LBJ Freeway HOT Lanes
Preliminary Feasibility Study
February 25, 2000

Mr. Thomas D. O'Grady, P.E.
Project Director
HNTB Corporation
1414 Dallas Parkway, Suite 630
Dallas, Texas 75240

Re: LBJ Freeway HOT Lanes Preliminary Feasibility Study

Dear Mr. O'Grady:

Wilbur Smith Associates (WSA) is pleased to submit this final report of our Preliminary Feasibility Study of the proposed high-occupancy toll lanes (HOT lanes) on the LBJ Freeway in Dallas, Texas. The HOT lanes would extend from I-35E to I-30, a total length of approximately 20 miles. Along this distance, there would be several different configurations:

- Four HOT lanes (two for each direction) constructed between Luna Road and I-35E;
- Six HOT lanes between I-35E and Preston Road (three for each direction);
- Four HOT lanes between Preston Road and Plano Road (two for each direction); and
- Two reversible HOT lanes constructed between Plano Road and I-30.

Under the proposal, vehicles with two or more passengers (HOV-2+) would travel free while single-occupancy vehicles (SOV) would pay a toll.

To gain an understanding of current congestion and traffic flow patterns in the corridor, WSA used videotape and other methods to both quantify traffic levels and qualitatively assess congestion through observation. Analyzing the data revealed the following characteristics that influence the analysis of the HOT lanes:

- A major component of the existing traffic congestion is caused by the merging and diverging traffic to/from the ramps;
- The availability of HOT lanes tends to increase the amount of HOVs in the overall traffic stream;
- Just because an HOV lane exists does not mean that all HOV traffic will use it. In fact, during the heaviest peak periods, only 63% to 66% of the total HOVs will use the lane; and
- Given the existing observed speeds during the peak periods, there appears to be the ability, with the addition of new HOT lanes, to "self" space in these lanes to SGVs to fill up the excess capacity not used by the HOV traffic.

To analyze the HOT lanes, WSA developed a technique that integrated three traffic analysis models: a traditional four-step macroscopic travel demand model to estimate global demand, a FRESIM traffic micro simulation model of the LBJ Freeway main lanes, and a market share model implemented in a spreadsheet to estimate the traffic levels likely to choose to pay a toll under different pricing and time-savings conditions.

Our analysis revealed that:

- The HOT lanes are anticipated to have travel time savings at all times of the day. The biggest benefit is expected to be during the morning peak in the eastbound direction with a typical time saving of about 10 minutes for a full length trip, and the evening peak (westbound), with a typical time saving of about nine minutes.
- In the morning peak, the highest HOT lane volume in the westbound direction was expected between Preston Road and U.S. 75, at close to 3,400. About 15% (520) of these are expected to be paying customers. In the PM peak, the highest eastbound volume in the HOT lane is expected between Preston and U.S. 75, with a volume of about 4,600. About 55% of these would be paying SGVs. Note that this volume exceeds the desired threshold of 3,600 vehicles per hour on this two-lane section of a HOT facility. Further refinement of toll rates and structure would be needed to get this traffic volume below this threshold.
- Hourly volume during the midday period are expected to be close to that of the peaks on many sections.
- Nighttime volumes are expected to be much lower per hour than during other periods.

The annual toll revenue in 2015 is estimated at approximately $12 million.

This preliminary study of HOT lanes on the LBJ Freeway has shown that HOT lanes could be an effective mechanism to provide a non-congested alternative for HOV's and for people willing to pay a toll. We expect that tolls within a reasonable range could be used to keep the HOT lanes flowing smoothly during congested periods.

As the project moves forward toward implementation, there are a variety of issues that remain to be explored, including pricing mechanisms, definitions of HOT, how trucks would be handled, further detailing of design-hour volumes, and toll collection/implementation issues.

Our key project staff, Tim Sorensen and Grace King, join me in expressing our appreciation to Matthew MacGregor of TxDOT and you for the cooperation and assistance we received over the course of this interesting study. It has been a pleasure to be of service to HNTB Corporation and TxDOT.

Sincerely,

Jeffrey N. Buchbaum, AICP
Vice President
# TABLE OF CONTENTS

## ILLUSTRATIONS

<table>
<thead>
<tr>
<th>FIGURE NUMBER</th>
<th>PAGE NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Location Map</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Westbound Schematic Diagram of HOT Lanes and Ramps</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Eastbound Schematic Diagram of HOT Lanes and Ramps</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Traffic Count Locations</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Hourly Traffic Volumes Westbound</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Hourly Traffic Volumes Eastbound</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Vehicle Occupancy Location Without HOV Lanes</td>
</tr>
</tbody>
</table>

