance Supervisors keep a diary. These diaries probably do not contain the detail that TTI might need unless the incident required a detour. When asked whether law enforcement would have information on incidents, Mr. Bedolla replied that they probably keep a dispatcher's log. To use that, the investigator would first need to determine the date of an incident from the Maintenance Supervisor's diary. Then, using the date, the log might provide sufficient information, although he was not sure. He remembered a burned bridge incident which occurred approximately 8 to 9 years ago. He mentioned another incident in which an overpass was hit by a large load approximately 8 months ago which forced TxDOT to close two of the total three lanes in one direction for 3 ½ hours. This was the most recent incident which has occurred within his jurisdiction. Mr. Bedolla stated that he could compile a list of personnel and equipment

that were required for the clean-up if that would be helpful to our study. Other than that, the district has responded to some minor spilled and one-lane closures.

Mr. Jimmy Harrod stated that he does not keep records, but he described the actions he takes when an incident or an accident occurs on a State roadway within his jurisdiction. He calls the district office and describes the problem once it is detected and tells office personnel the mile point and lane affected. Then he calls them back when the lane is open again. He stated that the District Maintenance Engineer, Mr. Dallas Comuzzi, might keep a record of these lane closures. He stated that incidents and accidents on his sections of freeway are sporadic -- there might be two in one month, then none for three or four months. One needed change which Mr. Harrod noted was a form for all incidents, not just those which damage TxDOT property. For example, no report is filed if there is no damage to TxDOT infrastructure.

Mr. Dallas Comuzzi was contacted by telephone to investigate what information they keep on incidents. He stated that his office did not maintain this information, but he suggested the Corpus Christi Police Department. However, contacts with and message left for Chief of Police Garrett were unsuccessful.

Mr. John Stringer was contacted within TxDOT's Safety Section. He was very helpful in providing two names and phone numbers at the City Police Department: Commander Bob Sullivan and Ms. Pat Eldridge.

Ms. Eldridge stated that only accident reports are available to provide requested information. Accident information would be available to TTI through Captain Smith, who is responsible for central records. However, the accident reports would probably not include all of the information we need. Ms. Eldridge emphasized that her department would not have the manpower to retrieve this information for TTI, because they are already understaffed. The suggestion was made of the maintenance supervisor who stated that their diaries would contain dates of major incidents. These dates might be used to request

detailed information from dispatcher logs. Ms Eldridge replied that this would still require a substantial amount of effort, and their staff simply could not do it.

The Corpus Christi Fire Department was contacted to ask for incident information. The call was transferred to an individual in data records. She stated that their information is stored by street address only, and that their records are **not computerized**. When asked whether they could provide information on a *segment of freeway*, she responded that they could not. When asked if she knew of any other agency which might have the type of records we need, she suggested the city police department, although she was not sure they would have it either.

El Paso:

Mr. Manny Aguilar was contacted at the TxDOT District Office, who stated that TxDOT does not keep the information that we need for this study, but he did provide a name and telephone number for the most likely source of the information. He gave the name of Mr. Jack Parks, Director, Office of Emergency Management. Upon calling directory assistance in El Paso and some trial-and-error calls for the best person to talk to, Mr. Ray Lopez was contacted at the El Paso Fire Department. In a follow-up conversation, he had discussed my request with their computer specialist. Mr. Lopez stated that the information would require an enormous amount of time to retrieve. He mentioned that one County emergency response vehicle alone made 50 runs (did not mention time period). It was suggested that TTI only needed information on major incidents. Mr. Lopez replied that Fire Chief Johns might approve the request if it does not require a large effort.

Mr. Carlos V. Chavez, Supervising Traffic Engineer, District 24, TxDOT was contacted and suggested contacting Lt. Cavazos of the El Paso Police Department. Lt. Cavazos referred Lt. Serna. Lt Serna referred Sgt. Gary Sinnell.

