
Executive Summary

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■ 1.0 Background

On February 22, 2001 the Minnesota State Legislature posted Bill H.F. 1054 (Minnesota Session Laws 2001, 1st Special Session, Chapter 8, Article 1, Section, Subdivision 7(c)) mandating that Mn/DOT conduct a study of how opening the High-Occupancy Vehicle (HOV) lanes on I-394 to general-purpose traffic would impact traffic flow and safety. The legislation provided, however, that Mn/DOT was not required to conduct the study if the Federal Highway Administration (FHWA) ruled that opening the lanes for the study violated U.S. DOT laws and regulations regarding the funding and operation of HOV lanes. In August 2001, FHWA barred Mn/DOT from opening the HOV lanes to all traffic for this study. Federal funds were used to build portions of the HOV facilities and if Mn/DOT decides not to comply with the FHWA guidance, all new federal funding will be withheld for projects in the Twin Cities area. Subsequently, Mn/DOT decided on its own to conduct a study using travel demand modeling and market research methodologies to evaluate the potential impacts of opening the HOV lanes on both I-394 and I-35W without changing actual lane operation. Mn/DOT selected an independent consultant team led by Cambridge Systematics, Inc. (CS) to conduct the study. A Technical Working Group (see Appendix A) was formed to review and provide guidance on project methodology and direction. The committee included representatives from 13 stakeholder agencies in the region.

■ 2.0 Key Findings

- Based on national averages, the HOV lanes are not operating at their full potential over the entire morning and afternoon peak periods analyzed. This situation is expected to improve in the future based on currently available forecasting tools. On average, the HOV lanes are carrying slightly more than half their vehicular capacity and move slightly less people per lane than their adjacent general-purpose lanes during the peak period. Instead of moving twice as many people as the adjacent general-purpose lanes as would be the case with a fully utilized HOV lane, they are carrying slightly fewer people.
- However, when congestion is at its peak, the HOV lanes are typically moving more people per lane than the general-purpose lanes. For example, using the 2nd Quarter 2001 HOV Report, eastbound I-394 at Louisiana during the 7:00 to 8:00 a.m. hour, the HOV lane moves 3,053 people per lane and the general-purpose lanes carry

2,076 persons per lane. As congestion increases over time, the HOV lanes will become more utilized during the peak period.

- The HOV lanes do provide significant travel time, reliability and cost savings to carpoolers and bus riders. The model and market research estimate that between 13 and 25 percent of carpoolers and transit riders in the two corridors will shift to driving alone if the HOV lanes are opened to all traffic.
- Opening the HOV lanes to all traffic is forecast to increase person and vehicular throughput which could result in net positive benefits in travel time, reliability, emissions, and fuel consumption. Even though vehicle miles of travel (VMT) will increase due to the shift of some carpoolers and bus riders to single-occupant vehicle (SOV) status, vehicle hours of travel will decrease due to improved traffic flow in the region. It should be noted that with or without the HOV lane, the levels of congestion forecast for 2020 will be much worse than under current conditions.
- Based on the secondary research, there are more than 2,500 lane-miles of HOV facilities in the U.S. and Canada. This is expected to double within the next 25 years. Opening the HOV lanes to all traffic is contrary to the direction being taken in other cities.
- The HOV lanes currently experience violation rates in excess of national norms, particularly on I-35W where enforcement is hampered by design constraints and high congestion. The highest levels of compliance are found on the barrier-separated sections of I-394.
- Users of the HOV lanes (bus riders and carpoolers) are highly supportive of the lanes with two-thirds to three-fourths supporting continued “as is” operation, and only a small number supporting opening the HOV lanes to all traffic.
- Non-users of the HOV lanes (SOVs) are less supportive with about one-third supporting modifying lane operation and one-third supporting opening the HOV lanes to all traffic.
- The total one-time capital costs of opening the lanes to all traffic is an estimated \$20 million to \$41 million; estimated annualized capital and operating and maintenance (O&M) costs would be \$4.7 million to \$6.4 million per year over 20 years. The major cost variable is whether the I-35W lanes would need to be “bought back” from the federal government as required under current federal rules. Despite these costs, opening the lanes would result in a benefit/cost ratio between 1.56 and 2.11 today. In the forecasted future (2020), the benefit/cost is estimated to be 1.32 with federal buy-back and 1.59 without buy-back costs.
- There is a high degree of confidence in the current model year analysis since it is based on actual field data. However, the future year analysis (2020) is speculative since it is based on a modeling tool which does not fully account for the potential impact of higher regional economic and population growth rates. The regional model is

currently being updated to reflect these growth increases as well as better reflect an integrated, multimodal public transportation system.

