6. DALLAS AREA-WIDE ITS STRATEGIC DEPLOYMENT PLAN

6. DALLAS AREA-WIDE ITS STRATEGIC DEPLOYMENT PLAN

Chapter 6 summarizes the recommended ITS Deployment Plan for the region. The chapter provides proposed staging of projects and estimated costs and benefits for the recommended ITS Deployment Plan.

6.1 Prioritization of Travel Corridors

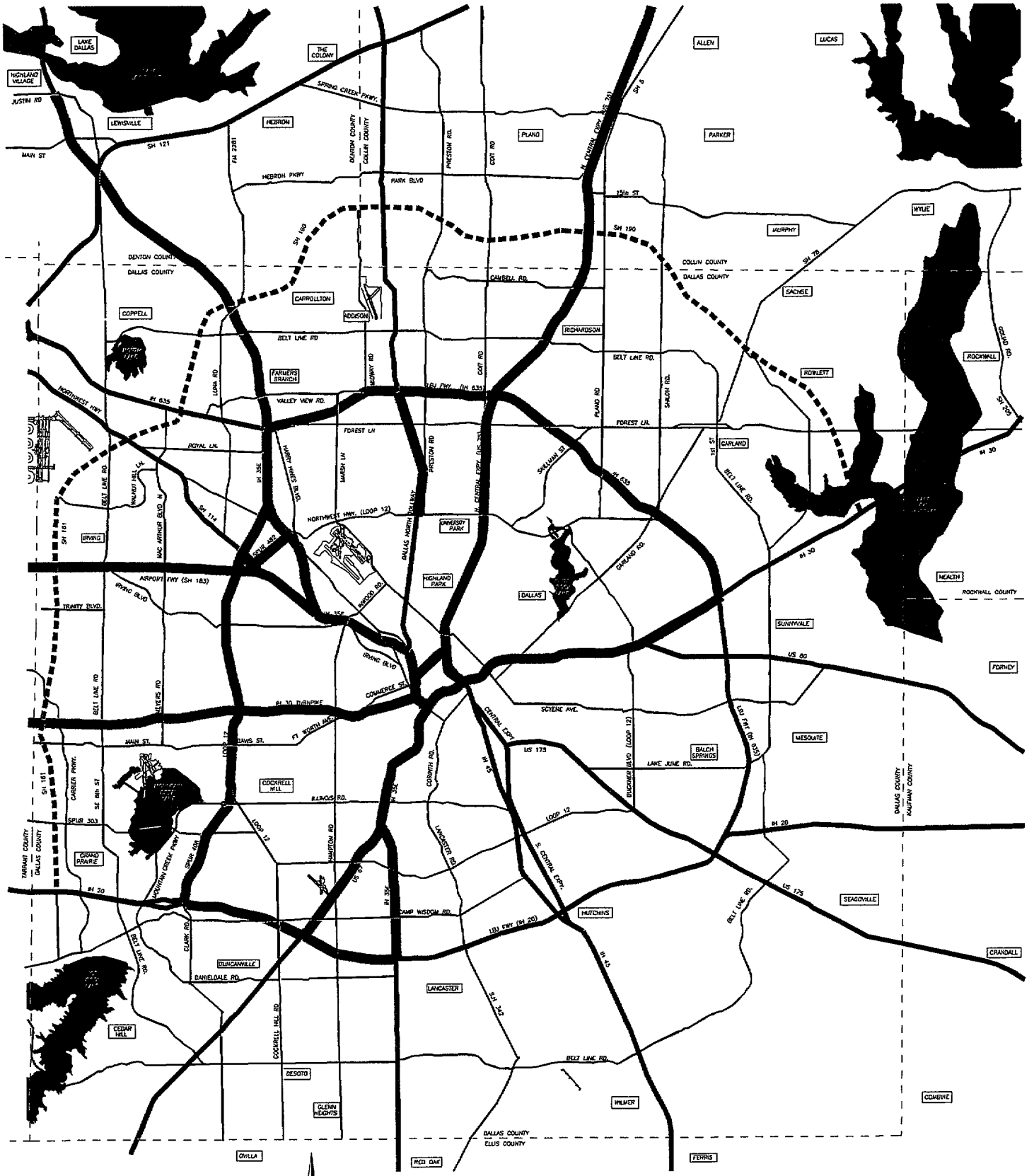
Early in the project, the Steering Committee agreed that freeways and freeway corridors would receive primary emphasis since the focus of the project is improved incident management. Regional arterials (as designated in North Central Texas Council of Governments' Mobility 2010 Plan Update) within those freeway corridors would also be included in the plan.

Given that the potential for incidents is generally proportional to congestion, freeways experiencing Level of Service (LOS) E or F in 1994 that are projected to continue experiencing LOS E or F in 2010 were considered "Strategic Corridors" and candidates for near-term implementation. Projects within Strategic Corridors are considered Priority 1 projects. The 1994 Peak Hour LOSS were determined from the 1994 ADT map published by TxDOT and existing lane configurations as well as from studies of area congestion locations. The 2010 Peak Hour LOSS were taken from the NCTCOG Mobility 2010 Updated Plan adopted in 1994 (1).

In addition to LOS considerations, a freeway facility may be considered strategic if it is of regional significance, such as one which provides a continuous corridor through the region. A freeway corridor may also be considered strategic if it provides a critical link between two strategic corridors either for continuity or to extend the communications backbone.

Strategic locations for early implementation are therefore identified by virtue of severe LOS deficiencies, safety considerations, critical links to strategic facilities and/or regional significance. In the deployment plan described subsequently, Priority 1 elements are recommended for implementation in the near-term, one to five years. Figure 6.1 depicts Strategic (Priority 1) Corridors.

Figure 6-1. Strategic Corridors



Other corridors are categorized as either Priority 2, 3, or 4, and are recommended for implementation in the medium-term, 6 to 10 years. The medium-term elements extend the near-term priorities toward developing the Dallas Area-Wide Intelligent Transportation System. Medium-term elements are categorized as either Priority 2, 3, or 4 according to their corresponding freeway's Peak Hour LOS for 1994 and 2010 as follows:

- Priority 1
  Freeways currently operating as LOS E-F and projected to continue operating at LOS E-F through the year 20 10.

- Priority 2
  Corridors where freeways are currently operating at LOS D with projected 20 10 LOS E-F; or

  Corridors where freeways are currently operating at LOS E-F with projected improved operations for the year 2010 of LOS D or better resulting from improved facilities or alternate facilities being in place.