Sgt. Sinnell stated that the only information they would probably have would be an officer's memory of recent incidents. He mentioned a snow storm two weeks prior that

completely closed the interstate for two hours. He also mentioned a fatality two months prior to that time when an automobile rear-ended a dump truck and caused significant delays to motorists. He ended that conversation promising to contact the Traffic Division. He stated that he had discussed my request with Mr. Larry Tifton and that no ledger or records are kept of incidents on the freeway. Even their accident reports would not necessarily reflect incidents. The accident report might mention in the narrative description something regarding an incident which had caused the accident, but this would omit some incidents. He mentioned that there are incidents where two of a total of three lanes are closed, but the police are not called to the site. Even if some of their units respond, they do not keep detailed records of lane closures or other details which would be important to our study.

Amarillo:

Mr. Leon Wood of TxDOT was contacted in District 4. Mr. Wood indicated that their District did not keep track of the major freeway incidents. Furthermore, they have not discussed formal incident management efforts as yet within the Traffic Management Team they have established for the Amarillo area. He did not believe either the police department or the city traffic engineering section kept track of major incidents either, but suggested we contact Gene Clouette of the police department to verify this.

The Amarillo Fire Department was contacted to inquire about information they may collect and keep regarding major freeway incidents. Chief Ross was contacted in their training division, who referred the emergency management coordinator for their department, Mr. Walt Kelly. He indicated that they did not keep any type of records on incident

characteristics such as frequency, location, duration, etc. He said no one at the department would be able to assist TTI, and suggested that contact be made with the police department. Lt. Gene Clouette was contacted once more; however, messages were never returned.

Beaumont:

Ted East of the Beaumont District was first called regarding major freeway incidents. He stated that the Department did not currently keep track of them. He suggested contacting Jim Cline of the Beaumont Traffic Department or J.R. Smith of the Beaumont Police Department. Mr. East did say they were upgrading the HAR system they had and planned to collect incident data when it was activated. This system was scheduled to be operational sometime in early 1993.

Jim Cline stated that he had cooperated with the police department to establish an alternate route plan for dealing with incidents occurring during the reconstruction of the US-69/I-10 interchange. This plan is enacted whenever it appears that the incident will require more than two hours to clear and will severely disrupt traffic.

J.R. Smith stated that major incidents in Beaumont occur infrequently, and said they did not keep specific records of major incidents. He said they would have some data from the fatal accidents which occur (they are required to collect more detailed information at these accidents). J.R. agreed to go through the past couple of years worth of records and summarize what information he could send to us regarding time and location of each fatal accident on the freeway, how severe the effect was upon traffic, its duration, and what

response actions they employed. He agreed to do this the second week of December 1992. As this date, that information had not been received.

The Beaumont Fire Department was contacted, specifically Pat Shelton in their training division. He indicated that they maintained an active database which listed each response they made, and he could sort on this file to pull out those which occurred on freeways. He is going to do this for the previous two years, if possible. Their records will have some information on the location of each call, the time of day, type of incident, and its duration (the time they went back to the station). However, they will not have any information on the severity of the incident in terms of its effect on traffic.

A followup with J.R. Smith at the Beaumont Police Department was initiated about the accident summaries he had promised to send. He indicated that they should be in the mail soon. In addition to the summaries, he is sending a copy of the corresponding accident reports for those incidents.

Dallas:

Mr. Cliff Franklin, North Central Expressway Mobility Task Force Coordinator, was contacted in October 1992 regarding incident data for the Dallas area. Mr. Franklin indicated that records from the newly-established service patrol on the Expressway might some data that could be obtained. However, oftentimes the patrol does not get involved in the major incidents since police, fire and other agencies have responded. He suggested we contact Lt. Michael Levi with the Dallas Police Department. A subsequent contact with Lt. Levi revealed that although the Department had at one time kept some records for

major freeway incidents, they had recently been discarded. The Department currently does not maintain a file on major incidents.

