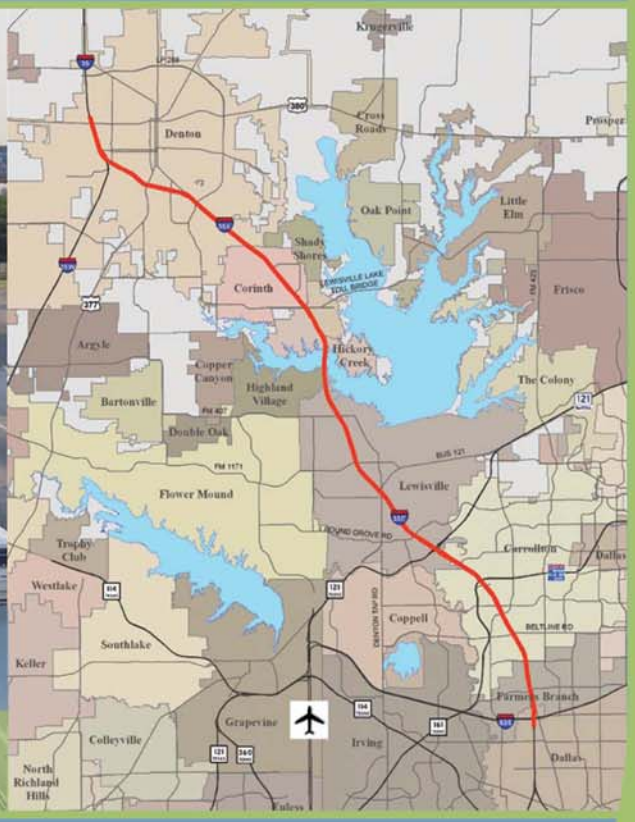
Level 2 Traffic and Toll Revenue Study

IH 35E Managed Lanes between IH 635 and US 380



Presented to: **Texas Department of Transportation**

DRAFT

October **2009**

THIS PAGE INTENTIONALLY LEFT BLANK

Level 2 Traffic and Toll Revenue Study

IH 35E Managed Lanes between IH 635 and US 380

Prepared for:

Texas Department of Transportation

Prepared by:

WilburSmith ASSOCIATES

DRAFT

October **2009**

THIS PAGE INTENTIONALLY LEFT BLANK

October 16, 2009

Mr. Doug Woodall, P.E.
Director of Planning and Development
Texas Turnpike Authority Division of TxDOT
125 East 11th Street
Austin, TX 78071

Re: IH 35E Managed Lanes Intermediate Level 2 Traffic and Toll Revenue Study

Dear Mr. Woodall:

Wilbur Smith Associates (WSA) is pleased to submit this report of our traffic and toll revenue study for the proposed IH 35E Managed Lanes project located in Dallas and Denton counties. The report summarizes the findings of the study, which included development of traffic and toll revenue estimates for a 52-year period.

This study builds upon previous study prepared by WSA and the extensive data collected as part of this study and enhanced the travel demand model with updated information. The study describes the methodologies implemented to collect new data within the corridor and the enhancements undertaken as part of the model development to forecast the traffic and toll revenue that the managed lane project will generate under defined alternatives.

Our project team, including Xiaojin (Jerry) Ji, Liren Zhou, Kristin McLeod and others, gratefully acknowledge the assistance and cooperation received from TxDOT as well as others contacted during the course of the study. WSA sincerely appreciates the opportunity to have participated in this important project.

Respectfully submitted,

WILBUR SMITH ASSOCIATES

Christopher E. Mwalwanda
Vice President

4925 Greenville Avenue, Suite 1300, Dallas, Texas 75206-4085
***P* 214-890-4460, *F* 214-890-7521 www.WilburSmith.com**

THIS PAGE INTENTIONALLY LEFT BLANK

DISCLAIMER

Current accepted professional practices and procedures were used in the development of these traffic and revenue forecasts. However, as with any forecast of the future, it should be understood that there may well be differences between forecasted and actual results that may be caused by events and circumstances beyond the control of the forecasters. The WSA review and analysis has relied upon the accuracy and completeness of all of the information provided (both written and oral) by TxDOT and several local and state agencies. Publicly available and obtained material has neither been independently verified, nor does WSA assume responsibility for verifying, such information and has relied upon the assurances of the independent parties that they are not aware of any facts that would make such information misleading.

WSA has made qualitative judgments related to several key variables within the analysis used to develop the traffic and revenue forecasts that must be considered as a whole; therefore selecting portions of any individual results without consideration of the intent of the whole may create a misleading or incomplete view of the results and the underling methodologies used to obtain the results. WSA gives no opinion as to the value or merit to partial information extracted from the report.

All estimates and projections reported herein are based on WSA' experience and judgment and on a review of independent third party projections and information obtained from multiple state and local agencies including TxDOT. These estimates and projections may not be indicative of actual or future values, and are therefore subject to substantial uncertainty. Future developments cannot be predicted with certainty, and may affect the estimates or projections expressed in the report, such that WSA does not specifically guarantee or warrant any estimate or projections contained within this report While WSA believes that some of the projections or other forward-looking statements contained within the report are based on reasonable assumptions as of the date in the report, such forward looking statements involve risks and uncertainties that may cause actual results to differ materially from the results predicted. WSA take no responsibility or obligation to advise of changes that may in any matter affect the assumptions contained within the report, following the date of this report as they pertain to: socioeconomic and demographic forecasts, proposed residential or commercial land use development projects and/or potential improvements to the regional transportation network.

The report and its content are confidential and intended solely for use for the IH 35E Managed Lane project. Any use by third-parties, other than as noted above, is expressly prohibited. In addition, any publication of the report without the express written consent of WSA, is prohibited. The results contained in this report are not intended to be used to secure or obtain project financing therefore disclosure of the material in any official statement, prospectus, private placement memorandum or other document used to facilitate, offer, buy, or sell securities is strictly prohibited.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

ILLUSTRATIONS

TABULATIONS

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

Wilbur Smith Associates (WSA) was retained by the Texas Turnpike Authority (TTA) division of the Texas Department of Transportation (TxDOT) to conduct an Intermediate Level 2 traffic and toll revenue study for the proposed IH 35E managed lanes between IH 635 and US 380 in Dallas and Denton counties. This analysis is part of TxDOT's ongoing efforts to evaluate the financial feasibility of the proposed IH 35E managed lane project between IH 635 and US 380, and provides the traffic and revenue forecast to support the TxDOT procurement of the project.

PROJECT DESCRIPTION

The IH 35E study corridor is approximately 28.0 miles and extends from US 380 in Denton County to IH 635 in Dallas County, as shown in **Figure ES1-1**. The existing corridor is a four-lane facility north of Corinth Parkway and a six-lane facility in the south with a one-lane buffer separated, concurrent HOV facility, between IH 635 and SH 121 that operations daily and is never closed. A reversible ramp connecting the HOV lane through the IH 635 interchange operates on weekdays only and opens in the southbound direction during the morning peak period (6:00-9:00 a.m.), and in the northbound direction during the afternoon peak period (3:30-7:00 p.m.). The IH 35E corridor serves as the primary route from Denton to Dallas and is divided into three analysis segments (south, middle and north segments) to account for the varying markets, the differing geometric configurations, and the traffic characteristics within each segment. The limits of each segment are provided below:

- **South Segment:** from IH 635 to President George Bush Turnpike (PGBT);
- **Middle Segment:** from President George Bush Turnpike (PGBT) to FM 2181/Swisher Road; and
- **North Segment:** from FM 2181/Swisher Road to US 380.