■ 3.0 Key Recommendations

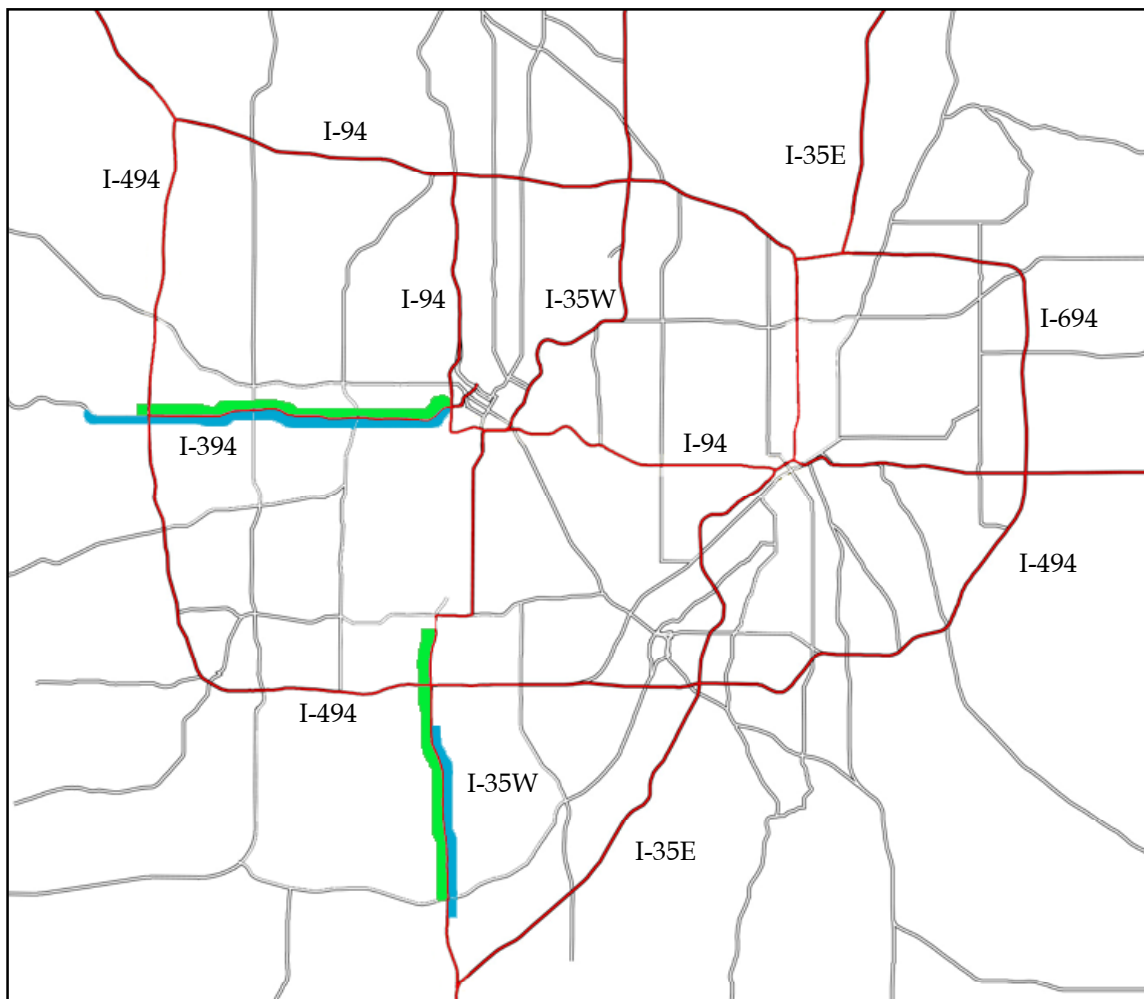
The following actions are therefore recommended:

- The HOV lanes should remain in operation as HOV lanes. Mn/DOT has made a long-term commitment to the development of a regional multimodal transportation strategy which provides Advantages to Transit (and carpooling). There are many strategies and policies in place throughout the region to provide multimodal transportation options, travel time advantages to transit, and ridesharing incentives. Opening the HOV lanes to all traffic would be counterproductive to these policies and strategies. In addition, opening the HOV lanes to all traffic now would make it nearly impossible to reclaim them should future conditions or policies warrant. Finally, it would break faith with the current users of the HOV lane who are highly supportive and do everyone in the region a favor by carpooling and riding the bus.
- Many lessons were learned from this study which can be applied in the future either to the existing HOV lanes (with some challenges), extensions of the existing lanes, or completely new lanes. From the research conducted as part of this study, there are a number of strategies which can be implemented to maintain the goals and policies of the region. These include the importance of barrier separation, effective enforcement, and the development of strategies to ensure that the HOV lanes are fully utilized. There is significant public support for modification of HOV lane operations. One such strategy, among others, which should be fully explored is the HOT (High-Occupancy/Toll) lane concept. While no one strategy is a panacea or without its own drawbacks, Mn/DOT should not settle for the limited choice of leaving the HOV lanes as they are or opening them to all traffic.

■ 4.0 Study Corridors

A high-occupancy vehicle (HOV) lane is a “lane where only high-occupancy vehicles are allowed to operate, which include exclusive bus lanes and bus ways.” On the study HOV lanes (shown in Figure ES.1), carpools of two or more people (2+), buses, vanpools, and motorcycles are permitted. Mn/DOT’s Traffic Management Center (TMC) operates the lanes.

Figure ES.1 Twin Cities HOV System



The I-35W HOV lane operates northbound from Burnsville Pkwy to 86th Street for a distance of 5.7 miles, and southbound from 66th Street to TH 13 for a distance of 7.5 miles. Both directions operate as HOV lanes from 6:00 a.m. to 9:00 a.m. and from 3:00 p.m. to 6:00 p.m. on weekdays. All traffic may use the lanes at other times. The lanes are designated by a “diamond” symbol and are not barrier separated from the adjacent general-purpose lanes. The lanes stop short of downtown Minneapolis.