Mr. Franklin was contacted again and asked to provide some of the MAP records for review and see how useful that data would be to the study. In addition, Ms. Carol Walters of the Arlington-TTI office was contacted to request a copy of a one-day study of freeway incidents in the Dallas area. However, upon receipt of the data, it was noted that the emphasis of that study was on mechanical breakdowns, and not accidents or other more significant incidents. Consequently, that data does not appear particularly useful to this study.

A copy of the December 1992 daily logs of the Dallas MAP vans operating on the North Central Expressway was received. Unfortunately, the logs indicate only the time on scene, the approximate location, the basic type of problem (mechanical, tire, accident, etc.), whether or not it blocked a lane (the number of lanes is not noted, however), and whether or not a tow truck was called. It is not possible to determine the types of vehicles involved (or the number involved) nor the duration of the incident. Consequently, this data does not appear to be very useful to the Study.

The Dallas Fire Department was also contacted, specifically Ms. Carolyn Garcia, the Public Information Officer. She stated they kept information relative to the Department's performance (total number of responses, average response time, etc.), but did not keep information on a response-by-response basis. For example, she could determine the number of major incidents responded to (involving two or more cars) nor could she subdivide according to roadway type. Likewise, she could pull out the number of responses to

hazardous material accidents and spills, but not by roadway type. In addition, no information is kept regarding incident duration, severity, time-of-day, etc. She indicated that no one else within the Department had this infromation either.

Austin:

Mr. David Gerard with the City of Austin was contacted as a starting point due to his cooperation with the local area Traffic Management Team. Mr. Gerard suggested that TTI contacted Enich "Bubba" Needham of Austin TxDOT for assistance.

Mr. Bubba Needham of the Austin area district (TxDOT) was contacted to investigate the State's involvement in incident response and records. Mr. Needham indicated that the State does not have any centralized data base on incident records. However, the maintenance department areas do have disposition logs on their respective response team allocations. He suggested contacting the Austin Police Department as they are the agency immediately responsible for incident management.

Lt. John Stewart of the Austin Police Department was contacted to investigate APD's role within incident response, management and records. Lt. Stewart stated that APD only has accidents listed by date and location. In addition, the duration for each incident is acquired through the dispatch logs which are only kept on file for 45 days and then erased. He also suggested that TTI contact the City of Austin Engineering Department as they are working on signal synchronization along I-35. Specifically, Lt. Stewart suggested that Sarveileh Monzafari and John Roscher be contacted at the City of Austin.

Captain Don Smith of the Austin Fire Department was contacted about AFD's involvement in incident response in the Austin area. Captain Smith was out of town and Lt. Calmon of the Communications Division was referred. Lt. Calmon stated that AFD only keeps individual (hard copy) records for 90 days. After that time they are transferred to their Statistical Analysis Department. Mr. Sid Frost was referred to TTI as the individual to contact in that department. Mr. Frost supplies federal and state agencies with statistical analysis reports of incidents for AFD. He indicated that his records are updated from 1989 to present and could possibly be transferred to computer disk. He would investigate the possibility of this transfer. He also suggested Mr. Carl Wren (AFD - Hazardous Materials) and Mr. Henry Fitzgerald (AFD - Emergency Medical Services) as individuals to contact for additional information.

Mr. Carl Wren, Fire Protection Engineer at the Fire Prevention Division of the Austin Fire Department, was contacted regarding information that they maintain on incident responses. He said that the Operations Division of AFD is responsible for reporting the response to incidents, and they use a standard form which is only maintained in hard copy form in chronological order. However, Mr. Wren indicated that his division has a computer log of their particular response calls that is maintained using the software dBase III+. Their records have such information as the location and date of the incident, the nature of the incident, injuries and deaths, as well as a 75-character description of the incident. Records date back to 1988 with 1991 being the first year with complete files. The data was requested in disk form for ease of use.

Mr. Carl Wren's office was contacted after the information was not received in a timely fashion. His assistant indicated that he would be out for two weeks but that he had

been working on the data request himself. A formal written request was then sent which included two diskettes for data storage. No response has been received to date.

