Appendix D

Value Pricing (HOT Lanes) White Paper

white paper

High-Occupancy Toll Lanes

prepared for

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High-Occupancy Toll Lanes
White Paper

Introduction

The purpose of this paper is to summarize available information on High-Occupancy Toll (HOT) lanes. The HOT-lane concept varies in detail from one application to another, but in general refers to High-Occupancy Vehicle (HOV) lanes where Single-Occupancy Vehicles (SOV) are permitted access for a fee. Actual experience with HOT lanes in the United States is limited, but projects that have been implemented have been the subject of substantial research and evaluation. Numerous studies to assess the feasibility of HOT lanes currently are being conducted around the United States. HOT lanes can be considered part of the broader concept of value pricing.

The Value Pricing Pilot Program authorizes value pricing projects under TEA-21. This program permits Federal Highway Administration (FHWA) to enter into cooperative agreements with up to 15 state or local governments or other public authorities to establish, maintain, and monitor value pricing projects. According to FHWA's report to Congress on the Value Pricing Pilot Program, value pricing "is a market-based approach to traffic management which involves charging higher prices for travel on roadways during periods of peak demand. Also known as congestion pricing, or road pricing, value pricing is designed to make better use of existing highway capacity by encouraging some travelers to shift to alternative times, routes, or modes of transportation." Any value pricing project may involve tolls on Interstate highways. States are allowed to permit SOVs in an HOV lane if the vehicles are part of a value pricing project as authorized by TEA-21.

This paper will include the following information:

- Background of value pricing and HOT-lane proposals in Minnesota;
- Description of existing HOT-lane projects;
- Findings from existing HOT-lane projects;
- Description of proposed HOT-lane projects;
- Potential benefits of HOT-lane projects; and
- Potential obstacles to HOT-lane projects.

Background

Since the passage of ISTEA in 1991, Minnesota has undertaken several initiatives designed to re-examine its reliance on state and federal motor-fuel tax revenues to fund transportation infrastructure projects. In 1993, the Legislature authorized Mn/DOT and other road

authorities to solicit proposals for development and operation of toll facilities within their jurisdiction, subject to the approval of the Commissioner of Transportation. Based on 1994 legislation, Mn/DOT and the Metropolitan Council conducted a joint study of road pricing and mileage-based fees for road usage. This study was conducted by Wilbur Smith Associates and SRF Consulting Group, and was completed in 1997. The study looked at a range of road pricing options; conducted an evaluation of those options, including a financial analysis; and identified criteria for future demonstration and testing. In 1995, state legislation required Mn/DOT to consider alternative financing options for all projects valued over $10 million.

The *Toll-Lane System Preliminary Feasibility Study* was a follow-up study to the Road Pricing Study, and also was conducted by Wilbur Smith Associates and SRF Consulting. This report was submitted to Mn/DOT and Metropolitan Council in early 1998 and provided a preliminary feasibility analysis of a toll-lane system in the Twin Cities metropolitan area. Two major elements of this program were:

1. Creation of a HOT-lane system that would permit SOVs to use existing and planned HOV lanes for a fee; and

2. Permitting SOVs to use HOV ramp meter bypass lanes for a fee.

Market research was conducted using focus groups and stakeholder interviews. Objectives of the research were to gauge public acceptance of these alternatives and determine what actions were needed to communicate with the public.

The report examined seven alternatives that presented various combinations of HOT lanes, HOV lanes, and ramp meter bypass alternatives. Under all of the options, the existing HOV lanes on I-394 and I-35W were to be converted to HOT lanes. Operational and financial analyses were conducted as part of this report, as well as an assessment of public opinion and acceptance.

Key findings from the technical portion of the study were identified as follows:

- HOT lanes have the potential to guarantee toll revenue at levels above the cost of implementation and operation of the required electronic toll system;

- HOT lanes reduce congestion in the unrestricted, general purpose lanes;

- HOT lanes preserve HOV-lane concepts;

- Ramp meter bypass buy-in traffic impacts are inconclusive and require further study; and

- A demonstration/pilot program study of the concept is required to evaluate various design and operational issues.

The legislature authorized a HOT-lane demonstration project on the I-394 HOV lanes in 1997 and the project was scheduled to start that summer. However, the Commissioner eventually withdrew Mn/DOT approval after public opposition to the project surfaced.

Mn/DOT currently is conducting a value pricing study under the FHWA's Value Pricing Pilot Program. A Value Pricing Advisory Task Force has been formed to provide overall guidance in developing value pricing proposals, to review various proposals that are developed, and to help build constituent support.

Mn/DOT currently is reviewing the effectiveness of its HOV lanes and has incorporated an analysis of HOT lanes into this project. The remainder of this paper will review HOT-lane experience elsewhere and discuss the applicability of the concept in Minnesota.

HOT-Lane Experience

This section includes a review of three HOT-lane applications in the United States. Represented are three different approaches to HOT-lane implementation and operation.