The I-394 HOV lanes operate eastbound from CR 101 South Junction to I-94 for a distance of 10.4 miles and westbound from I-94 to Carlson Parkway for a distance of 8.8 miles. There are two distinct operational sections. West of Highway 100, the HOV lanes operate in a similar way to the lanes on I-35W as non-barrier separated concurrent diamond lanes, but only operate in the peak travel direction (eastbound in the morning and westbound in the afternoon). Between Highway 100 and I-94, for a distance of 2.7 miles, the HOV lanes operate as reversible barrier-separated lanes. In this section, HOV operation is from 6:00 a.m. to 1:00 p.m. eastbound (toward downtown) and westbound from 2:00 p.m. to

midnight on weekdays. The HOV lanes are also operated on weekends during special events. General-purpose traffic is never allowed in the barrier-separated lanes.

■ 5.0 Objectives and Methodology

The study objectives were as follows:

- Estimate the impacts of opening the HOV lanes to all traffic both in the study corridors and in the region as a whole;
- Compile research regarding the benefits and costs of HOV lanes nationally and on variations of the HOV concept, such as HOT lanes;
- Identify the public's perception of the HOV lanes and the possible reactions of opening them; and
- Report and document the results for the legislature.

The study methodology consisted of the following elements which form the findings section of the report:

- The regional travel demand model maintained by the Metropolitan Council was used to forecast the results on traffic operations and mode split of opening the HOV lanes to all traffic.
- Market research was conducted to assess the viewpoints of study corridor travelers who use and do not use the HOV lanes, as well as the general population of regional commuters.
- Mn/DOT's 2nd Quarter 2001 HOV Report data was used to validate the travel demand model in the study corridors as well as compare various findings.
- Field data was collected on violation rates in the HOV lanes.
- The U.S. DOT's Intelligent Transportation System (ITS) Deployment Analysis System (IDAS)¹ model was used to quantify the benefits and disbenefits of opening the HOV lanes to all traffic based on the output of the regional model; the benefits were then compared to the costs of opening the lanes.

¹ IDAS was developed partially by CS under contract to the U.S. DOT; CS does not derive revenue from the use of IDAS on projects.

- Secondary research was conducted on the operation of HOV lanes elsewhere in the country, including the recent trend toward the development of HOT lanes in which SOVs are allowed to purchase access to the HOV lanes via a toll.

■ 6.0 Violation Rates

Ensuring use of the HOV lanes by authorized vehicles is enforced by the State Patrol and other local agencies. The consultant team conducted violation counts by stationing personnel on highway overpasses on I-394 and by reviewing videotapes of traffic operations on I-35W.

On I-35W, the violation rates in the HOV lanes were 33 percent in the a.m. and 41 percent in the p.m. On the concurrent flow sections of I-394, the violation rates were 19 percent in the a.m. and 24 percent in the p.m. Based on the secondary research (see Section 5.0), typical national violation rates on non-barrier separated concurrent HOV lanes are about 12 percent. Thus, violation rates on these facilities were much higher than national experience, particularly on I-35W. In the barrier-separated HOV lanes on I-394, violation rates were 9.5 percent in the a.m. and 13 percent in the p.m. While much lower than that experienced in the non-barrier separated sections, these violation rates were still higher than national experience, which averaged around five percent.

It is easier to enforce the operation of a barrier-separated HOV lane where vehicles can only enter and exit at a small number of controlled points, compared to a concurrent flow HOV lane where vehicles can dart in and out at will. This problem is compounded on I-35W by the lack of shoulder areas to pull violators over to the left. The State Patrol must pull violators over to the right across the general-purpose lanes, a process which is highly disruptive to traffic flow on a very congested corridor. As a result, there is less enforcement on I-35W than on I-394 – a condition clearly perceived by corridor drivers. Even if shoulder space were available on the left for enforcement, the fact that it is visible to motorists qualifies it as an incident and could create more crashes and increase congestion.

■ 7.0 Modeling Results

The regional highway network and trip assignment process were revised to capture changes in route and mode choice, which could result from opening the HOV lanes to all

traffic under current (2000) and future (2020) conditions². In addition to the opening of the HOV lanes, two other changes were also made in the regional model network:

1. The 2020 analysis included the extension of the I-35W HOV lane north to 46th Street as currently planned by Mn/DOT; for consistency, the “opened HOV lane to all traffic” scenario was then also tested to 46th Street.
2. In both analysis years, bus-only shoulders were added to both corridors, except where not physically possible without major construction, such as on the Minnesota River Bridge on I-35W and on the barrier-separated sections of I-394.³