## TABULATIONS

<table>
<thead>
<tr>
<th>TABLE NUMBER</th>
<th>PAGE NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Average Observed Eastbound Travel Speeds</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Average Observed Westbound Travel Speeds</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Definition of Analysis Periods</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Westbound Global Demand Volumes Near Marsh Lane</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Suggested Toll Rate Structure</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Estimated Toll Revenue by Time Period</td>
</tr>
</tbody>
</table>

### Chapter 1 Introduction
- Project Description
- Project Configuration

### Chapter 2 Existing Traffic Conditions
- Hourly Traffic Volumes
- Vehicle Occupancy
- Travel Speed
- Eastbound
- Westbound

### Chapter 3 Methodology
- Global Demand
- FRESIM Traffic Model
- Market Share Model
- Iteration of the Market Share Model and FRESIM Model

### Chapter 4 Traffic and Toll Revenue Estimates
- Global Demand Estimates
- Toll Rate Testing
- Estimated Traffic Volumes and Travel Speeds
- Toll Revenue estimates
- Areas for Further Study
- Disclaimer

Appendix A - Global Demand Estimates
Appendix B - Toll Rate Testing
Appendix C - Interchange to Interchange Movements
Appendix D - Toll Traffic Estimates
CHAPTER 1

INTRODUCTION

The LBJ Freeway (I.H. 635) is a circumferencial highway around Dallas (Figure 1). Since its completion in the 1970s, the freeway has been stimulating both commercial and residential growth in the corridor. As the result of continuing growth, the traffic on certain sections of the LBJ Freeway are heavily congested for many hours each day, and the condition may become even worse in the future if no roadway improvements are made. A Major Investment Study (MIS) of the segment between I.H. 35E and I.H. 30 has chosen high-occupancy toll (HOT) lanes as the locally preferred alternative for improvement in this corridor.

Wilbur Smith Associates (WSA) prepared this preliminary study of the traffic and toll revenue potential of the proposed HOT lanes on the LBJ Freeway. For the purpose of this study, the project was assumed to open in 2015.

PROJECT DESCRIPTION

The HOT lane concept WSA was asked to study would extend from I.H. 35E to I.H. 30. The total length is approximately 20 miles. Along this distance, there would be several different configurations (See Figure 1):

- Four HOT lanes (two for each direction) constructed between Luna Road and I.H. 35E;
- Six HOT lanes between I.H. 35E and Preston Road (three for each direction);
- Four HOT lanes between Preston Road and Plano Road (two for each direction); and
- Two reversible HOT lanes constructed between Plano Road and I.H.-30.

Under the proposal, vehicles with two or more passengers (HOV-2+) would travel free while single-occupancy vehicles (SOV) would pay a toll. The rationale for recommending HOT lanes is that high occupancy vehicle (HOV) lanes would not be fully utilized during the course of any given day. In order to optimize usage of these lanes, SOVs would be allowed to use the lanes as long as the total volume in the HOT lanes did not grow in excess of Level of Service (LOS) C – meaning travel speeds remain at the highest levels. The mechanism to regulate the SOV traffic would be to implement high enough tolls such that the number of HOVs and SOVs always provides traffic operations better at or better than LOS C. Tolls will vary by time period and direction depending on the level of congestion in the main lanes.

Implementing HOT lanes accomplishes several things:

- It continues to provide an incentive for HOV traffic (assuming the main lanes are congested and the HOT lanes are uncongested);
- Excess capacity in HOV lanes is utilized providing for optimal use of the lanes in peak periods; and
- It generates some revenue.
PROJECT CONFIGURATION

A schematic diagram of the westbound HOT lanes is shown in Figure 2. In the westbound direction, the HOT lanes would be accessed from the I-635 main lanes at two points: I-30 and between Miller Road and Plano Road. Access points for other roads would be at:

- I.H. 30;
- La Prada Drive;
- Between Northwest Highway and Shiloh Road;
- Between Miller Road and Skillman Avenue;
- Floyd Road;
- U.S. 75;
- Preston Road;
- Midway Road; and
- I.H. 35E.

The ramps connecting U.S. 75 and the HOT lanes would be opened for westbound HOT lane traffic only during the A.M. period. The reversible segment between Plano Road and I.H. 30 would also only be open for the westbound traffic during the A.M. period.

Figure 3 shows the configuration of the eastbound project. Access is similar to that in the westbound direction. The eastbound ramp connecting U.S. 75 and the HOT lanes as well as the reversible segment between Plano Road and I.H. 30 would only be open to eastbound traffic during the P.M. period.
EXISTING TRAFFIC CONDITIONS

Although the HOT lanes are not to be opened until 2015, it is important to understand the characteristics of the existing freeway. The existing freeway is generally four lanes in each direction. There are frontage roads along portions of the freeway and a single HOV lane in each direction between I.H.-35E and U.S. 75.

