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**THE DALLAS FREEWAY/HOV SYSTEM PLANNING STUDY: YEAR 2015
A SUMMARY OF RECOMMENDED HOV IMPROVEMENTS**

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and
North Central Texas Council of Governments

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IMPLEMENTATION STATEMENT

This study was sponsored by the Texas Department of Transportation (TxDOT) as part of an effort to identify a balanced transportation system for the future in the Dallas area. The system should accommodate the projected travel demand at the lowest public cost. The Dallas System Planning Study was a coordinated effort of the Texas Department of Transportation (TxDOT), Dallas Area Rapid Transit (DART), and the North Central Texas Council of Governments (NCTCOG) with technical assistance from the Texas Transportation Institute (TTI).

The mission of the study is to provide an intermediate planning step between the macroscopic planning performed by NCTCOG and TxDOT's Regional Planning Office and the detailed corridor analysis performed during the design phase of a roadway improvement project. The proposed system is a set of recommendations to be considered and evaluated as part of the development of the Mobility 2010 Plan Update, the long-range transportation plan for the Dallas area.

The Dallas System Planning Study was developed using a methodology that focuses on peak-hour passenger travel demand for the freeways in Dallas and surrounding counties. The study analysis differs from other planning efforts in the region by its focus on peak-hour passenger travel demands and roadway operating conditions, the use of 2015 as the design year for the facilities, and the acceptance of congestion for some alternatives to induce travel in higher-occupancy modes. The intent of the effort was to provide a system that served the travel needs with a reasonable and balanced level of congestion.

The study methodology uses an iterative process to examine congestion and the consequent shift in mode so that these two factors are consistent for an alternative. The proposed system balances money saved in construction against money lost in delay to find the optimum combination of mixed-flow, HOV, and express lanes necessary to move the demand.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views of the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. The engineer in charge was Carol H. Walters, P.E., #51154.

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SUMMARY

The Dallas Freeway/HOV System Planning Study is a joint project in cooperation with the Texas Department of Transportation (TxDOT), Dallas Area Rapid Transit (DART), the North Central Texas Council of Governments (NCTCOG), and the Texas Transportation Institute (TTI). The intent of this effort is to assist in the development of an area-wide freeway/HOV system that recognizes implementation constraints (right-of-way and construction costs) and provides reasonable peak-hour operating conditions on all freeway facilities, while incorporating the long-range plans developed by TxDOT, DART, and NCTCOG.

The Dallas System Planning Study is technical in nature and does not address issues such as the programming responsibilities of the agencies involved, the staging or priority of projects within each corridor, the source of funding for the recommended capacity improvements, or community concerns including the environmental effects of the recommended improvements. The proposed system is a set of recommendations to be considered and evaluated as part of the development of the NCTCOG Mobility 2010 Plan Update, the long-range transportation plan for the Dallas area. HOV facilities are a significant part of the recommended system in the Dallas System Planning Study, and their implementation is important to the successful operation of the Dallas area transportation system in the future. This report, therefore, focuses on the recommended HOV improvements resulting from the methodology.

The recommended system in the Dallas System Planning Study was developed using a methodology that focuses on peak-hour passenger travel demand in the year 2015 (derived from the year 2010 24-hour volume assignment provided by NCTCOG) for the freeways in the Dallas urban area. The goal of the Dallas System Planning Study has been to find the lowest-public-cost alternative in each corridor for a given volume of peak-hour person trips. Planning officials summed costs to the public, including construction, right-of-way, operating, and congestion costs for each alternative, and selected the *least-public-cost* alternative as optimum. This methodology uses an iterative process that balances money saved in construction against money lost in delay to find the optimum combination of mixed-flow, HOV, and express lanes necessary to move the demand. It also recognizes that some motorists will change their mode of travel when given the opportunity to avoid

congestion, resulting in more transit and carpool use. (Rail passenger volumes were held constant as provided by NCTCOG).