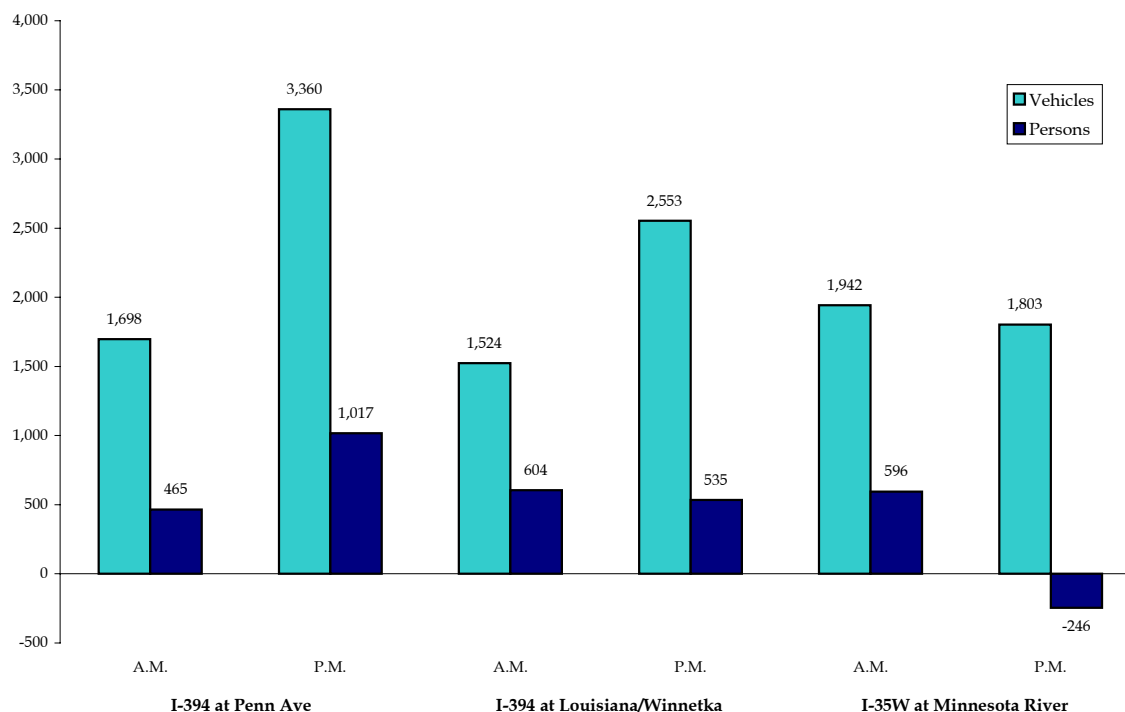
Based on Mn/DOT’s Quarterly Reports for Spring 2001 (the most recent data available), the actual person throughput for both the general-purpose and HOV lanes on both study corridors is around 2,000 persons per lane per hour during the peak periods. Based upon the secondary research, a typical HOV lane carries around 4,000 persons per lane, including buses during the peak hour. The HOV lane eastbound on I-394 at Louisiana carries the most persons per lane during the peak hour (3,053). The I-394 and I-35W HOV lanes are operating at about half of their potential during the peak period, and are processing fewer vehicles than would be the case if opened to all traffic.

Figure ES.2 shows the forecast change in vehicle and person throughput at three bottleneck points for a two-hour period in the morning and three-hour period in the afternoon in the two corridors if the HOV lanes were opened to all traffic today. As shown, both vehicular and person throughput are forecast to increase in most of the corridors if the HOV lanes are opened to all traffic reflecting the current under utilization of the lanes. The increase would be greater in vehicle throughput than in person throughput due to the mode shift from HOVs to SOVs resulting from the removal of the travel time advantage which the HOV lanes provide to carpoolers and transit riders. Thus, there would be an overall decline in average vehicle occupancy and increase in VMT. These increases would in general be greater on I-35W, where the high violation rates are already indicative of system breakdown.

² The 2020 model does not reflect new population growth projections.

³ It should be noted that vehicular operation on the bus-only shoulder is not equivalent to operation in the HOV lanes. Under current Mn/DOT operational rules, buses can only use the shoulders when the speed in the general-purpose lanes is no more than 35 mph; buses can never travel more than 35 mph and can not exceed the actual speed in the general-purpose lanes by more than 15 mph. Actual bus speed in existing shoulder lanes is typically around 25 mph. Also, bus-only shoulders are susceptible to weather- and incident-related disruptions.

**Figure ES.2 Model Change in Vehicle and Person Throughput – Year 2000
(A.M. and P.M. Peak Periods)**



The model forecasts a decrease in the number of carpool and bus person trips in the HOV corridors of between 20 and 25 percent in both study years. It is somewhat higher than the mode shift projected by the market research described below of 13 to 14 percent, but still does not represent a significant enough shift to overwhelm the added capacity if the HOV lanes were opened to all traffic.

The year 2000 modeling results can be viewed with a high degree of confidence, since they reflect actual data – the lanes are currently underutilized. A separate analysis using the 2nd Quarter 2001 HOV Report and the market research findings confirmed the modeling results and projected an even greater increase in vehicle and person throughput if the HOV lanes were opened (see Section 7.0). The 2020 forecasts are speculative. The Metropolitan Council’s regional model was last fully updated and validated based on 1990 (before the operation of the HOV lanes) census and travel survey data. A new model update will be completed in the next couple of years. Several aspects of the regional model could change and impact these findings, such as increased growth forecasts and a more robust regional transit system, thereby resulting in travel behavior changes.⁴

⁴ The Metropolitan Council’s regional travel demand model, like most standard four-step models currently in use in the country, does not explicitly address the controversial topic of induced
(Footnote continued on next page...)