WSA collected traffic volumes at four locations along the LBJ for a 24-hour period and performed vehicle-occupancy counts during the peak periods. The HOV lanes and main lanes were counted separately. Study locations are shown in Figure 4.

HOURLY TRAFFIC VOLUMES

Using videotapes from Texas Department of Transportation (TxDOT) at four locations along the LBJ Freeway, 24-hour traffic volumes were manually counted by the hour. There were two locations in the east portion with HOV lanes: Abrams Road and La Prada Drive, and two locations in the west portion: west of Marsh Lane and Montfort Drive. The videotapes were made on April 30-May 1, May 19-20, June 24-25, and July 22-23 in 1998. Figures 5 and 6 show the hourly traffic distribution at these four locations.

The traffic count data by hour reveals some interesting phenomena. First of all, sharp peaking during morning and evening peak periods was not in evidence in either direction. Looking into this further, WSA found that the periods of highest traffic throughput did not correspond to the periods of highest traffic congestion. WSA determined this by reviewing the congestion levels evident on the videotaped traffic streams. This indicates that traffic demand during heavy demand periods is considerably higher than can be accommodated due to the breakdown conditions normally associated with LOS F. This is noted by the different color bars in Figure 5.

For instance, at Marsh Lane, traffic actually experiences LOS F in both the A.M. and P.M. peak periods although the traffic volumes do not indicate that they reach this level. WSA believes that the reason for this phenomenon is the interaction of the freeway ramps with the high mainline traffic volumes. There are several high-volume ramps in this area. As the traffic builds on the mainline, the interaction with the high-volume ramps causes the breakdown in traffic before the mainline capacity threshold is reached, therefore causing LOS F to occur in mainline segments where they might otherwise operate at an acceptable LOS. This phenomenon is also present in the westbound direction as shown on Figure 6.

It is important to note that this data is based on a one day’s worth of observations at the four locations. WSA believes these patterns typical for the weekday condition on the LBJ.

It is also interesting to note that the westbound traffic and the eastbound traffic had an approximately 48/52 split in average daily traffic (ADT). Additionally, traffic volumes in the west porton were generally 30% higher than those in the east portion.

VEHICLE OCCUPANCY

WSA conducted surveys of vehicle occupancy at three locations in both directions on the LBJ on March 31, April 1 and April 2 in 1998. These locations were in the vicinity of Welch Road, Greenville Avenue, and Northwest Highway. The surveys were...
conducted in the A.M. (7:00-9:00 a.m), Midday (9:00 A.M. – 4:00 P.M.), and P.M. (4:00-7:00 p.m) periods.

There are no HOV lanes at Greenville Avenue and Northwest Highway. The percentages of SOV, HOV with 2 occupants and HOV with 3 or more occupants at these two locations are shown in Figure 7. During the study periods, SOV traffic ranged from a low of 81% to a high of 92%. The HOV 3+ category was between 1 and 2 percent during each of the periods.

The vehicle-occupancy count in the vicinity of Welch Road is summarized in Figure 8. This segment of I.H. 635 has an HOV lane. The percent of SOV traffic in this segment is generally less than at the other two locations. This could be an indication that there are some people switching to HOVs when there is an HOV lane available.

Not all high-occupancy vehicles use the HOV lanes. At the Welch Road location, a distribution of HOV (2+) vehicles between the HOV and the main lanes was developed (Figure 9). For much of the day, the majority of HOVs do not use the HOV lane. Use of the HOV lane by HOVs is highest during the peak periods in the peak direction: eastbound P.M. (66%) and westbound A.M. (63%). There are several reasons why HOVs might choose not to use the lanes:

- The exit and entrances to the HOV lanes may not be convenient for their particular trip;
- The trip is too short and weaving from the right side to the left side is not worth the effort; or
- Traffic is not congested enough to warrant use of the lane.
TRAVEL SPEED

One of the measures of effectiveness of a transportation facility is travel time from one point to another. Speed is especially important when evaluating the HOT lanes as speed is the value that drivers will be buying when opting to pay a toll. In order to determine the existing operating speeds on the LBJ Freeway, WSA conducted speed-delay studies. These studies were conducted on March 25, 1998. Following is a discussion of the travel speed in each direction in the area of the HOV lanes.

EASTBOUND

In the eastbound direction, the existing HOV lane starts around Josey Lane and ends around U.S. 75. Table 1 shows the comparison of average travel speeds on the HOV lanes and main lanes between Josey Lane and U.S. 75:

<table>
<thead>
<tr>
<th></th>
<th>HOV Lanes</th>
<th>Main Lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.M. Peak Period</strong></td>
<td>55</td>
<td>52</td>
</tr>
<tr>
<td><strong>Midday</strong></td>
<td>63</td>
<td>55</td>
</tr>
<tr>
<td><strong>P.M. Peak Period</strong></td>
<td>46</td>
<td>26</td>
</tr>
</tbody>
</table>

Average main lane speeds were about 50-55 mph along the studied corridor in the A.M. and midday periods.