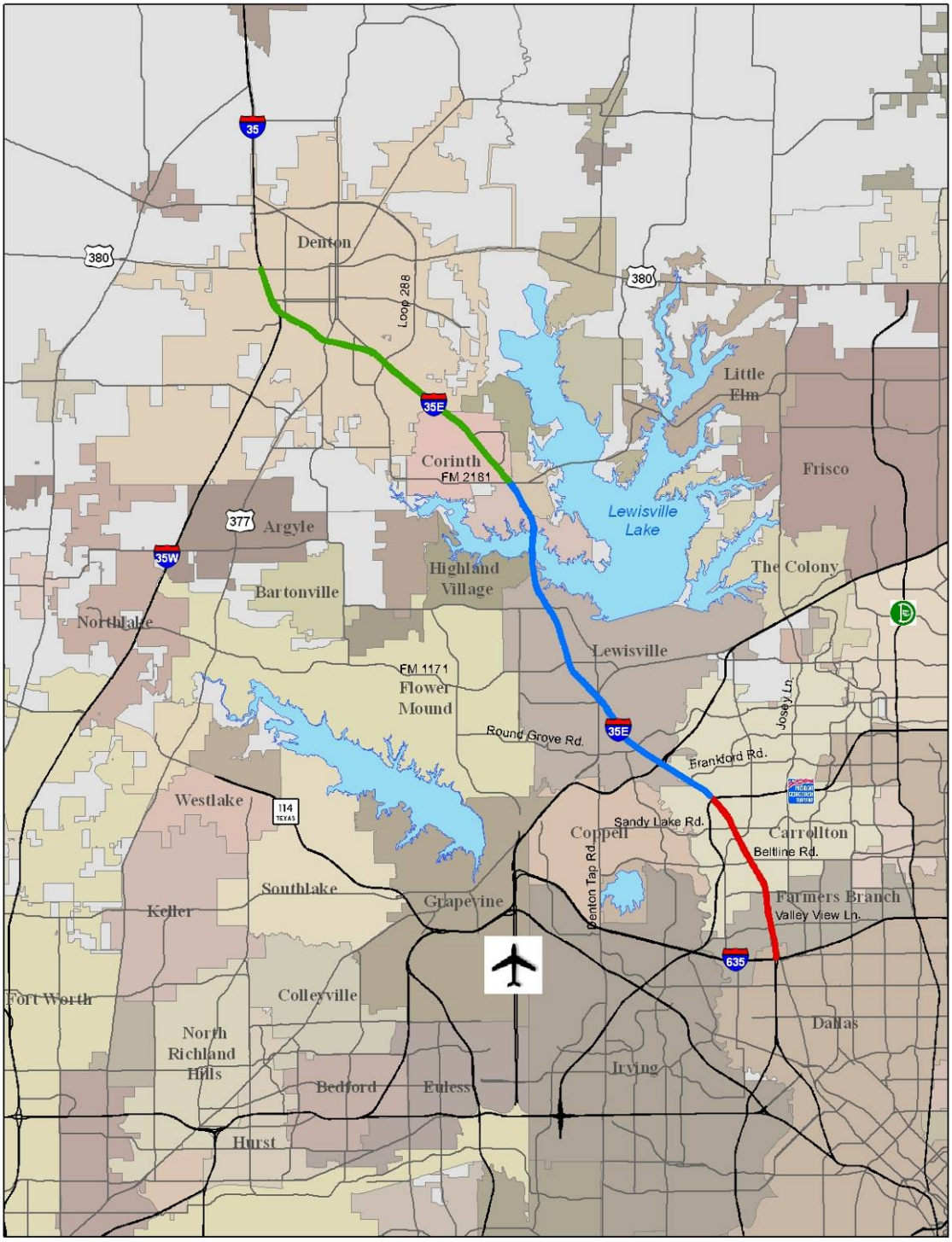


Figure ES-1. IH 35E Managed Lane Project Location and Segments

The proposed IH 35E managed lane project investigated as part of this study included the assessment of capacity expansions to the current general purpose lanes and frontage roads, and the construction of new managed lanes located within the median of the existing general purpose lanes. The full build-out of the entire project widens the general purpose lanes to 4 lanes in each direction (not including auxiliary lanes) along most of the project with the exception of several sections including the segments between PGBT and SH 121, IH 35E/IH 35W and US 77, and US 380 and IH 35E/IH 35W, where the more number of lanes widening occurs.

The proposed build-out of the frontage roads will include lane expansions at various locations and newly built lanes that will generate either 2 or 3 lanes running along the entire project limit. The ultimate build-out of managed lanes will consist of 2 lanes per direction with the exception of the section between IH 35E/IH 35W and US 77 where only 1 lane per direction will be built. A total of twenty-one (21) pairs of ramps are included in the ultimate configuration to/from the proposed IH 35E managed lanes with an average ramp spacing of approximately 1.4 miles. The ramps are located at/around US 380, IH 35W, US 377, Teasley Lane, US 77, Loop 288, Corinth Parkway, FM 2181, Turbeville Road, FM 407, Valley Ridge Boulevard, Business SH 121, Corporate Drive, SH 121 (Sam Rayburn Tollway) , PGBT, Beltline Road, Crosby Road, IH 635, and Harry Hines Boulevard.

STUDY OVERVIEW

This report details the data, methodology and results of the Level 2 traffic and toll revenue study for the proposed managed lanes along IH 35E, between IH 635 and US 380. A sketch level analysis for this corridor was performed by WSA in July 2008 to support the initial market valuation of the project. This study is the continuation of a more detailed traffic and toll revenue study to develop 52-year annual revenue forecasts for various proposed project alternatives using more detailed and recently collected data within the corridor. The study is not intended for use in financing; however, it provides a significant amount of additional information beyond that provided previously. The extensive data collected that was used to calibrate the travel demand model and enhance the model included:

- Traffic counts along IH 35E and several screenlines, and speed and delay information to establish a current baseline of traffic patterns in the study area, for purposes of base travel demand model calibration;
- Origin-destination surveys to capture the trip characteristics along the IH 35E corridor for use in evaluating and enhancing the trip tables obtained from North Texas Council of Government (NCTCOG);
- The stated-preference survey efforts to investigate the willingness-to-pay characteristics in the study area and capture other preferences affecting the use of the proposed managed lanes. This information is also critical in developing and enhancing the toll diversion characteristics in the corridor.

The study provides a detailed analysis of the existing trends and characteristics of traffic within the IH 35E corridor and investigates the toll feasibility of the corridor under a number of potential project alternatives in support of the TxDOT procurement process. The modeling of the corridor demand was performed for multiple future years, and annual revenue forecasts were then developed for different project alternatives as defined and requested by TxDOT staff. The latest travel demand model databases, including updated network and trip tables, and economic forecasts from the NCTCOG 2030 Mobility Plan were used as part of the analysis.