1. SR-91 Orange County, California – HOT lanes were added as new capacity to this congested freeway. A private corporation received a franchise to develop, operate, and maintain the HOT lanes.

2. I-15 San Diego County, California – HOV lanes were converted to HOT lanes and are operated by a toll authority.

3. I-10/U.S. 290 Houston, TX – As a result of congestion, HOV lane carpool requirements were increased from two to three or more passengers. Carpools with two persons were permitted to use the lanes for a fee, while three or more person carpools continue to use the lane for free.

Both California projects have been in operation for several years and have been the subject of major evaluation efforts. The Texas HOT lanes went into operation more recently and, as a result, more limited data are available.

SR-91 HOT Lanes (ExpressLanes)

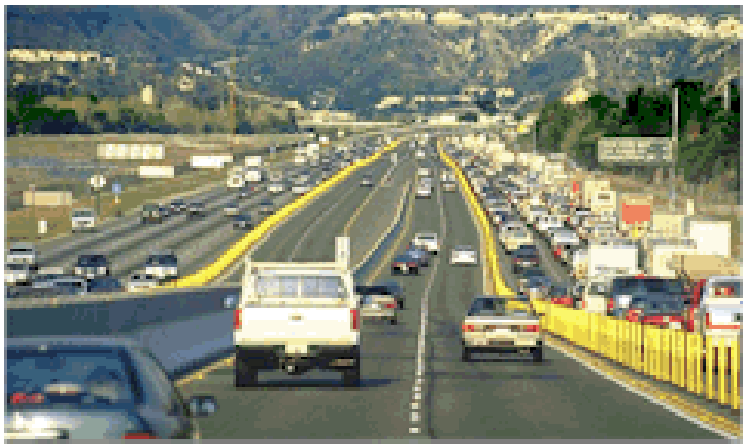
The SR-91 ExpressLanes, which opened in December 1995, represent the first application of value pricing in the United States. SR-91 links rapidly growing residential areas in Riverside County with major employment centers in the coastal areas of Orange County. As a result, this was one of California's most congested freeways carrying over 190,000 vehicles per day that were experiencing 30- to 45-minute delays over the 10-mile stretch of SR-91 in eastern Orange County. The SR-91 project was one of four private toll road ventures authorized by the California Legislature in 1989. A franchise agreement was signed between CalTrans and the California Private Transportation Corporation (CPTC) in 1990 for construction, operation, and maintenance of two toll lanes in each direction in the median of SR-91 between the SR-55 interchange in Orange County and the Riverside-

Orange County line, a distance of approximately 10 miles. The franchise period is 35 years, after which ownership reverts to the state of California. The capital cost of the project was $134 million, or $3.5 million per lane mile. This relatively low cost was achieved due to the availability of right-of-way within the median. Figure 1 shows the location of the SR-91 toll road within the region.

Figure 1. SR 91 Toll Road Location

There is no intermediate access to or egress from the toll lanes. There were also no alternate routes when the toll lanes began operation as the roadway cuts through a mountain pass; however, a parallel route has since been constructed. This parallel route, the Eastern Corridor, is also a toll road. The SR-91 toll lanes are separated from the non-toll lanes by a painted buffer and pylons. As shown below in Figure 2, this system is highly effective in providing separation, but still permits access/egress by emergency vehicles when required.

Figure 2. SR 91 ExpressLanes



All fares are collected electronically, using the FasTrak system in use on other Orange County freeways. Fares vary by time of day in order to maintain free flow in the lanes. Current fares range from a low of $1.00 to maximums of $4.75 for p.m.-peak eastbound traffic and $3.60 for a.m.-peak westbound traffic. The current westbound toll schedule, shown in Figure 3, illustrates the frequency with which fares are modified to maintain free flow. The fare at any given time is displayed on Variable Message Signs.

All users of the SR-91 ExpressLanes must have a valid FasTrak transponder. As of early 2000, there were 124,000 transponders distributed for the ExpressLanes. These transponders are interoperable with other toll roads in Orange County. Originally, three or more carpools were permitted to use the road for free, but they are now charged half-price. Three or more carpools must travel through the toll readers in a separate lane, where California Highway Patrol (CHP) enforcement personnel can confirm the number of passengers from an observation booth. Motorcycles also are permitted to use this lane and receive a 50 percent discount. Violators in both the three or more lane and the regular toll lanes have their license plates photographed as they pass the toll readers. Citations are issued by the CHP, and are sent by mail to violators who do not have a valid transponder. Fines for not having a valid transponder are $100 for the first offense, $250 for the second offense, and $500 for subsequent offenses within a year.

