HOUSTON VALUE PRICING PROJECT: FINAL REPORT

by

William R. Stockton, P.E., Ph.D.
Associate Director
Texas Transportation Institute

and

Mark Burris, Ph.D., P.E.
Susan T. Chrysler, Ph.D.
Ginger Goodin, P.E.
Michelle Hoelscher

Supporting Authors:
Justin Winn, Justice Appiah, John Wikander, Casey Dusza
Leslie Stengele, Linda Cherrington, and Lei Xu

Project Number: 408990
Research Project Title: Houston Value Pricing Pilot Project

Sponsored by the
Texas Department of Transportation
In Cooperation with the
U.S. Department of Transportation
Federal Highway Administration

2007

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

HOUSTON VALUE PRICING
DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Federal Highway Administration (FHWA) or the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation. The engineer in charge was Bill Stockton, P.E., (Texas # 41188) with Mark Burris, P.E., (Texas # 93123) as co-principal investigator.

ACKNOWLEDGMENTS

This project was conducted in cooperation with TxDOT and FHWA. The authors wish to thank the many individuals from both of those agencies that helped with the project. It took the work of far too many individuals to list to make the project a success. One person deserves specific mention, the project manager from TxDOT, David Fink, who was extremely helpful in bringing this project to completion. Houston METRO was also an important team member in the development of the project. Additionally, many TTI staff and students worked long hours on this project. Their efforts are greatly appreciated.

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

HOUSTON VALUE PRICING – ENHANCEMENT OF THE I-10W AND US-290 HOT LANES, PROJECT SUMMARY REPORT: PRINCIPAL FINDINGS AND RECOMMENDATIONS

ORIGIN AND PURPOSE

In February 2002, through the Federal Highway Administrations' (FHWA) Value Pricing Pilot Program (VPPP), funding was approved and provided to evaluate the expansion potential of the existing QuickRide (HOV-2 buy-in) program on I-10 West (Katy Freeway) and US-290 (Northwest Freeway), followed by implementation, as appropriate. This funding opportunity originated in the FHWA Value Pricing Program Call for FY 2000 proposals.

The original QuickRide (QR) program, implemented based on studies performed by Texas Transportation Institute during 1995 – 1997 (*1*), began in 1998 on the Katy Freeway (Katy). After considerable program success, QuickRide was expanded to the Northwest Freeway (NW) in 2000.

The initial charge of the current Houston Value Pricing (HVP) Project team was to examine and recommend alternatives to maximize the effective use of both High Occupancy Vehicle (HOV) lanes, relying on expanded HOV-2 buy-in (QuickRide-2, or QR-2) program during the peaks and potential single occupant buy-in (QuickRide-1, or QR-1) program during off-peaks. Early on in the project, it was deemed appropriate to focus on the Northwest Freeway given the enormous challenges the Katy presented under its current "under construction" phase. Construction-imposed limitations on enforcement sites on the Katy HOV lane prevent "typical" High Occupancy Toll (HOT) lane implementation; alternate approaches will be required but were determined not feasible.

OVERVIEW

The Katy and Northwest HOV lanes both offer significant travel time savings over the adjacent freeway lanes; Northwest primarily in the peaks, Katy all day. Vehicle counts reveal high usage of both HOV facilities during the peaks. Expanding peak period QR-2 would improve the effectiveness of the HOV lanes. Analysis of typical speeds on the general purpose lanes makes the HOV lanes very attractive to paying customers.

Excessive HOV lane violations during operational hours limit the efficiency and attractiveness to paying customers. A large percentage of vehicles do not meet occupancy requirements during operational hours. Violations of the occupancy and QuickRide requirements of the HOV lanes severely limit actual available capacity and have a severe adverse effect on public confidence and credibility. This alone has drawn critical public comments on surveys and focus group studies performed during the HVP project. Eliminating violators would allow more room for additional QuickRide users. The issue of violations and enforcement will be more fully discussed later in this report.

This report outlines the findings and recommendations for actions or policies needed to improve QuickRide-2 (QR-2) and to implement QuickRide-1 (QR-1). For implementation purposes, necessary technology has been installed, upgrades made to some legacy equipment, updated driver communications (signage) has been installed, and software for the use of allowing single occupancy vehicles (SOVs) in the off-peak of the Northwest QuickRide program has been developed. Allowing SOVs in the off-peak would generate substantial additional usage of the HOV lanes, generate revenues to offset costs, and provide a welcome travel option in both corridors.

CHAPTER 1: DATA COLLECTION AND ANALYSIS

Except for violations, the HOV lanes offer an attractive alternative and have adequate capacity to accommodate additional users.

INTRODUCTION

The Houston Value Pricing Pilot Program project team members evaluated current HOV lane usage to determine additional lane capacity during peak and off-peak usage. The findings of these trends and optimal operational options will be addressed in this chapter.

DATA COLLECTION AND ANALYSIS TO EVALUATE CURRENT USE OF HOT LANES

TTI engineers examined the use of the HOT lane by QuickRide participants focusing on the number of QuickRide uses, the timing of those uses, and any trends in usage. The number of billed QuickRide trips has increased over time (see Figure 1). Trends in billed usage of QuickRide include:

- During the AM periods, significantly fewer QuickRide trips are recorded from the middle of May to the beginning of September. This is partially due to parents no longer taking a child to grade school and therefore not having the 2-person carpool required for QuickRide.
- QuickRide usage is relatively constant throughout the week except on Friday, when usage drops.
- QuickRide usage is lowest at both the start and end of the QuickRide time period (6:45 am, 8:00 a.m., 5:00 p.m. and 6:00 p.m.) and greatest during the middle of the QuickRide period. This may be due to drivers changing their departure times slightly to avoid having to pay.
- Typically, approximately 70 percent of new enrollees were recorded using QuickRide for at least one year. However, this percentage dropped in the latter half of 2001.

EXPANDING QR-2 IS FEASIBLE

Currently, the HOV lane on the Northwest Freeway is open to HOV 2+ vehicles at all times except 6:45 a.m. to 8:00 a.m. Under these occupancy restriction levels the demand for HOV lane use during the afternoon peak period is approaching its capacity. This is resulting in increased travel times and decreased speeds on the lane. Speed data taken on the lane (between Pinemont and West Little York exits) clearly indicated the extent of this problem (see Figure 1 and **Error! Reference source not found.**).

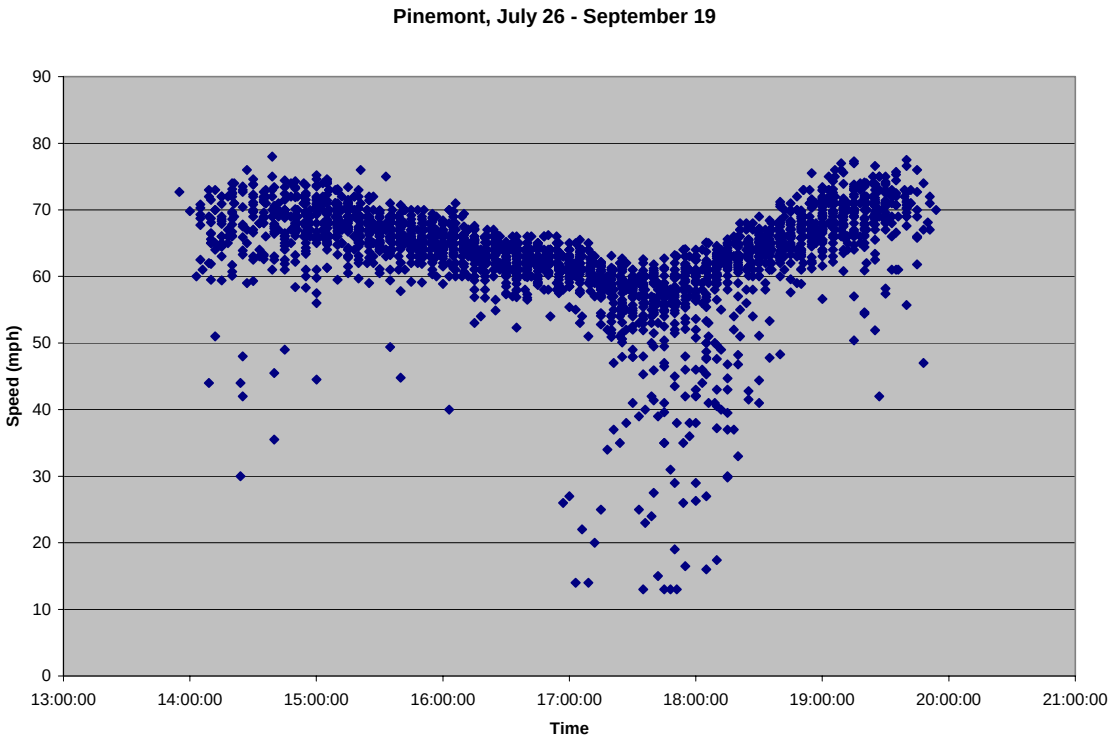


Figure 1. Travel Speeds by Time of Day

Table 1. Percentage of Time Periods Where Average Speeds Dropped Below 55 mph.

Pinemont, July 26 - September 19			
Time	**Total Data Points**	**Below 55 mph**	**Percent**
4:30 PM	120	1	0.8%
4:45 PM	121	2	1.7%
5:00 PM	121	8	6.6%
5:15 PM	121	27	22.3%
5:30 PM	121	40	33.1%
5:45 PM	120	38	31.7%
6:00 PM	121	34	28.1%
6:15 PM	121	17	14.0%
6:30 PM	121	6	5.0%
6:45 PM	121	0	0.0%
7:00 PM	118	0	0.0%
7:15 PM	111	5	4.5%

Data points are the number of 3-minute periods where travel speeds were recorded at this sensor between July 26 and September 19, 2004.

During the worst time period (5:30 p.m. to 5:45 p.m.) one-third of vehicles in the HOV lane traveled at speeds below 55 mph. With traffic levels on the freeway continuing to increase, these speeds are likely to decrease, resulting in poorer service for HOV and transit travelers. Two solutions to this problem appear to have the greatest potential:

(1) increase enforcement to reduce the number of violators in the lane, and

(2) increase the occupancy restriction to HOV 3+.

Each of these suggestions has the potential to solve the problem. However, the combination of the two would prove to be most effective.

Examination of Possible Expansion of QuickRide Hours

An analysis was performed to determine if it would be beneficial to expand the QuickRide hours beyond their current operating times. Currently, the QuickRide program operates from 6:45 AM to 8:00 AM in the morning peak on the Katy and Northwest Freeways, and it operates from 5:00 PM to 6:00 PM in the evening peak on the Katy Freeway. In order to determine whether an expansion of QuickRide hours was warranted, travel speeds and volumes on the HOV lane were examined (Figure 2 through Figure 7).

Figure 7The volume on the HOV lane, the average speed of the HOV lane and the time of day were analyzed. A spreadsheet was created to examine three factors: HOV lane volume, HOV lane speed, and the time of day. Fifteen-minute time periods were analyzed using 2002 average volume and speed data.