■ 8.0 Market Research

Public opinion surveys were conducted for four distinct market segments:

1. Carpoolers in the study corridors;
2. SOVs in the study corridors;
3. Bus riders in the study corridors; and
4. All peak period commuters in the region.

In general, the results of the carpool and bus surveys were very similar to each other, but very different from the results of the SOV and random surveys, which were also similar to each other. The demographic profile of all of the samples was similar and generally reflected a relatively affluent suburban commuting population. One significant exception was that the carpool and bus samples were much more likely than the SOV and random samples to have destinations in downtown Minneapolis, while the SOV/random samples were more likely to have suburban destinations. The HOV lanes provide the greatest travel time advantage to downtown commuters, and people with suburban destinations are in general less likely to carpool or ride the bus due to the greater dispersion of destinations and the widespread availability of free parking.

Table ES.1 show the response of travelers in the I-35W and I-394 corridors, respectively, to a polling question on the future operation of the lanes. As shown, between two-thirds (I-35W) and three-fourths (I-394) of bus riders and carpoolers support continued operation of the lanes as is. In contrast, only about one-quarter of the SOV and random sample support continued HOV lane operation as is. About one-third of all sample support some type of modification in operation; however, there is not widespread support for any specific modification strategy. Between one-third and one-half of the SOV/random samples support opening the HOV lanes to all traffic. There is little support for opening the HOV lanes to all traffic among bus riders and carpoolers. Clearly, opinions about the value of the lanes vary dramatically between users and non-users. The degree of support for the I-394 lanes are greater than support for the I-35W lanes; this is consistent with the high violation rates on I-35W.

demand. This theory holds that regardless of objective measures of trip generation, new trips will be generated to fill available highway capacity in areas of high congestion. This does happen under certain circumstances but not always. Therefore, the possibility of some or all of the new highway capacity created by opening the HOV lanes to all traffic being absorbed by new, currently unpredicted auto trips needs to be mentioned but cannot be forecast using existing tools.

Table ES.1 Poll by Sample and Survey

Survey	I-35W Sample			
	Continue	Modify	Open Up	Don't Know
Bus	62%	32%	6%	0%
Carpool	67%	29%	4%	0%
SOV	16%	34%	49%	1%
Survey	I-394 Sample			
	Continue	Modify	Open Up	Don't Know
Bus	72%	19%	6%	3%
Carpool	75%	18%	7%	0%
SOV	27%	35%	37%	1%
Survey	Random Sample			
	Continue	Modify	Open Up	Don't Know
	27%	34%	31%	8%

Figures ES.3 and ES.4 show what bus riders and carpoolers, respectively, would do if the HOV lanes were opened to all traffic. Very few bus riders (six to 11 percent depending on the corridor) say they would change modes (they would still have some travel time advantage on the shoulder lanes). Significantly more carpoolers would change modes. On I-35W, 15 percent say they would switch to driving alone, while two percent would shift to bus. On I-394, 16 percent would drive alone and eight percent would switch to bus. As mentioned above, these responses indicate a somewhat lower mode shift than that forecast by the travel demand model.

■ 9.0 Benefit/Cost Analysis

There would be an estimated monetary benefit of about \$10 million today if the lanes were opened to all traffic (see Section 9.0). This benefit is generated almost entirely by regional travel time savings. The total one-time capital costs of opening the lanes is estimated to be between approximately \$20 million and \$41 million, depending on whether it was necessary to “buy back” the I-35W lane from the federal government. Additional costs could result from litigation arising from changing the original EIS assumptions regarding lane operation. All of the dollar values shown are 2001 dollars.