Slower speeds were experienced in the segments from I.H. 35E to Marsh Lane and from Coit Road to U.S. 75. During the P.M. peak period, severe congestion was observed along the whole corridor with average travel speeds reaching approximately 30 mph.

WESTBOUND

In the westbound direction, the HOV lane begins in the vicinity of Preston Road and ends around Josey Lane. Table 2 shows the comparison of average traveling speeds on the HOT lanes and main lanes between Preston Road and Josey Lane:

<table>
<thead>
<tr>
<th></th>
<th>HOV Lanes</th>
<th>Main Lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.M. Peak Period</strong></td>
<td>53</td>
<td>45</td>
</tr>
<tr>
<td><strong>Midday</strong></td>
<td>61</td>
<td>53</td>
</tr>
<tr>
<td><strong>P.M. Peak Period</strong></td>
<td>50</td>
<td>Not collected</td>
</tr>
</tbody>
</table>

During the A.M. period, slower travel speeds were experienced from Jupiter Road to Hillcrest and from Marsh Lane to Josey Lane. The section between U.S. 75 and Coit Road constantly experienced congestion.

SUMMARY

Analyzing the data revealed the following characteristics that influence the analysis of the HOT lanes:

- A major component of the existing traffic congestion is caused by the merging and diverging traffic to/from the ramps;
- The availability of HOV lanes tends to increase the amount of HOVs in the overall traffic stream;
- Just because an HOV lane exists does not mean that all HOV traffic will use it. In fact, during the heaviest peak periods, only between 63% and 66% of the total HOVs will use the lane; and
- Given the existing observed speeds during the peak periods, there appears to be the ability, with the addition of new HOV lanes, to “sell” space in these lanes to SOVs to fill up the excess capacity not used by the HOV traffic.
CHAPTER 3

METHODOLOGY

The LBJ Freeway HOT lane concept presented several unique challenges in estimating the amount of traffic - both SOV and HOV - that might use the proposed HOT lanes. Some of these challenges are summarized below:

- A review of current traffic operations indicates that merging and weaving movements are the primary cause of congestion on the LBJ Freeway. This led us to explore ways to estimate traffic speeds on the freeway using microscopic, rather than macroscopic, techniques.

- Without a toll, the HOT lanes would operate as “express” lanes. This is because access to and egress from the HOT lanes would be far more limited than the main lanes. This means that traffic making longer movements on the freeway would be more likely to consider using the “express” lanes than traffic making shorter movements. This would be true both for SOVs and HOVs. Therefore, not all traffic forecast to use the LBJ Freeway could be considered “eligible” to use the new lanes.

- When considering the effects of tolls on usage of the “express” lanes (now referred to as “HOT” lanes), the key variable is the amount of travel time savings offered by the HOT lanes. This amount of travel time savings will vary according to how much traffic is using each of the lane types. This means that as more traffic uses the HOT lanes, the speed on the mainlines will improve thereby making the main lanes more attractive. The traffic estimation techniques had to adequately account for this.

An overriding goal of the HOT lane implementation is to keep the HOT lanes flowing at LOS C. So, WSA’s analysis focused on identifying the toll rates that would be necessary to maintain this objective.

To analyze this problem, WSA developed a technique that integrated three traffic analysis models:

Global Demand. A traditional four-step, macroscopic travel demand model developed by North Central Texas Council of Governments (NCTCOG) and focused by them to the LBJ Freeway corridor was modified by WSA to accommodate traffic estimates for different times of day. This model was used to develop the “global demand” for traffic in the HOT lanes and main lanes, prior to application of toll pricing.

FRESIM. A FRESIM traffic micro simulation model of the LBJ Freeway main lanes built by WSA estimated traffic speeds on different segments of the LBJ Freeway at different traffic loadings.

Market Share. A market share model implemented in a spreadsheet was used to estimate the traffic levels likely to choose to pay a toll under different pricing and time-savings conditions.

Figure 10 shows a flowchart of the traffic estimation model and how the three basic components were integrated. A description of each component is provided below. Table 3 summarizes the definition of the analysis periods, and the single hour within that period used for modeling purposes.

<table>
<thead>
<tr>
<th>Analysis Period</th>
<th>Represents Hours</th>
<th>Modeled Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>6:00-9:00 A.M.</td>
<td>7:00 A.M.</td>
</tr>
<tr>
<td>Evening</td>
<td>3:00 P.M.-7:00 P.M.</td>
<td>4:00 P.M.</td>
</tr>
<tr>
<td>Midday</td>
<td>9:00 A.M.-3:00 P.M.</td>
<td>11:00 A.M.</td>
</tr>
<tr>
<td>Night</td>
<td>7:00 P.M.-5:00 A.M.</td>
<td>9:00 P.M.</td>
</tr>
</tbody>
</table>

The hours in the analysis period were grouped together because they reflect similar traffic levels. The modeled hour was determined to be the most typical of the hours they represent.