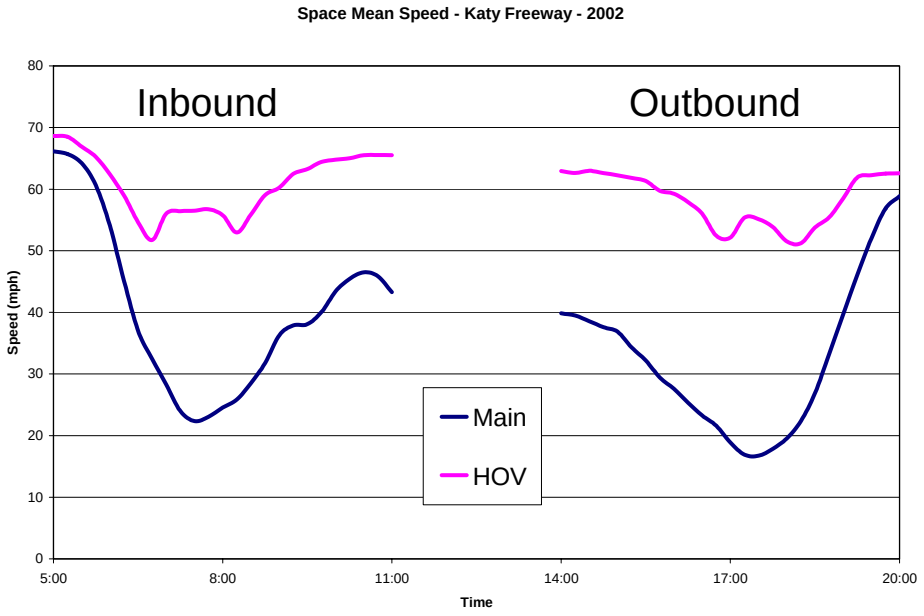


Figure 2. Space Mean Speed – Katy Freeway, 2002

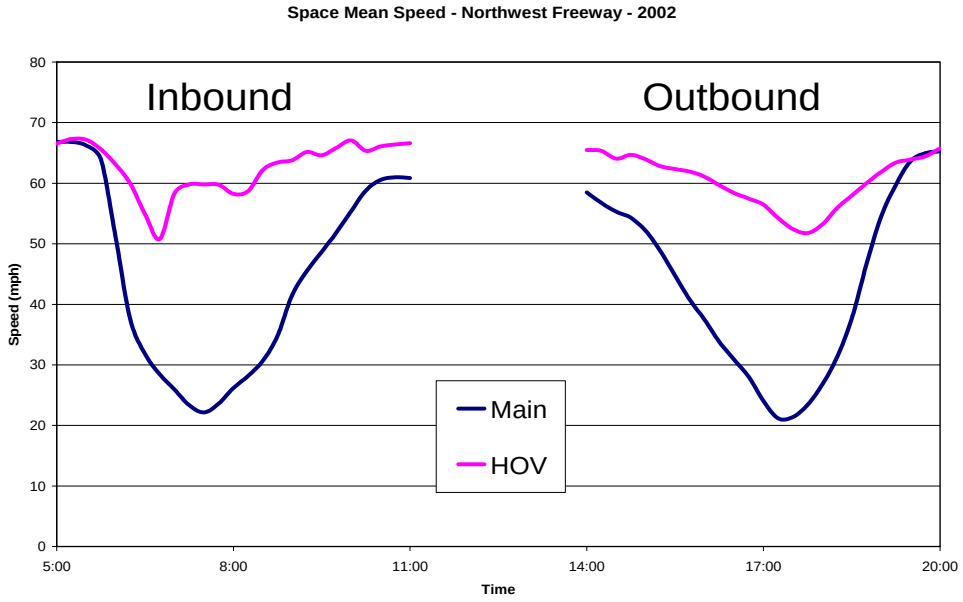


Figure 3. Space Mean Speed – Northwest Freeway, 2002

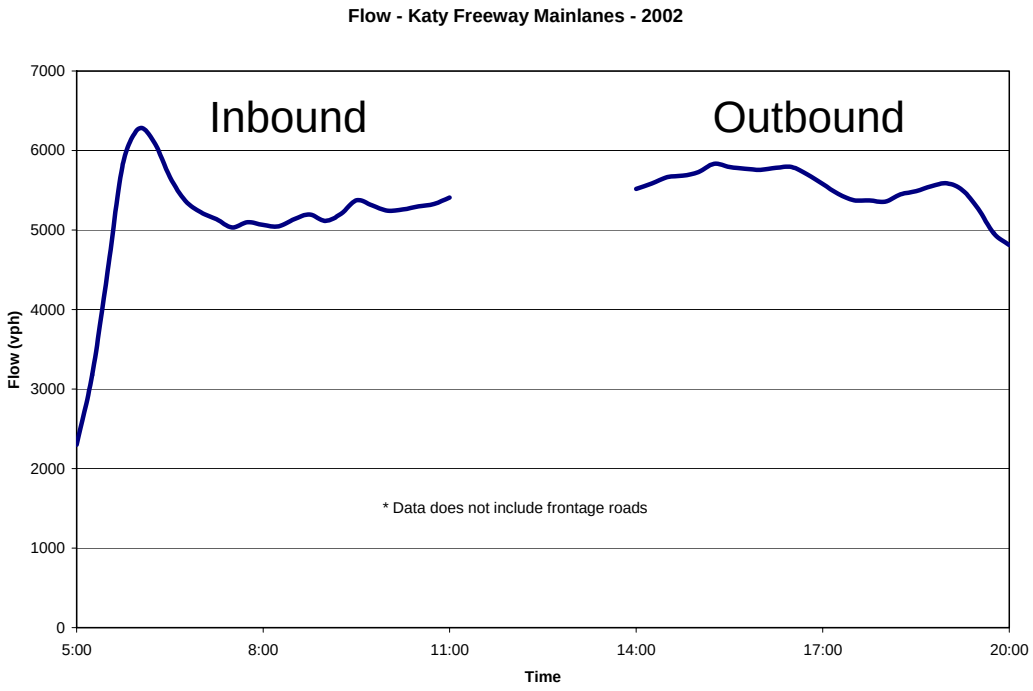


Figure 4. Flow – Katy Freeway Mainlanes, 2002

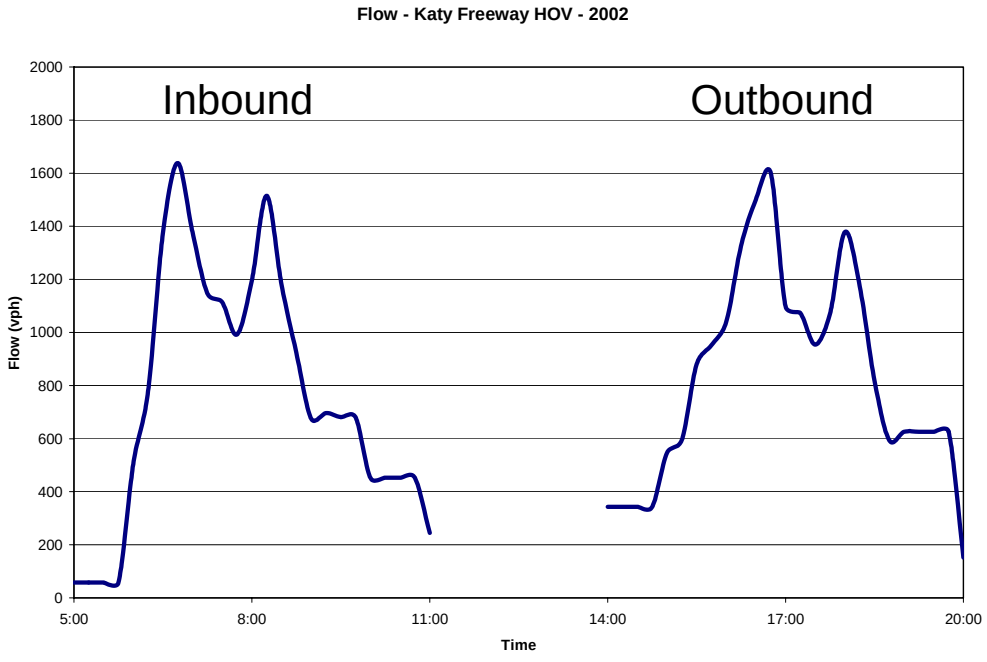


Figure 5. Flow – Katy Freeway HOV, 2002

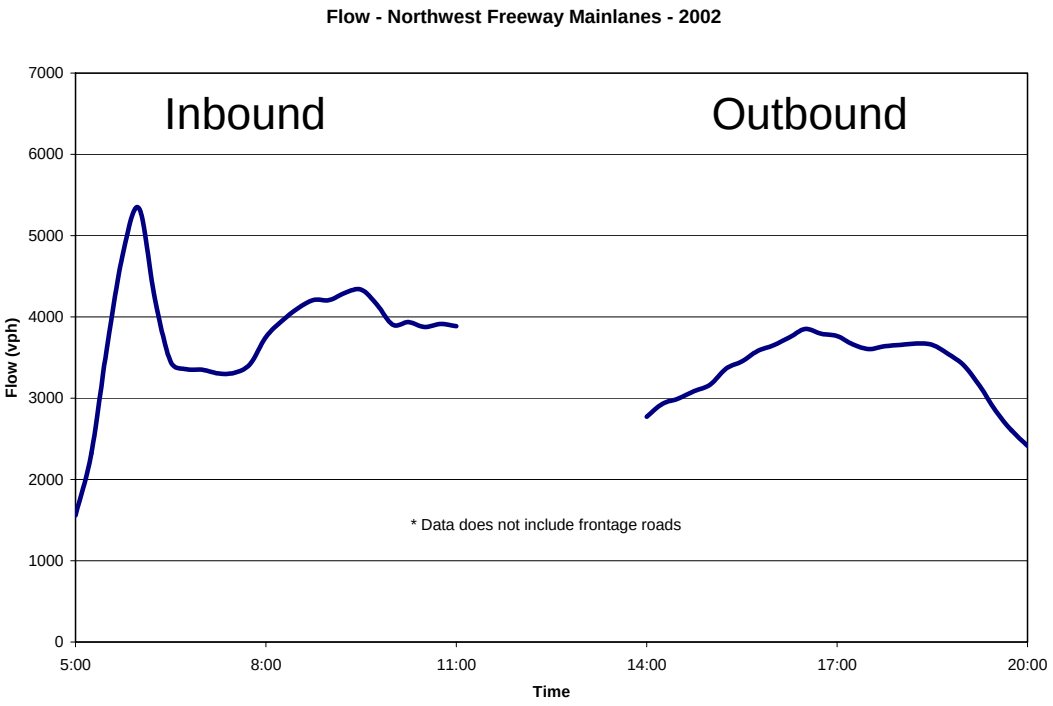


Figure 6. Flow – Northwest Freeway Mainlanes, 2002

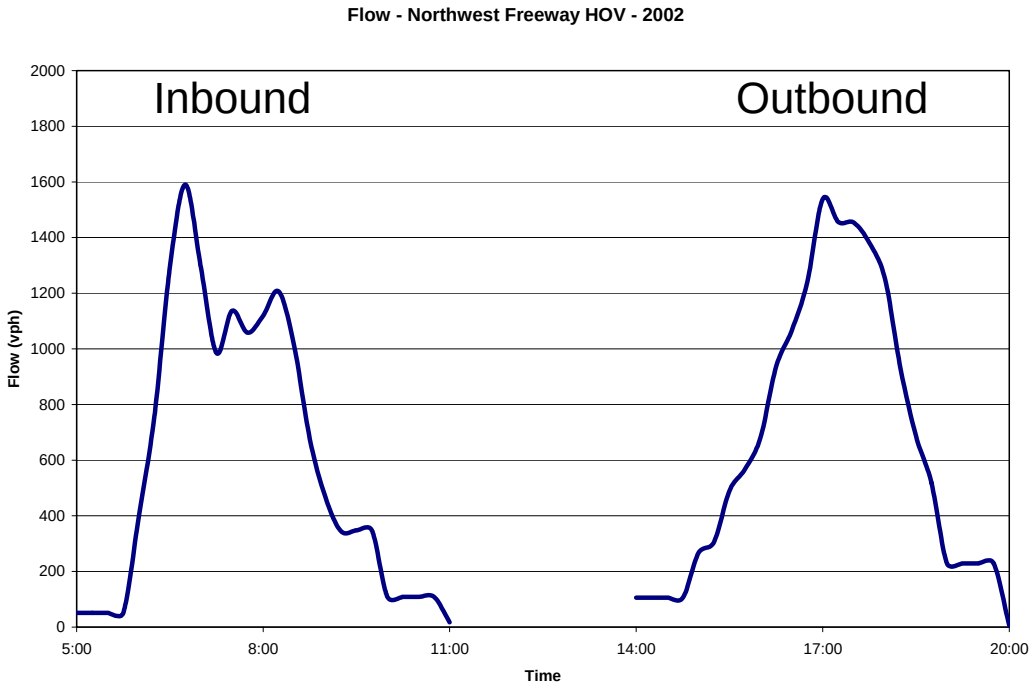


Figure 7. Flow – Northwest Freeway HOV Lanes, 2002

For each 15-minute time period, HOV lane volume is compared to a minimum requirement. If the volume is greater than the minimum, then that time period may qualify for conversion to QuickRide-2. A similar comparison was performed for average speed. Additionally, the spreadsheet also checks if the time period is located outside the current QuickRide hours. If a positive response is returned for all three tests, then that time period deserves careful consideration to be converted to QuickRide-2. Figure 8 through Figure 11 are examples of the spreadsheets. Table 2. Results of Expansion Analysisshows the results obtained from the analysis.

Table 2. Results of Expansion Analysis

Direction	**Times Qualifying for Expansion (start time of 15-minute periods)**
Katy Freeway AM	6:30, 8:15
Katy Freeway PM	4:45, 6:00
Northwest Freeway AM	6:30
Northwest Freeway PM	5:15, 5:30, 5:45, 6:00

Time	Current HOV Volume Greater than 1200 vph	Current HOV Speed Lower than 55 mph	Outside of QuickRide Period?	All Criteria Met?
5:00	NO	NO	**YES**	NO
5:15	NO	NO	**YES**	NO
5:30	NO	NO	**YES**	NO
5:45	NO	NO	**YES**	NO
6:00	NO	NO	**YES**	NO
6:15	NO	NO	**YES**	NO
6:30	**YES**	**YES**	**YES**	**YES**
6:45	**YES**	**YES**	NO	NO
7:00	**YES**	NO	NO	NO
7:15	NO	NO	NO	NO
7:30	NO	NO	NO	NO
7:45	NO	NO	NO	NO
8:00	NO	NO	**YES**	NO
8:15	**YES**	**YES**	**YES**	**YES**
8:30	NO	NO	**YES**	NO
8:45	NO	NO	**YES**	NO
9:00	NO	NO	**YES**	NO
9:15	NO	NO	**YES**	NO
9:30	NO	NO	**YES**	NO
9:45	NO	NO	**YES**	NO
10:00	NO	NO	**YES**	NO
10:15	NO	NO	**YES**	NO
10:30	NO	NO	**YES**	NO
10:45	NO	NO	**YES**	NO

Figure 8. Example of QuickRide Expansion Spreadsheet – Katy Freeway AM

Time	Current HOV Volume Greater than 1200 vph	Current HOV Speed Lower than 55 mph	Outside of QuickRide Period?	All Criteria Met?
14:00	NO	NO	**YES**	NO
14:15	NO	NO	**YES**	NO
14:30	NO	NO	**YES**	NO
14:45	NO	NO	**YES**	NO
15:00	NO	NO	**YES**	NO
15:15	NO	NO	**YES**	NO
15:30	NO	NO	**YES**	NO
15:45	NO	NO	**YES**	NO
16:00	NO	NO	**YES**	NO
16:15	**YES**	NO	**YES**	NO
16:30	**YES**	NO	**YES**	NO
16:45	**YES**	**YES**	**YES**	**YES**
17:00	NO	**YES**	NO	NO
17:15	NO	NO	NO	NO
17:30	NO	NO	NO	NO
17:45	NO	**YES**	NO	NO
18:00	**YES**	**YES**	**YES**	**YES**
18:15	NO	**YES**	**YES**	NO
18:30	NO	**YES**	**YES**	NO
18:45	NO	NO	**YES**	NO
19:00	NO	NO	**YES**	NO
19:15	NO	NO	**YES**	NO
19:30	NO	NO	**YES**	NO
19:45	NO	NO	**YES**	NO
20:00	NO	NO	**YES**	NO

Figure 9. Example of QuickRide Expansion Spreadsheet – Katy Freeway PM

Time	Current HOV Volume Greater than 1200 vph	Current HOV Speed Lower than 55 mph	Outside of QuickRide Period?	All Criteria Met?
5:00	NO	NO	**YES**	NO
5:15	NO	NO	**YES**	NO
5:30	NO	NO	**YES**	NO
5:45	NO	NO	**YES**	NO
6:00	NO	NO	**YES**	NO
6:15	NO	NO	**YES**	NO
6:30	**YES**	**YES**	**YES**	**YES**
6:45	**YES**	**YES**	NO	NO
7:00	**YES**	NO	NO	NO
7:15	NO	NO	NO	NO
7:30	NO	NO	NO	NO
7:45	NO	NO	NO	NO
8:00	NO	NO	**YES**	NO
8:15	**YES**	NO	**YES**	NO
8:30	NO	NO	**YES**	NO
8:45	NO	NO	**YES**	NO
9:00	NO	NO	**YES**	NO
9:15	NO	NO	**YES**	NO
9:30	NO	NO	**YES**	NO
9:45	NO	NO	**YES**	NO
10:00	NO	NO	**YES**	NO
10:15	NO	NO	**YES**	NO
10:30	NO	NO	**YES**	NO
10:45	NO	NO	**YES**	NO

Figure 10. Example of QuickRide Expansion Spreadsheet – Northwest Freeway AM

Time	Current HOV Volume Greater than 1200 vph	Current HOV Speed Lower than 55 mph	Outside of QuickRide Period?	All Criteria Met?
14:00	NO	NO	**YES**	NO
14:15	NO	NO	**YES**	NO
14:30	NO	NO	**YES**	NO
14:45	NO	NO	**YES**	NO
15:00	NO	NO	**YES**	NO
15:15	NO	NO	**YES**	NO
15:30	NO	NO	**YES**	NO
15:45	NO	NO	**YES**	NO
16:00	NO	NO	**YES**	NO
16:15	NO	NO	**YES**	NO
16:30	NO	NO	**YES**	NO
16:45	**YES**	NO	**YES**	NO
17:00	**YES**	NO	**YES**	NO
17:15	**YES**	**YES**	**YES**	**YES**
17:30	**YES**	**YES**	**YES**	**YES**
17:45	**YES**	**YES**	**YES**	**YES**
18:00	**YES**	**YES**	**YES**	**YES**
18:15	NO	NO	**YES**	NO
18:30	NO	NO	**YES**	NO
18:45	NO	NO	**YES**	NO
19:00	NO	NO	**YES**	NO
19:15	NO	NO	**YES**	NO
19:30	NO	NO	**YES**	NO
19:45	NO	NO	**YES**	NO
20:00	NO	NO	**YES**	NO

Figure 11. Example of QuickRide Expansion Spreadsheet – Northwest Freeway PM

Prerequisites for Expansion of QuickRide-2 hours

Increasing the occupancy restriction to HOV 3+ during the afternoon peak period will not require any additional equipment. In addition, no new equipment would be needed if the HOV lane operator also chooses to implement QuickRide during this period. However, it would be important to notify users of the lane of this impending change. Currently, existing members are not using QR frequently, and expanding QR hours will result in additional fees and, therefore, could be a possible deterrent for these users. To implement this option, it will be important to

not only notify these members of the new hours and charges but to emphasize the value and benefits of the QR program. While expanding QR 2 mainly affects existing members, it is also important to use this opportunity to promote new membership through a creative outreach campaign that promotes QR benefits and overcomes the carpooling inconvenience perception.