Henry Fitzgerald and Mr. Bob Ritchey were contacted at Austin EMS regarding the records they maintain on incidents on major freeways in Austin. They maintain information on all calls dating back to 1985 in database format using dBase IV. The information includes the following specifics: type of call, where the call occurred, which trucks were sent to the site, what happened at the site, and how the call ended (i.e., injury to hospital, death). Since March 1988, EMS went to a computer-aided dispatch system which includes the exact times of dispatch.

The records are kept in a computer network as well as on cartridges that hold two months of data that can be switched into and out of the system. These cartridge files include the original text, and all of the information is easily accessible. Since the mainframe system clears records after 85 days, Mr. Fitzgerald designed a program that downloads the information from the mainframe to a personal computer so that the information is not lost. The system also interfaces with DPS in Austin in order to access and report to the Federal Fatal Accident Reporting Service. Austin EMS logs between 35,000 and 40,000 calls each year, a very large portion of which are traffic-related calls.

Mr. Fitzgerald was sent a request for data on major traffic accidents on the following major freeways and facilities in Austin: IH 35, US 290, MOPAC (Loop 1), SH 71, Loop 360, and US 183. He was sent several diskettes for data storage. Extensive contact was maintained with Mr. Fitzgerald and Mr. Ritchey during the data transfer process. The files were sorted according to the request, and a memo field was included in each record in order

to access the original dispatch records. The data (approximately 6,500 records) was then compressed using PK Zip, stored on diskette, and sent to TTI. Mr. Ritchey included with the diskettes instructions for decompressing the data, noting that the decompressed data takes up approximately 15 MB of storage.

Ms. Samileh Monzafari was contacted at the City of Austin, Signals Department in order to discuss Austin's plans for altering frontage road and arterial signal cycles in the event of major freeway incidents. She explained that approximately six months ago, the TMT started looking at incident management and the need to devise a plan for IH 35. To date, the project is in the proposal phase for obtaining IVHS funding for future activities. Once the funds are appropriated, they will be able to devote several employees to the project on a full-time basis. As of yet, they have no guidelines established for the plan. She did indicate that a probable designation of the severity of incidents based on lane closures would be as follows:

Level 1	1 lane closed
Level 2	2 lanes closed
Level 3	3 lanes closed.

No further information was obtained and no further contact has been made.

San Antonio:

Mr. Sam Pennartz of TxDOT District 15 maintenance was contacted to investigate the Courtesy Patrol (CAP) operation within the San Antonio area. Mr. Pennartz indicated that the CAP was established to assist motorists in only minor incidents and breakdown situations (similar to Houston's MAP operation). He also implied that his CAP logs and

TxDOT Response Team disposition forms could be accessed. However, they were not in a computer format and could only be sorted by incident (i.e., date and location known). He stated that each maintenance department areas had record of their Response Team involvement but again incident records had to be accessed by date and location. He suggested contacting the San Antonio Police Department (SAPD) for a more comprehensive data base of incident records.

Sergeant Flammia with the San Antonio Police Department was contacted regarding the project. He was briefed on the focus of the project, and he indicated that they keep a record of the number of accidents (expressway and local facilities) but do not maintain anything regarding hazardous materials. Bill Strout, a statistician at Research and Planning was then contacted who then suggested that Public Works with the City of San Antonio be contacted.

Mr. Victor Vasquez at City of San Antonio Department of Public Works was contacted. He said that the SAPD maintains accident records which are the accident reports filed by the police officers on the scene. The reports are logged into a computer and Public Works has access to them. However, because of the limited capability of the antiquated computer system, it is difficult to access the information. It was his opinion that SAPD had the best access to the files in question. For their personal files, Public Works obtains hard copies of accidents where fatalities are involved for reference regarding intersections. These records also have notations regarding accident type. However, these records are in hard copy form only. Victor suggested that either SAPD Traffic Analysis or SAPD Traffic Investigation be contacted. Willie James in Public Works suggested contacting SAPD Accident Records Bureau.