Figure 2 of this report illustrates the recommended HOV lane facilities resulting from the analyses. These alternatives have been adjusted where necessary to maintain compatibility with adjoining freeway sections.

It is important to note the change in public goals implied in the Dallas System Planning Study: *Future congestion is accepted on freeways in Dallas during peak hours, and carpooling or use of transit is the solution offered to escape it.* This is a policy issue that needs to be understood, debated, and accepted or rejected before the recommended system from the Dallas System Planning Study can be partially or wholly adopted by any agency in the region.

The recommended system differs from the NCTCOG Mobility 2010 Plan and the DART Service Plan for three main reasons:

- 1) the study uses 2015 as the design year;
- 2) the study focuses on peak hour passenger travel demands, and
- 3) the study recognizes constraints in building mixed-flow lanes and accepts congestion for some alternatives to induce travel in higher-occupancy modes.

The results of the Dallas System Planning Study indicate, by the year 2015, 347 lane-kilometers (216 lane-miles) of HOV facilities are needed; the majority are reversible and have a two-or-more person per vehicle minimum occupancy requirement. The recommended HOV lane system includes 186 centerline-kilometers (116 centerline-miles) of which 129 kilometers (80 miles) are two-lane facilities and 58 kilometers (36 miles) are one-lane facilities. The total capital cost of the HOV improvements is approximately \$1 billion, \$827 million within the DART service area.

I. INTRODUCTION

The Dallas Freeway System Planning Study is a joint project in cooperation with the Texas Department of Transportation (TxDOT), Dallas Area Rapid Transit (DART), the North Central Texas Council of Governments (NCTCOG), and the Texas Transportation Institute (TTI). The mission of the study is to provide an intermediate planning step between the macroscopic-level planning performed by TxDOT's Regional Planning Office and NCTCOG and the detailed corridor design analyses performed by the district office of TxDOT. The intent of this effort is to assist in the development of an area-wide freeway/HOV system that recognizes implementation constraints (right-of-way and construction costs), provides lane balance and interchange configurations that will provide balanced and reasonable peak-hour operations on all freeway facilities, and incorporates the long-range plans developed by TxDOT, DART, and NCTCOG. Increasing the percentage of trips by public transit and carpools from current conditions will be a result of the implementation of the recommended system as proposed in the Dallas System Planning Study.

The Dallas System Planning Study is technical in nature and does not address issues such as the programming responsibilities of the agencies involved, the staging or priority of projects within each corridor, the source of funding for the recommended capacity improvements, or community concerns including the environmental effects of the recommended freeway or HOV lane improvements. The proposed system is a set of recommendations to be considered and evaluated as part of the development of the NCTCOG Mobility 2010 Plan Update, the long-range transportation plan for the Dallas area.