PROJECT ALTERNATIVES DESCRIPTION

Six unique project alternatives, developed to encompass several financing alternatives, were modeled to evaluate the revenue generation potentials of the proposed managed lanes as outlined in **Figure ES-2**. These alternatives reflect a combination of proposed phased opening years for the various corridor segments with varied overall corridor configurations. In addition to the three project segments discussed above, another two early or temporary projects (sub-segments) were also defined to form various project alternatives as part of this sub-segmentation. The “north early project” is a breakout of the north segment from Bonnie Brae Street to Loop 288. The “temporary north

widening" represents the temporary widening of the existing general purpose lanes to 3 lanes per direction, between Loop 288 to FM 2181, that is expected to be built to help transition traffic from the middle segments, under alternatives where the north segment is not built. The six alternatives analyzed as part of this study included:

- *Alternative 1* reflects the most optimistic and base case construction plan with built managed lanes, and general purpose and frontage road expansions along the south, middle, and north segments assumed to open in 2020, 2015 and 2018 respectively. The existing HOV lanes along the south segment would be converted to HOT lanes prior to the full managed lanes being built.
- *Alternative 2* defers the construction of the south and north segments until 2030, with the middle segment being built by 2015.
- *Alternative 3* is a slight variation of Alternative 2 and includes the construction of the north early project and temporary north widening as defined above.
- *Alternative 4* reflects the same construction time plan as Alternative 1, but defers the south segment until 2040.
- *Alternative 5* evaluates the deferral of the north segment until 2040, with the south and middle segments constructed as planned in Alternative 1.
- *Alternative 6* reflects the deferral of both the south and north segments by five years compared to Alternative 1, with the middle segment assumed to open in 2015.

The north early project and temporary north widening are assumed to be in place for both Alternative 5 and 6 with the deferral of the north segment.

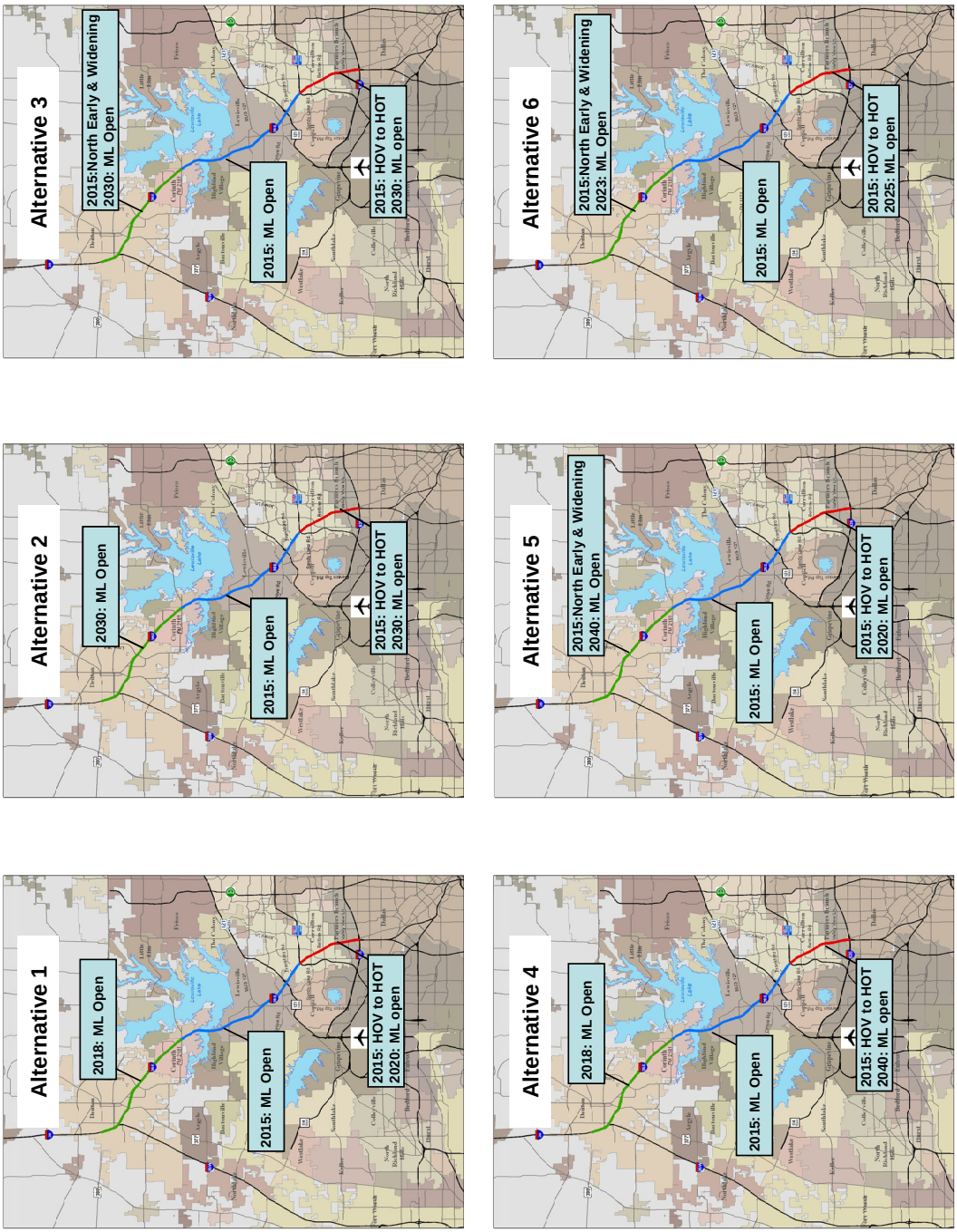


Figure ES-2. Project Alternatives

TRAFFIC AND REVENUE SUMMARY

The annual traffic and toll revenue estimates for the six alternatives of the proposed IH 35E managed lanes were developed based on the following basic assumptions:

- The segments of the proposed managed lanes are assumed to open to traffic no earlier than January 1, 2015 and will occur in phases as depicted by the defined six alternatives;
- The configuration, vehicle type eligibility, targeted operating speeds of the managed lanes, proposed access locations, and per mile toll rates will be implemented as described in this report;
- The tolls will be collected using electronic toll collection (ETC) with revenue-neutral video tolling based on distance traveled with an assumed minimum toll, and no cash will be accepted. *No toll evasion adjustments were made to the toll revenue estimates included in this report*;
- Transportation improvements as detailed in NCTCOG's Mobility Plan 2030: 2009 amendment will be implemented; no other competing routes or capacity improvements will be constructed within the forecast period and no additional general purpose lane capacity, outside the proposed MTP expansions, will be provided along the IH 35E corridor;
- Commercial vehicles/trucks with more than two-axles will have access to the managed lanes and will be charged 3.5 times the normal toll rate as derived from the average truck axle distribution along the corridor;
- Estimates of annual toll revenue included in this report have been adjusted to reflect "ramp-up" during the first three years of operation. The ramp-up volume was assumed to be 80 percent of the model estimate in the opening year, 90 percent in the following year, and 100 percent for all subsequent years;
- HOV2+ vehicles will receive a 50 percent discount during the AM and PM peak periods until 2025, to conform with the current Regional Transportation Council (RTC) managed lane policy;
- The value of time was increased at an average rate of 2.75 percent per year for the forecast period based on an economic analysis of the corridor;
- Annual revenues were calculated using an estimated 275 equivalent revenue days based on observed count characteristics in the corridor;
- Traffic during night time (7:30 p.m. - 6:30 a.m.) was not directly modeled in the travel demand model. Instead, the potential revenue generation during the night time was assumed to be 2 percent of the total daily revenue;

The baseline annual toll revenue estimates for the proposed IH 35E managed lane project are summarized in **Table ES-1** for the six alternatives evaluated. The IH 35E

managed lanes are expected to generate approximately $18 million in toll revenue at the opening year for the scenarios where the south segment is operated as high occupancy toll (HOT) lanes and the middle segment is fully built out. Additional toll revenue is expected for those alternatives where the north early project and temporary north widening are opened by 2015. Toll revenue is estimated to grow at an average annual rate that ranges between 16.5 percent and 22.5 percent, from 2015 to 2020 for the different alternatives. The relatively high growth rates are compounded and reflect the ramp up phenomenon of new toll project and the phased opening of the different segments. The average annual growth rate of revenue between 2020 and 2030 is expected to be approximately 12 percent. The high demand of the HOV traffic along the southern segment warranted the management of this demand to avoid the market impeding the flow of traffic in the lanes during the high demand peak periods. As such, the HOV lanes were converted to HOT lanes where the high-occupancy vehicles pay discount toll rate during peak period and full toll during off peak period to conform with the RTC managed lane toll policy. The toll revenue of the proposed IH 35E managed lane is expected to increase to approximately $370 million by 2050, and $558 million by 2060, reflecting the growth of around 4.2 percent to 5.1 percent between 2040 and 2060.