Figure ES.3 Reaction to HOV Lanes Opening Up
Bus Survey

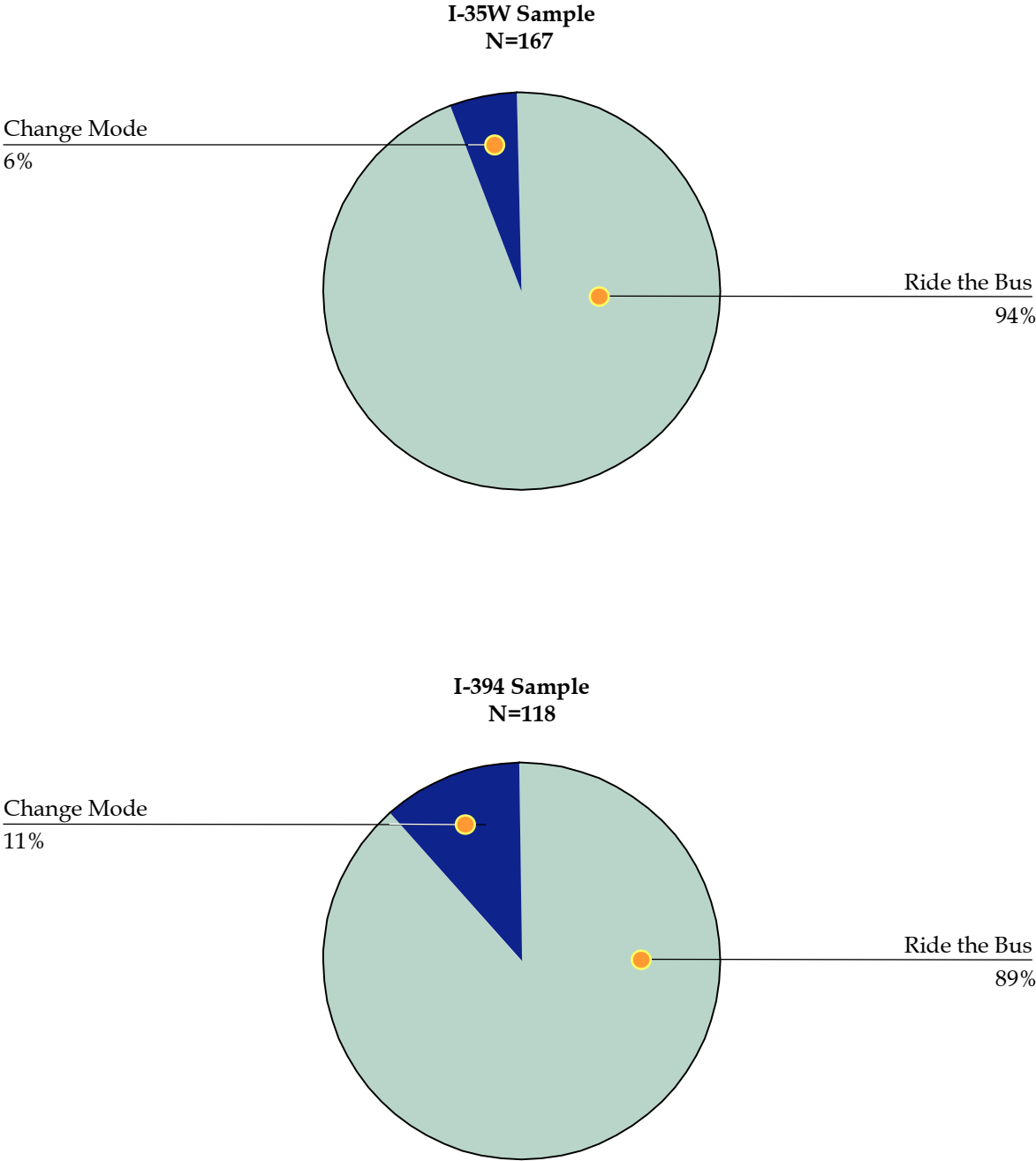
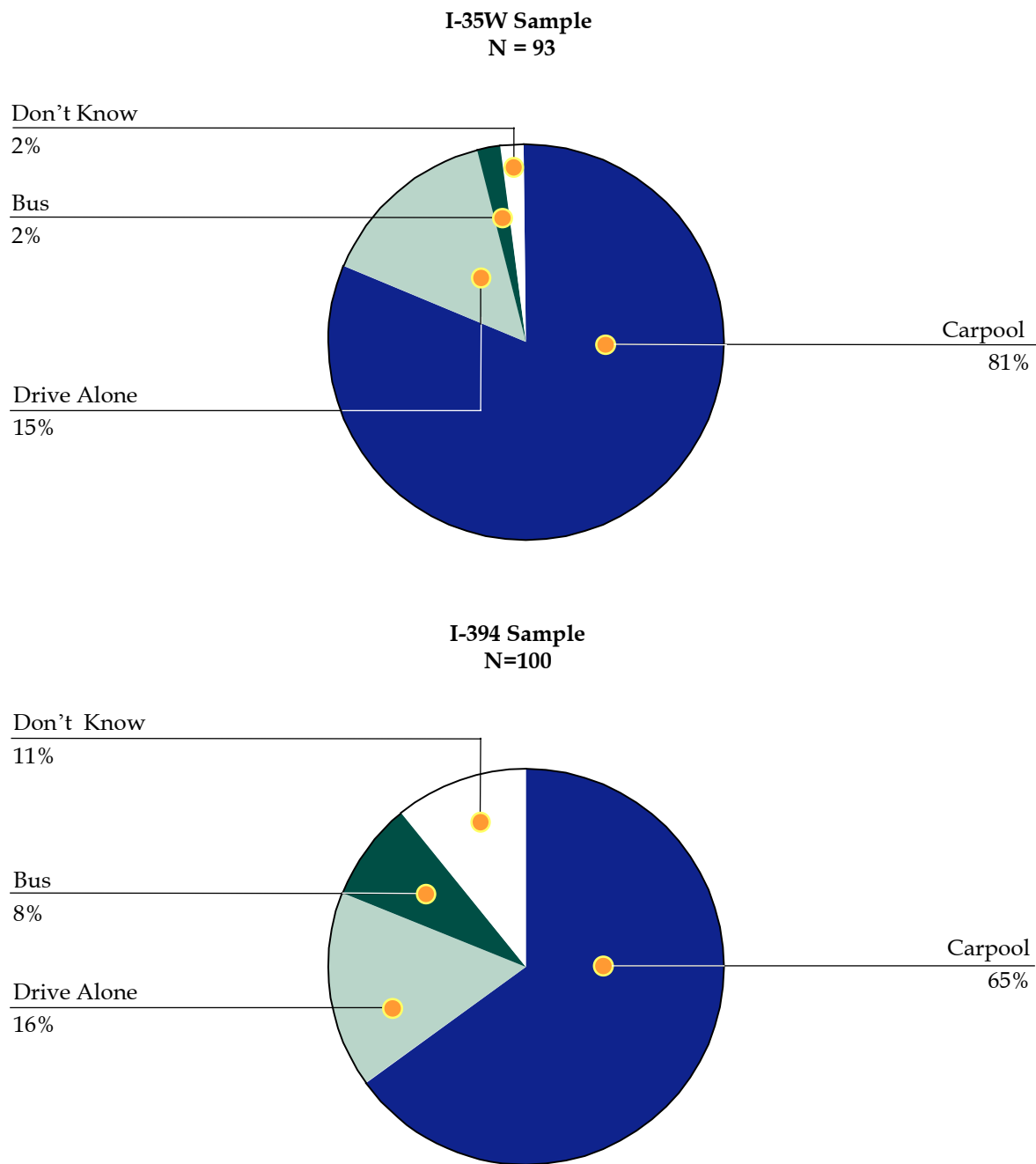