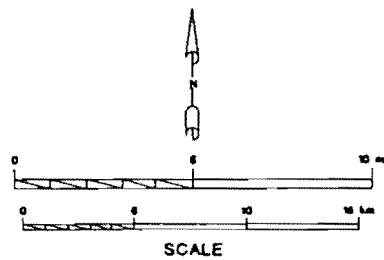
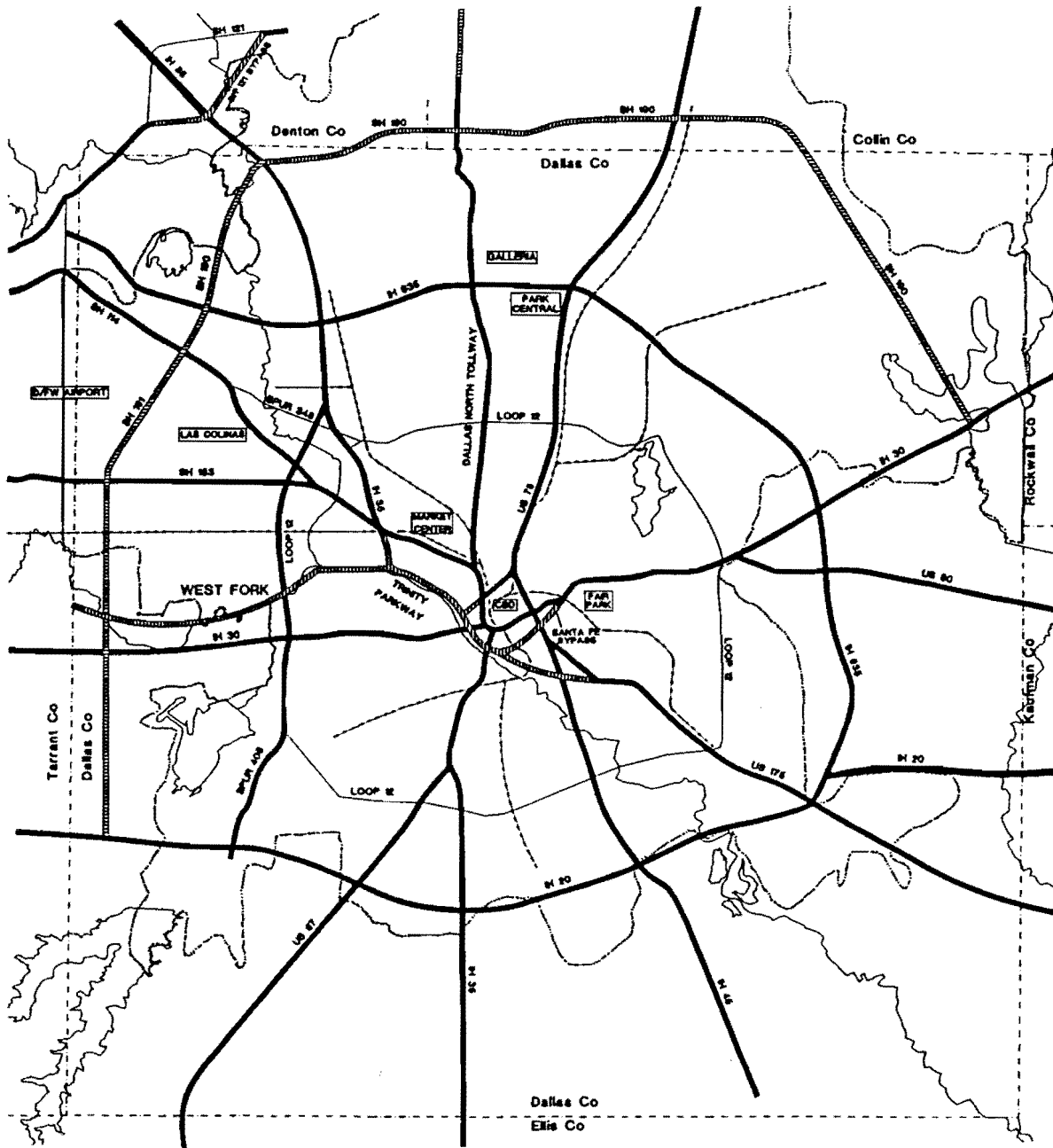
There are two key aspects that distinguish this system planning effort from typical planning efforts. First, the sizing of the facilities is based on peak-hour operation of the freeways and freeway interchanges. Second, passenger demand for buses, carpools, and single-occupant vehicles were analyzed as a system (rail demand was held constant as provided by NCTCOG). During the analysis, the peak-hour person-demand for each corridor and for the system was held constant, while various alternatives for serving the demand were evaluated for efficiency and cost effectiveness. Serving the demand did not mean eliminating congestion in every case. Alternatives with high-occupancy vehicle facilities will require congestion to induce commuters to shift from single-occupant vehicles to carpools or buses.