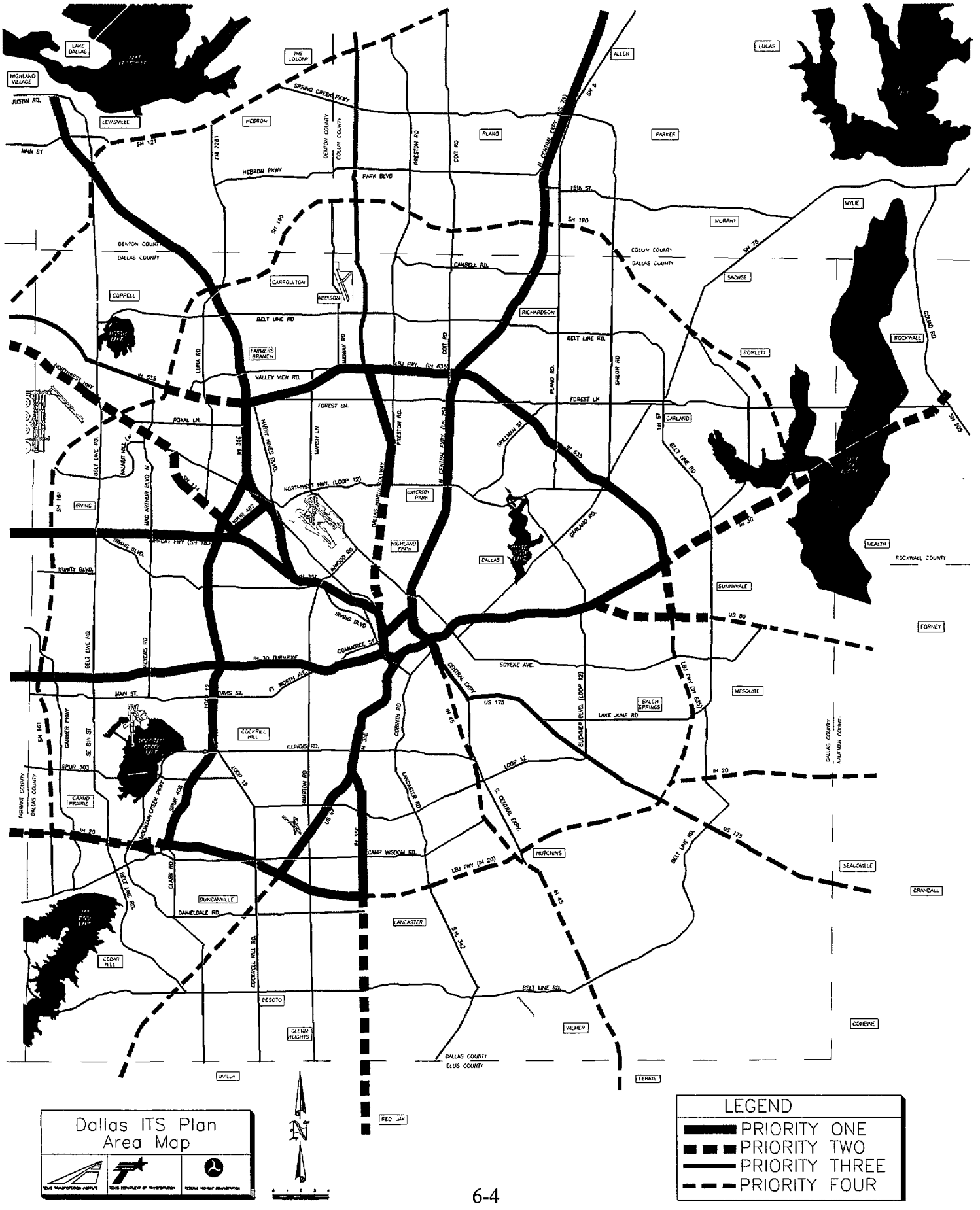
- Priority 3
  Corridors where freeways are currently operating at LOS A-C with projected 2010 operations degrading to LOS D or LOS E-F; or

  Corridors where freeways are currently operating at LOS D with projected improved 20 10 operations of LOS A-C resulting from improved facilities or alternate facilities being in place.

- Priority 4
  Corridors where freeways are currently operating at LOS A-C and projected to continue operating at LOS A-C through the year 2010.

Figure 6-2 illustrates freeway corridors by deployment implementation priorities. All near-term deployment elements are Priority 1 or strategic for implementation. Timing of implementation may also be influenced by other factors, such as funding availability, compatibility with regional projects, and the opportunity for incorporation into larger highway construction projects. The following sections decribe individual implementation elements.

Figure 6-2. Implementation Priorities



6.2 Deployment Plan

The deployment plan presented here emphasizes ITS elements that can be deployed without a total system deployment yet can enhance incident management, are effective in reducing congestion, and can be integrated into the ultimate implementation plan. It also recognizes and incorporates existing ITS elements that are currently in place or imminent, such as the TxDOT CMSs and the Transportation Management Satellite, as well as municipal computerized traffic signal control systems. TxDOT's Transportation Management Satellite will serve as the focal point for transportation information and management until such time as the Dallas Area Transportation Management Center (DATMC) is in place. Due to the absence of a permanent communications backbone for most of the freeway corridors, much of the initial data communication for system monitoring and information delivery will be via leased voice pairs or ISDN lines.

6.2.1 Functional Areas

ITS elements in the deployment plan discussion are classified into the following functional areas:

- System Management;
- Surveillance and Monitoring;
- Information Delivery;
- Control; and
- Data Communications.

6.2.2 Existing ITS-Related System

TxDOT has already implemented a solid base of ITS related systems that will be incorporated into the overall ITS plan. Table 6-l describes existing ITS related systems within the Dallas area by the functional areas described above. Construction on the Transportation Management Satellite has already begun. Many local cities already have in place or under construction advanced traffic control systems with central control and monitoring capability. Communication links between the systems and the Transportation Management Satellite will allow sharing of video and traffic data among the participating agencies.

Table 6-1. Existing ITS Capability

Functional Area	Elements		Description
Management and Operations	Centers	TxDOT	Transportation Satellite Center under construction
		Cities	City signal systems
		DART	DART operations center
	Mobility Assistance Patrols		Ten service vehicles
	Incident Management		No formal integrated plans
Surveillance and Monitoring	Vehicle Detectors	Freeways	Test sites on IH 30 and US 75 (video detection)
		Arterials	As part of City signal control systems
	CCTV	Freeways	Three cameras on US 75; One portable trailer
		Arterials	Cameras in Garland, Richardson, and Plano
	Wireless		Cellular to 911
	Vehicle Probes		DART buses
Information Delivery	Info to Home/Work		Dial-in to TxDOT (lane closures)
	Info to Drivers		CMS at various locations on US 75, IH 635, IH 35E, Sp 366, IH 30
	Info to Media		News releases, private traffic information services
	Info to Transit Users		Dial-in for schedules
Control	Signal Operations for Incidents		Manual overrides
	Ramp Metering		None
	Adaptive Signal Operations		None
	Lane Control Signals		Reversible lanes on Ross Ave and Live Oak St in east Dallas
Data Communications	Video	Freeways	Direct cable/leased lines
		Arterials	CATV in Richardson, Garland, and Plano
	Traffic	Freeways	None
		Arterials	Local communications network
	Control	Freeways	Cellular and leased lines
		Arterials	Local communications network
Interagency Communications (Cities, TxDOT, DART, Counties)	Communications		Telephone

6.2.3 Near Term Deployment (1 to 5 Years)

All near-term deployment elements are considered to be Priority 1 or top priority projects. Within Priority 1, projects are sub-divided as either Group A, Group B, or Group C, as shown below:

- Group A includes freeway management projects that have been completed or are under construction, and other complementary ITS elements on and off freeway;

- Group B includes freeway management projects that are under design and other complementary ITS elements on and off freeway; and

- Group C includes freeway management projects considered to be Priority 1 from a congestion level or regional significance aspect that are not funded at this time. Other complementary ITS elements on and off freeway are also specified.

Timing of implementation may also be influenced by factors such as funding availability, compatibility with regional projects, and the opportunity for incorporation into larger highway construction projects.

The Intelligent Transportation Infrastructure (formerly known as the Core Infrastructure) components of an Intelligent Transportation System as described by the FHWA are (2):

- Freeway Management Systems;
- Traveler Information Systems;
- Incident Management Programs;
- Traffic Signal Control Systems;
- Transit Management Systems;
- Electronic Toll Collection Systems;
- Electronic Fare Payment Systems;
- Emergency Response Providers Systems;* and
- Rail Road Crossings Systems.*

* Infrastructure components added in January 1996.

The Dallas Area-Wide ITS Plan near-term priorities will concentrate in four general areas, all of which support and form a basis for implementation of the core infrastructure features and their sub-elements:

- Improved incident freeway management procedures;
- Collection and assimilation of real time traffic and travel information;
- Processing and management of traffic and travel information; and
- Dissemination of traffic and travel information.

Table 6-2 shows an overview of the near-term implementation plan. Individual elements and their interactions are described in the following sections.