A conservative estimate of potential annual QuickRide revenues from this change is $25,000.[1] This estimate assumes that some enforcement will be in place–without enforcement it is likely the number of QuickRide users, and revenues, would be substantially less.

The evaluation of current enforcement operations has revealed extremely high violation rates, as high as 50 percent in some locations. As demonstrated in field tests, violation rates can be cut in half with a combination of dedicated law enforcement to the QuickRide operation and the use of technology to enhance the efficiency and effectiveness of the enforcement process in the field. Additional enhancements to other aspects of the program may serve to reduce violation rates even further, including the following:

- judicial outreach,
- enhancements to the adjudication process,
- improved toll account management,
- enhancements to signing, and
- public education.

Upgrading enforcement operations, both with consistent on-site law enforcement officers and installation of supporting technology, should be considered a minimum prerequisite for proceeding with expansion of QR-2. Other program enhancements are not QR-2 prerequisites per se, but should be strongly considered in the overall implementation plan.

[1] This revenue estimate assumes (a) no new accounts and $0 in new monthly administration charges, (b) 250 QuickRide days per year, (c) $2 per QuickRide use, and (d) 50 uses per afternoon. The 50 uses is slightly less than 67% of the 77 morning QuickRide uses on Northwest. The 67% is the percentage of afternoon QuickRide uses on Katy Freeway as compared to morning uses.

Determination of Optimum Reversal Time

The HOV lanes on the Katy and Northwest freeways in Houston are single lane and barrier separated. At some point in the day, the HOV lane must be closed and cleared out to reverse the direction of flow. Currently, the HOV lanes are closed from 11:00 a.m. to 2:00 p.m. each day. However, the researchers have been informed by METRO officials that the reversal time can be shortened to two hours. Therefore, the base case scenario for the analysis was that the reversal time occurred between 11:00 a.m. and 1:00 p.m.

A number of possible reversal times were examined using 2002 average speed data for the freeway main lanes (see Appendix A). Each of the possible reversal times was compared against the base case scenario. For each reversal time, the HOV time savings gained was compared to the HOV time savings that was lost by changing the reversal time. For instance, suppose the reversal time were to be moved back 30 minutes so that it began at 10:30. The HOV lane would then be closed from 10:30 to 11:00, a time which it had previously been open. Conversely, the HOV lane would now be open from 12:30 to 1:00, a time which it had previously been closed. To evaluate this new scenario, the travel time savings of using the HOV lane from 10:30 to 11:00 was compared to the time savings of using the HOV lane from 12:30 to 1:00. If the savings of the gained time was greater than the time savings of the lost time, then a positive change was calculated, indicating an increase in overall benefit. A negative change would indicate a decrease in overall benefit.

The travel time savings for each scenario was calculated as follows:

$$\Delta TTS = \frac{D}{S_{gained}} - \frac{D}{S_{lost}}$$

where:

ΔTTS = change in travel time savings

D = the length of the HOV lane

S_{gained} = the speed on the main lanes during the gained HOV lane time

S_{lost} = the speed on the main lanes during the lost HOV lane time

The net change in travel time savings (in seconds per vehicle) is shown in Table 3 and Table 4. The tables indicate that the best reversal time is from 10:30 AM to 12:30 PM on the Katy Freeway and from 11:30 AM to 1:30 PM on the Northwest Freeway. However, the change in travel time savings may not necessarily be large enough to warrant changing the reversal time. Additionally, the two lanes should be closed for reversal at the same time to reduce public confusion. Therefore, 11:00 AM to 1:00 PM is the recommended reversal time.

Table 3. Reversal Time Analysis Results for the Katy Freeway

Proposed Reversal Time	Change in Travel Time Savings (sec/veh)
9:00-11:00	-329
9:30-11:30	-92
10:00-12:00	45
10:30-12:30	**58**
11:00-1:00	0
11:30-1:30	-6
12:00-2:00	12
12:30-2:30	6
1:00-3:00	-37

Table 4. Reversal Time Analysis Results for the Northwest Freeway

Proposed Reversal Time	Change in Travel Time Savings (sec/veh)
9:00-11:00	-537
9:30-11:30	-244
10:00-12:00	-79
10:30-12:30	-13
11:00-1:00	0
11:30-1:30	**5**
12:00-2:00	1
12:30-2:30	-34
1:00-3:00	-112

CHAPTER 2: EXTENDED USE OF HOV LANES

Allowing single occupant vehicles (SOVs) onto the HOV lane during off-peak period would be significantly advantageous, but SOVs cannot be accommodated without substantial changes in enforcement and account management.

DESCRIBE BENEFITS AND POTENTIAL USERS

There is significant room in the HOV lane during the off-peak periods of the day. Along many freeways in the nation this would not be of interest, as there is generally available capacity in the general purpose lanes of a freeway in the off-peak periods as well. However, along some of Houston's more congested freeways, including Northwest (US 290) Freeway and Katy (I-10 West) Freeway, the general purpose lanes can become congested, even in the off-peak period (see Figures 14-17). Thus there is an opportunity to alleviate some of the congestion on the general purpose lanes by allowing SOVs on the HOV lanes during off-peak periods. However, care must be taken to ensure that the HOV lanes do not become congested by allowing too many SOVs on the lanes. Therefore, appropriate pricing must be used to regulate demand for the lane. Conversely, careful study should be done to see if there may be a demand for the HOV lane by SOVs during the off-peak. If demand is too low then development of the option may prove to be more costly than it is worth. Plus, enforcement of these SOVs will be critical to ensure free-flow on the HOV lanes. This section of the report investigates these issues.

EXAMINATION OF POSSIBLE ALLOWANCE OF SOVS ON THE HOV LANE

The possibility of allowing single occupant vehicles (SOVs) on the HOV lane was also examined. A spreadsheet similar to that used for the expansion analysis was created to examine three factors: travel time savings, available capacity, and the time of day. First the travel time savings of using the HOV lane was calculated (Figure 12 and Figure 13). If the time savings was above a set minimum, then the spreadsheet returns a positive response. Next, the available capacity of the lane is measured by subtracting the volume of the lane from its capacity. If the

available capacity is above a set minimum, the spreadsheet returns a positive response. Next, the time of day is checked to determine if it is outside the QuickRide period. It was decided that SOVs would only be allowed on the HOV lane during non-QuickRide hours. If the time period is outside of QuickRide hours, the spreadsheet returns a positive response. If a positive response is returned in all three cases, then the time period qualifies for SOV allowance. Figure 14 through Figure 17 are examples of the spreadsheets. Table 5 shows the results obtained from the analysis.

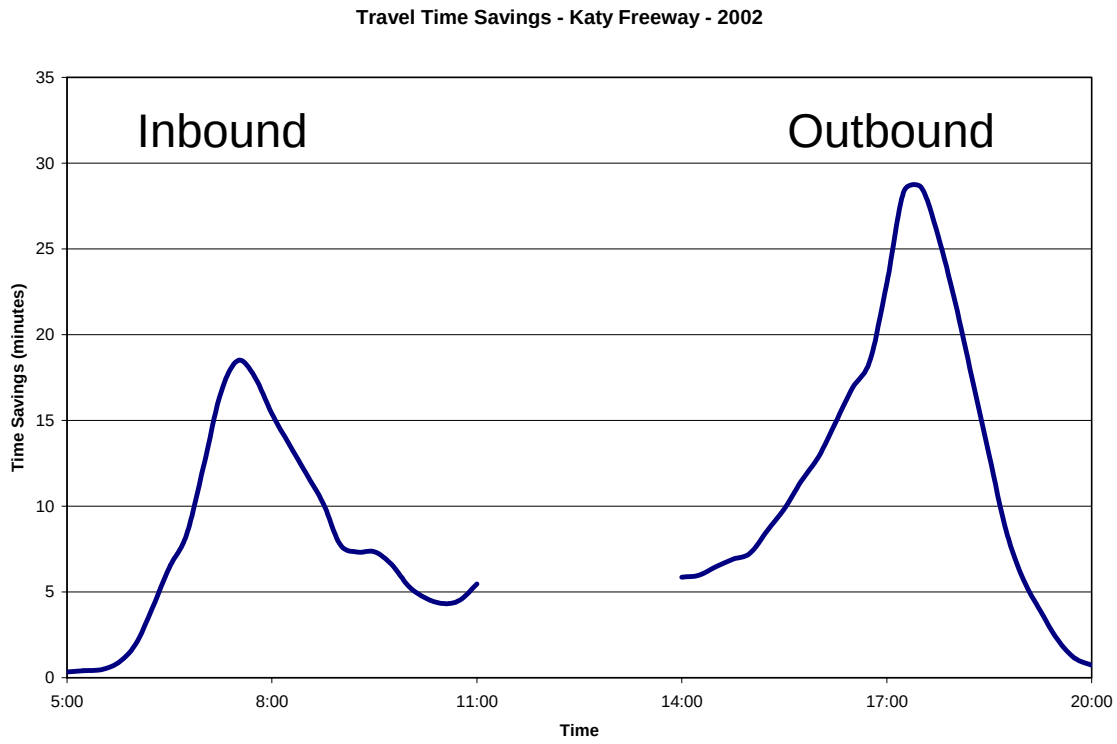


Figure 12. Travel Time Savings – Katy Freeway, 2002

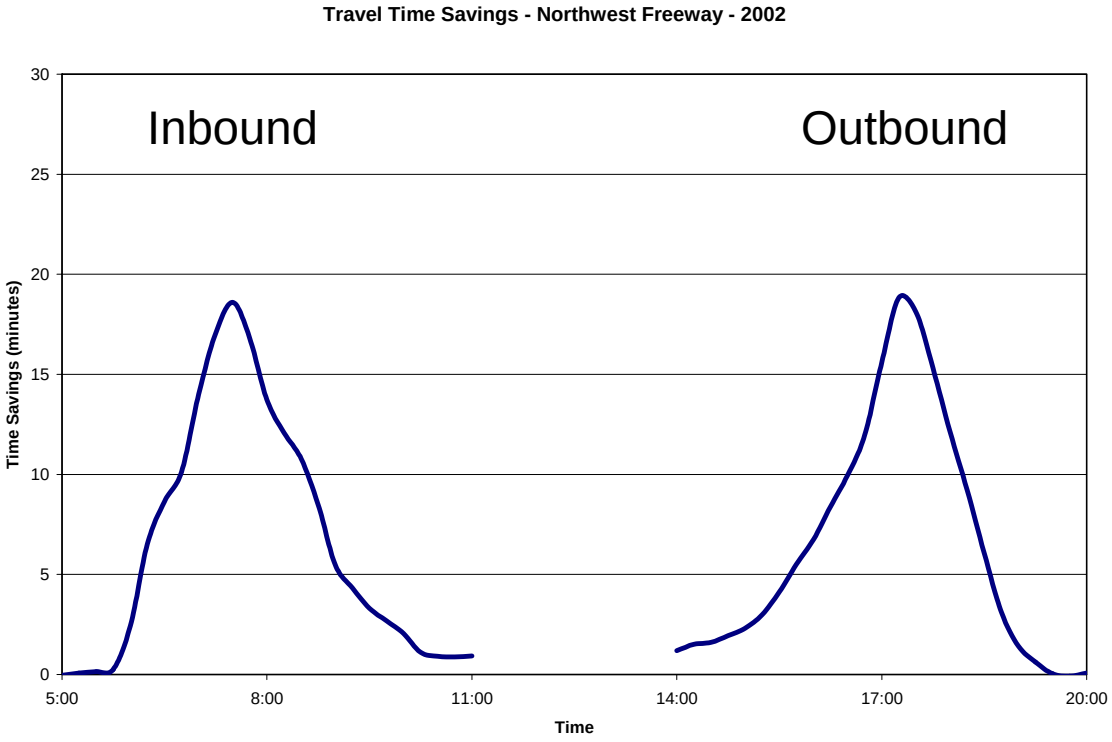


Figure 13. Travel Time Savings – Northwest Freeway, 2002

Table 5. Results of SOV Analysis

Direction	Times Qualifying for SOV Allowance
Katy Freeway AM	8:45, 9:00, 9:15, 9:30, 9:45, 10:00
Katy Freeway PM	2:00, 2:15, 2:30, 2:45, 3:00, 3:15, 3:30, 3:45, 6:30, 6:45, 7:00
Northwest Freeway AM	6:15, 8:45, 9:00
Northwest Freeway PM	3:45, 4:00, 4:15, 6:15, 6:30

Time	Travel Time Savings Greater than 5 Minutes	Available Capacity Greater Than 500 vph	Outside of QuickRide Period?	All Criteria Met?
5:00	NO	**YES**	**YES**	NO
5:15	NO	**YES**	**YES**	NO
5:30	NO	**YES**	**YES**	NO
5:45	NO	**YES**	**YES**	NO
6:00	NO	**YES**	**YES**	NO
6:15	NO	**YES**	**YES**	NO
6:30	**YES**	NO	**YES**	NO
6:45	**YES**	NO	NO	NO
7:00	**YES**	NO	NO	NO
7:15	**YES**	NO	NO	NO
7:30	**YES**	NO	NO	NO
7:45	**YES**	**YES**	NO	NO
8:00	**YES**	NO	**YES**	NO
8:15	**YES**	NO	**YES**	NO
8:30	**YES**	NO	**YES**	NO
8:45	**YES**	**YES**	**YES**	**YES**
9:00	**YES**	**YES**	**YES**	**YES**
9:15	**YES**	**YES**	**YES**	**YES**
9:30	**YES**	**YES**	**YES**	**YES**
9:45	**YES**	**YES**	**YES**	**YES**
10:00	**YES**	**YES**	**YES**	**YES**
10:15	NO	**YES**	**YES**	NO
10:30	NO	**YES**	**YES**	NO
10:45	NO	**YES**	**YES**	NO

Figure 14. Example of SOV Allowance Spreadsheet – Katy Freeway AM

Time	Travel Time Savings Greater than 5 Minutes	Available Capacity Greater Than 500 vph	Outside of QuickRide Period?	All Criteria Met?
14:00	YES	YES	YES	YES
14:15	YES	YES	YES	YES
14:30	YES	YES	YES	YES
14:45	YES	YES	YES	YES
15:00	YES	YES	YES	YES
15:15	YES	YES	YES	YES
15:30	YES	YES	YES	YES
15:45	YES	YES	YES	YES
16:00	YES	NO	YES	NO
16:15	YES	NO	YES	NO
16:30	YES	NO	YES	NO
16:45	YES	NO	YES	NO
17:00	YES	NO	NO	NO
17:15	YES	NO	NO	NO
17:30	YES	YES	NO	NO
17:45	YES	NO	NO	NO
18:00	YES	NO	YES	NO
18:15	YES	NO	YES	NO
18:30	YES	YES	YES	YES
18:45	YES	YES	YES	YES
19:00	YES	YES	YES	YES
19:15	NO	YES	YES	NO
19:30	NO	YES	YES	NO
19:45	NO	YES	YES	NO
20:00	NO	YES	YES	NO