Table ES-1
Estimated Baseline Annual Toll Revenue (in Thousands)

Year	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
2015	$18,010	$18,010	$19,180	$18,010	$19,180	$19,180
2020	$49,720	$38,680	$41,100	$48,150	$42,680	$41,100
2030	$137,710	$124,430	$124,430	$130,000	$117,310	$137,710
2040	$239,150	$239,150	$239,150	$224,530	$230,130	$239,150
2050	$370,510	$370,510	$370,510	$370,510	$370,510	$370,510
2060	$558,200	$558,200	$558,200	$558,200	$558,200	$558,200
Average Annual Growth						
2015-2020	22.5%	16.5%	16.5%	21.7%	17.3%	16.5%
2020-2030	10.7%	12.4%	11.7%	10.4%	10.6%	12.9%
2030-2040	5.7%	6.8%	6.8%	5.6%	7.0%	5.7%
2040-2050	4.5%	4.5%	4.5%	5.1%	4.9%	4.5%
2050-2060	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%

In addition to the baseline assumptions, a risk assessment was undertaken to examine the impact of the level of uncertainty associated with multiple key variables upon which travel demand is dependent. The key variables evaluated as part of the risk assessment of this study included the ramp-up factor, truck percentage share, truck toll factor, revenue days, socioeconomic forecasts, values of time, and toll diversion. The risk assessment was performed for both the midline and modified scenarios with the modified case reflecting the more aggressive of the revenue growth assumptions. The estimated annual toll revenues of the modified case are summarized in **Table ES-2** and **ES-3** for the six alternatives along with the baseline toll revenue.

The managed lanes are expected to generate $18.0 million in toll revenue in the opening year of 2015 under the baseline assumptions, while approximately $42.2

million in revenue is expected under the modified scenario assumptions, reflecting an approximate 2.3 factor increase over the baseline revenues. The toll revenue under the modified case assumptions is estimated to grow to approximately $348.6 million by 2030 for Alternative 1 as compared to $137.7 million under the baseline assumptions. The toll revenue is expected to grow at an average annual growth rate of around 5.7 percent for project Alternative 1 between 2030 and 2040 under the baseline case, while the growth rate could reach 6.6 percent under the modified case. As is expected, the uncertainty for the managed lane revenue forecasts may be significantly higher than the traditional toll road given some unique operating characteristics of managed lanes that include the parallel competing alternatives, and more specifically, the congestion pricing that needs to be implemented to effectively manage the demand along the managed facilities.

Table ES-2
Estimated Annual Toll Revenue Range (in Thousands)

	Alternative 1		Alternative 2		Alternative 3	
Year	Baseline	Modified	Baseline	Modified	Baseline	Modified
2015	$18,010	$42,220	$18,010	$42,220	$19,180	$45,510
2020	$49,720	$128,060	$38,680	$96,800	$41,100	$104,270
2030	$137,710	$348,620	$124,430	$327,090	$124,430	$327,090
2040	$239,150	$660,550	$239,150	$660,550	$239,150	$660,550
2050	$370,510	$1,104,600	$370,510	$1,104,600	$370,510	$1,104,600
2060	$558,200	$1,682,150	$558,200	$1,682,150	$558,200	$1,682,150
Average Annual Growth						
2015-2020	22.5%	24.8%	16.5%	18.1%	16.5%	18.0%
2020-2030	10.7%	10.5%	12.4%	12.9%	11.7%	12.1%
2030-2040	5.7%	6.6%	6.8%	7.3%	6.8%	7.3%
2040-2050	4.5%	5.3%	4.5%	5.3%	4.5%	5.3%
2050-2060	4.2%	4.3%	4.2%	4.3%	4.2%	4.3%
Difference from Baseline						
2015		134.4%		134.4%		137.3%
2020		157.6%		150.3%		153.7%
2030		153.2%		162.9%		162.9%
2040		176.2%		176.2%		176.2%
2050		198.1%		198.1%		198.1%
2060		201.4%		201.4%		201.4%

Table ES-3
Estimated Annual Toll Revenue Range (in Thousands)

Year	Alternative 4		Alternative 5		Alternative 6	
	Baseline	Modified	Baseline	Modified	Baseline	Modified
2015	$18,010	$42,220	$19,180	$45,510	$19,180	$45,510
2020	$48,150	$124,400	$42,680	$107,930	$41,100	$104,270
2030	$130,000	$341,910	$117,310	$294,270	$137,710	$348,620
2040	$224,530	$628,040	$230,130	$648,570	$239,150	$660,550
2050	$370,510	$1,104,600	$370,510	$1,104,600	$370,510	$1,104,600
2060	$558,200	$1,682,150	$558,200	$1,682,150	$558,200	$1,682,150
Average Annual Growth						
2015-2020	21.7%	24.1%	17.3%	18.9%	16.5%	18.0%
2020-2030	10.4%	10.6%	10.6%	10.6%	12.9%	12.8%
2030-2040	5.6%	6.3%	7.0%	8.2%	5.7%	6.6%
2040-2050	5.1%	5.8%	4.9%	5.5%	4.5%	5.3%
2050-2060	4.2%	4.3%	4.2%	4.3%	4.2%	4.3%
Difference from Baseline						
2015		134.4%		137.3%		137.3%
2020		158.4%		152.9%		153.7%
2030		163.0%		150.8%		153.2%
2040		179.7%		181.8%		176.2%
2050		198.1%		198.1%		198.1%
2060		201.4%		201.4%		201.4%

CHAPTER 1
INTRODUCTION

Wilbur Smith Associates (WSA) was retained by the Texas Turnpike Authority (TTA) division of the Texas Department of Transportation (TxDOT) to conduct an Intermediate Level 2 traffic and toll revenue study for the proposed IH 35E managed lanes between IH 635 and US 380 in Dallas and Denton counties. This analysis is part of TxDOT's ongoing efforts to evaluate the financial feasibility of the proposed IH 35E managed lane project between IH 635 and US 380, and provides the traffic and revenue forecast to support the TxDOT procurement of the project.

OBJECTIVE AND SCOPE OF STUDY

This report details the data, methodology and results of the Level 2 traffic and toll revenue study for the proposed managed lanes along IH 35E, between IH 635 and US 380. A sketch level analysis for this corridor was performed by WSA in July 2008 to support the initial market valuation of the project. This study is the continuation of a more detailed traffic and toll revenue study to develop 52-year annual revenue forecasts for various proposed project alternatives using more detailed and recently collected data within the corridor. The study is not intended for use in financing, however, it provides a significant amount of additional information beyond that provided previously. The extensive data collected that was used to calibrate the travel demand model and enhance the model included:

- Traffic counts along IH 35E and several screenlines, and speed and delay information to establish a current baseline of traffic patterns in the study area, for purposes of base travel demand model calibration;
- Origin-destination surveys to capture the trip characteristics along the IH 35E corridor for use in evaluating and enhancing the trip tables obtained from North Texas Council of Government (NCTCOG);
- Stated-preference survey efforts to investigate the willingness-to-pay characteristics in the study area and capture other preferences affecting the use of

the proposed managed lanes. This information is also critical in developing and enhancing the toll diversion characteristics in the corridor.