Ms. Maria Duran at the San Antonio Police Department Accident Records Bureau was contacted. She said that they are on the same system as the rest of the city and it would be next to impossible to access the records in question. The individual facilities would have to be identified, and she would have to pull all of the individual records and provide hard copies. She then suggested that EMS, under the jurisdiction of the SAFD, be contacted.

Captain Montez at EMS Administration with the San Antonio Fire Department also indicated that they were on the same system as the rest of the city. Like the SAPD, only hard copies of individual incidents could be obtained. He then suggested calling the Hazardous Materials Division of SAFD for more information.

Captain De Lorenzo at Hazardous Materials, SAFD was contacted. He was briefed on the project and he offered to pull their specific files for 1991 and 1992 since they did not have many incidents. The records have dispatch times, type of incident, equipment sent, procedures, etc. Once he finishes his previous projects, he will print out hard copies of the files and either mail or fax them to TTI.

Houston:

Mr. Carlton Allen and Mr. Pat Siek, who coordinate the Motorist Assistance Program (MAP) for District 12 TxDOT, were contacted regarding incident response procedures and records for the Houston area. They indicated that the MAP program's goal is to assist in the clearing of minor incidents and breakdowns within the Houston freeway network. MAP involvement on major freeway incidents is limited to detection of the incident and dispatch

communication to the Houston Police Department (HPD). Once HPD is on scene they (MAP) are to continue their patrol in order to assist in any minor secondary incidents that might occur. There are some infrequent cases where MAP deputies might assist HPD in their traffic control activities. MAP records are also kept for every assistance call that is made by the deputies. These records are kept by TxDOT and can be accessed by date and location.

Mr. Allen and Mr. Siek also stated that HPD would probably have the most comprehensive data base within the Houston area since they are the agency typically in charge on scene. They suggested contacting Lt. Eikenhorst of HPD for access to this data. In addition, HPD does call TxDOT's Response Team to the scene of an incident if:

1) there is freeway pavement or guardrail damage,
2) there is cargo spill (i.e., liquids that require sand for clean up, cargo that must be moved with heavy equipment, etc.),
3) assistance is needed to implement diversion strategies or evacuation (i.e., placement of arrow boards, portable changeable message signs, etc.).

TxDOT does keep a log of their Response Team involvement (disposition forms) which Mr. Allen does keep on file. However, these forms are listed by date and location and do not always include detection, response and clearance times. This information is possibly in the phone dispatch records for the district and/or with the equipment records within each maintenance department area. All these records could be cross-referenced as long as the date and location of the incident was known.

Mr. Allen also suggested that TTI contact the Houston Fire Department's Hazardous Materials group. HFD Hazardous Materials is called to the scene of any major incident

that involves a potentially hazardous cargo spill. In addition, unless TxDOT's MAP or Response Team is involved the district would have no record of the incident on file.

Lt. Eikenhorst of the Houston Police Department's solo division was contacted to investigate incident response records and procedures for his division. He stated that he had been keeping records of all freeway major incidents within the Houston area since 1986. He had initiated this record keeping in response to the city's request for additional officer requirements and current justification of his division. The division keeps all these records on file in a hard copy format. He stated that his assistant could copy these for use in this study.

Captain Danny Snell with the Hazardous Materials Response Team at the Houston Fire Department was contacted regarding records they maintain on responses to hazardous materials incidents on major freeways. He indicated that they maintain records of all of their calls on the Mackintosh computer system using the software Hypercard. He said that their records date back to 1980 (both hard copy and computer forms) and include such incident specifics as the type of incident, the type of materials involved, the location of the incident, the time of day, and the total response time. He was unsure if the information files could be converted to DOS format.

Captain Snell sent a copy of the Hazardous Materials Response Team's Annual Report for 1991 which gave a summary of all activity during that year. After reviewing the report, Captain Snell was contacted again in order to request hard copies of freeway incidents in 1991 (as mentioned in the Annual Report) and similar incidents in 1992. The

number of incidents was small enough to make the hard copy request reasonable. No response has been received to date.

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