Large commercial vehicles are not allowed in the ExpressLanes. The following explanation is taken from the SR-91 customer web site. "The only oversized vehicles that are allowed on the 91 Express Lanes are motor homes and buses. Large trucks may not use the Express Lanes for several reasons: 1) Caltrans has approved a maximum vehicle weight of 10,000 pounds for the 91 Express Lanes; 2) under California law, a variety of vehicles – including vehicles towing a trailer, and trucks with more than two axles, may only use the right two lanes of a four-lane limited-access highway such as the 91 freeway. Therefore, these vehicles may not use the 91 Express Lanes, and; 3) most larger trucks

Figure 3. SR-91 Westbound Toll Schedule

Time	Day						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Midnight				1.00			
1:00 a.m.				1.00			
2:00 a.m.				1.00			
3:00 a.m.				1.00			
4:00 a.m.		1.90					
5:00 a.m.		3.20				3.10	
6:00 a.m.		3.30				3.20	
7:00 a.m.		3.60				3.50	1.45
8:00 a.m.	1.45	3.30				3.20	1.70
9:00 a.m.	1.45	2.65					2.05
10:00 a.m.	2.05	1.70					2.05
11:00 a.m.	2.05	1.70					2.30
Noon	2.05	1.70					2.30
1:00 p.m.	2.30	1.70					2.30
2:00 p.m.	2.30	1.70					2.30
3:00 p.m.	2.30	1.70				2.05	2.30
4:00 p.m.	2.45	1.70				2.05	2.45
5:00 p.m.	2.45	1.70				2.05	2.45
6:00 p.m.	2.45	1.70				2.40	2.05
7:00 p.m.	2.05	1.00				1.70	
8:00 p.m.	2.05	1.00					
9:00 p.m.	2.05	1.00					
10:00 p.m.		1.00					
11:00 p.m.		1.00					

using the 91 freeway must stop at one of the weigh stations located near Weir Canyon Road, which is not accessible from the 91 Express Lanes. Therefore, trucks required to stop may not use the Express Lanes."

CalTrans has funded significant research in the corridor to measure the impacts of the toll lanes, including both "before" and "after" studies. The most recent evaluation report was prepared by Edward Sullivan of Cal Poly State University at San Luis Obispo and issued in December 2000. It covers the period through mid-1999. Some of the major findings of that report are listed below:

- The Express Lanes reached a peak ADT of 33,000 in 1998 three years after the December 1995 opening, representing 14 percent of total ADT. This volume represented 85 percent of the growth in corridor traffic during that period. It is estimated that about 20 percent of the traffic that shifted to the ExpressLanes in the first year after opening were returning to the freeway from parallel city streets. Overall traffic on SR-91 increased from 190,000 to 200,000 ADT to 220,000 to 230,000 ADT between the period prior to the 1995 ExpressLanes opening and 1999.

- No parallel freeway corridor existed at the time the ExpressLanes opened. However, a parallel toll road, the Eastern Transportation Corridor, opened in 1998. In the six to eight months following the opening, traffic on the SR-91 ExpressLanes dropped from 33,000 ADT to 24,000 ADT and then stabilized.

- There is a strong correlation between ExpressLane usage and time savings. Over the period of evaluation, the percentage of travelers using the express lane ranged from seven percent of total freeway volume in the mid-day peak when time savings were minimal to around 35 percent in the heaviest p.m.-peak hour.

- Typical p.m.-peak delays on the SR-91 freeway prior to opening of the ExpressLanes were in the range of 30 to 45 minutes (time in excess of free flow condition). In the six months following the opening, delays in the free lanes were reduced from five to 10 minutes. Over a three-year period, they gradually climbed back to about 30 minutes.

- Fine-tuning of the toll structure had a significant impact on peak-period behavior. Originally, a single toll rate was charged for the entire period between 3:00 p.m. and 7:00 p.m. This resulted in a very pronounced peak at around 5:00 p.m. After tolls were adjusted on an hourly basis (see Figure 3) peak demand began to spread out.

- Initially no toll was charged for three or more person carpools. Immediately after opening, there was a dramatic increase in three or more person carpools of over 40 percent. After the 50 percent toll for HOVs was implemented in 1998, about one-third of HOV traffic moved back to the free lanes. Most of this shift occurred during off-peak and at the edges of the peak periods.

- It appears that the ExpressLanes had no impact on either the number of HOV two commuters or on patronage of the Inland Empire-Orange County (IEOC) commuter rail line serving the corridor.

- The percentage of SR-91 corridor commuters who use the ExpressLanes at least some of the time increased from 28 percent to 42 percent in the first three years of operation.

- In the first year after opening, more SOV commuters shifted to HOVs than vice versa. HOV commuters are more likely to choose the ExpressLanes, due in part to the opportunity to split tolls and in part to the travel time savings achieved.

- Discounts are provided to those who use the lane more than 20 times per month. Only about 12 percent of transponder owners take advantage of this option.

- As expected, the primary reason for using the ExpressLanes is travel time savings. About one-third of users gave other reasons, primarily driving comfort and safety. These two reasons are those cited primarily by drivers who pay to use the lane during off-peak periods. About 58 percent of ExpressLane users felt ExpressLanes were safer than the free lanes, while 14 percent felt they were less safe.