GLOBAL DEMAND

We have defined the term “global demand” as the amount of traffic that would use the corridor if no tolls were charged. This is made up of HOVs that would find it convenient to use the HOT lanes, SOVs that would benefit from the HOT lanes, and traffic that would choose to continue to use the main lanes. The components of the global demand were estimated with the NCTCOG LBJ Focus Travel Demand Model. WSA modified the model to reflect the agreed-upon current concept for the HOT lane project. WSA also
implemented the model for four, one-hour time periods representing typical traffic levels for the A.M. peak period, mid day, P.M. peak period and night time period.

For each time period, WSA ran the NCTCOG model twice, to get a clear picture of each component of the global demand. The first run was made to identify all eligible HOVs that would use the HOT lane. This was done by banning all SOVs from the HOT lane in the assignment process. The amount of HOV traffic extracted from this model run was kept constant throughout the remainder of the analysis, since HOVs would not be subject to behavior changes as a result of tolling.

The second model run was used to get an estimate of all SOV traffic that would be likely to use the HOT lanes, and to identify the remaining traffic on the main lanes. Remember that not all traffic would find it convenient to use the HOT lanes because of the limited on- and off-ramp opportunities. In this run, SOVs were permitted to use the HOT lanes, under toll-free conditions. The result was an estimate of ramp-to-ramp movements on the HOT lanes of SOVs. This model run also produced mainline ramp volumes that were fed into the first pass of the FRESIM model (described below).

FRESIM TRAFFIC MODEL

WSA’s observations of current traffic patterns on the LBJ Freeway indicated that traffic speeds had little to do with mainline capacity. The determining factors were more related to merging and weaving movements associated with on- and off-ramps. Since use of the HOT lanes by paying customers would be primarily motivated by time savings, WSA figured that a traffic simulation model would provide a better estimate of speed characteristics than a traditional traffic assignment model.

FRESIM is a microscopic freeway simulation model developed by FHWA that models each vehicle as a separate entity. The behavior of each vehicle is represented in the model through interaction with its surrounding environment, which includes freeway geometry and other vehicles.

For this project, an electronic base of the project provided by HNTB was used to develop the mainline LBJ system in the model. Traffic from the global demand process described above were used in the first pass of the FRESIM model to estimate travel speeds on the mainlines. Note that only the main lanes were modeled with FRESIM. We assumed that the HOT lanes would always be priced such that speeds of 65 mph would be maintained at all times.

The result of the FRESIM model process was average traffic speeds for each link of the LBJ Freeway main lanes. These average traffic speeds were then exported to the Market Share model (described below).

MARKET SHARE MODEL

The Market Share model was used to estimate the number of vehicles that would choose to pay a toll to use the HOT lanes. It was implemented in a spreadsheet, and was driven by the following data:

• Mainline ramp traffic estimates, from the Global Demand model.
• Estimates of HOV traffic in the HOT lanes, from the Global Demand model.
• Estimates of SOV traffic in the HOT lanes, identified by interchange-to-interchange movements, from the Global Demand model.
• Ramp-to-ramp distances and speeds in the HOT lanes, calculated from the geometrics of the project description.
• Assumed travel speeds in the HOT lanes (which did not vary).
• Main lane average travel speeds by freeway segment, from the FRESIM model.
• A toll structure, which included a per-mile toll rate, and a minimum toll charge. These values were provided by WSA, and a variety of rate structures were tested.
• An estimate of an average value of time. This was based on recent work done by WSA for the North Texas Tollway Authority.
• A market share function which estimates the probability of a driver choosing the tolled lanes based on their toll cost per minute of time savings. This curve was developed by WSA based on work done on other similar projects.

The market share model was first run based on the global-demand traffic estimates and the initial speeds from the FRESIM model. The result was an estimate of SOV traffic that would pay a toll and use the HOT lanes, and SOV traffic that would choose to use the main lanes instead.

ITERATION OF THE MARKET SHARE MODEL AND FRESIM MODEL

After the first run of the market share model, the revised estimate of main lane traffic volumes (by ramp) were fed back to the FRESIM model. Revised estimates of main lane link speeds were extracted from FRESIM, and fed into the Market Share model, after which a revised set of traffic estimates in the HOT lanes versus the main lanes were prepared.

This process was repeated until the speed differential between the last two FRESIM runs was less than 10%. At that time, the traffic estimates in the HOT lanes and main lanes, and the speed estimates of the main lanes were “fixed.”