FUNCTIONAL AREAS	ELEMENTS		NEAR TERM DEPLOYMENT (1-5 YEARS) Priority 1		
			Group A	Group B	Group C
management and Operations	Centers		Transportation Management Satellite	Tie in strategies to Satellite	Tie in IH 635 (north) to Satellite Design Dallas Area TMC
	MAP		Emphasize Mobility	Expand coverage level →	→ →
	Incident Management		Total station units for accident investigation	Incident Management Training Traffic Safety Officer	Improved clearance procedures
	DART		DART representative in Satellite	Flexible routing	Electronic fare
Surveillance and Monitoring	Vehicle Detectors	Freeways	Detectors on US 75	Non-intrusive detectors at strategic locations	Detectors on LBJ
		Arterials	Detectors in City signal systems →	→ →	→ →
	CCTV	Freeways	CCTV on US 75	Compressed Video/ISDN on IH 35E, IH 30, US 67, SH 183	Portable CCTV CCTV on IH 635 (north)
		Arterials	Extend Existing Systems	CCTV at strategic locations (CATV or Compressed Video/ISDN)	
	Wireless		EMS radios Monitoring Cellular phones	Cellular *999	Cellular positioning
	Probes			DART probes	MAP vehicle probes
Information Delivery	Info to Home/Work		Commercial Radio Metro traffic	Dial-in Internet	CATV Kiosks
	Info to Drivers		CMS on US 75, IH 635, IH 35E, IH 30 (various locations)	CMS & HAR on IH 35E (north), SH 183	CMS & HAR on IH 35E (south), US 67 (south), IH 635 (north)
	Info to Media		Phone link Internet →	→ →	→ →
	Info to Transit Users			Dynamic schedule arrival times	Paratransit arrival notification
Control	Signal Operations for Incidents		Incident timing plans for US 75 (Tier 1)	Incident timing plans at strategic locations (Tier 1)	Incident timing plans on IH 635 (north) (Tier 1)
	Ramp Metering		Install ramp metering infrastructure (conduits and pullboxes) as part of freeway construction projects →	→ →	→
	Lane Control Signals		Arterials		Lane control signals on IH 635
Data Communications	Video	Freeways	Fiber and ISDN on US 75	ISDN at strategic locations	Fiber on IH 635
		Arterials	CATV	ISDN/CATV →	→ →
	Traffic	Freeways	Fiber on US 75	ISDN at strategic locations	Fiber on IH 635
		Arterials	Local communications network	Local communications network →	→ →
	Control	Freeways	Cellular/ISDN/Leased Voice Grade	→ →	→ →
		Arterials	Local communications network	Local communications network →	→ →
Interagency Communications (Cities, TxDOT, DART, Counties)	communication		Phone link Internet	Initial wide area network (TxDOT, Dallas, Plano, Richardson)	Expand wide area network

Table 6-2. Near-Term Deployment

6.2.3.1 Management

Management of traffic and transportation as referred to in this implementation plan includes a freeway management center, traffic information processing center, city traffic signal control systems, incident management program, and mobility assistance patrols.

6.2.3.1. I Management Centers

- Transportation Management Satellite

  Until implementation of a Dallas Area Transportation Management Center is completed, the Transportation Management Satellite will serve as the focal point for freeway management and information exchange activities. Currently under construction, it will be located on the North Central Park and Ride Site near the US 75 and IH 635 interchange. CCTV, CMSs, HAR and vehicle detectors deployed on US 75 will be operated and monitored from this location. As other critical freeway locations (IH 35E, SH 183, US 67) are implemented, they will also be tied into the Transportation Management Satellite, as will the IH 635 control and monitoring systems associated with HOV lanes after they become operational.

- City Traffic Signal Control Systems

  City traffic control systems will continue to operate autonomously. When incidents identified by the Transportation Management Satellite warrant implementation of incident timing plans, cities would be notified. Video and traffic data will be shared between control centers.

- DART Operations Center

  The DART Operations Center will continue to operate autonomously, but information affecting traffic operations will be exchanged.

- Regional Transportation Management Center

  At present, TxDOT's Dallas and Fort Worth Districts are proceeding with plans for a Transportation Management Center (TMC) in each District. These TMCs will be linked with high speed communications lines, which will allow rapid exchange of data and coordinated control and management strategies. Dallas and Fort Worth District staffs have had and will continue to have discussions regarding a future Bi-District Transportation Management Center. Such a regional TMC logically would be located somewhere along the Dallas and Tarrant County boundary and would be linked to the area TMCs in Dallas and Fort Worth.

6.2.3.1.2 Mobility Assistance Patrols

The nucleus of a strong Mobility Assistance Patrol (MAP) program is currently operating on the Dallas area freeways; as funding permits, the MAP program would also be expanded. The term Mobility Assistance Patrol is used to indicate an emphasis on restoring capacity (improving mobility) as opposed to a service patrol. Services would still be a part of the MAP's duties during off-peak hours, but the primary focus during peak hours would be on restoring capacity. In addition to clearing the freeway of minor incidents, the MAP would also take on expanded responsibilities during clearance of major incidents. At the request of the commanding officer at the scene, MAP personnel would set up traffic control, allowing traffic to move safely by the scene while securing the safety of those handling the incident and associated investigation. This will sometimes involve assuming responsibility for removal of vehicles and cargo under the authority granted to TxDOT by the Texas Legislature in 1991.

As part of its interagency work with the Dallas District of TxDOT, TTI will conduct a detailed evaluation of the MAP operations.

6.2.3.1.3 Incident Management Program

Recommendations for upgrading and improving incident management procedures were previously discussed in Chapter 2.

6.2.3.2 Surveillance and Monitoring

Surveillance of traffic and travel will be accomplished using several sources of information. No single source of information will provide sufficient traffic data and information for control and information delivery functions. Sources of information in the near-term will include Closed Circuit Television, vehicle detectors, probe vehicles (DART fleet and toll tags), and cellular telephone reports.

6.2.3.2.1 Vehicle Detectors

- Freeways

  A guiding philosophy for the plan development has been to minimize installation of vehicle detectors where cutting of existing pavements is required. It is recommended loop detectors be installed only in conjunction with other primary construction projects, and non-intrusive detectors (radar, acoustic, video) will be utilized to the extent possible at other freeway locations. Video imaging (machine vision) detectors will be installed on IH 635 north as part of the HOV system project, and loop detectors are being installed on US 75 during its reconstruction. In the near-term, non-intrusive

detectors would be installed at critical locations (freeways experiencing LOS E or F in both 1994 and 2010).

- Arterial

  Detectors will be present in individual city signal systems.

6.2.3.2.2 Closed Circuit Television

Closed circuit television will be implemented to a limited degree on both freeways and arterials. Video images will be available for sharing among agencies via a Wide Area Network.

- Freeways

  CCTV cameras are being installed on US 75 during its reconstruction and will be monitored from the Transportation Management Satellite. Cameras are also planned for IH 635 north. Strategic locations identified for early implementation (SH 183, IH 35E, IH 30, and US 67) would also be monitored via compressed video (CV) transmitted over leased ISDN lines.

- Arterials

  Richardson, Garland, and Plano have installed CCTV cameras as part of their cable television system. Other cities with funding committed for the installation of surveillance cameras include Carrollton, Dallas, Farmers Branch, Grand Prairie and Mesquite. Additional locations identified for early implementation where cable television systems are not available would be monitored via compressed video (CV) transmitted over leased ISDN lines.

6.2.3.2.3 Cellular Telephone Reports

Cellular telephone reports have become the dominant means of incident detection. In the near-term, 911 calls going to city emergency services will serve as an incident detection mechanism. However, 911 is experiencing overload, and it is recommended that a separate, free cellular line (*999) for reporting freeway incidents be provided. Establishing communication links, either telephone or radio, between the Transportation Management Satellite and city emergency services will be a high priority as the near-term hardware and management systems are implemented in the Transportation Management Satellite.

6.2.3.2.4 Vehicle Probes

Vehicle probes are another source of traffic stream evaluation and monitoring. Although some commercial products are currently deployed or under development, the primary source of such information in the near future is the

DART fleet and toll tag equipped vehicles. Equipping the MAP vehicles or other public agency vehicles with GPS antennae and transmitters would add to the information sources. Should a vehicle tracking vendor offer a proven product at a reasonable price, it could also be incorporated into the surveillance subsystem. As cellular positioning matures and becomes proven, it is recommended it also be incorporated into the Transportation Management Satellite.

6.2.3.3 Information Delivery

Information delivery to travelers will take place at several sites and by various modes. Both the private sector and the public sector will be involved in information delivery. The following discussion of information delivery is categorized by where the information is delivered.

6.2.3.3.1 Information to Homes or Work Sites

Traveler information obtained by the various surveillance systems will be made available through commercial radio and television, commercial kiosks or computer terminals at employment and recreational centers, and commercial traffic information providers, such as Metro Traffic and Shadow Traffic. With the proliferation of the Internet, a homepage providing real-time traveler information also provides a cost effective information delivery medium. As the information base is expanded, homepages specific to individual corridors may be developed. Dial-in information may also be provided to callers through recorded messages.