- The 1999 study data showed that propensity to use the ExpressLanes increased significantly with income. Approximately 20 percent of those in the under $40,000 annual-income category used the express lanes, compared to 25 percent in the $40,000 to $60,000 category; 40 percent in the $60,000 to $100,000; and 50 percent in the $100,000+ category. A significant drop occurred in usage from 40 percent to 25 percent by the $40,000 to $60,000 group between 1996 and 1999.

- Female SOV drivers have a much higher propensity to use toll lanes, nearly 50 percent compared to fewer than 30 percent for SOV male drivers. Middle-aged drivers are more likely to use the express lanes than younger or older drivers.

- Approval of toll financing in general remained in the 50 percent to 75 percent range during the first three years of operation. However, approval for variable tolls by time of day dropped from the range of 55 percent-75 percent to 30 percent-50 percent over the same period. This probably reflects the sharp increase in peak-hour tolls that was required to maintain free flow. These opinions did not vary significantly by income, except for those over $100,000 annually, who were more favorable toward variable tolls.

- Approval of the idea of private, for-profit toll roads declined significantly in the corridor over the first three years of operation. This is due in part to public relations problems and press coverage related to the CPTC's efforts to sell the business to a private non-profit corporation. Charges of irregularity, investigations, lawsuits, and threatened lawsuits all contributed to this change.

- Revenue increased over the first several years, and then dropped slightly after the opening of the Eastern Transportation Corridor. However, toll increases mitigated most of the impact of the 25 percent decline in traffic volume. Table 1 shows the four-year pattern of operating expenses and revenues. CPTC reported that, in 1998, it began generating adequate revenue to begin paying back capital construction expenses.

Table 1. SR-91 ExpressLanes Revenue and Operating Cost

Year	Total Revenue	Total Operating Expenses
1996	$ 7,100,000	$6,300,000
1997	$13,900,000	$9,100,000
1998	$20,100,000	$8,700,000
1999	$19,500,000	$9,100,000

- The price elasticity calculated for the combined a.m. and p.m. peak periods (six busiest hours) was –0.7 to –0.8 (10 percent toll increase results in seven percent to eight percent decrease in usage). This appears to be slightly higher for the single peak hour, where toll rates are highest.

- The toll lanes did not have a significant impact on accidents on SR-91 itself, either in the toll or the free lanes. Accident rates dropped after opening, but this may have been due to the higher rate that was experienced during construction. There were increases in accidents rates on some adjacent sections, particularly in Riverside County. While the results are not conclusive, this may have occurred due to the increased volume of traffic traveling to or from SR-91 during peak periods.

The unique financial and management arrangement of the SR-91 ExpressLanes will continue to provide useful information to others considering HOT-lane and value pricing projects.

I-15 HOT Lanes

The I-15 HOT lanes represent a very different approach than SR-91. Rather than new construction, the HOT lanes on I-15 were originally constructed as HOV-only lanes, and were converted for HOT lane use. The system consists of two reversible lanes constructed in 1988 along an eight-mile stretch of I-15 about 10 miles north of San Diego. This corridor serves approximately 250,000 ADT, and rapid traffic growth is projected to continue in the corridor. Figure 4 shows the I-15 HOT Lanes project corridor. The lanes are separated from the mainline by a permanent barrier as shown in Figure 5.

Lanes were originally opened for southbound traffic between 5:45 a.m. and 9:15 a.m., and to northbound traffic between 3:00 p.m. and 7:00 p.m. Hours have been extended to 11:00 a.m., and the lane now opens for afternoon traffic at 1:00 p.m.. Lanes are closed on weekends and holidays. The HOV lanes were underutilized, leading to a proposal by the San Diego Association of Governments (SANDAG) to create a HOT lane under the U.S. DOT's Congestion Pricing Pilot Program. The program provided approximately $8 million over a three-year period, which was matched by $2 million of state funds. The original three-year period of the demonstration ended in 1999, and was subsequently extended by the Legislature.

The first phase of the project, called *ExpressPass*, was implemented in December 1996. During this phase, SOV drivers were permitted to use the lane with purchase of a permit. The permit allowed the user unlimited use of the lane for a flat monthly fee, which was initially set at $50 and then raised to $70. Color-coded windshield stickers were provided as proof of purchase, and visual inspection by CHP personnel was used as the enforcement method. After a six-month period, the stickers were replaced by electronic transponders. Permits were increased slowly during this period, since state-enabling legislation required that level of service 'C' be maintained in the lane. At the end of this phase of the project, 1,000 ExpressPass permits had been sold.