Figure ES.4 Reaction to HOV Lanes Opening Up
Carpool Survey



The annualized capital and operating and maintenance costs of this change would be between approximately \$4.7 million and \$6.4 million over 20 years. The largest single capital cost (aside from the federal buy back) is estimated to be \$9 million for environmental studies on both I-394 and I-35W (or possible litigation). Operating costs are split between foregone federal revenue related to bus operation in dedicated transit facilities, and the costs associated with the operation of additional buses. This results in benefit/cost ratio of opening the lanes of 1.56 (with the federal buy back) to 2.11 without it.

In 2020, the monetary value of opening the expanded HOV system to all traffic is approximately \$13 million (2001 dollars). Due to an increase in the number of buses required in 2020 to maintain headways, the estimated annualized capital and operating and maintenance costs increased from the 2000 values to between \$8.4 and \$10 million per year over 20 years. For 2020, the benefit/cost ratio is estimated to be 1.32 (with federal buy back) or 1.59 (without buy-back).

■ 10.0 Secondary Research

The objectives of this task were to review current trends in HOV deployment across the country and to compare these trends with the operation of HOV lanes in the Twin Cities. Data were collected by reviewing literature and web sites, and interviewing five nationally recognized experts in the field (see Appendix B).

More than 2,500 lane miles of HOV facilities are operated in the U.S. and Canada, a figure which is forecast to double within the next 25 years. There are four basic types of HOV lanes: 1) barrier separated, 2) concurrent, 3) contra-flow, and 4) shoulder lane. The goals of HOV lanes are to increase person throughput and mobility, encourage HOV travel by improving travel performance, improve transit schedule and adherence, and reduce congestion and the externalities it causes in terms of air quality and energy consumption.

Keys to the success of lanes include location (areas of high congestion do better); enforcement; interagency coordination; synergy with parking policy, trip reduction ordinances, and transit and ridesharing programs; public and policy-maker support; and education and marketing. Among the most common challenges faced by lane operators are enforcement (as discussed previously) and the “empty lane syndrome,” in which the public perceives the lane is underutilized because of the number of vehicles in the lane as opposed to the number of people being moved by the lane (which should be the true measurement of its value).

HOT lanes represent an emerging trend in HOV lane deployment in which SOVs are offered the opportunity to purchase access to the lanes via tolls in order to achieve improved utilization of the lanes. HOT lanes can also be a revenue generator often used to fund increases in transit service or other transportation improvements, and allows for the preservation, regulation, and control of traffic speed through variable tools. HOT lanes represent an application of the “value pricing” concept being considered in many parts of the country as a way to apply market discipline to highway usage. The two most prominent

HOT lanes applications have been in California on I-15 in San Diego and on SR 91 in Orange County. Both lanes operate in areas of extreme congestion with generally few alternate routes. Tolls are collected electronically and vary by time of day and/or demand for travel in the lane. The lanes are barrier separated and afford excellent enforcement opportunities. The HOT lanes are heavily utilized, violation rates are low, and the lanes have experienced increasing levels of public acceptance. While SOV rider profiles in the lanes are somewhat more affluent than the general population, this tendency is less pronounced than was expected.

■ 11.0 Conclusions and Recommendations

The debate about the value of HOV lanes should be seen in the larger context of major transportation planning and growth issues in the Twin Cities region. This region, like many urbanized areas outside of the older densely populated Eastern and Midwestern cities, is dominated by SOV travel. It faces two basic types of strategies for mitigating future travel demand: 1) respond to the region's traditional reliance on and demand for SOV travel by building more general-purpose highway capacity; or 2) attempt to alter this pattern by also investing in alternative strategies, such as rail transit and HOV lanes.

Most regions, of course, will ultimately pursue some combination of both strategies with perhaps an emphasis on one or the other. Either strategy can potentially succeed or fail, and the success of each is likely to have different regional mobility outcomes. Some cities have over the past decades opted to try to “build their way out of congestion” with varying degrees of short-term success. Atlanta provides a cautionary lesson about the long-term implications of this strategy. Atlanta is one of the fastest growing human settlements in the history of the world. It has 12 lane freeway sections crossing the downtown. The results are the longest commutes of any U.S. urban area (including Los Angeles), increasing concerns about quality of life and business competitiveness, and failure to meet federal air quality standards resulting in countless lawsuits and the temporary withholding of federal highway funds. Georgia is now undertaking a major investment in rail transit and HOV facilities. Other regions, such as Portland and San Diego, have successfully embraced public transportation despite long histories of auto dependence, while others have not shared in this success.