The estimated HOT lane volumes were compared with the desired traffic threshold value for the HOT lanes. If estimated traffic in the HOT lanes were over the threshold, different tolls were tested to ensure the combined HOT traffic does not exceed the threshold for the HOT lanes but remain as close to that value as possible. A threshold value of 1,800 vehicles per hour per lane was set as the maximum desired traffic level in the HOT lanes, beyond which speed degradations would be likely.
CHAPTER 4

TRAFFIC AND TOLL REVENUE ESTIMATES

This chapter documents WSA’s estimates of traffic and toll revenue on the proposed LBJ Freeway HOT lanes.

GLOBAL DEMAND ESTIMATES

Using the methodology outlined previously, the initial estimates of global demand were determined including interchange-to-interchange movements of SOV traffic in the HOT lanes, HOV traffic in the HOT lanes and the mainline ramp volumes. These volumes were checked for reasonableness in the following manner:

- Estimates of HOV traffic as a percentage of the total hourly traffic in a particular direction were reviewed. Experience has shown that for this type of roadway configuration, 15% to 20% HOV traffic is not unreasonable. If the NCTCOG model showed a higher percentage of HOV usage, WSA adjusted the distribution between HOV lanes and main lanes to make the result more reasonable. WSA found that this kind of adjustment was necessary in the westbound direction for the morning peak period between I.H. 35 and U.S. 75.

- The modeled estimates of hourly traffic for the four analysis periods were compared to the average weekday traffic estimates prepared by TxDOT.

A detailed layout of the global demand estimates is presented in Appendix A. To better understand the components of the global demand estimates, Table 4 provides the mainline volumes for a segment of the westbound project in the vicinity of Marsh Lane. At this location you can see some of the critical components that drive the process. The westbound morning peak is clearly a commuter peak indicated by the high HOV component in the HOT lanes.

While total traffic volumes are higher in the P.M. period, the HOV component is much less indicating commuter traffic does not contribute as much in the P.M. as in the A.M. This location also highlights the high midday traffic volumes that are expected in some areas. This provides a greater opportunity for use of the HOT lanes during the midday period.

Table 4

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Main Lanes</th>
<th>Total Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.M.</td>
<td>2,613</td>
<td>5,774</td>
</tr>
<tr>
<td>Midday</td>
<td>232</td>
<td>6,348</td>
</tr>
<tr>
<td>P.M.</td>
<td>339</td>
<td>12,122</td>
</tr>
<tr>
<td>Night</td>
<td>36</td>
<td>7,324</td>
</tr>
</tbody>
</table>

TOLL RATE TESTING

The purpose of this proposed HOT lane facility is to maximize the available roadway capacity in the HOT lanes while still generating a benefit for HOV users. As such, and based on direction from TxDOT, WSA analyzed potential toll rates that would attract the most people to the HOT lanes without causing traffic delays. WSA was not concerned about maximizing toll revenues. In all cases, HOV traffic was allowed to use the HOT lanes for free.

In setting the toll structure, two components were assumed:

- A per-mile rate, and
- A minimum toll.

Under this concept, vehicles would pay a set toll rate per mile, but would always have to pay a minimum amount to use the system at all. For example, a person making a 5-mile trip with a $0.10 per mile toll would normally pay $0.50; however, if the minimum toll were set at $1.00 they would pay the higher amount. The minimum toll is intended to discourage short-distance travel on the HOT lanes that may cause localized congestion in the HOT lanes.

All of the analysis regarding toll rates was done at 1999 dollar levels. No inflation was assumed. This means that the toll rates that might be implemented in 2015 would probably be considerably higher than those described here. We’ve assumed that the rates would be adjusted for inflation through 2015.

WSA began the testing in the westbound direction using the A.M. peak hour. Various combinations for per-mile and minimum toll rates were tested. For each combination, the FRESIM and Market Share models were run to determine the final traffic volumes at that given toll structure. These volumes were then compared to desired traffic volume thresholds. If the traffic volumes did not exceed the threshold then an acceptable toll structure was found. If traffic volumes exceeded the threshold, adjustments to the minimum toll and/or the per-mile toll rate were made and the model rerun. A summary of this effort is in Appendix B.

We found that a relatively high minimum toll was more effective at keeping the HOT lanes uncongested than a high per mile rate. The most effective rates were found to be $0.20 per mile with a $1.20 minimum toll. These toll rates were then tested in the eastbound direction during the P.M. peak. During the P.M. period in the eastbound direction, this toll structure worked well except for the section between Preston Road and U.S. 75.

During the off-peak periods (midday and night) a $0.10 per mile is suggested, with no minimum toll. The resulting toll schedule is as shown on Table 5. WSA found that high tolls were not necessary during the off-peak travel times to keep traffic flowing smoothly in the HOT lanes, and these are relatively arbitrary values that could be set at a variety of different levels.