The study provides a detailed analysis of the existing trends and characteristics of traffic within the IH 35E corridor, as shown in **Figure 1-1**, and investigates the toll feasibility of the corridor under a number of potential project alternatives in support of the TxDOT procurement process. The modeling of the corridor demand was performed for multiple future years, and annual revenue forecasts were then developed for different project scenarios as defined and requested by TxDOT staff. The latest travel demand model databases, including the updated network and trip tables, and the economic forecasts from the NCTCOG 2030 Mobility Plan were used as part of the analysis.

The overall scope of work for the Level 2 traffic and revenue analysis included a review of background material, traffic data collection, an analysis of the regional economic growth, model calibration and development, and estimates of traffic and revenue for the corridor segments. In addition, a traffic and revenue risk assessment was performed to evaluate the potential range of revenue likely to be generated from the managed lane project.

EXISTING CORRIDOR DESCRIPTION

The IH 35E study corridor is approximately 28.0 miles and extends from US 380 in Denton County to IH 635 in Dallas County, as shown in **Figure 1-1**. The existing corridor is a four-lane facility north of Corinth Parkway and a six-lane facility in the south with one-lane buffer separated, concurrent HOV facility, between IH 635 and SH 121 that operates daily and is never closed. A reversible ramp connecting the HOV lane through the IH 635 interchange operates on weekdays only and opens in the southbound during the morning peak period (6:00-9:00 a.m.), and in the northbound during the afternoon peak period (3:30-7:00 p.m.). The IH 35E corridor serves as the primary route from Denton to Dallas and is divided into three analysis segments (south, middle and north segments) to account for the varying markets, the differing geometric configurations, and the traffic characteristics within each segment. The limits of each segment are provided below:

- **South Segment:** from IH 635 to President George Bush Turnpike (PGBT);
- **Middle Segment:** from President George Bush Turnpike (PGBT) to FM 2181/Swisher Road; and
- **North Segment:** from FM 2181/Swisher Road to US 380.

The south segment of IH 35E is approximately 4.5 miles and is located between IH 635 and President George Bush Turnpike (PGBT). The southern terminus of the corridor is at the major directional interchange with IH 635 and is located along the northwestern edge of the city of Dallas. The facility also runs through the city of Farmers Branch located to

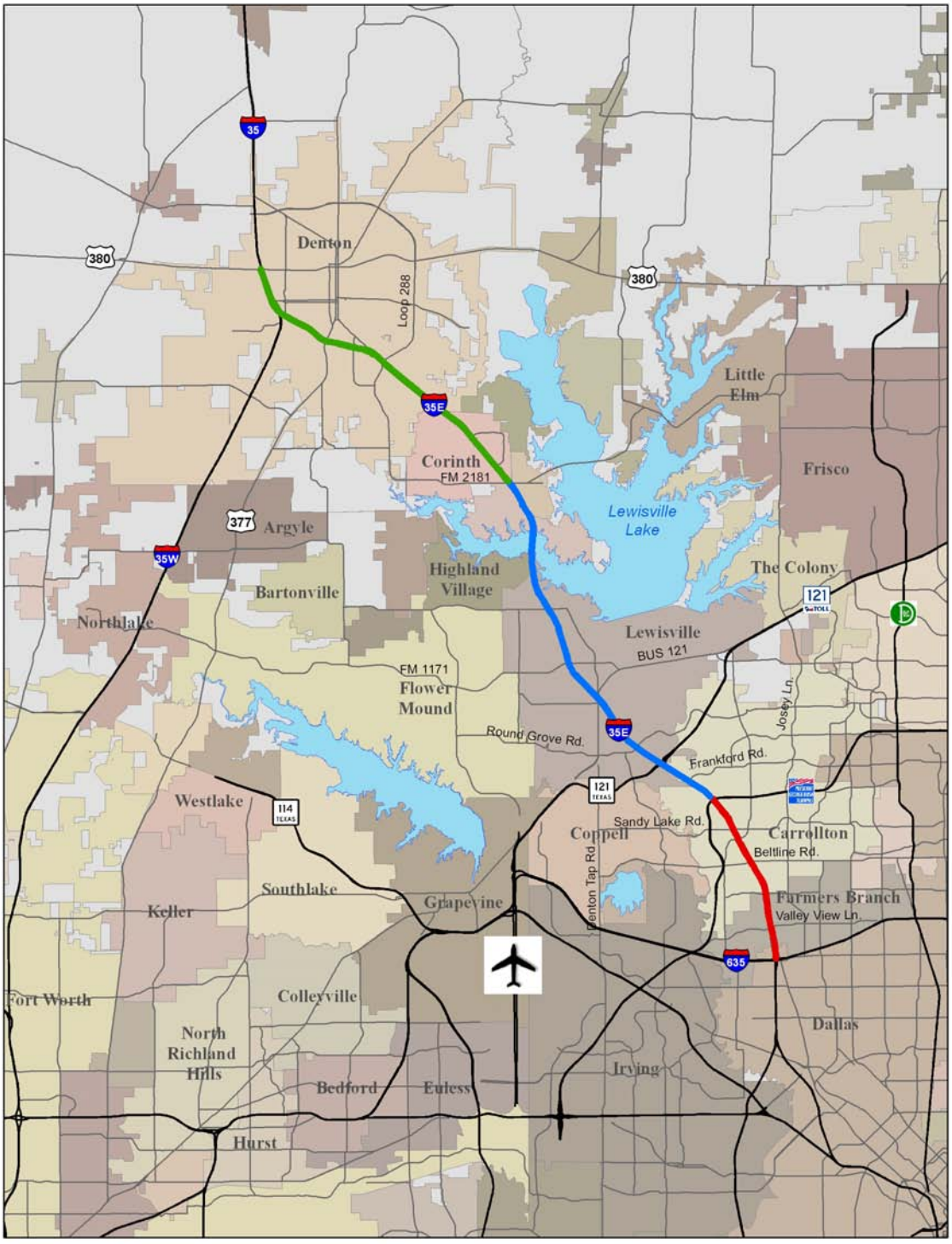


Figure 1-1. IH 35E Managed Lane Project Location and Segments

the north of the IH 635 interchange, and the city of Carrollton that is approximately two miles further north, where the corridor intersects with the President George Bush Turnpike (PGBT). The existing operational concurrent HOV lanes run the full length of this southern segment. The southern segment of the corridor currently exhibits high traffic demands in both directions during both the morning and afternoon peaks; however, the peak direction is clearly in the southbound direction during the morning peak period and in the northbound during the evening peak period.

The middle segment of IH 35E extends from PGBT to FM 2181/Swisher Road, just north of the Lewisville Lake Bridge connection. This segment of the corridor is primarily within the jurisdiction of the city of Lewisville, and intersects with the SH 121 Tollway (Sam Rayburn Highway) and several arterial streets such as the business route of SH 121. This middle segment of the corridor currently exhibits high traffic demands in the southbound direction during the morning peak period and northbound during the evening peak period. The existing concurrent single HOV lane per direction currently extends from PGBT until just north of the SH 121 interchange.