Figure 15. Example of SOV Allowance Spreadsheet – Katy Freeway PM

Time	Travel Time Savings Greater than 5 Minutes	Available Capacity Greater Than 500 vph	Outside of QuickRide Period?	All Criteria Met?
5:00	NO	YES	YES	NO
5:15	NO	YES	YES	NO
5:30	NO	YES	YES	NO
5:45	NO	YES	YES	NO
6:00	NO	YES	YES	NO
6:15	YES	YES	YES	YES
6:30	YES	NO	YES	NO
6:45	YES	NO	NO	NO
7:00	YES	NO	NO	NO
7:15	YES	YES	NO	NO
7:30	YES	NO	NO	NO
7:45	YES	NO	NO	NO
8:00	YES	NO	YES	NO
8:15	YES	NO	YES	NO
8:30	YES	NO	YES	NO
8:45	YES	YES	YES	YES
9:00	YES	YES	YES	YES
9:15	NO	YES	YES	NO
9:30	NO	YES	YES	NO
9:45	NO	YES	YES	NO
10:00	NO	YES	YES	NO
10:15	NO	YES	YES	NO
10:30	NO	YES	YES	NO
10:45	NO	YES	YES	NO

Figure 16. Example of SOV Allowance Spreadsheet – Northwest Freeway AM

Time	Travel Time Savings Greater than 5 Minutes	Available Capacity Greater Than 500 vph	Outside of QuickRide Period?	All Criteria Met?
14:00	NO	YES	YES	NO
14:15	NO	YES	YES	NO
14:30	NO	YES	YES	NO
14:45	NO	YES	YES	NO
15:00	NO	YES	YES	NO
15:15	NO	YES	YES	NO
15:30	NO	YES	YES	NO
15:45	YES	YES	YES	YES
16:00	YES	YES	YES	YES
16:15	YES	YES	YES	YES
16:30	YES	NO	YES	NO
16:45	YES	NO	YES	NO
17:00	YES	NO	YES	NO
17:15	YES	NO	YES	NO
17:30	YES	NO	YES	NO
17:45	YES	NO	YES	NO
18:00	YES	NO	YES	NO
18:15	YES	YES	YES	YES
18:30	YES	YES	YES	YES
18:45	NO	YES	YES	NO
19:00	NO	YES	YES	NO
19:15	NO	YES	YES	NO
19:30	NO	YES	YES	NO
19:45	NO	YES	YES	NO
20:00	NO	YES	YES	NO

Figure 17. Example of SOV Allowance Spreadsheet – Northwest Freeway PM

RESULTS

The purpose of this analysis was not to obtain results but rather to develop a method for determining whether proposed changes to QuickRide may be feasible. The input values used in the analysis are not definitive. The spreadsheet allows them to be changed, thus allowing the parameters of the analysis to be altered. Therefore, the results obtained in this analysis are not the "right answer," but rather an example of the type of analysis that was performed. However, a few conclusions can be made based on the data that was analyzed. First, there appear to be

portions of the day when it would likely be beneficial to allow SOVs on the HOV lane for a toll. The data shows an excess capacity during the off-peak hours of the day. Additionally, the data shows that the volumes on the HOV lane are very close to, if not above, capacity during the shoulder periods outside of QuickRide hours. This would suggest that expansion of QuickRide hours may be necessary.

EXTENDING QUICKRIDE TO SOVS IS FEASIBLE IN THE OFF-PEAK

In examining the travel speeds and traffic volumes on the Northwest Freeway throughout the entire day it was clear that there was little additional room for vehicles during the morning and evening peak periods (see Figure 18). Also, allowing SOV travelers on the HOV lane during the peak period for a premium price (well above the $2 currently charged for QuickRide) would not only be complicated, but would cause congestion on the lanes. Therefore, this possibility was quickly eliminated from consideration.

Conversely, significant excess capacity exists on the lane during the off peak periods. In addition, travel speeds on the HOV lane are significantly higher than on the general purpose (or main) lanes during the periods before and after the peak periods (the “shoulder” periods) (Figure 19). Therefore, the potential exists to sell this access capacity on the HOV lane to SOV vehicles during the shoulder periods without negatively impacting the performance of the lane.

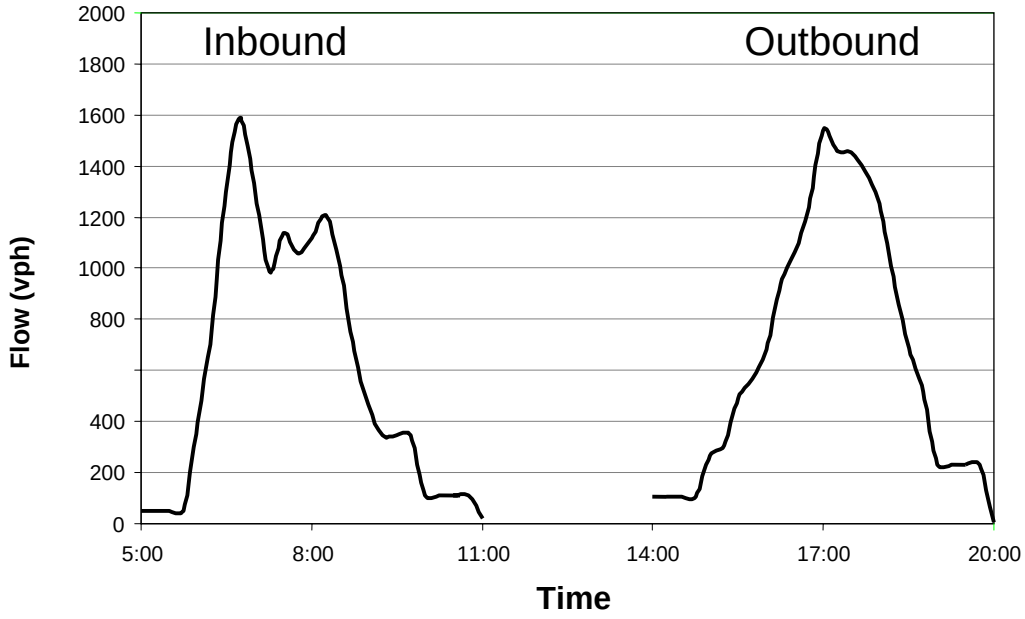


Figure 18. Travel Volumes on Northwest HOV Lane

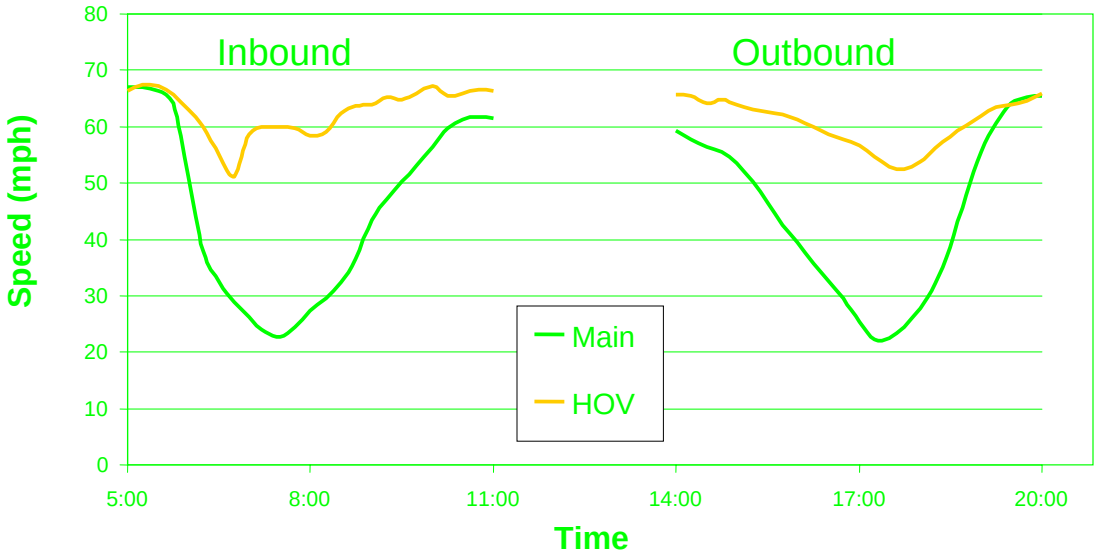


Figure 19. Travel Speeds on Northwest Freeway

However, there are relatively small time periods during the off-peak where travel time savings on the HOV lane are consistently substantial. Therefore, revenue estimates were based on very conservative assumptions regarding use of the lane by SOV vehicles. Potential annual revenue is conservatively estimated to be $270,000. [2]

PROJECT EFFORTS TO IMPROVE PUBLIC UNDERSTANDING AND RESULTS

Market Research, User Needs and Public Understanding

Surveyed QuickRide Users

A survey of all QuickRide enrollees and former enrollees was conducted in the spring of 2003. This survey provided an understanding of the characteristics of QuickRide participants, along with the socio-economic and commute characteristics that influence QuickRide usage (see Appendices A–C).

QuickRide participants were well educated (about 73.9 percent of participants had college or postgraduate degrees), married (approximately 90 percent were married), and had high incomes (about 62 percent of respondents stated an annual household income of $100,000 or more). In the week prior to the survey, 67 percent of participants were commuting when they used QuickRide. The average trip length of respondents was 45.3 minutes. Respondents perceived an average QuickRide travel time savings of 29.77 minutes, approximately double average actual time savings. Most respondents carpooled with a co-worker, an adult family member, or a child. Most participants enrolled in QuickRide to either avoid traffic congestion on the main lanes (66.2 percent) or to take advantage of the possibility of traveling with their carpool partner even during the rush hour (22.6 percent). An average of 70.8 vehicles are now being used to travel for every 100 former QuickRide participants, which is 20.8 more vehicles than that required for 100 current QuickRide participants. The most frequently cited method of finding out about QuickRide was through family members or friends (39.8 percent).

[2] This revenue estimate assumes the only paying QR-1 uses would occur between 8:45 and 9:15 a.m. and 3:45 to 4:00 p.m. QR-1 would be available for longer periods than this – but the travel time savings is such that only a few travelers would be likely to choose QR-1 on a typical day. The average toll was assumed to be $1, and there were 250 QuickRide days per year plus 4,000 new QuickRide accounts.

The primary issue limiting QuickRide use appears to be one of convenience rather than cost. Both current and former participants cited the inconveniences of carpooling as the greatest deterrent to QuickRide use while 73.4 percent of participants reported that the toll had little or no significant impact on their decision to use QuickRide.

Conducted Focus Groups Discussions

Three focus groups were held during August 2003 to discuss the current QuickRide program and potential changes in the pricing structure. The first group was comprised of commuters that used Northwest 290 (NW 290) for the commute. The second group included commuters that used Interstate 10 West (I-10) for the commute (one participant was a QuickRide dropout). Collectively, the participants in the first two focus groups are referenced as "commuters." The third group consisted of current QuickRide users. The purpose of the focus groups was to provide an opportunity to probe knowledge of the existing QuickRide operation, to discuss opinions about different tolling concepts and to investigate reaction to the suggestion of allowing single-occupant vehicles (SOV) into the HOV lanes with a toll. The focus group discussions helped to frame the questions for a survey of non-users.

Surveyed Non-Users

In the fall of 2003 a survey of all travelers along the two HOT lane corridors was conducted. [Analysis of Travelers in HOT Corridors.doc] Over 17,000 surveys were distributed with over 3,500 responses received. This survey provided useful information on the socio-economic and commute characteristics of those travelers not using QuickRide. Most importantly, it provided information on the value of travel time savings for these travelers. This information was necessary to predict the number of travelers who would use QR-1 (the off-peak SOV version of QuickRide).

Area Commuters

Research of the Houston area commuters identified low awareness of the QuickRide program and its operations. Therefore, significant public education is necessary to gain greater awareness

of QR and thus increase usage and new membership regardless of what changes are made in the program.

Past public education efforts on the QR program have been minimal and inconsistent. Promotional materials produced and previously utilized to obtain new QR memberships did not include a consistent graphic identity/program logo to help reinforce program recognition. Information on the QR program is secondary or not easy to find in Houston Metropolitan Transit Authority (METRO) literature and in its website. Road signage promoting the QR program has been nonexistent, and most METRO staff are not very knowledgeable about the QR program and benefits. Therefore, significant efforts (as proposed in the public education plan) are needed to obtain program awareness, interest, perceived value, and new members.

Existing QR Members

Research indicates that existing members are happy with the current QR program. If QR hours are expanded, there will be less of a "free" period (more fees) for 2-person vehicles. Therefore, existing members will need positive and thorough information on these changes, as well as reinforcement of the travel time savings benefit of QR.

Existing QR members also expressed strong feelings against allowing SOVs on the lane for fear that it would adversely affect their travel time. If this access is allowed in off peak hours, this concern must be addressed with clear and effective information, highlighting how these changes will benefit them and not increase travel time.

Traffic congestion is bad and getting worse on both freeways; the public is desperate for relief/solution.

Causes of and contributions to low public awareness/understanding:

- low profile in METRO marketing activities,
- difficult to find on METRO web site, and
- not included on HOV lane signage.

Project Efforts to Improve QuickRide program

Market Research

- All materials sent to the public, such as the survey and accompanying letter, were developed and reviewed from the public's standpoint to ensure that the messages were clear, concise, and consistent, and that they always communicated/reinforced the benefits of the HOV lanes and the QuickRide program.
- Written public comments, included on the survey documents, were grouped, coded, and analyzed to identify key public issues regarding the freeway system, HOV lanes, QuickRide, and public transportation. This important information was used to develop the communications plan. Additionally, a comprehensive report outlining these interesting findings was also prepared for the project sponsors.

Enforcement

- Violation letters, while primarily developed to help in the enforcement task by reminding users of the proper use of the HOV lanes, were also used as a promotional tool for the QR program.
- Warning cards, also developed to aid the enforcement process, served as an education tool. The warning cards were designed with motorists in mind. The present information in a form that is easy for motorists to keep in their car —a leave behind serving as a reminder of HOV hours, vehicle occupancy, proper placement of transponders, etc. It also included information for QuickRide membership. Additionally, these items were designed so it was also easy for METRO officers to simply check off the violation and appropriate action the driver needed to take to correct it.

Toll Account Management

- Assisted METRO staff in toll account management by providing a temporary employee to assist while METRO staff was on leave.

- Assessed strengths and weaknesses of current program based on the experience of the TTI assigned temporary employee.
- Identified a source for additional business rules for account management to address current deficiencies.
- Prepared materials to mail to violators who did not have a QuickRide tag or transponder, and ask them to join the program.
- Reviewed account management policies and recommended changes.
- Suggested changes to enrollment form to improve toll management administration.
- Developed procedures for disposition of non-paying accounts.
- Investigated options for outsourcing.

Graphic Identity

- A graphic identity was created for QuickRide for consistent use in all public communication and signage. A simple, easy to read, and recognizable logo was created.