Table 5

<table>
<thead>
<tr>
<th>Suggested Toll Rate Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.M.</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Eastbound</td>
</tr>
<tr>
<td>Westbound</td>
</tr>
</tbody>
</table>

ESTIMATED TRAFFIC VOLUMES AND TRAVEL SPEEDS

Figures 11 and 12 show the estimated HOT lane volumes at the above toll rates for each of the four, one hour periods studied. Note that the U.S.75 ramp and the eastern segment are reversible HOT lanes. The westbound direction is open during the A.M. peak and the eastbound direction during the P.M. peak. The highest volume ramps are the access points to/from the main lanes.
volume in the HOT lane is expected between Preston and US 75, with a volume of about 4,000. About 55% of these would be paying SOVs. Note that this volume exceeds the desired threshold of 3,600 vehicles per hour on this two-lane section of HOT facility. Further refinement of toll rates and structure would be needed to get this traffic volume below this threshold.

- Hourly volume during the mid day period are expected to be close to that of the peaks on many sections.
- Night time volumes are expected to be much lower per hour than during other periods.

### TOLL REVENUE ESTIMATES

Using the traffic volumes in conjunction with toll rate structure, an annual toll revenue estimate was calculated for the opening-year of the project (2015). Table 6 has the toll revenue breakdown by period for a typical weekday.

<table>
<thead>
<tr>
<th>Period</th>
<th>Toll Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.M. (3 hours)</td>
<td>$11,068</td>
</tr>
<tr>
<td>Midday (6 hours)</td>
<td>$15,604</td>
</tr>
<tr>
<td>P.M. (4 hours)</td>
<td>$19,123</td>
</tr>
<tr>
<td>Night</td>
<td>$968</td>
</tr>
<tr>
<td>Total Weekday</td>
<td>$41,763</td>
</tr>
</tbody>
</table>

The yearly toll revenue is based on the weekday toll revenue for 250 days a year. Weekend toll revenues are assumed to be 40% of the weekday toll revenues. Based on the information, the estimated annual toll revenue in 2015 is estimated at approximately $12 million.

### AREAS FOR FURTHER STUDY

This preliminary study of HOT lanes on the LBJ Freeway has shown that HOT lanes could be an effective mechanism to provide a non-congested alternative for HOVs and for people willing to pay a toll. We expect that tolls within a reasonable range could be used to keep the HOT lanes flowing smoothly during congested periods.
WESTBOUND TRAFFIC CHARACTERISTICS SUMMARY

<table>
<thead>
<tr>
<th>Location</th>
<th>Travel Spd (mph)</th>
<th>ML</th>
<th>HOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floyd Rd</td>
<td>A.M.</td>
<td>58</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>56</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>P.M.</td>
<td>53</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>58</td>
<td>65</td>
</tr>
<tr>
<td>Preston Rd</td>
<td>A.M.</td>
<td>49</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>45</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>P.M.</td>
<td>44</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td>Luna Rd</td>
<td>A.M.</td>
<td>27.9</td>
<td>17.7</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>23.8</td>
<td>19.7</td>
</tr>
<tr>
<td></td>
<td>P.M.</td>
<td>25.9</td>
<td>19.8</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>21.4</td>
<td>18.9</td>
</tr>
<tr>
<td>ML - Mainlanes</td>
<td>HOT - High Occupancy Toll Lane</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>HOT Lane Volume</th>
<th>ML</th>
<th>HOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floyd Rd</td>
<td>A.M.</td>
<td>2,379</td>
<td>2,849</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>724</td>
<td>878</td>
</tr>
<tr>
<td></td>
<td>P.M.</td>
<td>1,482</td>
<td>1,880</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>93</td>
<td>97</td>
</tr>
<tr>
<td>Preston Rd</td>
<td>A.M.</td>
<td>3,558</td>
<td>2,553</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>536</td>
<td>213</td>
</tr>
<tr>
<td></td>
<td>P.M.</td>
<td>1,164</td>
<td>846</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>45</td>
<td>7</td>
</tr>
<tr>
<td>Luna Rd</td>
<td>A.M.</td>
<td>2,849</td>
<td>3,164</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>878</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>P.M.</td>
<td>1,880</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>97</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**FIGURE 13**
## Travel Time Comparison

<table>
<thead>
<tr>
<th></th>
<th>A.M.</th>
<th>Midday</th>
<th>P.M.</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full Length Trip (min)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML</td>
<td>25.6</td>
<td>25.7</td>
<td>27.7</td>
<td>21.2</td>
</tr>
<tr>
<td>HOT</td>
<td>18.8</td>
<td>18.5</td>
<td>18.2</td>
<td>18.3</td>
</tr>
</tbody>
</table>