The north segment of IH 35E stretches from FM 2181 to US 380 in the city of Denton. The US 380 intersects with IH 35 just north of the merging interchange of IH 35E and IH 35W as the northernmost termini of the proposed corridor. The peak traffic patterns along this segment of IH 35E are more evenly distributed between the two directions, however, the southbound direction exhibits slightly higher volumes during the morning peak period, while the northbound direction exhibits slightly higher volumes during the afternoon peak period. Both directions currently exhibit moderate traffic congestion during the afternoon peak.

IH 35E MANAGED LANE PROJECT DESCRIPTION

The proposed IH 35E managed lane project investigated as part of this study included the assessment of capacity expansion to the current general purpose lanes and the frontage roads, and the construction of new managed lanes located within the median of the existing general purpose lanes. The full build-out of the entire project consists of the widening of the general purpose lanes to 4 lanes in each direction (not including auxiliary lanes) along most of the project with the exception of following sections:

- The segment between PGBT and SH 121 – no expansion on existing freeway mainlanes, however a 3-lane collect-distribute (CD road) in each direction will be built;
- The segment between IH 35E/IH 35W to US 77 – widening will occur from the existing 2 lanes per direction to 3 lanes per direction; and
- The segment between US 380 and IH 35E/IH 35W – widening will occur to 5 lanes per direction.

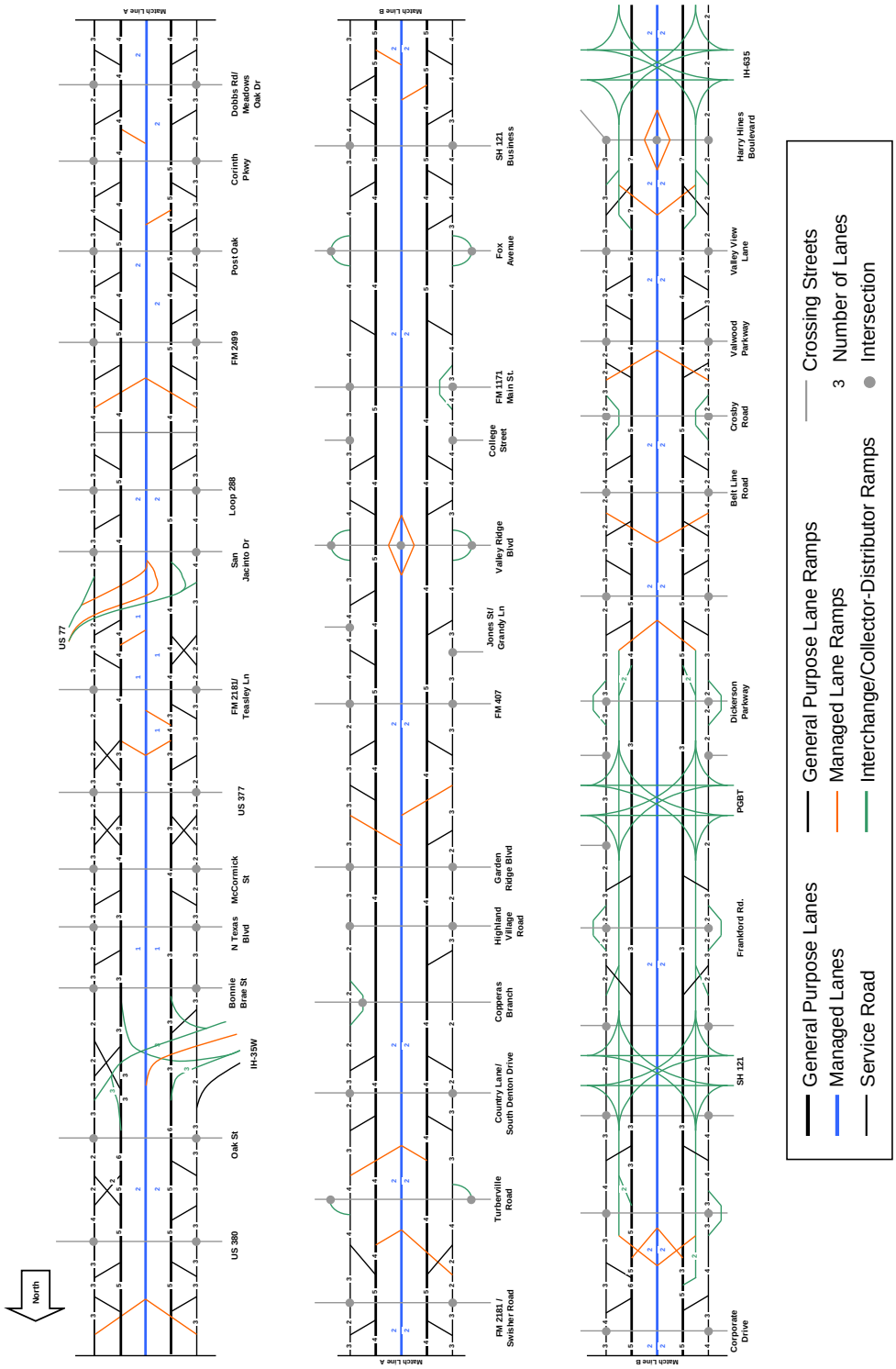


Figure 1-2. Configuration of IH 35E Managed Lane Project

The proposed build-out of the frontage roads will include lane expansions at various locations and newly built lanes that will generate either 2 or 3 service lanes running along the entire project limit. The ultimate build-out of managed lanes will consist of 2 lanes per direction with the exception of the section between IH 35E/IH 35W and US 77 where only 1 lane per direction will be built. The ultimate configuration and number of lanes of the future IH 35E corridor, including general purpose lanes, frontage road, managed lanes and ramps, are shown in **Figure 1-2**. A total of twenty-one (21) pairs of ramps are included in the ultimate configuration to/from the proposed IH 35E managed lanes with an average ramp spacing of approximately 1.4 miles. The ramps are located at/around US 380, IH 35W, US 377, Teasley Lane, US 77, Loop 288, Corinth Parkway, FM 2181, Turbeville Road, FM 407, Valley Ridge Boulevard, Business SH 121, Corporate Drive, SH 121 (Sam Rayburn Tollway) , PGBT, Beltline Road, Crosby Road, IH 635, and Harry Hines Boulevard.

PROJECT ALTERNATIVES DESCRIPTION

Six unique managed lane alternatives, were evaluated as part of this study and reflect various combinations of the corridor segments along with differing phasing of the segments. In addition to the three project segments discussed above, two early/temporary projects were also defined as partial build-out phases of the overall segments. The "north early project" is a breakout of the north segment from Bonne Brae Street to Loop 288, while the "temporary north widening" represents the temporary widening of the existing general purpose lanes to 3 lanes per direction between Loop 288 and FM 2181, under the scenarios where the northern segment is not built. A schematic of the various segments, including the two additional phasing definitions, is shown in **Figure 1-3**.

The toll operation and pricing policies follow the guidelines defined by the Regional Transportation Council (RTC) managed lane policy and incorporates the TxDOT staff directives regarding the analysis of each of the alternatives. Under the baseline policy, the single occupant vehicles (SOVs) pay a full toll rate, and the high occupant vehicles with two or more passengers (HOV 2+) receive a 50 percent discount during the peak periods but pay a full toll rate during the off-peak periods. Trucks are allowed to travel on the managed lane but pay a higher toll rate calculated based on the SOV toll rate and takes into account the number of axles. The six alternatives analyzed as part of this study included:

Alternative 1 – This project alternative is the same as analyzed in the sketch level study and reflects the ultimate project full build out under an accelerated schedule. This alternative assumes the middle segment will be open by 2015, the north segment by 2018, and the south segment by 2020. Prior to the south segment opening to traffic by 2020, the existing single lane per direction HOV facility will be converted to managed lanes in 2015.