- En-Route Information to Motorists

  Changeable message signs are presently provided at various freeway locations throughout the Dallas area. Additional CMS sites and Highway Advisory Radio (HAR) are planned for IH 35E (north) and IH 635 in connection with the HOV lane construction. Additional sites identified as critical from a congestion, safety, or operational aspect are recommended to be implemented. These include IH 35E (south) and US 67.

6.2.3.3.2 Information to Media

Initially, information to radio and television or other media will be via phone links or dial-in systems. Internet homepages, updated on a near real time basis will also be accessible to media as well as to the general public.

6.2.3.3.3 Information to Transit Users

The DART Transit Operations Center will be linked to the Transportation Management Satellite, and work space is provided in the Transportation Management Satellite for DART personnel. All information coming into the Transportation Management Satellite will be available for distribution to DART patrons.

6.2.3.4 Control

In the near-term, most control functions will continue to be locally based with traffic data and information sharing among agencies providing for more efficient operations.

6.2.3.4.1 Signal Operation for Incidents

During the course of the plan development, the Steering Committee adopted a procedure for signal operation during major incidents. The approach calls for jointly (TxDOT and cities) developed incident timing plans (ITP) to be implemented by individual cities affected upon notification of an incident by the Dallas Area Transportation Management Center. In the near-term, the Transportation Management Satellite will notify those cities (Tier 1) with central signal control capability. Initially, only those cities adjacent to US 75 would be affected. As surveillance information sources are expanded to other freeways, the program would be expanded to additional cities with borders adjacent to freeways being monitored.

6.2.3.4.2 Lane Control Signals

- Freeway Locations

  Lane control signals (LCS) for the purpose of incident management are currently being utilized and evaluated in the Fort Worth District. As the Transportation Management Satellite becomes fully functional, consideration should be given to adding LCS at critical locations. In addition to non-recurrent congestion, LCS can also be used to mitigate recurrent congestion. Recurrent congestion locations where freeway LCS may be beneficial include entrance ramps with heavy volumes, freeway merges, and freeway-to-freeway direct ramps.

- Arterial Locations

  It is recommended that cities explore opportunities to increase capacity and mitigate congestion through the use of LCS on regional arterials experiencing unbalanced peak hour traffic flows.

  It is also recommended that dynamic lane assignment signs be used to maximize approach capacities at intersections experiencing changing traffic patterns throughout the day. Cities should explore opportunities to use dynamic lane assignment signs at intersection approaches with changing traffic patterns throughout the day. Prime candidates for dynamic lane assignment installations include intersection approaches on freeway service roads and freeway diversion routes. Other intersection approaches locations

that should be considered are those located near major traffic generators, such as Fair Park, Reunion Arena, and high density employment areas.

6.2.3.5 Data Communications

It is recommended that transmittal of detector data and video, as well as control commands, continue on the local communications network (LCN) within cities and on available fiber optic cable or leased lines for freeway functions. Except in special circumstances such as critical links, it is recommended fiber optic cable be installed primarily as part of other freeway reconstruction projects due to the high cost of conduit installation on existing facilities.

6.2.3.5.1 Video Images

- Freeway Locations

  Transmission of video on US 75 initially will be leased via ISDN lines and will convert to fiber optic cable as the fiber backbone is installed as part of the US 75 reconstruction. Locations identified as critical will be interconnected via ISDN lines. IH 635 locations will be interconnected to the Transportation Management Satellite via fiber optic cable installed as part of the HOV lane construction.

- Arterial Locations

  Video within cities will be transmitted primarily on local CATV channels where cable franchises allow; where franchises do not allow, locations identified as critical will be served by ISDN lines with compressed video formats.

6.2.3.5.2 Traffic Data

- Freeway Locations

  Transmission of data on US 75 will initially be via leased ISDN lines and will convert to fiber optic cable as the fiber backbone is installed as part of the US 75 reconstruction. It is recommended that locations identified as critical for near-term deployment be interconnected via ISDN lines if fiber is not available. IH 635 locations will be interconnected to the Transportation Management Satellite via fiber optic cable installed as part of the HOV lane construction.

- Arterial Locations

  Transmission of data within cities will be via local communication networks associated with local traffic control systems.

6.2.3.6 Interagency Communications

The essential tenet of the distributed concept for the Dallas Area-Wide ITS Plan is the sharing of video and traffic data among the various agencies for the purpose of coordinated, integrated transportation management, particularly during incident conditions. Ultimately, a Wide Area Network (WAN) will provide for interagency communication. Initially, interagency communications will be by telephone and through an Internet Homepage. TxDOT, Dallas County, and the Cities of Dallas, Plano, and Richardson are entering into an agreement for design and testing of an experimental Wide Area Network. The system will most likely be Internet based, and other cities will be allowed to join the network as it is developed. Based on the experience with this test, the WAN will be expanded if proven successful, or else another approach will be developed.

Communication and shared management between TxDOT's Dallas and Fort Worth Districts will be essential. Two pilot projects on SH 183 with links between the two districts are currently underway. These projects are the first in the state where two TxDOT Districts will be interconnected for mutual ITS traffic management. One project will deploy surveillance and information delivery hardware, such as CCTV, detectors, CMSs, kiosks, and dial-in traveler information. The second project will involve sharing of traffic data and video between the Dallas and Fort Worth Districts for the purpose of coordinated information delivery. A fiber optic cable link is planned.

6.2.3.7 Summary of Near Term Deployment Priorities

All elements described as near-term (l-5 years) are considered Priority 1 for implementation. Within Priority 1, projects are subdivided as Group A, Group B, or Group C, not necessarily indicating schedule or timing.

6.2.3.7.1 Group A

Group A includes freeway management projects that have been completed or are under construction and other complementary ITS elements on and off freeway:

- Transportation Management Satellite (under construction at US 75 and Churchill Way);
- Transportation Management Satellite monitoring, control and user interface (under development);
- CCTV and detectors on US 75 (under construction);
- Changeable Message Signs (in place on various strategic freeway locations);
- City signal systems and CCTV capability monitoring;

- Cell phones for incident reporting;
- Internet homepage for traffic information; and
- Incident condition signal timing plans on US 75.

In addition, TxDOT's Mobility Assistance Patrols are currently operating in an expanded mode.

It is essential that implementation of the Transportation Management Satellite and the associated traffic monitoring systems proceed expeditiously so that a nucleus for other early action ITS related functions can go forward. Incident timing plans would be developed and implemented for those areas where surveillance is present on US 75. Information delivery and other elements would be initiated as information sources become available.

6.2.3.7.2 Group B

Croup B includes freeway management projects that are under design and other complementary ITS elements on and off freeway:

- Expand freeway monitoring and information delivery to other strategic corridors;
- Implement initial wide-area communications network (TxDOT, Dallas, Plano, Richardson, Dallas County);
- Initiate incident management training;
- Assign Traffic Safety Officer;
- Initiate cellular incident reporting systems;
- Expand city signal systems and CCTV capability monitoring;
- Expand use of DART vehicle tracking system (probes); and
- Implement flexible routing for DART buses.

In addition to the Mobility Assistance Patrols and improved on-site incident management, the primary service to travelers is delivery of information either for pre-trip planning or en-route decision making. In order to provide information to the traveler, there must be a reliable source of information and a means to convey it. Until the DATMC is implemented and a backbone communications system is available, data from information sources such as vehicle detectors or CCTV cameras would be transmitted to the Transportation Management Satellite over

leased lines (video from the CCTV cameras would be transmitted using a compressed format). While continuous coverage in these potential corridors is not feasible at this time, selective placement of CCTV cameras, including on top of private or public buildings, would give a wider field of view.

In addition to critical designated freeway locations, other freeway locations would be considered for CCTV camera and CMS deployment prior to full regional capability at freeway-to-freeway interchanges and at freeway-to-regional arterial interchanges. Figure 6-3 illustrates the deployment of CCTV cameras according to this criteria.

Incident timing plans for cities with central signal control capability would be developed and implemented for those areas where surveillance is present; information delivery and other elements, as shown previously in Table 6-2, would be deployed as information sources become available.