Figure 20. Quick Ride Logo

Program Website

- www.quickride.org (see Figure 21) was launched as a quick and easy way for the public to obtain information and sign up for the program. While QR information is also included on the METRO website, users have to first search "METRO Services" and then click on "Commuter Services" before they reach the link to QuickRide information. METRO's QuickRide information can be found at: http://www.ridemetro.org/TransportationServices/Carpool_Vanpool_Services/QuickRide_carpool.asp

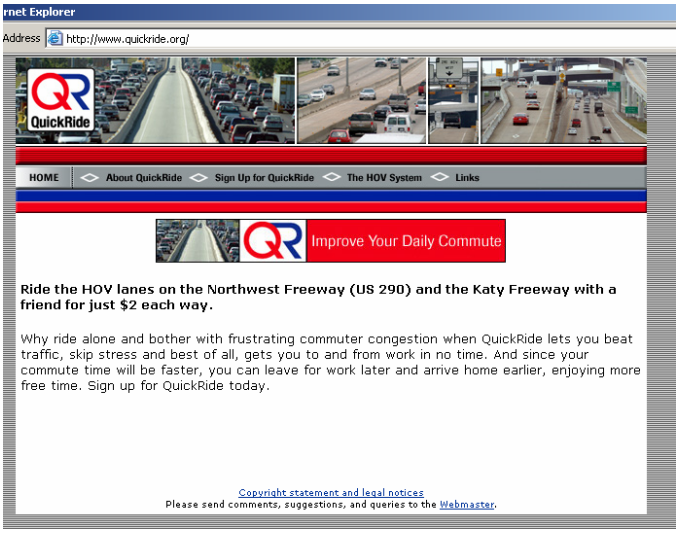


Figure 21. Quick Ride Website Developed by TTI

ADDITIONAL REQUIREMENTS NEEDED IN PLACE FOR SOV ALLOWANCE (QR-1)

Absence of Standard Operating Procedures (SOP) Inhibits Growth of Customer Base

Current operating practices are wholly inadequate to support increasing the QuickRide program; HOV lane enforcement and QuickRide account management require major overhauls to assure success. During the QuickRide operating hours a comparison of vehicle counts to QuickRide billings quickly revealed legacy equipment replacement was needed to capture an accurate number of patrons for billing purposes:

- dedicated staffing (dedicated staffing will ensure SOPs are followed),
- improved customer service (dedicated staffing will lead to improved customer service), and
- existing account management practices require upgrade and expansion to accommodate QR-1, automated toll account management.

BUDGETED COST OF ACCOUNT MANAGEMENT IS HIGH COMPARED TO SIMILAR PROGRAMS

Researched and Documented METRO Costs for HOV Enforcement and Operations

In November and December 2003 financial reports were provided by METRO to document costs for HOV enforcement and operations. The data were used to verify the costs attributable to QuickRide (QR).

METRO keeps records on actual QR expense for tags, billing, etc. (QR administration) and the revenues recovered. In the 2002 calendar year there was a $12,900 advantage to revenue ($135,600 revenue, $122,700 administration expense). For the first 11 months of calendar year 2003 there was almost $8,400 advantage to revenue ($141,000 revenue, $132,700 administration expense). The administration expenses do not include anything for HOV lane operations or enforcement.

METRO also keeps records on expenses for HOV-lane operations and enforcement (separately). METRO allocates all system-wide HOV operations and HOV enforcement expenses to each HOV lane according to the number of hours the lane is open per week. They have prepared some worksheets that pull out the hours during which QR is in operation and calculated the allocated costs for "HOT-only operating hours." It is important to note these are not unique costs for QR, these are the allocated costs of a share of all HOV system operations and enforcement.

The HOV-lane operations and enforcement expenses are designated as "in-kind costs" and are not attributed to the cost of QR when METRO reports on QR revenues and expenses. The actual cost for the 2002 calendar year (the allocated cost for "HOT-only operating hours") was $112,200 for enforcement and $83,200 for operations for a total $195,400. For the first 11 months of calendar year 2003, the allocated cost for "HOT-only operating hours" was $121,200 for enforcement and $79,600 for operations for almost $200,800.

Developed Cost Estimate for METRO Enforcement and Operations for QuickRide Options

In January 2004 a cost estimate was prepared for each QR option using cost allocation data for METRO enforcement and operations for HOV. The methodology was developed with METRO staff. Draft data was prepared and presented to METRO for review and comment. The options considered were:

- expand QR-2 hours.
- add QR-1 hours.
- expand HOV operating hours by reducing the midday turnaround time to two hours.

Cost estimates included incremental increase in direct METRO cost and increase in allocated HOV cost for expanded QR hours.

In February 2004, the cost estimate data was revised to reflect additional METRO enforcement officers on duty during current QR hours.

Allowing SOVs

If QR is expanded to allow SOVs, there are many public education challenges to address:

1. Research identified that current QR users are strongly against allowing SOVs on the lane. Their concerns are that SOVs will hamper travel time reliability and enforcement. Therefore, these members will need consistent and convincing information on the times SOVs are allowed on the lanes, as well as assurance that enforcement will be prevalent. Although existing members may see this option as a negative, the opportunity exists for them to be occasional SOV users, creating a new feature and benefit for them.
2. Allowing SOVs will most likely be received by the media as “big news” and should get sufficient news coverage. Therefore, efforts must be made to have the media properly educated on how this will work and improve overall travel.

3. The public needs consistent information on how it will work, as well as how to sign up for QR.
4. Existing Harris County Toll Road Authority (HCTRA) toll tag users need to understand that they also need to sign up for QR and that their toll tag alone is not sufficient to utilize these HOT lanes.
5. Replace toll tag batteries or issue new tags to patrons with tags older than four years.
6. Park & Ride QuickRide sign-up days.

CHAPTER 3: VIOLATION AND ENFORCEMENT

Violations have a significant and detrimental impact on operations, revenue, customer satisfaction and agency credibility.

DESCRIBE HOW VIOLATIONS SEVERELY IMPACT CREDIBILITY

Enforcement is a critical element to the successful operation of an HOV or HOT facility. The purpose of an enforcement program is to ensure that operating requirements, including vehicle occupancy levels and proper payment of toll, are maintained to protect HOV travel-time savings, to discourage unauthorized vehicles, to maintain a safe operating environment, and to maximize revenue. Visible and effective enforcement promotes fairness and maintains the integrity of the facility to help gain acceptance among users and non-users. Effective enforcement also contributes to the credibility of the operating agencies.

An important component of this study was to evaluate QuickRide compliance levels, identify factors contributing to non-compliance, and implement solutions to enhance compliance. As highlighted in this chapter, there have been high levels of non-compliance that can be attributed to a variety of factors: lack of public knowledge or confusion over the QuickRide program, limited police resources and supporting technology applications, public perception of non-enforcement, and creative cheaters who have exploited vulnerabilities in the current system. A significant number of survey respondents added written comments about enforcement of the HOV lane restrictions, such as suggestions for higher fines, requests for more police monitoring, and frustrations with high levels of abuse of the lanes by ineligible users. Ultimately, the problems with non-compliance and the public perception concerns related to enforcement will affect driver confidence in successful operation of an SOV scenario if enforcement issues are not adequately addressed.

EVALUATION OF ENFORCEMENT

QuickRide Compliance

Enforcement of QuickRide requires METRO police officers to visually verify up to three items for every vehicle using the HOV lanes during the QuickRide periods. This takes place at designated HOV enforcement areas so as to reduce the impact on traffic flow. The first observation is the number of passengers. If the vehicle has three or more occupants no further observations are required, and the vehicle is legitimate. If the vehicle has only a single driver who is not a law enforcement officer, then the vehicle is an obvious violator and is pulled over and cited. If the vehicle has two occupants, the officer must visually observe the following to assess compliance: (1) a toll transponder; and (2) a hang pass on the rearview mirror with a current monthly stamp affixed indicating the user has established an account with METRO. HCTRA transponders are allowed if a QuickRide account has been established with METRO.

Evaluating Effectiveness

The first step in evaluating the effectiveness of the current enforcement operation was to collect data on compliance rates and composition of HOV violators. Initial data collection efforts occurred during three days in February and April 2003. The violation rates were uniform across both data collection periods. The graph shown in Figure 22 illustrates representative values for QuickRide for the initial data collection according to each user category. By counting as violators all two-person vehicles that did not display both a toll transponder and a hang pass, TTI consistently observed between 55 percent and 65 percent of the users on the Katy and Northwest HOV lanes as violators as shown in Figure 22.

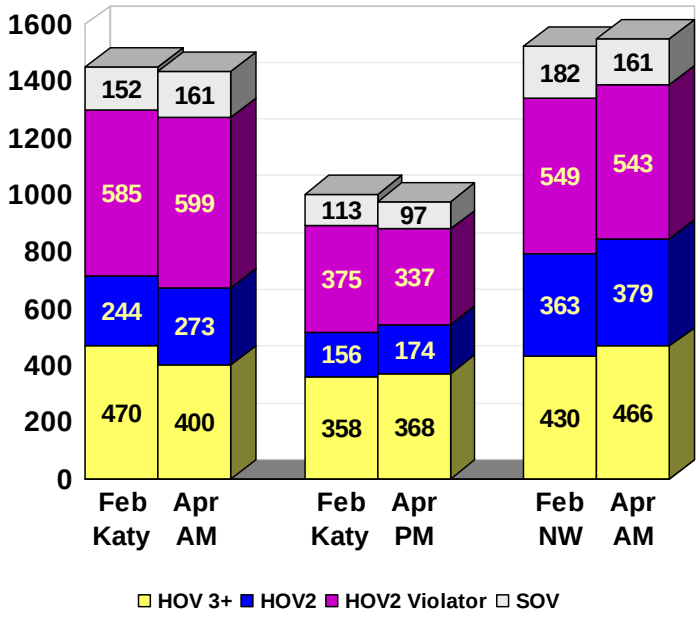


Figure 22. Categories of Users on Katy and Northwest during QuickRide, 2003

In addition to these two data collection efforts, field techniques using billing readers were used in an attempt to identify whether those two-person vehicles displaying the proper "permits" were actually valid accounts. By comparing observations with actual transponder reads, some general conclusions were drawn:

- More than 50 percent of vehicles displaying both a toll transponder and a hang pass could not be matched to valid QuickRide accounts.
- More than 50 percent of vehicles recorded as QuickRide enrollees were not displaying their rearview mirror hang pass.
- Approximately one-fourth of vehicles recorded with toll transponders lacked both a QuickRide transponder and hang pass (they were likely HCTRA transponders not enrolled in QuickRide).

The results are detailed in Technical Memorandum 2-4 Compliance Levels for Current Operations, and Technical Memorandum 2-5 Analysis and Classification of HOT Lane Violations (Appendix C, D).

PROJECT EFFORTS TO REDUCE VIOLATIONS AND RESULTS

Strengthened Enforcement Procedures

In August 2003, METRO implemented the following TTI recommendations on a short-term basis in order to immediately enhance compliance:

- Increase enforcement presence along the Katy and Northwest HOV lanes during QuickRide hours. Staffing of enforcement areas during these periods was typically sporadic, averaging one to two peak periods per week. During the test period, enforcement areas were staffed daily during peak periods.
- Standardize policing procedures to improve efficiency of operations.
- Post signs communicating maximum $200 fine.
- Send friendly reminder letters to enrollees and to non-enrollees who were using the facilities; of all the letters, 1500 were sent to non-enrollees (potential violators during the QuickRide period) that described the QuickRide operation, including hours of operation, requirements to comply, and information on the process for enrollment.

The impacts of these changes were reflected in a third data collection effort performed in October 2003. Overall violations decreased at all locations to a range of 40 percent to 55 percent. These reductions were large enough to increase the capacity by 200-300 vehicles on the Katy and 1000 vehicles on the Northwest. However, the drop still did not meet a violation rate target value of 10 percent to 15 percent. Due to resource constraints and other agency priorities, the increased enforcement presence was not sustained beyond October 2003 shown in Figure 23.

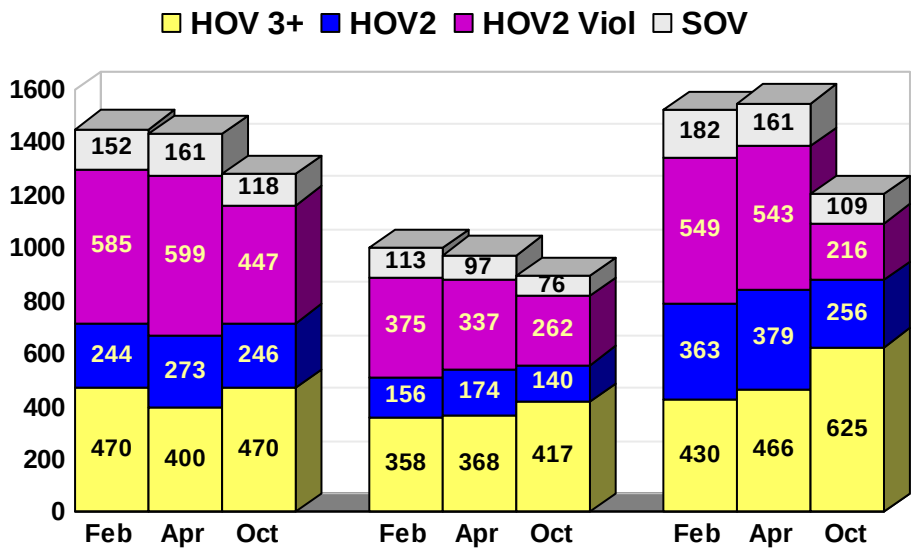


Figure 23. Categories of Users on Katy and Northwest during QuickRide, 2003

The results are detailed in Technical Memorandum 2-8 Field Implementation of Enforcement Strategies (Appendix E).

Citation Analysis

TTI obtained City of Houston HOV citation data for a two-year time period between October 2001 and October 2003. All HOV lanes in Houston were included, which comprises six different facilities. A total of 10,807 citations were assigned to the court docket for that time period, with 45 percent (4863 citations) going to court, 34 percent (3708) pending as of October 2003, and 21 percent (2236) paid before the court date. Based on a review of the data, the following observations are made:

- 65 percent of the cases going to court were dismissed.
- 70 percent of those dismissed were due to the officer not being present.
- Of the cases that were not dismissed, 98 percent of the defendants plead "no contest" or "guilty," and 96 percent of the defendants were found guilty.
- The average fine for those found guilty was $116. The average fine for those paid before the court date was $123.

- Of the 10,807 citations assigned to the court docket, 68 percent of those were written on the Katy HOV lane.

The results are detailed in Technical Memorandum 2-10 Adjudication of HOV Citations (Appendix F).

CHAPTER 4: TECHNOLOGY ENHANCEMENT

****WE DO NOT RECOMMEND IMPLEMENTING SOV ALLOWANCE WITHOUT PROVIDING THE PREREQUISITES FOUND IN CHAPTER 2.****

The addition of new technology and improvements to legacy equipment has improved the quality of existing revenue collection and enabled the eventual additions of SOVs.