II. BACKGROUND

The Dallas urban area considered in the Dallas System Planning Study includes all of Dallas County and the southern portion of Denton and Collin Counties. Figure 1 shows the existing freeway system and three proposed freeways (SH 161, SH 190, and the Trinity Parkway/West Fork). All of these corridors were evaluated in the study except for the southern half of US 75 (between the central business district and IH 635) and the Dallas North Tollway. US 75 is currently being upgraded to an eight-lane freeway with a light-rail transit facility in the corridor. Acquisition of any additional right-of-way in this corridor for the purpose of increasing capacity would be very costly due to the development along the corridor. The Dallas North Tollway is also within a narrow right-of-way with little room for additional capacity.

TxDOT maintains a 10-year Project Development Plan that includes all freeway and principal arterial facilities planned on the state system (1). This plan gives priority to the approved projects in the Dallas District. In 1985, TTI developed an HOV System Plan for the Dallas District of TxDOT (2). This plan evaluated the viability of HOV facilities in corridors that did not include fixed-guideway transit facilities proposed by DART. In 1989, DART updated their long-range transit system plan to include light-rail facilities, HOV lanes, and a commuter rail line (3). In 1990, the NCTCOG produced the Mobility 2010 Plan (4). This plan is the region's current 20-year transportation plan for guiding the implementation of roadway and transit improvements in the Dallas-Fort Worth metropolitan area. The NCTCOG Mobility 2010 Plan incorporates the plans of all agencies and municipalities, evaluates future travel demand and system alternatives, and presents the alternatives necessary to best meet the mobility needs of the region.

The plans from the different agencies produced slightly different alternatives within the system due to the starting assumption and the goal of each plan. TxDOT developed a freeway plan with no preferential treatment; NCTCOG developed a plan to best meet the mobility needs of the region at traffic flow speeds of 72 kph (45 mph) or better, and DART developed a long-range transit system plan. As these plans move toward implementation, it is becoming essential that all the components be compatible. The Dallas System Planning Study was an effort to bring together the various plans and develop an analysis technique to balance the supply of, and demand for, transportation facilities in the Dallas area.



LEGEND:

- DART Service Area Boundary
- - - - Rail System Plan
- Existing Freeways
- Possible Future Freeways
- Primary Arterials
- Note: Santa Fe Bypass connects to both HOV and general-purpose lanes on I-30 East

Figure 1. Dallas System Planning Study Freeways

III. METHODOLOGY

A major effort in the Dallas System Planning Study was developing a methodology to create and analyze both a freeway and HOV system. The goal of the study was to provide an efficient and cost effective transportation system to the public. Study officials measured cost effectiveness by comparing the total of the following three cost components estimated for each alternative:

- Capital -- cost of construction and right-of-way for each alternative.
- Operating -- costs associated with operating any element of the system, including reversible roadways or traffic management systems (vehicle operation costs are not included).
- Congestion -- cost of travel delay associated with traffic congestion on any alternative.

The net present value of each cost component was estimated. Future values, as in congestion for example, were discounted back to the present year. The highest ranking alternative for each corridor was the one with the lowest sum of the three cost components. The lowest total cost alternative is the one which represents the least cost to the public to accommodate the projected demand.

The strategy of the Dallas System Planning Study was to determine the demand, try to serve the demand with different alternatives, estimate mode shift (commuters who change their modes of travel due to congestion) as appropriate, and estimate the cost of the alternative. The critical sections of the system were examined to identify the level of congestion. Each alternative served a constant amount of travel demand, with the travel mode varying depending on the facilities provided in the alternative. The study methodology did not examine shifts to travel outside the freeway corridor nor shifts to or from rail.