Alternative 2 – This project alternative reflects a more conservative project phasing and assumes that only the middle segment will be constructed by 2015. The existing HOV lanes along the south segment under this alternative will be converted to managed lanes in 2015. Both the north and south segments are assumed to be fully built by 2030 according to the North Central Texas Council of Government (NCTCOG) 2030 Mobility Transportation Plan.

Alternative 3 – This alternative is similar to alternative 2 under the assumption that the north early project and temporary north widening as defined previously will be in place by 2015. The north and south segments are both assumed to be fully built by 2030.

Alternative 4 – This project alternative assumes the middle segment to be open by 2015 and the north segment by 2018. The south segment will not be built until 2040, however, the existing HOV lanes along the south segment will be converted to managed lanes and open to traffic by 2015.

Alternative 5 – This project alternative assumes the middle segment to be open by 2015 and the south segment by 2020. The existing HOV lanes along the south segment will be converted to managed lanes and open to traffic by 2015. The north segment will not be built until 2040; however, the north early project and temporary north widening will be constructed by 2015.

Alternative 6 – This alternative assumes the middle segment open by 2015, the north segment by 2023, and the south segment by 2025. The existing HOV lanes along the south segment will be converted to managed lanes and open to traffic by 2015. The north early project and temporary north widening will be constructed by 2015.

Table 1-1
IH 35E Managed Lane Project Alternatives

Alter-native	South Segment	Middle Segment	North Segment
	From PGBT to IH 635	From FM 2181 to PGBT	From US 380 to FM 2181
1	2015 HOV converted to HOT 2020 full build-out	2015 full build-out	2018 full build-out
2	2015 HOV converted to HOT 2030 full build-out	2015 full build-out	2030 full build-out
3	2015 HOV converted to HOT 2030 full build-out	2015 full build-out	2015 North Early Project and Temporary North Widening 2030 full build-out
4	2015 HOV converted to HOT 2040 full build-out	2015 full build-out	2018 full build-out
5	2015 HOV converted to HOT 2020 full build-out	2015 full build-out	2015 North Early Project and Temporary North Widening 2040 full build-out
6	2015 HOV converted to HOT 2025 full build-out	2015 full build-out	2015 North Early Project and Temporary North Widening 2023 full build-out

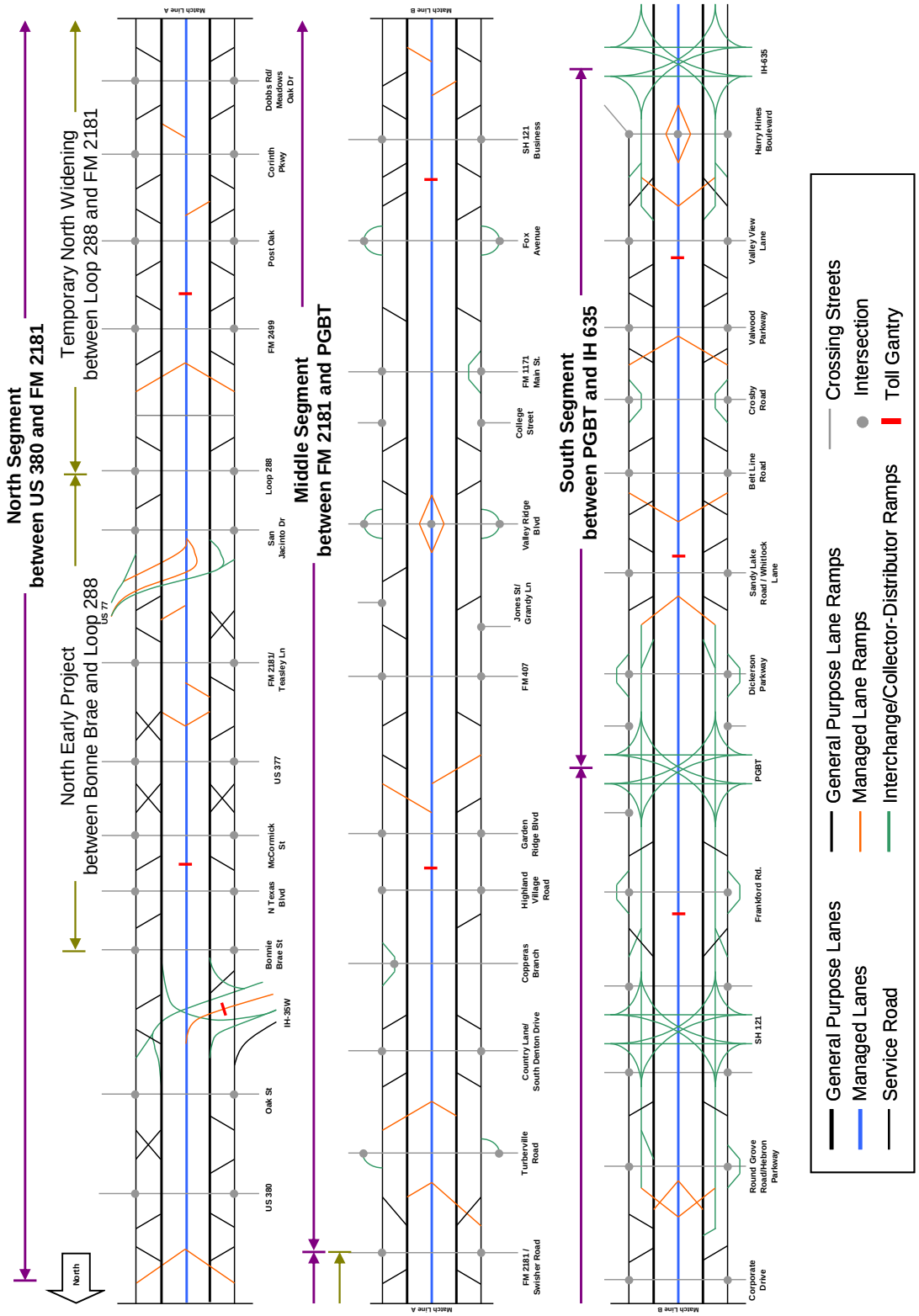


Figure 1-3. Project Segment and Alternative Configuration

REPORT STRUCTURE

The report is divided into several chapters that refer to major work elements undertaken as part of the study.

- **Chapter 1 – Introduction**: Provides an introduction to the project and describes the objective and purpose of the study, outlines the project configuration, segmentation and project alternatives, and summarizes the report structure.

- **Chapter 2 – Existing Traffic Trends and Characteristics**: The extensive traffic data collected as part of this study is described and summarized in this chapter. Data collection efforts that were undertaken included a comprehensive traffic count collection program, speed and delay runs, an origin-destination survey, and a stated-preference survey. The methodologies implemented for each of these efforts and their respective results are detailed and summarized.

- **Chapter 3 – Dallas-Fort Worth Area Transportation Characteristics**: The existing and future transportation characteristics of the Dallas-Fort Worth Metropolitan Area (DFWMA) are briefly summarized in this section of the report based on the North Central Texas Council of Government's (NCTCOG) "Mobility Transportation Plan 2030 (MTP)" and its most recent 2009 Amendment.