ACTIONS TO ENHANCE TECHNOLOGY

In April 2004, two AVI readers were installed at the Eastern Extension enforcement area on Katy to assist METRO officers in identifying valid QuickRide customers. These readers provide visual confirmation of enrollment in the form of an indicator light. A fixed reader was installed at the PM enforcement area on an overhead sign bridge as shown in Figure 24. A portable, trailer-mounted AVI reader was installed at the AM enforcement area as shown in Figure 25. With the installation of this technology, the officer's task was simplified. First the officer looked for the number of occupants. For those vehicles with two occupants, the officer checked for a green light indication to confirm a valid QuickRide account. With two occupants and no green light, the officer assumed the driver to be a violator.

Figure 24. AVI Enforcement Reader at Katy Eastern Extension – PM Direction

Figure 25. AVI Enforcement Reader at Katy Eastern Extension – AM Direction

In addition to the technology, a "warning card" was developed for officers to hand out as an alternative to a finable citation during the first 30 days of the test period. The warning card provided information on the QuickRide program; hours of operations, transponder and occupancy requirements, and procedures for verifying enrollment should the driver actually have a transponder on board (e.g., dead transponder battery, HCTRA transponder not enrolled,

expired credit card). After the 30-day trial period the officers began ticketing violators. During the months of April and May 2004, the enforcement area at the Eastern Extension on Katy was fully staffed with two to three officers daily during both peak periods.

The impacts of the technology features are reflected in the third data collection performed in late April 2004. The violation rate at the Eastern Extension enforcement area, where the test was conducted, dropped to 29% to 33%, while violation rates remained the same or higher at other locations. The violation rates, while improved, still did not reach the 10% to 15% target violation rate.

The results are detailed in Technical Memorandum 2-8 Field Implementation of Enforcement Strategies (Appendix E).

Signage

Traffic Control Devices

The team conducted a human factors analysis of the information needed at each driver decision point. This analysis guided the development of sign categories and decisions regarding the location of signs along mainlanes and in Park and Ride facilities for both the NW and Katy corridors. In creating new signs, the team used design elements identified in METRO's User-Friendly Sign upgrade program including the use of the distinctive banner across all signs to identify them as separate from other traffic signs.

The sign categories identified were:

Program Information

- White background with black letters with METRO banner across top
- Informs drivers of the QuickRide program
- Links the logo with the full name
- Provides enrollment contact information through website address
- Installed away from critical decision points because the information contained is not relevant to time-critical go/no go decisions and may serve to distract drivers

Regulatory Signs

- White background with black letters with METRO banner across top
- Operating hours
- Vehicle restrictions (e.g., no towed trailers)
- Occupancy requirements
- Installed in advance of entrance points
- Other regulatory signs such as Speed Limit and Fine Postings should follow same design principles

Price Signs

- Hybrid signs with conventional static portion showing occupancy classes and electronic variable message component showing lane status and price
- Large version for high-speed mainlane slip ramps points
- Installed at least 1000 feet upstream to allow adequate decision time
- Small version for low-speed Park and Ride entry points
- Installed in a location in the parking lot where a safe exit is still possible if a driver decides not to enter

The initial implementation delivered by this project has provided the Price Signs on the Northwest Freeway inbound slipramp and at the Park and Ride lot entrances along this corridor. Due to low traffic volumes and cost considerations, the price signs were not initially installed at the entrance ramp from the frontage road at Dacoma. The recommendations chapter identifies future expansion of the signing program to include the Program Information and Regulatory signs identified in the human factors analysis.

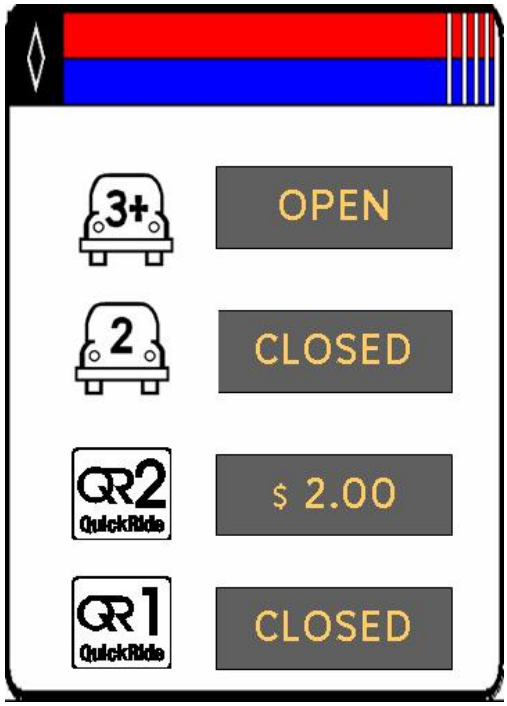
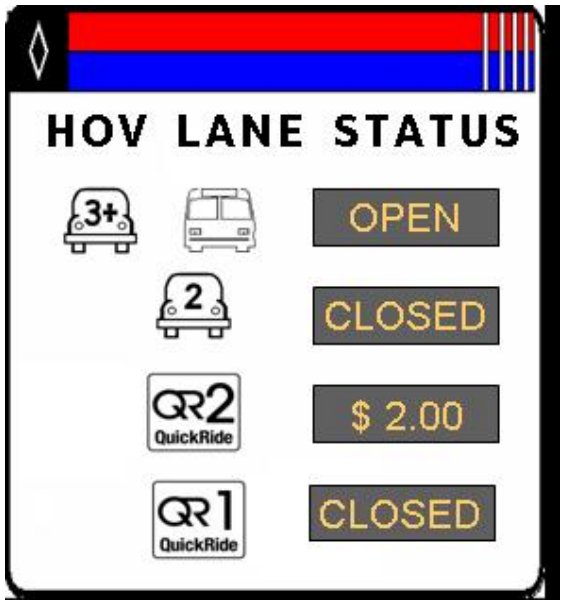


Figure 26. Price Signs for Park and Ride Lots after SOV Operations Are Implemented.



Note: This sign contains text HOV LANE STATUS and Bus logo. These were dropped for Park and Ride lot signs to reduce the size given the limited right of way in these facilities.

Figure 27. Price sign for slip ramp entrance.

IDENTIFICATION REQUIREMENTS FOR DYNAMIC PRICING AND TOLL COLLECTION

Two main technological components are required for dynamic pricing: (1) tolling equipment and (2) speed and flow measurement. Since dynamic pricing requires the toll to vary frequently, in this case every 5 minutes, the billing readers must distinguish where, and more importantly *when*, the vehicle entered the HOT lane. This was accomplished by adding all of the current AVI readers to the QuickRide billing system. Therefore, the software controlling the billing readers on the Northwest Freeway went from allowing only 2 (AVI readers 36 and 40) to allowing all 10 (AVI readers 36, 37, 38, 40, 42, 43, 44, 46, 48, 49). Additionally, improvements to these readers and the communication methods used by the readers were undertaken to ensure better data collection from those readers. For example, some of these readers used land-line modems that also transmitted data from the general purpose lanes. So much traffic data would flow into these modems that their buffers would be exceeded, and HOT lane data would be lost. New wireless code division multiple access (CDMA) modems were added to these readers to overcome this problem.

Secondly, to set the correct price that will ensure free flow conditions, it was necessary to both (a) monitor speeds in real time and (b) monitor the entry and exit of vehicles in real time. To accomplish these goals, 6 WaveTronix™ vehicle detectors have been installed along Northwest Freeway and 2 along Katy Freeway.[3] These devices supply speed and flow data in real time to a pricing algorithm. This algorithm then stores the data on the AVI transponder number of the traveler and the current toll (to later use for billing purposes) and sends the data in real-time to the dynamic message signs (DMS) displaying the toll.

To determine the correct price of the HOT lane option for SOV travelers, the stated preference questions from the non-user survey were examined. Using the value of travel time savings indicated in the survey, the predicted travel time savings on the HOT lane, and the need to keep the HOT lane flowing at free flow speed a pricing algorithm was developed. This

[3] The WaveTronix™ devices on Katy Freeway will provide METRO data on the operational characteristics (speed and flow of traffic) of the Katy HOT lane that they did not have access to before. Due to the importance of this data it was felt that the WaveTronix™ devices installed on Katy at the beginning of this project should remain there, despite the fact dynamic pricing would not be implemented on Katy Freeway.

algorithm, along with the communication links to the DMS and the WaveTronix™ devices, were successfully tested using a demonstration web site http://traffic.houstontranstar.org/quickride/ (see Figure 28).

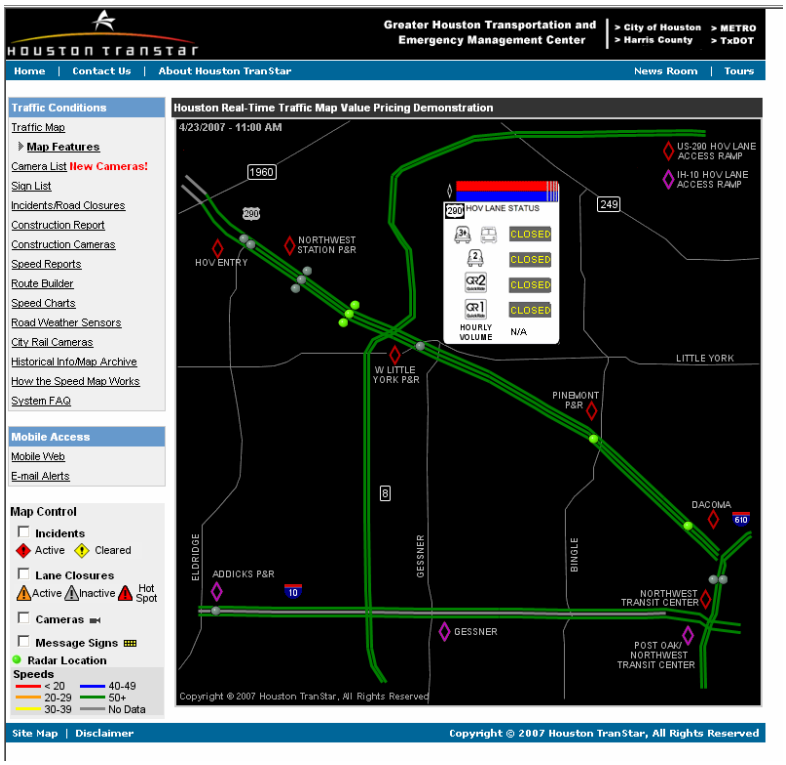


Figure 28. Demonstration Web Site

TOLL COLLECTION IMPROVEMENTS – NEWLY INSTALLED ANTENNAS

New antennas were installed at some Automatic Vehicle Identification (AVI) locations on Houston's Katy and Northwest Freeway HOT lanes to determine if different antennas resulted in improved reading of transponders. This AVI system is used to track and charge for the use of QuickRide, the Katy and Northwest Freeway HOT program. The original Transcore AA3100 Yagi Antennas were replaced with Transcore AA3152 Universal Toll Antennas. The antennas connected to readers 39 and 46, which are located just northwest of the Pinemont exit on the Northwest Freeway, were replaced on Sunday, October 12, 2003. The antennas connected to readers 15 and 18, located between the Gessner and Post Oak exits on the Katy Freeway, were replaced on Tuesday, October 14, 2003. The total replacement cost was $10,318.

DATA COMPARISON

In an effort to determine changes in performance due to the new antennas, data from the replaced antennas was (1) compared to data from nearby antennas, and (2) compared to data from the same location prior to the installation of the new antennas. The total number of daily reads during the peak periods was collected for both the week prior to installation (Oct. 6–Oct. 10) and the week following installation (Oct. 20–Oct. 24). The week prior to installation is called the "before" period, and the week following installation is referred to as the "after" period. The peak periods used were 6:30 to 8:15 in the mornings, and 4:45 to 6:15 in the evenings. Reader malfunctions caused no QuickRide uses to be logged during some periods. The resulting zero values on readers 14 and 19 were removed when determining the averages.

RESULTS

I-10 Katy Freeway

The resulting data can be seen in

Table 6 and Table 7. The region containing the replaced antennas is shown in Figure 29. Both antennas showed a small increase in average reads during the week following replacement, 1.2% on antenna 15 and 4.4% on antenna 18.

In an attempt to control for a possible increase in QuickRide use during the "after" period, the reads collected on the new antennas were compared to those collected by nearby antennas which were not replaced. In this case, antenna 18 was compared to antenna 19, while antenna 15 was compared to antenna 14. Compared to antennas 14 and 19, antennas 15 and 18 have a greater number of average reads in both the "before" and "after" weeks. As such, no conclusions can be drawn based on this data.

I-10 Katy Freeway – Extended Data

In an attempt to draw a meaningful conclusion regarding the relative performance of the new AVI antennas, data from the three weeks before and three weeks after installation were analyzed for antennas 18 and 19 (see Table 8 and Table 9). Antennas 18 and 19 were used as there were no access points between these two antenna locations, meaning the same number of QuickRide users should pass each antenna. The results were inconclusive again.

Another potential factor influencing the number of recorded tag reads is the reader's ability to dial into the modem bank to upload its data. If the modem bank is busy, then the reader cannot connect, and data cannot be transmitted. If this happens too many times in a row, the storage capacity of the reader can be exceeded, and data is lost.

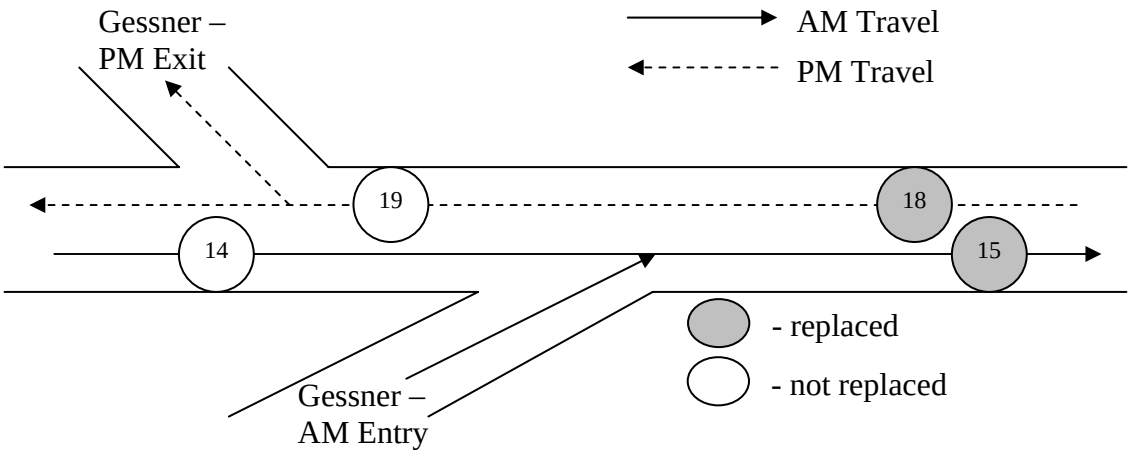


Figure 29. Readers on Katy Freeway

Table 6. Data Collected before Antenna Installation – Katy Freeway Comparison

Antenna	Oct. 6	Oct. 7	Oct. 8	Oct. 9	Oct. 10	Average
15	682	761	660	673	608	677
14	538	573	547	0	0	553
18	516	522	491	388	472	478
19	563	84	487	0	475	402

*shading indicates an antenna that was replaced

Table 7. Data Collected after Antenna Installation – Katy Freeway Comparison

Antenna	Oct. 20	Oct. 21	Oct. 22	Oct. 23	Oct. 24	Average
15	688	698	707	714	616	685
14	544	489	615	571	424	529
18	500	497	520	476	502	499
19	514	486	509	421	499	486

*shading indicates an antenna that was replaced

Table 8. Extended Data: Antennas 18 and 19 before Installation

Date	Antenna 18	Antenna 19
9/22	516	529
9/23	512	0
9/24	578	590
9/25	546	521
9/26	512	0
9/29	547	582
9/30	548	562
10/1	558	295
10/2	570	551
10/3	547	292
10/6	516	563
10/7	522	84
10/8	491	487
10/9	388	0
10/10	472	475
AVERAGE	**522**	**461**

Table 9. Extended Data: Antennas 18 and 19 after Installation

Date	Reader 18	Reader 19
10/20	500	514
10/21	497	486
10/22	520	509
10/23	476	421
10/24	502	499
10/27	531	521
10/28	586	543
10/29	587	524
10/30	527	513
10/31	489	514
11/3	464	457
11/4	502	0
11/5	506	562
11/6	461	527
11/7	538	562
AVERAGE	**512**	**511**

US 290 Northwest Freeway

A similar investigation was performed on the new antennas installed on the Northwest Freeway (see Figure 30). The resulting data can be seen in Table 10 and

Table 11. The number of reads on antenna 39 decreased by 30.3%, and the number of reads on antenna 46 decreased by 7.7%, possibly due to fewer travelers with transponders using

the lanes. To check if this was the case, reads from unaltered antennas were compared to reads from the new antennas. As with the antennas replaced on the Katy Freeway HOT lane, the antennas which were replaced on the Northwest Freeway had a larger average number of reads than their comparison antennas (40 and 45). However, these pairs of readers have an HOV lane entry/exit point located between them, which may be the cause of the differences in observed vehicles. As a result, no conclusions can be drawn from this data.