Figure 4. I-15 HOT Lanes Corridor Map

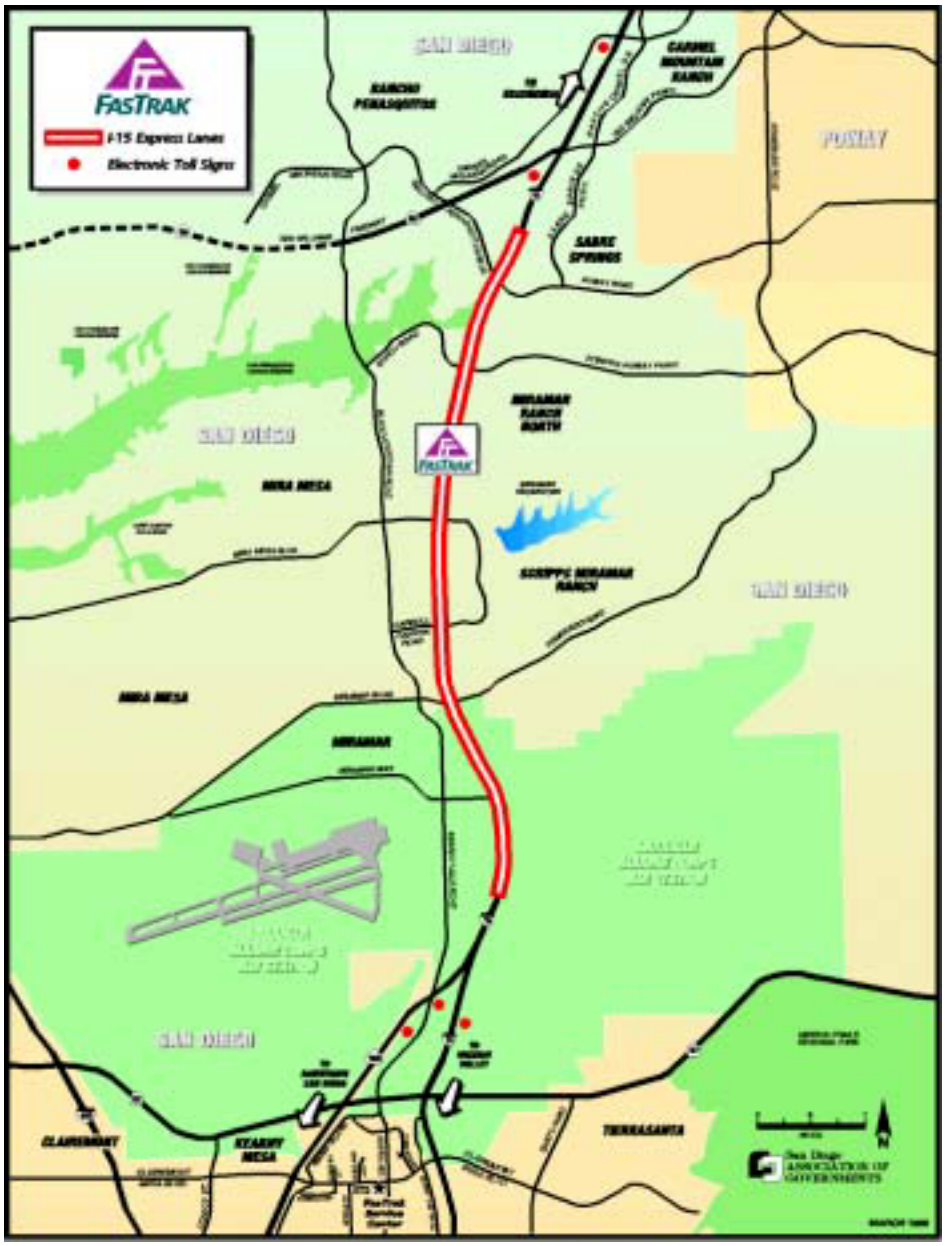


Figure 5. I-15 FasTrak Lanes

In March 1998, the second phase of the project, known as "FasTrak," was initiated. The flat rate monthly fee was replaced with a per-trip toll. Published toll rates currently range from $0.50 at periods of lowest demand to $4.00 during the highest peak hour. However, tolls can be varied based on the level service in the FasTrak lanes, and can be raised to as much as $8.00 during periods of severe congestion. Electronic signs in front of HOT-lane entrances provide advance notice of the toll as motorists approach the lane. One of these signs is shown in Figure 6.

Figure 6. I-15 FasTrak Dynamic Message Sign

Throughout the demonstration period, two or more HOVs and motorcycles have continued to use the lanes without transponders. SOV users go through a separate lane to have their transponder verified by a reader. A CHP officer is generally stationed in the toll zone for enforcement purposes. The officer has an electronic monitor available to identify toll violators and watches for carpool violations.

The project's stated primary goals were: 1) to maximize use of the existing I-15 Express Lanes; 2) to fund new transit and HOV improvements in the I-15 corridor; 3) to test

whether allowing solo drivers to use the Express Lanes' excess capacity can help relieve congestion on the I-15 main lanes; and 4) to use a market-based approach to set tolls.

An ongoing evaluation effort by San Diego State University indicated that these goals have been achieved. Some of the major conclusions of this evaluation were:

- Revenue from the project, $1.6 million per year, has been adequate to fund operating expenses and also has provided funds for a new express bus service called the Inland Breeze. Analysis of ridership on this service indicates that it primarily serves a transit-dependent market and has not yet attracted choice riders.