IV. RESULTS

Figure 2 summarizes the recommended HOV improvements resulting from the previously described methodology. Specific information associated with these improvements (e.g., costs and number of lane-kilometers) is included in Table 1. The majority of the 347 lane-kilometers (216 lane-miles) of HOV facilities included in the recommended system are reversible and have a two-or-more person per vehicle (2+) minimum occupancy requirement. The recommended HOV lane system includes 186 centerline-kilometers (116 centerline-miles) of which 129 kilometers (80 miles) are two-lane facilities and 58 kilometers (36 miles) are one-lane facilities.

The estimated total cost of the HOV improvements associated with the recommended system is approximately \$1 billion, as indicated in Table 1. If expressed on a per-kilometer basis, this cost would amount to approximately \$5.4 million per centerline kilometer (\$8.7 million per centerline mile) or \$2.9 million per lane-kilometer (\$4.7 million per lane-mile) of HOV facility. It should be noted that 299 lane-kilometers (186 lane-miles) of the 347 lane-kilometers (216 lane-miles) or 152 centerline kilometers (95 centerline miles) of the 186 centerline kilometers (116 centerline miles) of HOV facilities included in this system fall within DART's current service area boundaries. Similarly, the total construction cost corresponding with the HOV improvements within the DART service area is \$827 million. The operating and maintenance costs for these improvements total \$3.5 million per year and are not included in the construction cost figures shown in Table 1. All of the costs included in Table 1 are in 1990 dollars.

Table 2 summarizes the ridership estimates for the HOV facilities shown in Figure 2. It is estimated that a total of 375,000 persons per day will be using the recommended HOV system by the year 2015. The vast majority of these persons (90%) will be in the form of carpools. The relatively low percentage of bus ridership is due to the presence of rail lines in most of the corridors listed in Table 2. For the purposes of this study, it was assumed that DART would not provide significant express-bus service adjacent to rail lines.

Table 1. Construction Costs and Physical Characteristics Associated with HOV Improvements in Recommended Dallas System, Year 2015

Freeway Corridor	Limits	Recommended Alternative ¹	No. of Lanes		Kilometers (Miles)		Lane-Kilometers (Lane-Miles)		Construction Cost (\$M)		Annual Operating Cost (\$M) ⁴
			Total ²	In DART Service Area ³	Total ²	In DART Service Area ³	Total ²	In DART Service Area ³	Total ²	In DART Service Area ³	
IH 30E/Santa Fe	CBD to IH 635	HOV (2+)R	2/1	2/1	19 (12)	14 (9)	26 (16)	23 (14)	80	66	0.35
IH 30W	SH 360 to IH 35E	HOV (2+)R	2	2	23 (14)	10 (6)	45 (28)	26 (16)	107	50	0.35
IH 35N	Loop 12 to SH 121	HOV (2+)R	2/1	2/1	21 (13)	14 (9)	47 (29)	34 (21)	160	108	0.35
IH 35S/US 67	IH 30 to IH 20	HOV (2+)R	2/1	2/1	14 (9)	14 (9)	26 (16)	27 (17)	60	60	0.35
IH 635N	SH 161 to US 75	HOV (2+)B	4B/1R	4B/1R	19 (12)	19 (12)	56 (35)	56 (35)	179	179	0.35
IH 635E	US 75 to IH 30	HOV (2+)R	2	2	18 (11)	18 (11)	35 (22)	35 (22)	82	72	0.35
IH 35S	US 67 to IH 20	HOV (2+)R	1	1	6 (4)	6 (4)	6 (4)	6 (4)	17	17	- ⁵
US 75	IH 635 to Parker	HOV (2+)R	2/1	2/1	12 (7)	12 (7)	18 (11)	18 (11)	53	53	0.35
US 80	IH 30 to IH 635	HOV (2+)R	1	1	5 (3)	0 (0)	5 (3)	0 (0)	16	0	- ⁶
SH 161	IH 30 to IH 635	E HOV (2+)R	2	2	18 (11)	13 (8)	35 (22)	26 (16)	99	68	0.35
SH 183	IH 35E to Co. Line	HOV (2+)R	2	2	16 (10)	16 (10)	32 (20)	32 (20)	102	102	0.35
Loop 12	IH 35E to Spur 408	HOV (3+)R	1	1	16 (10)	16 (10)	16 (10)	16 (10)	52	52	0.35
Totals					186 (116)	152 (95)	347 (216)	299 (186)	1007	827	3.5

Notes: Construction for recommended alternatives is at-grade unless otherwise noted.
All costs are in 1990 dollars.