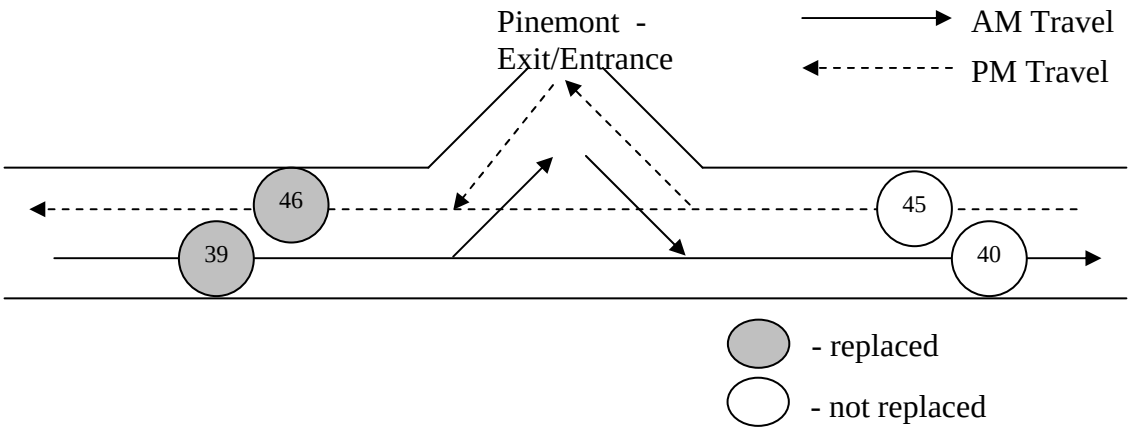


Figure 30. Readers on Northwest Freeway

Table 10. Data Collected before Installation – Northwest Freeway Comparison

Antenna	Oct. 6	Oct. 7	Oct. 8	Oct. 9	Oct. 10	Average
39	203	215	232	265	191	221
40	211	174	171	198	232	197
46	194	211	200	218	218	208
45	70	64	88	38	57	63

*shading indicates an antenna that was replaced

Table 11. Data Collected after Installation – Northwest Freeway Comparison

Antenna	Oct. 20	Oct. 21	Oct. 22	Oct. 23	Oct. 24	Average
39	150	175	151	180	115	154
40	169	168	153	108	135	147
46	186	229	198	186	159	192
45	81	106	127	165	26	101

*shading indicates an antenna that was replaced

SUGGESTIONS FOR ADDITIONAL ANALYSIS

Unfortunately, the data collected does not indicate whether the new antennas are more accurate than the old ones. One possible cause of this is the analysis time period. It is possible that the reader or antenna may have random down times during the QuickRide periods. This may explain why antennas 18 and 19 do not indicate the same number of reads. Perhaps by using a time segment smaller than the QuickRide period, such as 15-minute segments, the two antennas can be compared more accurately.

On the Northwest Freeway, there are no other antennas on the HOV lane segment where the new antennas are located, making direct comparison between the old and new antenna types impossible. One possible solution is to connect both the new and old antennas to the same reader. However, this may be operationally or cost prohibitive.

The next step should be an in-depth analysis of transponder reads on both the mainlanes and the HOV lane to determine if the new antennas are better tuned than the old ones to focus on the HOV lane only, as opposed to detecting QuickRide transponders on vehicles in the mainlanes. Additionally, the possible loss of data due to busy modem banks causing communication failure should be examined.

CHAPTER 5: CHALLENGES AND RISKS

OLDER TOLL COLLECTION TECHNOLOGY IS OPTIMIZED FOR VEHICLE COUNTING

One issue with the technology employed for QR-1 is the AVI system in place for reading electronic toll collection ETC transponders. This system was designed for capturing average travel speeds and as such did not need to reach the same accuracy levels as found in toll collection systems. Therefore, transponder reads are still missed–although the exact number is impossible to determine. Another problem is the location of the devices was again optimized for travel speed determination. Determining the time and location of the SOV vehicle's entry to the HOV lane (and therefore the correct toll) will have to be estimated based on when the first reader that identified the vehicle. Due to this estimation the toll charged will have to be the lower of the current toll or the toll in the preceding 5-minute tolling period. Additional communication issues with these devices were fixed as part of the project by installing dedicated wireless modems on the readers.

NO INFRASTRUCTURE IN PLACE FOR DYNAMIC PRICING

Traffic Signs

The price signs are located before the billing readers. The lag, or cascade, of updates along the corridor must also be addressed to properly coordinate the price posted with the billing. The operating agency may also want to create a log of posted prices by time of day to aid in resolving any toll disputes that may arise.

Vehicle Detection

As noted previously, to appropriately price access by SOV vehicles to the HOV lane new technology was required to detect the traffic flow and speed on the HOV lane. Although this

technology has proven to be effective, there is always the possibility of a failure with the vehicle detection equipment, a communications failure, or a failure with the server that determines the correct price. This occurred in January of 2005 when one of the WaveTronix™ sensor's communication boxes was apparently struck by a vehicle and destroyed – eliminating all data from that sensor. If any of these items fail in such a way that it is impossible to ensure the HOV lane is at free flow conditions, then the HOV lane will be closed to SOV vehicles (basically a fail safe mode).

Enforcement of HOV Occupancy Is Inherently Challenging

There are two primary challenges associated with reducing violations during QuickRide periods. First, enforcement of HOV occupancy is inherently challenging for METRO officers. Occupancy verification, particularly at high speed enforcement areas, is difficult, especially during low light periods and with situations such as tinted windows, backseat occupants, and panel vans. The enforcement task is even more challenging during QuickRide periods due to the multiple visual tasks an officer must perform in a matter of seconds to verify account status along with occupancy. The current system for enforcing compliance has not been effective:

- Under the current system, HOV2 violators during the QuickRide periods are impossible to detect with certainty.
- Transponder verification and billing at the point of enforcement is not presently used; toll evasion is evident.
- Additional problems exist for Katy Freeway during construction due to impacts at enforcement areas. Although the HOV lane has been operational during construction, the existing enforcement areas have not been available on a consistent basis. This has been done to allow contractor flexibility during construction, but has severely limited the ability to perform enforcement.
- Even those who are ticketed may not pay a fine.

Furthermore, the required enforcement compliance has not yet been accomplished and may not be achievable. The best violation rate achieved after the test period, during which technology

and other procedures were put into place, was approximately 29%. This was double the violation rate on the I-15 value priced express lanes in San Diego, where similar technology and a comparable level of officer presence is employed.

Second, HOV enforcement is no longer a core function for the METRO police force. As of November 2004, changes in the METRO organizational structure resulted in the HOV enforcement section being assimilated into other traffic management functions. This change was made to ensure sufficient resources for other priority efforts, particularly rail safety and security. As a result, HOV enforcement does not have the same emphasis, level of dedicated staff resources, or the level of officer experience as it has in previous years.

Customer Usage Is Highly Irregular ("Opportunity" Trips)

One additional risk is a potential lack of interest from SOV travelers in paying to travel on the HOV lane during off-peak periods. Although the survey of SOV travelers clearly indicated an interest in this option, there exists the possibility that travelers would choose this option infrequently. Current QuickRide travelers use QuickRide on an infrequent basis (see Figure 31). In addition, HOT lane researchers in California have found most travelers on both SR-91 and I-15 chose the HOT lane on an infrequent basis. Therefore, it is important to encourage a large number of travelers to enroll in QR-1 and ensure a large pool of users from which a small number may choose QR-1 on any given day.

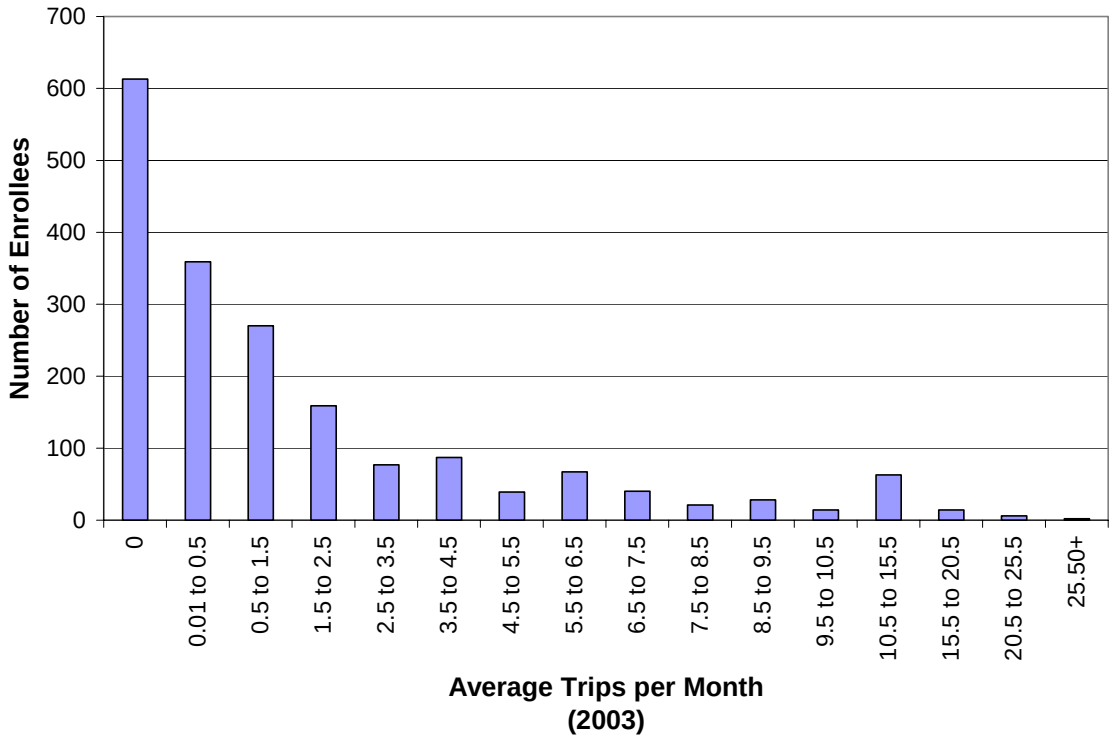


Figure 31. Frequency of QuickRide Trips

Toll Account Management

Additional QuickRide participation requires improved and expanded toll account management. The existing lack of staff resources dedicated to toll account management, absence of standard operating procedures, and the limited automated account technology results in poor customer service and failure to collect a full accounting of tolls. The addition of tolling for SOV travelers is beyond the capacity of the current program for account management.

Public Information

Overall, the challenge for the public education task is to build awareness and educate QR members and the public on a basically unknown and underutilized time-saving travel option. Another challenge to address in this area, is overcoming the public's perception of the inconvenience of carpooling (identified in our research).

PREREQUISITES FOR EXPANDED QUICKRIDE OPERATION

Tolling Equipment

Dynamic pricing requires the toll to vary frequently (potentially as often as every minute–but every 5 minutes is more realistic). Since the price varies frequently, the current method of capturing transponder reads will not work. The current method cannot distinguish where, and more importantly *when,* the vehicle entered the HOT lane. For dynamic pricing, the system must be able to determine (with reasonable accuracy) when the vehicle entered the HOT lane. Although this information needs to be recorded in real time (as it is now), there is no need to process the data in real time. Billing could occur much as it is done now. Currently, records of the exact transponder identification number, time, billing reader, and date are stored and then sent to METRO on a daily basis. This would work for the dynamic pricing system as well, as long as a record of the price during each time period was also recorded and matched to the usage records. To make reasonable assumptions on the time of entry of each paying QuickRide user would require data from the following readers:

- Northwest Freeway, Inbound: 36, 37, 38, 40, 42
- Northwest Freeway, Outbound: 43, 44, 46, 48, 49

Speed and Flow Measurement

To set the correct price to ensure free flow conditions it is necessary to both (a) monitor speeds in real time and (b) monitor the entry and exit of vehicles in real time. Basically, the toll will rise as traffic congestion on the HOV lane increases. In this manner price will limit the number of SOVs accessing the lane. In the event the lane becomes congested despite a high toll level then access to the lane for SOV vehicles should be halted until such time traffic returns to free flow conditions.

To accomplish these goals, six Wavetronix™ vehicle detectors have been installed. These devices supply this data in real time to a pricing algorithm. This algorithm then both stores the pricing data (to later use for billing purposes) and sends the toll price data in real time to the dynamic message signs displaying the price.

Enforcement

The evaluation of current enforcement operations has revealed extremely high violation rates. Field tests have demonstrated that violation rates can be significantly reduced by both increasing law enforcement coverage and employing technology to assist officers in verifying QuickRide accounts.

Many concerns about enforcement were raised in the open comment portion of the user survey and focus groups. The QuickRide user focus group was particularly critical of the consistency of enforcement of the HOV lanes on Katy and NW. More than 60 survey respondents raised concerns about all aspects of enforcement, but predominately about the lack of patrol officers, high rate of SOV usage, and high usage by those without proper QuickRide "permits".

The following items should be considered non-negotiable prerequisites for extending QR to SOV use in the off-peak:

- Provide consistent on-site law enforcement officers throughout expanded QR periods with sufficient frequency to dissuade violators.
- Install supporting technology.
- Outreach to judges in order to affect changes in the adjudication process that eliminate other avenues for cheaters to avoid penalties for non-compliance.
- Improve toll account management, particularly violator processing and tracking
- Enhance signing and step up public education efforts to provide drivers with clarity regarding operating requirements.