- Contrary to some expectations, HOV usage increased in the corridor; although it declined slightly after implementation of the FasTrak system. Overall, HOV usage increased from 7,700 vehicles daily to 13,000 during the first three years of the demonstration. Total traffic in the lanes increased from 9,400 vehicles daily to 17,500. About 25 percent of HOT lanes users are SOVs, or about 4,500 daily. Approximately 24,000 transponders have been issued.

- FasTrak was considered successful in distributing volume away from the peak period toward the edges of the peak and free flow traffic has been maintained.

Under worst traffic conditions, FasTrak users save about 20 minutes of delay (increased travel time over free flow conditions) over the 10-mile length of the corridor. However, there has been a slight reduction in congestion on the main lines of I-15 due to a shift of volumes from the middle of the peak to the edges of the peak.

- Detailed studies of enforcement effectiveness were conducted. About $300,000 was spent on enforcement activities of the CHP during the first three years of the project. CHP had an active presence in the HOT lane between two and five days per week and between 100 and 300 hours per month. This was greater than the level of enforcement prior to HOT-lane implementation and, as a result, SOV violation rates were reduced substantially during the course of the demonstration period, from 15 percent to about five percent. The ability to fund more effective enforcement was made possible by project revenue. Enforcement activities generated about $100,000 in citations over the three-year period. Although enforcement did not pay for itself through citations, it was necessary to maintain the integrity of the program. The report concluded that additional expenditures on CHP enforcement would have diminishing returns, and that a system relying on both CHP and camera enforcement should be considered.

- Surveys show that the majority of FasTrak users support the per-trip pricing concept and their acceptance increased over time. They were willing to pay higher tolls in order to keep the lane uncongested. Travelers on the main line also supported the program, although less decisively than FasTrak users; and both groups agreed that the program was fair to all users.

- Surveys indicated that users of FasTrak tend to be from higher-income groups, were more highly educated, were more likely to be middle-aged females, and come from two or more vehicle households.

The I-15 demonstration has generally been successful in meeting its objectives. The HOT lanes are more effectively utilized than the original HOV lanes. Increased usage comes not only from SOV buy-in, but from increased HOV usage as well. Funds collected have provided for improved enforcement and have funded additional transit service in the corridor.

The success of this program has led SANDAG, CalTrans, and the Metropolitan Transit Development Board (MTDB) to cooperate on a more ambitious "Managed Lane" (ML) project in the corridor. The ML project will incorporate the existing HOT-lane segment and extend another 12 miles to the north. The major elements of this project include:

- Construction of four median, barrier-separated lanes for the length of the corridor. This would involve adding two lanes to the existing segment and adding four to the northern end of the corridor. The lanes would have a moveable barrier system, so that three lanes would be provided in the peak direction and one in the off-peak direction. The HOT lane pricing scheme will incorporate both peak direction and off-peak direction traffic.

- A continuous 20-foot enforcement shoulder will be provided along the length of the project.

- The MLs will be in operation 24 hours per day, seven days per week.

- Unlike the existing HOT lanes, there will be intermediate access/egress points with separate ramps for HOVs and transit vehicles. SOV drivers buying into the lane may be allowed to use these ramps, but this has not been decided.

- A Bus Rapid Transit (BRT) system will be incorporated into the corridor with stations and park-and-ride lots at access points.

- An improved communications backbone will be provided and real-time traffic information will be offered, so that SOV drivers can determine the benefits of using the lanes.

The first phase of this project is scheduled for completion by 2004, with 2012 as the goal for completing the entire project. Most of the $200 million required for the first phase has been committed, but funding will be a continuing challenge in finishing the project.

I-10 Katy Freeway

The Katy Freeway (I-10) is one of the busiest and most congested corridors in the Houston area. The HOV lane is a 13-mile single reversible lane that originally opened in 1984. It was successful enough in attracting buses and carpools that congestion began to occur in the lane by 1988. At that point, Houston METRO, the operator of the lane, restricted use to three or more carpools only. The number of carpools dropped by half and speed returned to free flow. However, the number of people moved in the lane was reduced by 30 percent. In order to increase the number of people served, METRO used a Pilot

Program, known as QuickRide, to permit two or more carpools to buy their way into the lane for a $2 per trip fee. Three or more carpoolers are free. Transponders are required for two or more carpools, and approximately 650 users signed up in the first year after the program began in January 1998. Actual usage is estimated at about 150 to 200 daily during both peak periods. This indicates that, on any given weekday, about 25 percent of transponder owners actually use the lane. Initial surveys indicated that about five percent of Transponder owners use the lane five days per week. While the overall impact has been modest, HOV usage overall has increased and most of the QuickRide users are commuters who formerly used the SOV lanes.

The lane currently operates inbound from 5:45 a.m. to 11:00 a.m. and outbound from 2:00 p.m. to 8:00 p.m. The QuickRide program is only in effect from 6:45 a.m. to 8:00 a.m. and from 5:00 p.m. to 6:00 p.m. At all other times that the lane is open, two or more carpools are permitted. This project is, therefore, a very limited experiment to control volume during the period of highest usage.