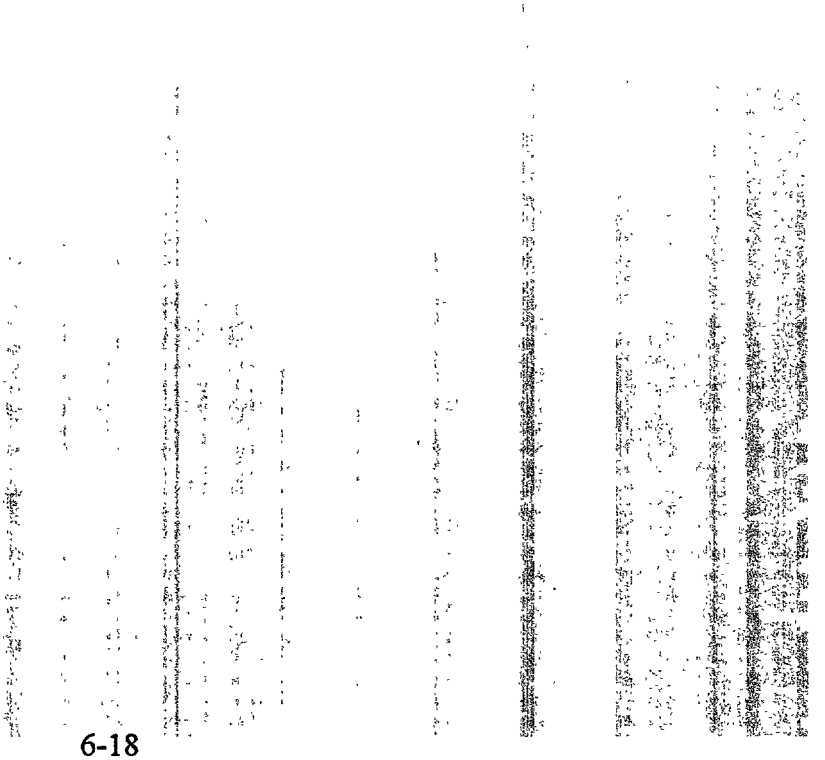
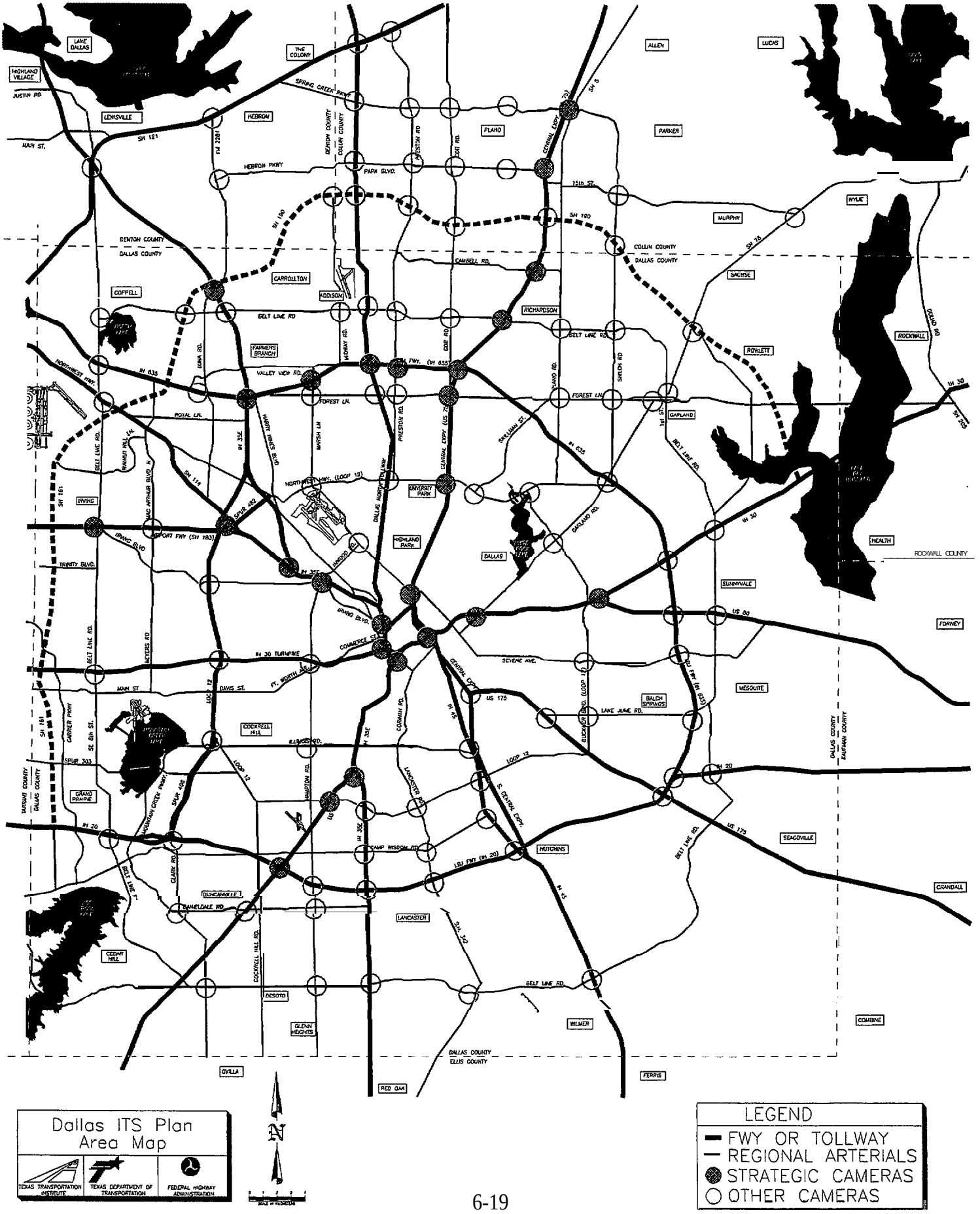


Figure 6-3. Preliminary Camera Locations



6.2.3.7.3 Group C

Croup C includes freeway management projects considered to be Priority 1 from a congestion level or regional significance aspect which are not funded at this time. Other complementary ITS elements on and off freeway are also specified:

- Expand freeway monitoring and information delivery to other strategic corridors;
- Expand wide-area communications network;
- Implement improved incident clearance procedures;
- Distribute information to travelers via CATV and kiosks; and

  Collect electronic fares on DART.

6.2.4 Medium-Term Implementation Plan (6-l 0 years)

The Dallas Area-Wide ITS Plan's medium-term elements will extend the near-term priorities toward developing an area-wide Intelligent Transportation System for the Dallas area. The most significant medium-term addition to the ITS is the Dallas Area Transportation Management Center (DATMC). Table 6-3 lists an overview of the medium-term implementation plan. Medium-term elements are categorized as either Priority 2, 3, or 4, as previously described and illustrated in Section 6.1 and Figure 6-2 respectively. Individual implementation elements are described in the following sections.

Table 6-3. Medium-Term Deployment

FUNCTIONAL AREAS	ELEMENTS		MEDIUM TERM DEPLOYMENT (6-10 YEARS) (Priority 1 elements are shown in Table 6.2 - NEAR TERM DEPLOYMENT)		
			Priority 2	Priority 3	Priority 4
Management and Operations	Centers		Implement DATMC		
	Incident Management		Add special equipment	Implement shared HAZMAT	
	DART		DART Representatives in DATMC		
Surveillance and Monitoring	Vehicle Detectors	Freeways	Extend vehicle detection →	→	→
		Arterials	Tie in City system detectors →	→	→
	CCTV		Extend CCTV →	→	→
	Wireless		Extend cellular positioning capability	→	→
	Probes		Public vehicle probes	AVI/AVL	Commercial vehicle probes
Information Delivery	Info to Home/Work		Extend kiosks →	→	→
	Info to Drivers		Extend CMS and HAR →	→	→
	Info to Media		Direct video, graphics, and text link	→	→
Control	Signal Operations for Incidents		Extend incident timing plans (Tier 1) & frontage roads (Tier 1&2)		→
	Ramp Metering		Develop ramp metering plan	Ramp meters at critical locations	Expand Metering
	Adaptive Traffic Signals		Incorporate as proven →	→	→
	Lane Control Signals		LCS at critical locations →	→	→
Data Communications	Video	Freeways	Expand fiber/ISDN →	→	→
		Arterials	Expand CATV/ fiber/ISDN →	→	→
	Traffic	Freeways	Expand fiber/ISDN →	→	→
		Arterials	Local communications network →	→	→
	Control	Freeways	Expand fiber/ISDN →	→	→
		Arterials	Local communications network →	→	→
Interagency Communications (Cities, TxDOT, DART, Counties)	Communications		Expand wide area network →	→	→

6.2.4.1 Management

Management of traffic and transportation as referred to in this implementation plan includes a freeway management center, traffic information processing center, city traffic signal control systems, incident management program, and mobility assistance patrols.