¹HOV (2+)=High-occupancy vehicle lane(s) with a minimum occupancy requirement of two-or-more persons; (3+)=three-or-more persons; E=Elevated (as opposed to at-grade) construction; R=Reversible; and B=Bi-directional.

²The total amount included in the recommended System Plan.

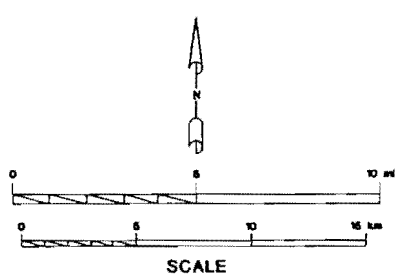
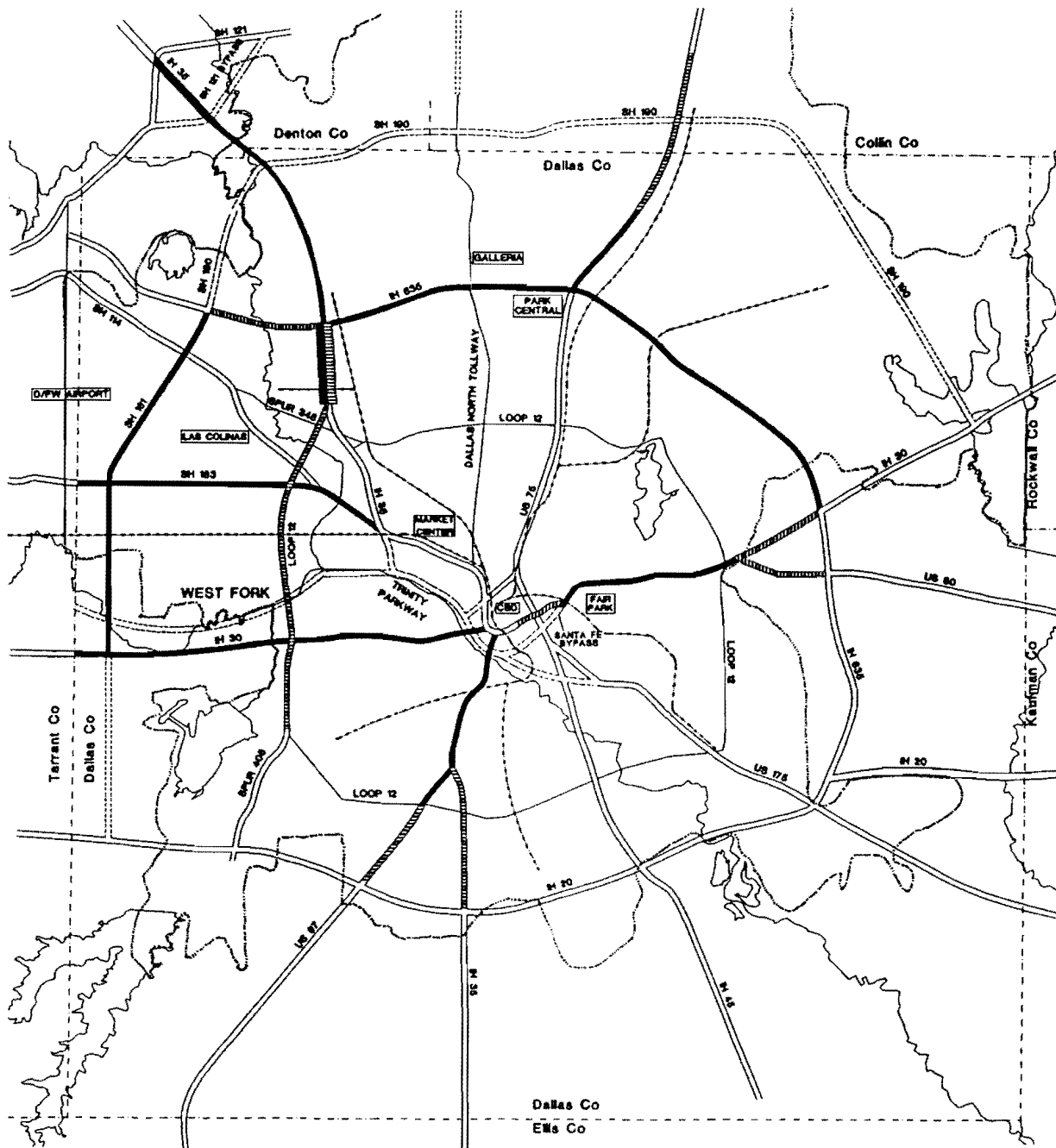
³The portion of the recommended improvements which fall within the DART service area.