### Traffic Speed

<table>
<thead>
<tr>
<th></th>
<th>ML - Mainlanes</th>
<th>HOT - High Occupancy Toll Lane</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOV HOV</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.M.</td>
<td>45</td>
<td>66</td>
</tr>
<tr>
<td>Midday</td>
<td>45</td>
<td>66</td>
</tr>
<tr>
<td>P.M.</td>
<td>46</td>
<td>66</td>
</tr>
<tr>
<td><strong>Night</strong></td>
<td>57</td>
<td>65</td>
</tr>
</tbody>
</table>

### Volume in a Typical Hour (vph)

<table>
<thead>
<tr>
<th></th>
<th>A.M.</th>
<th>Midday</th>
<th>P.M.</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ML</strong></td>
<td>45</td>
<td>45</td>
<td>46</td>
<td>57</td>
</tr>
<tr>
<td><strong>HOT</strong></td>
<td>28</td>
<td>44</td>
<td>33</td>
<td>56</td>
</tr>
</tbody>
</table>

###东向交通特性总结

- **Travel Time Comparison**
  - 全程旅行时间（分钟）
    - A.M.: 25.6
    - Midday: 25.7
    - P.M.: 27.7
    - Night: 21.2
  - HOT: 18.8
  - A.M.: 18.5
  - Midday: 18.2
  - Night: 18.3

- **交通速度**
  - ML-主车道
  - HOT-高 occupancy专用车道
  - A.M.: 45
  - Midday: 45
  - P.M.: 46
  - Night: 57

- **典型小时流量** (vph)
  - A.M.: 45
  - Midday: 28
  - P.M.: 46
  - Night: 57
Due to the preliminary nature of this study, there are a variety of questions that have not been answered. These are summarized below.

**Pricing Mechanism.** For ease of analysis, we have assumed that the pricing would be done on a fixed-time basis. This means that for any given time, the customers will know in advance what the toll will be. However, since the prime motivation of this project is to provide for a free-flowing HOT lane facility at all times, it may be more appropriate to use a dynamic pricing strategy. Under dynamic pricing, tolls are changed in real-time, in response to actual traffic conditions.

Since our analysis used typical traffic conditions, it was not really possible to analyze the specific effects of dynamic pricing. However, dynamic pricing has been proven to be feasible on the I-15 project in San Diego. Given the long time-horizon for the LBJ project, it is likely that the state of the art of the technology that allows variable pricing will improve over time, providing for additional possibilities in the area of implementation.

**Definition of HOV.** We maintained a definition of 2 or more people in a car as HOV, which is consistent with how HOVs are now defined in the Dallas area. This was appropriate given the amount of space being devoted to HOVs. Should future condition warrant, a definition of 3 or more people could be implemented to reduce volume in the HOT lanes.

**Trucks.** We have assumed that trucks would not be eligible to use the HOT lanes. This provides the greatest benefit to passenger cars desiring to bypass congestion, since trucks take up more roadway capacity and have slower acceleration and deceleration characteristics which affect traffic flow. Although allowing trucks in the HOT lanes would affect passenger car flow, trucks on tight deadlines could also possibly benefit from the HOT lanes, and be willing to pay the price.

**Design-Hour Volumes.** The estimates of global traffic demand used in this study relied heavily on the existing NCTCOG travel demand model. These travel demand models do not always provide good estimates of traffic on a ramp-by-ramp basis. There are also some anomalies related to the directionality of travel. Considering the mission of the preliminary traffic and revenue study, this was not a fatal flaw, and the overall estimates of traffic and speeds on the facility are reasonable. However, the volumes presented in this report and the appendices are not appropriate for use in estimating design-hour volumes without a considerable amount of adjustment or refinement.

**Implementation Considerations.** Implementation of HOT lanes on the scale proposed for the LBJ Freeway has never been done before. There are numerous implementation issues that should be considered, such as:

- Distinguishing HOV for SOV traffic through tolling zones and enforcement mechanisms;
- Traffic design and operation of tolling zones; and
- Signing and advance notification of toll rates.

**DISCLAIMER**

Current professional practices and procedures were used in the development of these findings. However, there are sometimes differences between forecasted and actual results caused by events and circumstances beyond the control of the forecaster and these differences could be material. This study is not intended to, nor has enough information been gathered for this report to be used in any form of funding package. A study that would be used for financing would entail a far more rigorous investigation into the basis of growth estimates contained in the regional demand model, a significant program of hourly ramp traffic counts in the study area and travel pattern and trip characteristics surveys of motorists using the corridor. These factors could result in findings that differ substantially from those presented here.
APPENDIX A

GLOBAL DEMAND ESTIMATES
APPENDIX  B

TOLL RATE TESTING
APPENDIX C

INTERCHANGE TO INTERCHANGE MOVEMENTS
APPENDIX  D

TOLL TRAFFIC ESTIMATES