Signing

An additional user category designated as QR-1 (QuickRide 1) is necessary to implement SOV operations in the off-peak. This designation informs drivers that they must be enrolled in QuickRide, and that a vehicle is eligible with a single occupant.

Figure 32. QuickRide 1

The price signs have been designed to accommodate a fourth line of text and pricing information. The communications protocol is designed to allow price and lane status to be displayed on the corresponding variable message panel. Until SOV operations are approved, when the signs are installed, the QuickRide 1 line is covered by a blank panel, and the variable message block remains blank.

Toll Account Management

- high cost per account,
- lack of standard operating procedures for revenue collection,
- lack of automated management systems,
- limited staff, competing responsibilities, and
- additional (committed) resources are required to expand number of accounts.

CHAPTER 6: RECOMMENDATIONS — MOVE FORWARD

Based on the extensive analysis conducted on behalf of the local operating agencies, it is recommended that QuickRide be expanded and extended. There are four basic options that the operating agencies could consider.

OPTIONS

- Do Nothing – not recommended; the benefits to the HOV lane(s) and the traveling public far exceed any cost or effort required for expanding the QuickRide program.
- Expand QR-2 – QuickRide-2 on the NW Freeway should be expanded to longer hours and the PM peak period.
- Implement [QR-1 and dynamic pricing] on NW Only – because of ongoing construction on I-10, off-peak implementation of single occupant buy-in to the HOV lane (QuickRide-1) should be implemented only on the NW Freeway.
- Implement NW as a First Step for a Broader Implementation – QuickRide-1 could potentially benefit all Houston HOV lanes, but the local operating agencies should become proficient and successful on the NW Freeway first, then expand to other corridors.

A summary of implementation recommendations is included below.

IMPLEMENT DYNAMIC PRICING AND QR-1 ON NW, AS FIRST STEP IN BROADER IMPLEMENTATION

1. To improve customer satisfaction
2. To re-establish credibility
3. To increase revenue (decrease cheaters)
4. Likely breakeven cost revenue on NW

INSTALL FULL SIGNING SYSTEM ON NW

The site for each of the signs on NW has been identified with cooperation from TxDOT and METRO staff. The large price sign, and accompanying power and communications connections, has been installed on NW. The price signs for the Park and Ride lots have been installed as well. The additional Program Information and Regulatory signs have been designed and installed.

Figure 33. Program information sign

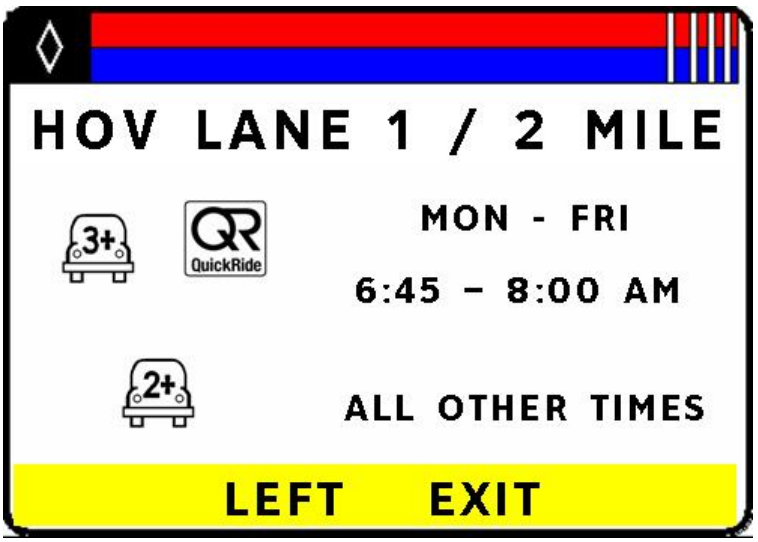


Figure 34. Regulatory sign (example operating hours)

CONTRACT FOR HIGH-LEVEL ENFORCEMENT

Due to conflicting priorities for law enforcement resources, current enforcement levels provided by METRO for QuickRide operating hours–both current operations and expansion–are not sufficient to provide a reasonable level of compliance. Contracting for a high level of consistent enforcement with another agency such as the Harris County Sheriff's Department, City of Houston, or other agency will establish consistency in enforcing the program. Contract enforcement can occur under the Interlocal Agreement provisions of the Texas Code.

Estimates were prepared for contract enforcement for the NW implementation and are shown in Table 12. The estimates cover manpower costs ($26 and $39 hourly charges for regular and overtime hours, respectively) and do not include charges for vehicles and other equipment. Court appearances are estimated to require 20% of an officer's time, so hours must be increased by approximately 25% over the amount to cover the QR operation times. This is based on the assumption that vigorous enforcement will produce more citations, and that the officers will be scrupulous in backing up their citations by appearing in court.

Table 12. Cost estimates for Contract Enforcement during QR periods along NW

Proposed QR Hours of Operation	Total Hours Required	Cost Estimates	
		Low	High
Current QR Hours (AM only)	470	$12,200	$18,300
AM and PM QR	850	$22,000	$33,000
AM and PM QR with off-peak QR-1	2450	$63,400	$95,000

The estimates for manpower costs for NW assume the following enforcement regime:

Four enforcement locations are utilized:

1. NWTC AM exit ramp
2. NWTC PM entrance ramp
3. Dacoma AM exit ramp
4. Dacoma PM entrance ramp

- During the first two weeks, all locations are manned for each AM or PM period.
- After the initial two-week period, for each AM or PM period, one of the two enforcement sites is manned, with the selection of site determined randomly. For example, to obtain a two-week schedule for AM enforcement, flip a coin 10 times, with heads or tails determining which of the two AM sites will be manned.
- Every three months, a two-week period is chosen at random for full enforcement as in the initial two weeks.

IMPLEMENT ENFORCEMENT TECHNOLOGY

Four automatic vehicle identification AVI Violation Enforcement Systems have been deployed along the NW, one as a fixed installation and the others as portable trailer units. The locations are illustrated in Figures L and M. In addition to the AVI violation enforcement systems, two handheld violation enforcement readers have been developed. These handhelds are intended to provide METRO patrol officers with an additional means of verifying valid QuickRide transponders and identifying faulty transponders after a suspected violator is pulled over. The handheld units have additional utility in the event METRO wants to establish a remote customer service operation at a park-and-ride lot to check account status for drive-up customers.

The results are detailed in Technical Memorandum 2-8 Field Implementation of Enforcement Strategies (Appendix E). A detailed field guide for implementation has also been developed and submitted.

ADDRESS ADJUDICATION ISSUES

The citation analysis revealed that there are some issues to be addressed with the citation adjudication process. Outreach to judges is needed for general education and to determine the possibility for changing the times cases are heard from peak hours to a time period outside QuickRide operating hours. The partnering agencies should also explore possibilities for raising the occupancy violation fine level above $200.

ALTERNATIVE OPERATING APPROACH

Enforcement operations can be greatly simplified by requiring all vehicles, including toll-exempt HOVs, to be equipped with transponders. Under this operating scenario, the officer's task is simplified in that toll account verification can be performed by a video enforcement system (VES) using license plate recognition (LPR) rather than by the patrol officer. It is suggested that low-speed enforcement areas with separate AVI readers be established at park-and-ride lots or transit centers as locations where HOV3+ occupancy can be verified by an officer and receive a credit for the trip. In this way, a carpool self-declares that it is eligible for a free trip, putting the burden of proof on the driver and requiring the officer to verify that the occupancy requirement is met. Violation of the occupancy requirement at the "credit lane" would result in the issuance of a citation for occupancy violation, as is the case now.

The advantages of this approach are (1) simplification of the enforcement operation and (2) increased revenue from toll violators who could be charged an administrative fee that returns to the operator in addition to the toll. The current violation penalty is a citation for occupancy violation (moving violation), and no revenue returns to METRO for any citations issued.

The drawbacks to the approach, and the reasons it has not been pursued up to this point, are as follows:

- METRO does not have the legal authority to perform video enforcement.
- The requirement for authorized HOVs to set up an account and display a transponder may negatively impact the formation of carpools, particularly casual carpools.
- Legitimate carpools accessing the HOV lane by slip ramp must get off the HOV lane at a park-and-ride lot to access the "credit lane" to avoid being charged a toll.
- The approach is not conducive to out-of-town travelers who could spontaneously use the HOV lane.

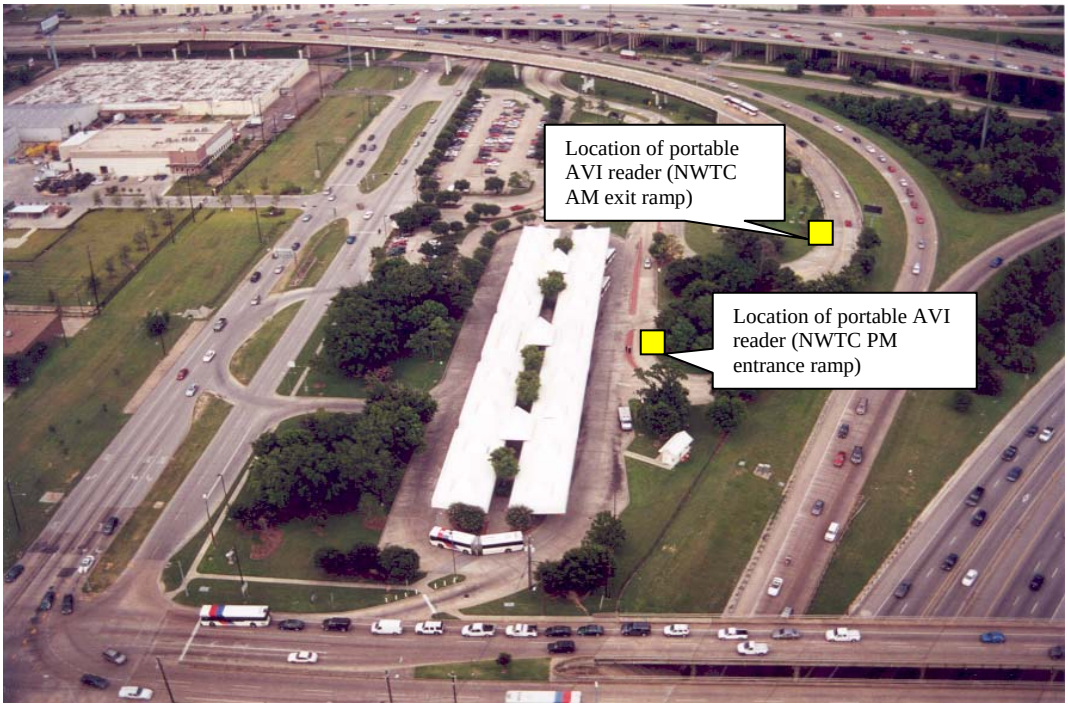


Figure 35. Aerial view of AVI Violation Enforcement locations at NWTC ramps on the NW HOV lane

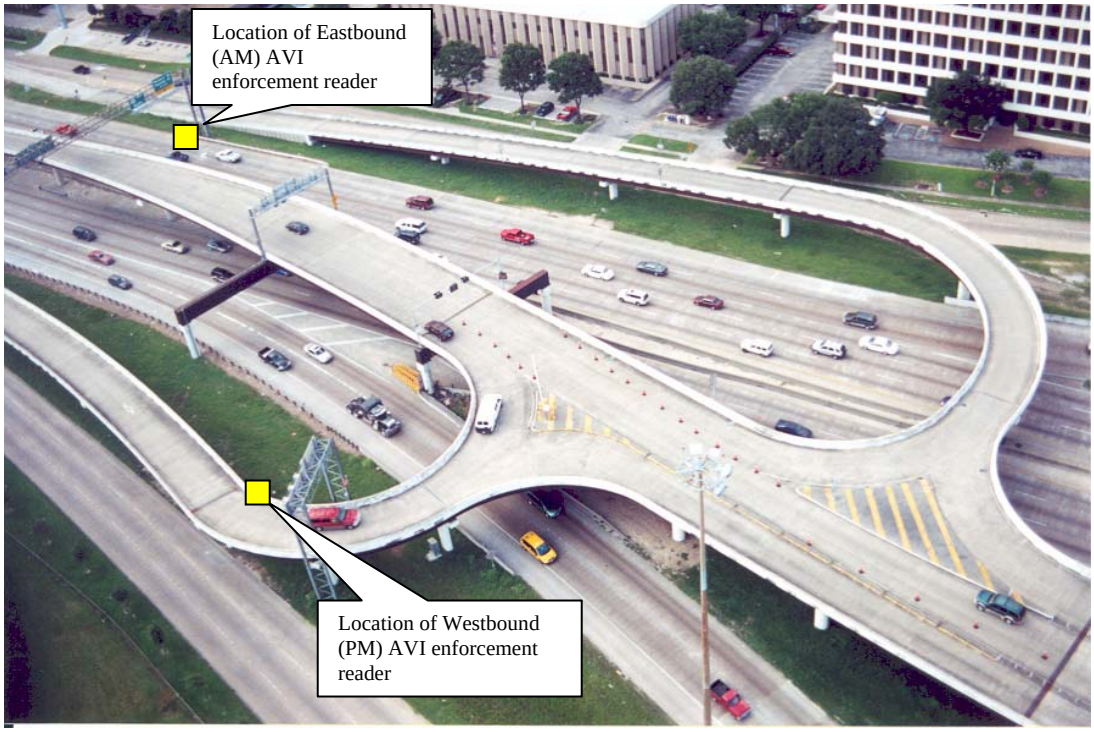


Figure 36. Aerial view of AVI Violation Enforcement locations at the Dacoma wishbone ramps on the NW HOV lane

UPGRADE OR OUTSOURCE TOLL ACCOUNT MANAGEMENT

Upgrade or outsource toll account management to improve customer satisfaction and to permit expansion of number of users. There are three options for action:

- METRO invests staff and automated systems to enhance account management.
- Enter into interlocal agreement with HCTRA.
- Outsource to private industry.

The recommendation is to enter into an interlocal agreement with HCTRA. The benefits to be achieved include:

- Reduce cost per account.
- Reduce total cost.
- Manage increase in QR accounts.
- Benefit from proven processes and systems.

- Simplify policies and procedures for customers.
- Act expeditiously, simpler than other options.

PUBLIC INTEREST MARKETING FOR NW, AGGRESSIVE MARKETING LATER

With the current conditions on the Katy Freeway, it is recommended to postpone any changes to the QR program as the freeway will be converted to include managed lanes. This affords an opportunity for the recommended changes to be piloted on NW. During this time, it is recommended that public education efforts be limited to direct mail with existing QR members complimented by public relations efforts. The public relations efforts recommended are employee education, a series of news releases and community group presentations until changes are implemented on both freeways. Once it is feasible to implement the changes on the Katy freeway, a full public education plan (detailed below) is recommended.

Messages

1. The QR program is available as a faster travel option to motorists on the Katy and Northwest Freeways, and it helps motorists save time and money.
2. The HOV/HOT lane is a free and time-saving option for carpools.
3. QR is convenient, easy to join, and easy to use.
4. Houston has some of the most successful HOV lanes in the country and is on the cutting edge with the latest in transportation technology.
5. METRO and TxDOT are working together to improve transportation in the community.