⁴The annual operating and maintenance cost.

⁵The operating and maintenance cost for this section of HOV facility is included in the cost for IH 35S/US 67.

⁶The operating and maintenance cost for this section of HOV facility is included in the cost for IH 30E.

⁷Santa Fe Bypass is a two-lane reversible facility with priority HOV access between IH-30 East and Trinity Parkway.



LEGEND:

- Dart Service Area Boundary
- - - Rail System Plan
- ||||| 1 Lane HOV
- ==== 2 Lane HOV

Notes:

1. Santa Fe Bypass connects to both HOV and general-purpose lanes on I-30 East.
2. The section of I-635 between I-35 and US 75 is a bi-directional facility.
3. Loop 12 is a 3+ HOV lane, all other HOV facilities are 2+.

Figure 2. Recommended System for Dallas in the Year 2015, HOV Lane Improvements

Table 2. Estimated Ridership for Recommended HOV Facilities, Year 2015

Freeway Corridor	Recommended Alternative ¹	Estimated Number of Persons Utilizing Respective HOV Facilities					
		Carpools		Buses		Total	
		Peak Hour ²	Daily	Peak Hour ²	Daily	Peak Hour ²	Daily
IH 30E	HOV (2+)R	8,400	33,600	4,300	17,200	12,700	50,800
IH 30W	HOV (2+)R	8,800	35,200	1,500	6,000	10,300	41,200
IH 35N	HOV (2+)R	8,000	32,000	400	1,600	8,400	33,600
IH 35S	HOV (2+)R	8,800	35,200	1,200	4,800	10,000	40,000
IH 635N	HOV (2+)B	8,800	35,200	1,200	4,800	10,000	40,000
IH 635E	HOV (2+)R	6,000	24,000	500	2,000	6,500	26,000
US 67	HOV (2+)R	4,800	19,200	25	100	4,825	19,300
US 75	HOV (2+)R	8,800	35,200	900	3,600	9,700	38,800
US 80 ³	HOV (2+)R	2,300	9,200	0	0	2,300	9,200
SH 161	E HOV (2+)R	8,400	33,600	0	0	8,400	33,600
SH 183	HOV (2+)R	8,300	33,200	0	0	8,300	33,200
Loop 12 ⁴	HOV (3+)R	2,400	9,600	0	0	2,400	9,600
Totals		83,800	335,200	10,025	40,100	93,825	375,300

¹HOV (2+) = High-occupancy vehicle lane(s) with a minimum occupancy requirement of two-or-more persons; R = Reversible; B = Bi-directional; and E = Elevated (as opposed to at-grade) construction.

²25% of the daily ridership is estimated to occur during the peak hour.