Other HOT-Lane Projects Proposed and Under Study

A number of other cities are considering implementation of HOT lanes projects, either through new construction or through conversion of HOV lanes. Studies include evaluation of HOT lane options on specific facilities. These include U.S. 101 in Sonoma County, California, where a recent study found that addition of a single reversible HOT lane in the median would be more effective in reducing congestion in the free lanes than an HOV option. The revenue generated would be adequate to support operating expenses and pay a portion of the capital cost. A study of the LBJ Freeway (I-635) in Dallas showed that without pricing 20 lanes would be required to meet demand. A pricing option with eight free lanes and six priced lanes was selected as a more feasible option to meet the needs in the corridor. A number of more general studies of value pricing options are underway similar to the one now underway in Minnesota, including projects in Atlanta, San Francisco, Portland, New York/New Jersey, and Seattle.

Potential Benefits of HOT Lanes

Limited experience has shown that HOT lanes can provide benefits to both the traveling public and operating agencies. These benefits include:

- Increased usage of HOV lane – The "empty lane" syndrome associated with HOV lanes continues to be a public relations headache for many transportation agencies, including Mn/DOT. Resentment among motorists who are unable or unwilling to carpool tends to increase, along with the speed differential between the general lanes and the HOV lanes. The hostility of this constituency can make it very difficult to obtain political support for new construction that only provides HOV lanes. HOT lanes have been successful in helping agencies to address these issues. HOT lanes have increased both usage of the HOV lanes and overall throughput on the roadway. So far, they have done so without reducing the incentive to rideshare. It should be

noted that all three applications discussed above are on freeways that are among the busiest and most congested in the United States, all carrying in the range of a quarter million vehicles daily.

- Reduced congestion in non-HOV lanes – On SR-91 capacity was added to accommodate the HOV lane, with a significant positive impact on non-HOV-lane congestion. Over time, congestion returned, but has still not reached previous levels. On I-15, a small impact on general usage lanes has been noted. It is clear that this impact will differ depending on local conditions, particularly the level of latent demand and the availability of alternate routes. Each proposal must be carefully analyzed if this is an objective.

- Overall optimization of facility usage – Both the SR-91 and I-15 HOT lanes have resulted in overall improvements in speed and throughput. Impacts on air quality and safety cannot be clearly identified.

- Peak demand spread over longer period – Variable pricing based on time of day (SR-91) or time of day and volume (I-15) has proven effective in shifting demand and maintaining free flow on HOT-lane facilities. Operating agencies have been able to experiment with different toll structures successfully to meet this objective. It is important that operating agencies have the maximum flexibility possible to make these adjustments and be able to explain their policies effectively to customers.

- Additional revenue to pay for transportation improvements – The Inland Breeze bus service along I-15 provides a good example of how HOT lanes can generate revenue to improve alternate modes of transportation. Many agencies are facing major reconstruction costs for existing freeways; the HOT-lane concept provides one potential source of revenue to fund some of these very expensive projects. It should be noted that the SR-91 project was able to add capacity very inexpensively due to the availability of right-of-way in the median and the lack of major bridge construction. HOT lanes will provide adequate revenue to fund operations and possibly pay for a portion of capital expenses, but it is not realistic to anticipate that revenue will support major construction projects that cost hundreds of millions of dollars.

- Customers make their own decisions regarding the tradeoff between money and time – While providing more choices can generally be considered a positive benefit, this must be balanced against equity concerns. The importance of this benefit needs to be debated locally in each area that considers HOT-lane implementation.

Potential Obstacles to HOT-Lane Conversion

As previously discussed, the three corridors with active HOT-lane projects are not typical U.S. urban freeway corridors. Besides experiencing very severe congestion and exceptionally high volumes, they all have barrier-separated lanes and had existing toll infrastructure in place in the region. These differences must be noted in considering HOT-lane implementation in Minnesota.

- Need to implement toll structure – Both California and Texas had existing toll infrastructure being put in place at the time their HOT lanes were implemented. Toll infrastructure requires significant up-front investment in electronic equipment, communications, accounting software and personnel, public information, and management. This investment will be more cost-effective if it is spread over a larger regional toll system. Also, customers are more likely to obtain transponders if they can be used on other toll facilities in the region. The feasibility of HOT lanes in Minnesota will be impacted by the ultimate size of a toll system in the region. If this system is very limited, the investment in infrastructure for HOT lanes may not be very cost-effective.

- Potential opposition to tolls or variable pricing – Tolls and variable pricing have been accepted reasonably well in southern California and Texas. At one time, tolls were not accepted in these areas, but their popularity has increased due to increased congestion and limited available funding for transportation system maintenance and improvement. It appears that users are more willing to accept tolls if they have a clear understanding of how funds are being spent. Since Minnesota has traditionally not had toll roads, significant public relations efforts will be required to implement even a limited HOT-lane program.