6.2.4.1.1 Management Centers

- Dallas Area Transportation Management Center

  The Dallas Area Transportation Management Center (DATMC) would now serve as the focal point for all freeway management and information exchange functions. The DATMC will house freeway management hardware/software and operations personnel as well as equipment and personnel for interfacing to and exchanging information with other local control systems. The DATMC should also accommodate emergency management services personnel, DART operations personnel, MAP dispatchers, and possibly police personnel from local cities. It will also be in direct communication with the Fort Worth Area Transportation Management Center regarding data exchange as well as coordination of operations on a regional basis.

- City Traffic Signal Control Systems

  Tier 1 city traffic control systems would continue to operate autonomously. Where incidents identified by the DATMC warrant implementation of incident timing plans, cities would be notified, and they will respond accordingly. Information affecting traffic operations will be exchanged.

- DART Operations Center

  DART Operations Center will continue to operate autonomously; however, information affecting traffic operations will be exchanged with other agencies. DART operations personnel will have designated work stations in the DATMC.

- Mobility Assistance Patrols

  MAP personnel would now be dispatched from the DATMC.

6.2.4.1.2 Incident Management Program

It is recommended that the incident management program be upgraded and improved by the addition of regionally shared special equipment such as a heavy duty wrecker or inflatable bags for quickly righting overturned large vehicles. Shared HazMat equipment is also recommended; equipment would be stored

within the District, as well as within the Fort Worth District, with interdistrict use of major HazMat equipment.

6.2.4.2 Surveillance

CCTV and vehicle detectors would be extended according to priorities indicated previously in Figure 6-2. AVI and AVL probes would be incorporated as feasible from the commercial vehicle and private vehicle sector.

6.2.4.3 Information Delivery

Information delivery to travelers would be extended by kiosks, CMSs, and HAR as previously indicated by the priorities shown in Figure 6-2. Direct video, graphics and textual data would be made available to the media.

6.2.4.4 Control

Surface street control functions would continue to be locally based with traffic data and information sharing among agencies, providing for improved efficiencies of operation. Incident timing plans would be implemented as increased surveillance sources become available. Direct control of frontage road intersections during incidents would be implemented at locations in cities without computer control capabilities. Ramp metering would be implemented in capacity deficient freeway sections and at freeway sections where incident experience is at a level warranting ramp control.

6.2.4.5 Data Communications

Data communications media would be extended according to priorities indicated previously in Figure 6-2. Extension of fiber cable would be primarily in areas where other construction is taking place. Alternative communications media may become available and should be investigated; in particular, more companies will be offering fiber, and other media and lease rates will likely be very competitive.

6.2.4.6 Interagency Communications

The Wide Area Network as developed in the near-term will be extended to other areas as more information is available from agencies through the DATMC.

6.2.5 Long-Term Implementation (I I years +)

Projects considered for implementation in the long-term are those considered to be in research or development phases. These would include collision avoidance systems, automated vehicle operations, and other vehicular control systems. These systems hold promise in both safety and in realizing more roadway capacity; however, these systems, still in research and development stages, are outside the planning horizon of this study.

Most of these developments will be vehicle-based and will not depend to a great extent on ATMS for operation. Data exchange may be desirable, and the system design should reflect an open architecture, to the extent practical.

6.3 Dallas Area-Wide ITS Plan Benefits and Costs

Based on system elements specified in the area-wide plan, detailed benefits and cost data for the recommended plan were developed. The following sections describe the evaluation criteria and expected benefits and costs of the recommended plan.

6.3.1 Benefits Evaluation Criteria

Benefits of traffic management and control systems can accrue in terms of both quantifiable values and in more subjective non-quantifiable benefits. Traditionally, the prime method of system justification or evaluation is a benefit/cost analysis that compares benefits accruing to the public in terms of dollars compared to capital, operating, and maintenance dollar costs of system projects. Benefits measured in dollars include travel time savings, reduction in accidents, and reduction in fuel consumption.

Other benefits are less readily measurable in dollar terms. For example, reduction in vehicle emissions are less readily quantifiable in dollars, although it is generally recognized that reduction of pollutants can have an effect on respiratory illnesses and even death rates for persons afflicted with such ailments. Harmful effects on the environment, such as on plant and animal life, are real but not easily put into dollar terms. Reduction of fuel consumption is readily measurable in dollar costs of fuel, but such reduction also contributes to an accepted national goal of less dependency on fossil fuels, which is not quantifiable.

For purposes of the cost/benefit analysis for the Dallas Area-Wide Early Deployment Planning Project, dollar cost savings from three measurable criteria will be used:

- Motorist delays;
- Fuel consumption; and
- Accidents.

Costs and benefits were derived from review of the experience of operational systems. Subsequent to tabulation and analysis of costs and benefits by project staff, FHWA published an informal report with estimated costs for ATMS “Core Infrastructure Elements II” (3). Comparison of the two data sources indicated that the assumptions and estimates by the project staffwere generally in accord with the FHWA report.

6.3.1.1 Annual Motorist Delay Costs

Implementation and operation of an Intelligent Transportation System can be expected to reduce motorist delay in two categories: recurrent and non-recurrent congestion. Recurrent congestion may be addressed through effkient traffic signal control (including ramp metering); pre-trip information to assist travelers with route, departure schedules and modal choice; and en-route signing (visual or audio) to influence diversion. Based on annual delay estimates for Texas urban areas developed by the Texas Transportation Institute (TTI), motorists' delay costs associated with recurrent and non-recurrent congestion, are an estimated $340 and $570 million respectively for the Dallas area (4). Non-recurrent congestion, caused by accidents and other incidents, is addressed through incident management functions, such as monitoring of cellular reports of incidents, detection of incidents by vehicle detectors or CCTV, and Mobility Assistance Patrols. In support of incident management, en-route and pre-trip planning information delivery may also be employed.

6.3.1.2 Annual Fuel Consumption Costs

Reduction in freeway delay produces a generally proportional reduction in fuel consumption. Based on TTI studies for the Dallas area, it is estimated that annual fuel costs associated with recurring and non-recurring congestion exceed $55 and $92 million respectively (4).

6.3.1.3 Annual Accident Costs

Texas Department of Public Safety records indicate there were 10,519 reported accidents on Dallas area freeways in 1994. Of these accidents, 0.7% involved fatalities, 54.8% were injury accidents, and 44.5% involved property damage only (5). Using a weighted average cost of $14,794 per accident, the total costs resulting from accidents in 1994 exceeded $155 million. In addition to the reported accidents, many minor accidents (without injuries or major property damage) occur and go unreported.

6.3.2 Dallas Area-Wide ITS Plan Estimated Benefits

Most benefits accruing from advanced freeway and freeway corridor management and information systems are interrelated. Delivering various user services will often involve the same hardware and management elements. For example, a CCTV system may contribute to early detection and verification of incidents for dispatch of appropriate emergency services. The same CCTV system may also provide a source of information for messages on CMSs or real-time flexible routing of transit vehicles. The benefits of each function, if it were a stand alone system, would be tangible and measurable. However, the benefits of stand alone systems are not necessarily additive. In order to account for the interrelated nature of user benefits attributable to the recommended

elements, the benefits of the various systems were analyzed using a root of squares summed analysis (RSS). The resulting analysis, while conservative, indicates that substantial benefits can be realized from an advanced Intelligent Transportation System and can also account for the interrelatedness of control elements.