³Ridership predictions at this site are low due to necessary lane balance at IH30/US80.

⁴Ridership predictions at this site are low due to 3+ operation of the HOV facility.

One of the major constraints associated with implementing the HOV improvements cited previously is funding limitations. It is recognized that the recommended system is rather ambitious in consideration of the current (and probable future) state of the economy. This recommended system can, however, be considered as a realistic identification of the infrastructure improvements required to efficiently meet the peak-hour travel demands in the Dallas urban area in the year 2015.

V. CONCLUSIONS

TECHNICAL FINDINGS

The recommended system for Dallas includes more HOV facilities than the long-range transit system plan developed by DART. This difference is primarily due to the fact that the recommended system includes fewer general-purpose lane additions and, thus, more HOV facilities are needed. In addition, the recommended system in the Dallas System Planning Study was developed for the year 2015, while DART's plan was developed for the year 2010.

CONGESTION MANAGEMENT APPROACH

Freeway capacity improvements are becoming vastly more difficult to implement. In an era of increasing public involvement in issues ranging from air quality to noise, any transportation improvement which could be viewed as having detrimental environmental effects will be more and more closely scrutinized. Right-of-way is no longer readily available in heavily urbanized corridors, precluding some capacity improvements and driving up the cost of others. Construction costs are increasing partly because of the expense of construction under heavy traffic. Fewer projects can be implemented with a flow of funding from fuel tax, which is declining as fuel efficiency increases. Under these constrained conditions, future travel demand will not be served adequately if reliance on the single occupant automobile continues undiminished and if travel demand continues to be heavily concentrated during only a few hours of the day.

Previous regional planning efforts and freeway design have been predicated on the goal of achieving traffic flow speeds of 72 kph (45 mph) or better during the peak hours of travel, assuming that low levels of vehicle occupancy continue. Conversely, the goal of the Dallas System Planning Study has been to find the lowest-public-cost alternative in each corridor for a given volume of peak-hour person trips. This framework views travel delay, construction, and operation of roadways as costs to the public. It also recognizes that some motorists will change their mode of travel when given the opportunity to avoid congestion, resulting in more transit and carpool use. This implies the acceptance of congestion, and attendant delay, during the peak hour for mainlane

traffic. High-occupancy vehicles are afforded greater speeds and are expected to draw a greater percentage of travelers into carpooling or transit usage; this, in turn, will decrease congestion through reduction in mainlane vehicle volumes as more people leave their vehicles at home or in a park-and-ride lot. The Dallas System Planning Study methodology uses an iterative process to examine congestion and the consequent shift in modes so that these two factors are consistent for an alternative. The proposed system balances money saved in construction against money lost in delay to find the optimum combination of mixed-flow, HOV, and express lanes necessary to move demand.

It is important to note the change in public goals implied: *Future congestion is accepted on freeways almost everywhere in Dallas during peak hours, and carpooling or use of transit is the solution offered to escape it.* This is a policy issue that transportation officials at the highest levels need to understand, debate, and accept or reject.

IMPLEMENTATION RESPONSIBILITY

One concern that transportation officials should address as projects are prioritized is identifying the agency that will be responsible for turning the plans into actions. The construction and reconstruction of new highway facilities will probably continue to be the responsibility of TxDOT. DART will probably continue to fund rail transit guideway construction. It is, therefore, the high-occupancy vehicle lane element of the recommended system that does not have a designated lead agency. HOV facilities are a significant part of the recommended system in the Dallas System Planning Study, and their implementation is important to the successful operation of the Dallas area transportation system in the future.

Successful implementation will require that the area agencies continue to work in a cooperative manner so that the transportation improvements can be consistent with the limited area-wide funding. Limits on funding may mean that not all elements recommended for a corridor can be implemented, but with a cooperative project development process, the shortfall in person movement capacity from one element or mode may be addressed in another element.

REFERENCES

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