The data suggests that the Twin Cities would more efficiently process traffic now and in the future (as projected by the current regional travel model) if the HOV lanes were opened to all traffic. Public opinion on the lanes is divided with a high level of support among users and more of a desire for change among non-users. However, none of the survey markets had a majority of respondents in favor of opening the lanes to all traffic. Violation rates are relatively high compared to national experience and enforcement is constrained by design parameters.

Opening the HOV lanes to all traffic involves significant capital and recurring operational costs and raises potentially significant institutional issues involving buy-backs from the

federal government, revised EISs, and potential litigation. Bus-only shoulders are not an equivalent replacement for transit operations as speeds and reliability are lower, and they cannot easily be constructed along all segments of the two corridors. Similarly, the opening of the barrier-separated HOV section of I-394 to mixed traffic, while feasible, is not optimal from an engineering and operational perspective.

Therefore, opening the HOV lanes to all traffic is a complicated operational and policy matter. More importantly, opening the HOV lanes to all traffic will also contribute to pointing the region toward reliance on future highway construction and expansion and away from the development of alternative transportation systems and choices. If these HOV lanes are opened to all traffic, it is doubtful they could ever be reclaimed for HOV use if conditions warranted, and development of new HOV facilities would become highly unlikely. This is not a decision to be made lightly.

Mn/DOT has adopted a long-term multimodal transportation policy of providing Advantages for Transit. It is unlikely that the region can in the long-term “build its way out of congestion” by relying exclusively on the construction of new general-purpose highway lanes to meet future growth. It is, nevertheless, apparent that the current two limited HOV lanes are not achieving their full potential and that in the short-term traffic throughput could be increased and congestion eased in these corridors by opening the lanes to all traffic. While this situation is not currently forecast to change, presently available forecasting tools in the Twin Cities region are not currently able to assess the impacts of more rapid regional economic growth nor the development of a greatly enhanced multimodal regional transportation system. The HOV lanes represent one component of a long-term Advantages for Transit strategy which also involves the development of light rail transit, commuter rail, a full integrated regional bus system and a range of travel demand management strategies. The long-term effects of such a multimodal system, in a region of rapid economic growth, could result in very high utility for each component of the system.

Therefore, we believe that opening the HOV lanes to all traffic today would be a misguided short-term response to a long-term problem which Mn/DOT and the commuters of the Twin Cities would come to regret. If the HOV lanes were opened to all traffic, it would be difficult to recreate these lanes if conditions change in currently unanticipated ways; it would be equally difficult to justify the construction of new HOV lanes. Thus, a key pillar in a long-term strategy of providing Advantages to Transit and discouraging SOV use will have been abandoned before it was permitted the opportunity to mature into an effective system.

Important lessons have, however, been learned in this study which Mn/DOT should consider in developing strategies for improving the operation of the existing HOV lanes and in planning for any future HOV lanes or expansions of the existing lanes. It is apparent that the HOV lanes are currently underutilized, that enforcement is difficult, and that barrier-separated lanes work better. In order to address these problems, Mn/DOT should consider a range of strategies. While some of these strategies may be challenging to implement on the current lanes due to design constraints, they can more easily be adapted to new lanes in the future. These strategies potentially include the following:

- Increase the use of barrier separation;
- Provide better enforcement areas;
- Increase violation fines;
- Adjust hours of operation to focus on the most congested times;
- Use the lanes to help maintain traffic flow during major incidents;
- Make geometric improvements in access and egress points to the existing reversible barrier-separated lanes if opened to all traffic; and
- Seek to develop strategies for increasing person throughput by increasing the eligibility requirements for access to the lanes, including consideration of the HOT lane concept (High-Occupancy/Toll lanes) or improving the transit system.

All possible strategies have advantages and disadvantages. For example, barrier separation reduces violation rates and improves the operation and attractiveness of the lanes, but also excludes commuters with destinations prior to the lane terminus unless HOV on/off ramps are constructed which can be a costly venture. HOT lanes raise issues of enforcement (based on current technology, barrier separation is a requirement), equity and popular support. However, the HOT lane concept has been approved by the U.S. DOT and successfully implemented in several venues. They have several potential advantages:

- Preserve the Advantages for Transit (and carpooling) inherent in the HOV lane concept;
- Provide opportunities for SOV drivers to purchase access to the lanes, thereby maximizing the utility of the HOT lanes and adjacent general-purpose lanes;
- Enable individuals to place a value on the cost of congestion; and
- Generate revenue to support further investment in transportation systems.

Although there is no history of toll lanes in Minnesota, HOT lanes are not general-purpose toll lanes (people have the choice of driving in free or toll lanes depending on the value they place on their time) and they have been successfully implemented in regions with equally strong freeway traditions. While opposed initially in areas such as Los Angeles and San Diego, they have become popular once in operation. Recent market research in the Twin Cities has demonstrated increasing levels of support for the concept, and supportive legislation has already been introduced. Clearly, an educational effort would be required to develop public support for the concept. We believe that Mn/DOT should explicitly consider the HOT lane approach in its future highway planning activities.