6.3.2.1 Non-Recurrent Freeway Congestion

Non-recurrent (incident related) freeway congestion accounts for well over half of the total freeway congestion and is most readily addressed by advanced freeway management techniques. Incident detection and clearance and the provision of traveler information for pre-trip planning and for route selection during trips are elements contributing to reduction of delays due to non-recurrent congestion. Table 6-4 indicates the estimated impact of various ITS elements and their combined impact; using the RSS analysis, the combined ITS elements resulted in estimated reductions in non-recurrent congestion of 48% and 23% for strategic and other freeways respectively. As previously illustrated in Figure 6-2, strategic freeways primarily entail all freeways experiencing LOS E or F in both 1994 and 20 10 (Priority 1 freeways), with other freeways, being either Priority 2,3, or 4.

Table 6-4. Non-Recurrent (Incident) Freeway Congestion Reduction Factors

ITS Element	Strategic Freeways (Priority 1)	Other Freeways (Priorities 2, 3 & 4)
Incident Management Plan / Mobility Assistance Patrols	40%	20%
Roadway Detection (loops, radar, VIP detectors, probes,etc.)	5%	5%
CCTV Cameras	15%	5%
*999 Cellular Phone Hotline for Reporting Incidents	10%	5%
Ramp Meters	5%	3%
Lane Control Signals	5%	3%
Changeable Message Signs (CMS)	15%	5%
Highway Advisory Radio (HAR)	10%	5%
Root of Squares Summed (RSS)	**48%**	**23%**

6.3.2.2 Recurrent Freeway Congestion

Theoretically, in the absence of capacity restricting incidents, there would be no need for traffic responsive information delivery systems since traffic patterns would be thoroughly repeatable. However, even without capacity limiting incidents, day to day traffic variations can have a significant enough effect to warrant freeway traffic control measures. The primary means of controlling traffic demand on freeways is ramp metering. Additional measures would include information delivery to travelers, either pre-trip or en-route, though with lesser

effectiveness than in a non-recurrent incident condition. Ramp metering on US 75 in the early seventies resulted in a reduction of delay and accidents of about 15%. Other systems throughout the country have reported similar results with delay reduction as high as 40% or more. For this analysis, a 30% delay reduction factor was used for ramp meters located within strategic corridors.

Initially, ramp metering would be applied only in consistently congested areas where demand upstream of freeway bottlenecks could be diverted to other facilities or other travel modes. Due to geometric constraints on many existing entrance ramps in the Dallas area., this study assumes that ramp metering would be applied at only 40% of the entrance ramp locations within designated strategic corridors in the plan area. Table 6-5 shows the estimated impacts of ITS elements on recurrent freeway congestion. Using the previously described RSS analysis, benefits resulting from the deployment of ramp meters and lane control signals are an estimated 30% and 6% reduction in recurrent delay for strategic (Priority 1) and other (Priorities 2,3, or 4) identified freeways, respectively.

Table 6-5. Recurrent Freeway Congestion Reduction Factors

ITS Element	Strategic Freeways (Priority 1)	Other Freeways (Priorities 2,3 & 4)
Ramp Meters (including ramp closures)	30%	5%
Lane Control Signals	5%	3%
Root of Squares Summed (RSS)	30%	6%

6.3.2.3 Regional Arterial Congestion

In the absence of incidents, congestion on regional arterials is generally consistent from day to day and is managed by traffic control systems where they exist in individual cities. Improvement in system operation can be realized through upgraded hardware and control techniques. Since several cities in the study area have in place central computer signal systems that have been optimized, it is assumed that a conservative 10% delay reduction will occur with upgraded systems and access to information sharing through the Wide Area Network.

Non-recurrent delay due to incidents occurs in two ways. First, diverted traffic from freeway incidents will use the adjacent frontage road and surface street system. The previously described working arrangements for implementation of mutually developed incident signal timing plans would manage traffic and minimize delay under these conditions. Benefits accruing for that situation are included in the benefits for improved freeway incident management measures. A second area where delays due to incidents occur is on surface streets not related to

freeway incidents. Detection of such incidents is more difficult than on freeways due to the greater geographical area and the innate greater variability of speeds, stops, and densities. However, several cities have or will in the near future implement CCTV monitoring capability on some city streets. Coupled with incident/system detectors in computer-monitored signal systems, the opportunity for incident detection on arterials will exist.

6.3.2.4 Accident Reduction

Several aspects of accident reduction are related to advanced transportation management systems. Any traffic control system, freeway or arterial, that reduces congestion also reduces accidents. Typically, improved signal operation on surface streets results in accident reductions in the range of 10 to 25%. Guidelines by California Department of Transportation (CALTRANS) for estimating accident reduction due to freeway management and information systems attribute a 25% reduction for systems with ramp metering. FHWA guidelines show a 37% reduction in accidents where comprehensive freeway management systems are implemented. Finally, it has been shown that upwards of 20% of all freeway accidents are secondary accidents occurring upstream of a previous accident.

It is not feasible to apply these reductions to individual facilities due to the overlapping influence of the various control techniques. Therefore, a conservative estimate of 15% will be used in the analysis for overall accident reduction due to advanced transportation management systems.

6.3.2.5 Dallas Area-Wide ITS Plan Benefit Calculations

Benefits in terms of motorist delay savings, fuel savings, and accident reductions will all accrue from the implementation of a comprehensive Intelligent Transportation System. Estimated benefit calculations for the proposed Dallas Area-Wide ITS Plan are shown in Table 6-6 below.

Table 6-6. Dallas Area-Wide ITS Plan Benefit Calculations

Annual Costs	Annual Recurrent Delay Costs ($1,000,000's)	Annual Recurrent Fuel Costs ($1,000,000's)	Annual Incident Delay Costs ($1,000,000's)	Annual Incident Fuel Costs ($1,000,000's)	Annual Freeway Accident Costs ($1,000,000's)	**Total Costs ($1,000,000's)**
Freeways (strategic corridors)	$219.0	$35.6	$389.0	$62.9	$117.0	**$823.5**
Other Freeways	$73.0	$11.8	$129.6	$20.9	$39.0	**$274.3**
Regional Arterials	$48.0	$7.6	$51.4	$8.2	NA	**$115.2**
Totals ($100,000's)	**$340.0**	**$55.0**	**$570.0**	**$92.0**	**$156.0**	**$1,213.0**

Reduction Factors	Annual Recurrent Delay Reduction Factor	Annual Recurrent Fuel Reduction Factor	Annual Incident Delay Reduction Factor	Annual Incident Fuel Reduction Factor	Annual Freeway Accident Reduction Factor
Freeways (strategic corridors)	30%	30%	48%	48%	15%
Other Freeways	6%	6%	23%	23%	15%
Regional Arterials	10%	10%	10%	10%	NA

Annual Benefits	Annual Recurrent Delay Savings ($1,000,000's)	Annual Recurrent Fuel Savings ($1,000,000's)	Annual Incident Delay Savings ($1,000,000's)	Annual Incident Fuel Savings ($1,000,000's)	Annual Freeway Accident Savings ($1,000,000's)	**Total Savings ($1,000,000's)**
Freeways (strategic corridors)	$65.7	$10.7	$186.7	$30.2	$17.6	**$310.8**
Other Freeways	$4.4	$0.7	$29.8	$4.8	$5.9	**$45.6**
Regional Arterials	$4.8	$0.8	$5.1	$0.8	NA	**$11.5**
Totals ($100,000's)	**$74.9**	**$12.1**	**$221.7**	**$35.8**	**$23.4**	**$367.9**

6.3.2.6 Summary of Benefits

6.3.2.6.1 Motorist Delay Savings

Annual motorist delay savings in terms of dollars resulting from implementation of the Dallas Area-Wide ITS Plan are an estimated $74.9 and $221.7 million for recurrent and non-recurrent congestion, respectively. Total annual motorist delay savings (combined recurrent and non-recurrent) are an estimated $296.6 million. (Motorists delay savings were calculated using a time value of $8.92, the value used by NCTCOG in their benefit calculations.)

6.3.2.6.2 Fuel Consumption Savings

Annual fuel consumptio savings in terms of dollars resulting from implementation of the Dallas Area-Wide ITS Plan are an estimated $12.1 and $35.8 million for recurrent and non-recurrent congestion respectively. Total annual fuel consumption savings (combined recurrent and non-recurrent) is an estimated $47.9 million. (Fuel consumption savings were calculated using a fuel value of $1.18 per gallon.)