- Safety concerns – With the exception of a limited portion of I-394, existing HOV lanes in Minnesota are concurrent and not separated from the other lanes of traffic. Weaving, speed differential between HOV and general lanes, and incident response and clearance are already concerns. Implementation of HOT lanes without barrier separation would increase safety concerns by placing more traffic in the inside lane. While the previous HOT-lane study conducted for Mn/DOT and Metropolitan Council indicated that safety concerns could be adequately addressed, more detailed traffic and safety analysis would be required.

- Enforcement – Enforcement is one of the major concerns in implementation of HOT lanes. It is important to note that, in all of the existing applications described above, the lanes are separated by a barrier from the general lanes and there are no access/egress points along the way. This enables enforcement activities to be conducted safely and from a single point, greatly reducing expenses. SR-91 uses both electronic and manual enforcement methods, while I-15 relies primarily on manual enforcement. In both cases, HOT-lane traffic is routed into a single lane to increase the ease of observation and limit the amount of electronic equipment required.

- Without barrier separation, enforcement would be far more difficult and significantly more expensive. The 1998 Minnesota HOT-lane study proposed electronic readers every half mile in order to discourage weaving out of the lane to avoid toll readers. In addition, a minimum charge would be proposed upon entry. Even with these proposals, it is likely that under conditions where congestion exists in the free lanes but not in the HOT lanes, motorists will try to weave in and out to gain a time advantage. This will create safety problems and cut the advantage of the HOT lane. Given the lack of inside shoulder space along much of the proposed HOT-lane right-of-way on I-35W in particular (presenting current enforcement challenges), currently camera enforcement

would be the only safe and cost-effective method of addressing both toll and carpool violations.

- Equity – Equity has been a concern in all HOT-lane applications, represented by the term "Lexus lanes" that has been applied by some opponents. Both California applications indicate that HOT-lane users tend to have higher incomes, although the difference is less pronounced than originally anticipated on SR-91. Surveys conducted for both California projects indicated that equity was not a major concern. Users of the general lanes seemed willing to accept the tradeoff between time and money, and also realized some benefit from SOV users shifting to the HOT lanes. It is clear that equity concerns will differ significantly from one metropolitan area to another. It is important to understand local concerns through an extensive public participation process, preferably supported by market research.

- Negative impact on transit and ridesharing – Negative impacts on transit and ridesharing have not been realized on existing projects. In general, it appears that HOT lanes have increased awareness of ridesharing and led to increase in carpool formation and usage. Impacts on transit appear to have been neutral, but there is limited data to review.

- Availability of alternate routes – The availability of alternate routes can impact the success of HOT lanes and lead to potentially undesirable diversion patterns. This could be an issue particularly on I-394; the I-35W corridor is constrained by a limited number of river crossings.

Additional Study Needs

In order to fully address the feasibility of HOV- to HOT-lane conversion on I-394 and I-35W, additional analysis need would need to be conducted. Any consideration of HOT lanes should include a review of the assumptions and analysis conducted as part of the 1998 regional HOT lanes study. In addition, new technologies and developments in the field since that time would need to be considered. If HOT lanes were to be considered, it is recommended that a study proceed in two separate phases:

1. The first phase would include a technical evaluation of HOT-lane feasibility with regard to physical layout, safety, traffic flow, and enforcement. Preliminary benefit/cost analysis of the system would need to be conducted.

2. If the HOT-lane concept were considered to be feasible, a second phase (including market research, public participation, and further financial analysis) would need to be initiated.

A proposed work scope for the study could include:

1. Working with Mn/DOT and stakeholders identified by Mn/DOT, establish a set of goals and objectives for HOT-lane operation. Establish criteria and appropriate measurements for evaluation of HOT-lane alternatives.

2. Identify potential HOT-lane alternative alignments for conversion of I-394 and I-35W HOV lanes, including different options for lane separation. Identify facility constraints and roadway modifications required to provide safe operation.

3. Identify requirements for developing a toll infrastructure to service the HOT lanes. Included will be start-up, capital, and operating and maintenance costs. Institutional issues related to toll implementation and their impact on costs also would be discussed.

4. Review and adjust models used to estimate HOT-lane diversion in 1998 study, particularly in light of results available from I-15 and SR-91 HOT-lane projects. Revise estimates for I-35W and I-394 HOT-lane conversion. Estimates will include a range of usage based on tolls charged and travel time savings over the regular lanes.

5. Initial alternatives developed under Item 2 will be revised or adjusted, as necessary, based on estimates of usage developed in Item 4.

6. Provide economic analysis for preferred alternatives. Include all costs and revenues associated with value pricing operations, including staff, violation proceeds, customer service center costs, interest income, discount elimination, transponder costs, transponder life cycles, equipment maintenance, and replacement costs.

7. Options for enforcement will be developed and evaluated for cost-effectiveness. Alternatives will include both manual and automated methods of enforcement, in addition to combinations. Required legislation for the various options will be identified.

8. The findings of this effort will be summarized and presented to Mn/DOT. If Mn/DOT decides to proceed with further analysis, a work program will be developed for:

    a. Market analysis;

    b. Public participation process; and

    c. Additional financial feasibility analysis.

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