6.3.2.6.3 Accident Reductions Savings

Assuming a 15% reduction of freeway accidents resulting from the implementation of the Dallas Area-Wide ITS Plan, estimated annual accident savings is $23.4 million. (Accident savings were calculated using an average weighted value of $14,794 per accident.)

6.3.2.6.4 Total Annual Benefits

Total annual benefits (sum of motorist delay, fuel consumption, and accident savings) resulting from implementation of the Dallas Area-Wide ITS Plan are an estimated $367.9 million.

6.3.2.6.5 Non-Quantifiable Benefits

In addition to the measurable benefits described in the previous sections, other benefits resulting from the implementation of a comprehensive Intelligent Transportation System, less readily quantifiable, are nevertheless real and advantageous. These benefits include:

- Special event management;
- Heightened sense of personal safety;
- Improved customer service in terms of information and dependability;
- Database for system evaluation and planning;
- Contributing to meeting national goals of reduction of fossil fuel consumption;
- Contributing to meeting national mandates for vehicle emissions reduction;
- Reduction of driver fatigue due to less congestion; and
- Providing a focal point for regional transportation management activities.

6.3.3 Dallas Area- Wide ITS Plan Estimated Costs

Estimated cost data were secured from the literature review and from review of current ITS related planning, implementation and operations studies, as well as from the TxDOT Dallas District. Additionally, order of magnitude costs were cross-checked with a recent informal FHWA report with guidelines for implementation of a core ATMS infrastructure based Intelligent Transportation System. As with benefits, support systems are highly interrelated. For example, a transportation management center without information sources would be less than effective in information delivery. Changeable message signs without an information source for determining message content also would be less than effective. While some elements can work independently, e.g., the mobility assistance patrols, their effectiveness is synergistic when part of an integrated transportation management system. Estimated implementation, operation, and maintenance costs were determined for individual elements and were summarized by the general categories of Management, Surveillance, Information Delivery, Control, and Data Communications for review purposes, but the benefit/cost analysis will be performed on the total system deployment for the reasons stated.

6.3.3.1 Dallas Area-Wide ITS Plan Ultimate Deployment Costs

Table 6-7 on the following page summarizes estimated capital, and operations and maintenance costs by individual ITS elements. The estimated capital (implementation) cost for the ultimate Dallas Area-Wide ITS is approximately $103 million; the corresponding annual operations and maintenance costs associated with the proposed system is $10.7 million.

6.3.3. 1.1 Dallas Area- Wide ITS Plan Estimated Annualized Costs

Annualized capital cost for the ultimate system, assuming a 15 year life and a 6% rate of return, is $10.6 million. The combined annualized capital cost and annual operations and maintenance costs for the ultimate system is $21.3 million.

6.3.3.1.2 Dallas Area- Wide ITS Plan Estimated Benefit/Cost Ratio

Using the expected annual savings/benefits ($367.9 million) calculated previously in Table 6-6, an estimated Benefit/Cost ratio of 17.3 will result from deployment of the ultimate Dallas Area-Wide ITS.

Dallas Area Transportation Management Center (DATMC):																	
Facility & communications	1																
Computers/hardware/software	1																
24 hrs/day, 7 days/week operating staff (average salaries & benefits)	20																
System Design & Integration:																	
DATMC/City TMC's/DART	1																
Communications:																	
Fiber (US 75 & IH 635; installed in conjunction with other construction projects) per km	80																
Fiber (IH 35E, US 67, SH 183 and other strategic locations) per km	100																
Wide Area Network (WAN) servers	3	1	1	1	1	1	1	1	1	1	1	1	2	1	1		1
ISDN lines for WAN (installation & lease costs)	24	4	2	2	2	2	2	1	1	1	1	1	2	1	1		1
ISDN lines for field devices (installation & lease costs)	168	70	12			8	6			13	2	3	5	3	7		10
Surveillance & Detection (*denotes demonstration/test projects):																	
Dedicated *999 incident reporting cellular hotline	1																
24 hrs/day, 7 days/week *999 operating staff (average salaries & benefits)	5																
Frwy inductive loop detector stations on US 75 & SH 190 (4 frwy lanes/station)	120																
Freeway radar/microwave detector stations (4 frwy lanes/station)	140																
Arterial radar/microwave detectors for temporary detection (per intersection approach)		40	20	12	16	8	12	16	8								
Arterial incident/system detectors (3 lanes/station)		150	30	18	30	12	26	36	8	12	2	4	4	4	10	20	
• Video imaging detectors stations (4 frwy lanes/station or 3 arterial lanes/station)	20	4	4	4	4	4	4	4	4								
CCTV cameras w/ live video	60	2		10	10			18	4								
CCTV cameras w/ compressed video	140	60	10			6	4			11	1	2	4	2	6	8	8
• Freeway CCTV w/ VIP capability (4 frwy lanes/station)	10																
• Arterial CCTV w/ VIP capability (per intersection)		2	2	2	2	2	2	2	2								
Probes (AVI/toll tag readers)	60																20
Control Strategies:																	
Ramp meters	60																
Freeway lane control signals (4 frwy lanes/stations)	120																
Traffic signal upgrades (central computer control & monitoring capability)	45	644	105		56	32	86	22	43	49	8	48	42	52	12	41	
Tri-annual arterial traffic signal timing re-evaluations (per traffic signal)	45	1213	155	94	135	75	102	115	48	58	26	50	42	52	12	41	
Arterial dynamic lane assignment signs (frwy serv. rds, arterials & frwy diversion routes)	50	60	10	8	10	8	8	8	4	4	2	4	4	4		4	
Traveler Information:																	
CMS	90																7
HAR (10-watt)	10																
Kiosks (TxDOT in conjunction with DART)	50																
Incident Management:																	
Police & Fire incident management training (course development & training)	1																
Development & maintenance of area-wide incident response signal timing plans	1																
Mobility Assistance Patrol (MAP) vehicles	20																
24 hrs/day, 7 days/week MAP operating staff (average salaries & benefits)	60																
Portable HAR	4																
Portable CMS	10																
Portable CCTV	4																
Traffic Safety Officer (salary & benefits)	2																

6.4 Summary of the Dallas Area-Wide Intelligent Transportation System Plan

The Dallas Area-Wide Intelligent Transportation System Plan is the result of the cooperative efforts of a Steering Committee made up of representatives of various transportation agencies in the Dallas area. The plan recommends advanced technology to address transportation-related mobility and environmental issues with particular emphasis on incident detection, clearance and management. The plan conforms to developing national architecture standards while addressing specific needs identified in the Dallas area. A one to five year near-term and six to ten year medium-term deployment plan is specified within the plan. Evaluation of estimated costs and benefits results in a benefit to cost ratio of 17 to 1, meaning that for every dollar invested $17 are returned to the traveling public.

Funding the implementation of the plan elements will be a challenge because there is no designated single source of funding. Therefore, coordination and cooperation among operating agencies (TxDOT, cities, counties, toll authority, and DART) and partnerships with the private sector are essential. Existing systems in cities and counties have been and will probably continue to be funded from sources such as general revenues, bond funds, state and federal sources, and local assistance funds from DART. State funding for implementation of ITS systems has and will probably continue to come from general state highway revenues and various federal sources. Advanced Public Transit Systems have been and will continue to be funded from DART sales tax revenues and demonstration funding. As a prime user of city and state highway infrastructure, DART will also benefit from ITS improvements. Funding for the various ITS systems may also include operational test and demonstration funding from federal sources.

The key to the Dallas Area-Wide Intelligent Transportation System Plan's successful implementation is continued interjurisdictional cooperation and coordination among governmental agencies. North Central Texas Council of Governments has incorporated ITS systems into their planning and programming roles and continues to be an advocate for interjurisdictional cooperation. Intelligent Transportation Systems can play an important role in the region-wide goal of improved freeway incident management and in increased mobility and environmental improvements.

6.5 References

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3 ***Cost Estimate and Assumptions for the Core Infrastructure.*** Federal Highway Administration, Office of Traffic Management and Intelligent Transportation Systems (HTV-10). June 1995.

4 T. Lomax, D. Schrank and S. Turner. ***Urban Roadway Congestion - 1982 to 1992, Volumes I and 2.*** Report No. FHWA/TX-94-113 l-7. U.S. Department of Transportation, Federal Highway Administration, Washington, D.C. and Texas Department of Transportation. July 1995.

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