- **Chapter 4 – Economic Growth Analysis:** This chapter reviews the historical demographic growth trends in the Dallas-Fort Worth region and the expected future growth. This review focused on an evaluation of the socioeconomic variables that feed into the travel demand forecasting process as specifically used by NCTCOG. These variables include population, households, employment, and major employment establishments and other proposed developments which may have an impact on facility demand. The review of the demographics begins with an assessment at the region-wide and county level demographics, followed by the review of the cities located along the study corridor, and finally evaluates the Traffic Analysis Zones (TAZ) 5-miles around the corridor.

- **Chapter 5 – Modeling Approach:** This section describes the travel demand modeling process used in the traffic and revenue forecast for this project. The calibration of the base-year travel demand model is described and other major elements in the modeling process are discussed to include global demand estimates, travel time simulation modeling, and market share analysis using developed micro-models.

- **Chapter 6 – Traffic and Toll Revenue Estimates:** The key assumptions and estimated traffic and toll revenue for the proposed IH 35E managed lane project are presented in this chapter, and the toll collection configuration, toll revenue

sensitivity analysis, and the final forecasted baseline traffic and revenue characteristics are outlined and summarized.

- **Chapter 7 – Toll Revenue Risk Assessment:** The key parameters of traffic and revenue estimates used in the risk assessment process are outlined and discussed. The toll revenue risk assessments for the six defined project scenarios are then described and summarized under moderate and aggressive risk assumptions.

CHAPTER 2

EXISTING TRAFFIC TRENDS AND CHARACTERISTICS

This chapter summarizes the comprehensive data collection effort that was undertaken as part of the study and summarizes the historical traffic count data provided by TxDOT along the study corridor. The data collected include traffic counts, speed and delay information, origin-destination and stated-preference surveys. The methodologies implemented for the various data collection efforts are described in detail and the key data and parameters generated as a result of these data collection efforts are then summarized.

TRAFFIC COUNT PROGRAM

A comprehensive traffic count program was conducted on each exit and entrance ramp of IH 35E between IH 635 and US 380, including the direct connectors from the major crossing freeways of IH 635, PGBT, SH 121 and IH 35W. C J Hensch & Associates, Inc, a local data collection firm, was retained to collect all the counts for this project. Traffic volume counts were also collected along four key screenlines within the study corridor. In addition, occupancy counts and vehicle classification counts were performed at select locations along IH 35E to capture a cross-section of the demand along the corridor. The majority of the count locations gathered continuous 48-hour period counts, while several mainlane count locations were collected for a continuous seven-day period in order to obtain information regarding the IH 35E corridors' daily variations in traffic and weekend travel patterns. The automatic counts were all summarized by 15-minute time periods to capture a disaggregated temporal distribution of the current corridor traffic demand.

In addition to the automatic counts, manual vehicle occupancy counts were conducted at four locations along IH 35E to measure the existing carpooling characteristics of each corridor. The manual counts were collected at these locations during daylight hours in both directions.

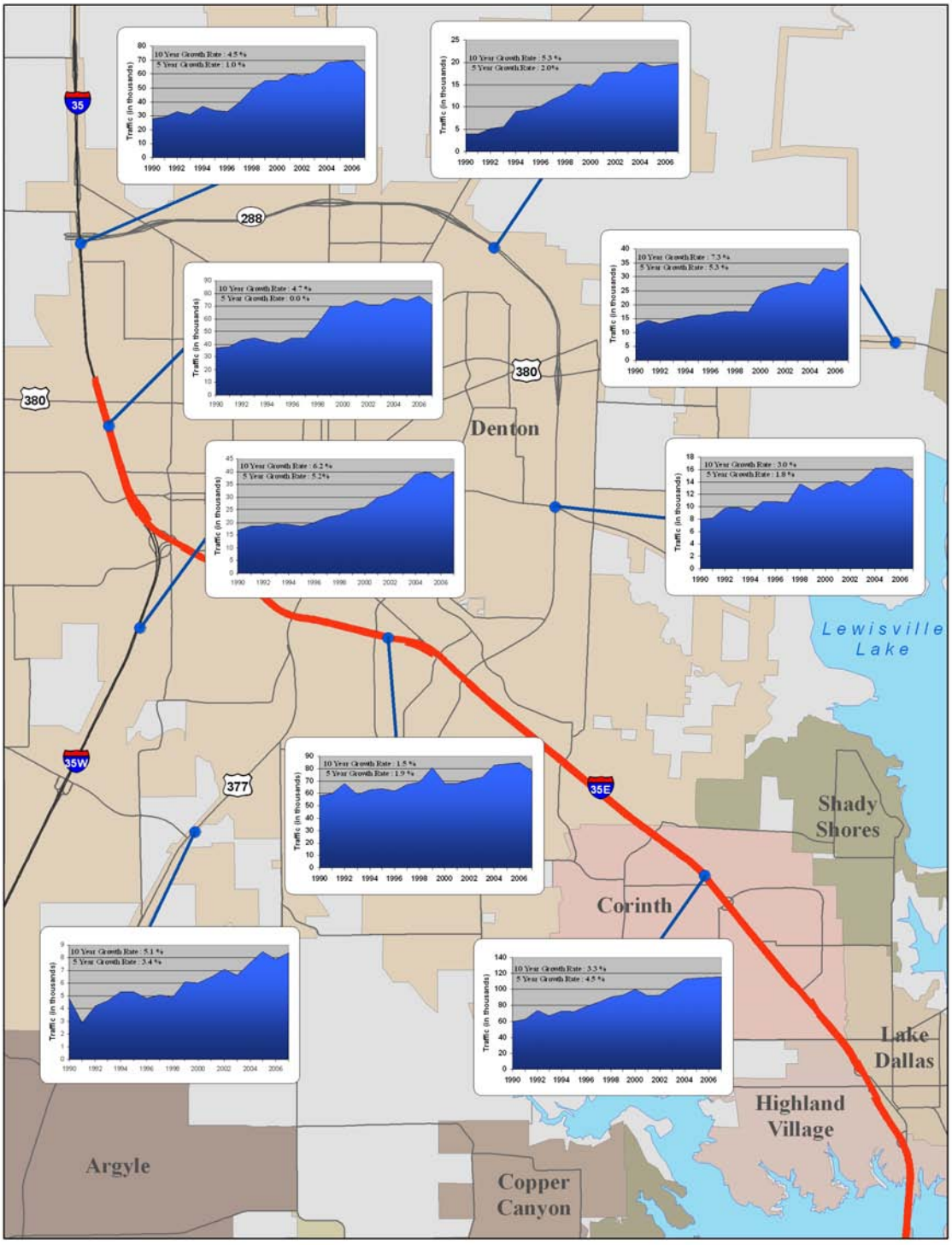
The following sections provide a detailed description of the traffic count efforts that were undertaken and the summarized results. The historical traffic counts along the corridor are first summarized to outline the historical growth trend of traffic since 1990. A detailed description of the current traffic exhibited along IH 35E and the screenlines within the entire corridor are then described and summarized.

HISTORICAL TRAFFIC GROWTH

This section provides an overview of the historical growth of traffic along key facilities within the study corridor. **Figures 2-1** and **2-2** show the historical traffic trends along several facilities in the study area from 1990 until 2007 that were obtained from the Transportation Program and Planning Division of TxDOT. Two historical growth rates (1997 to 2007 and 2002 to 2007) representing the long-term and short-term growth trends, respectively, were calculated and displayed for each location.

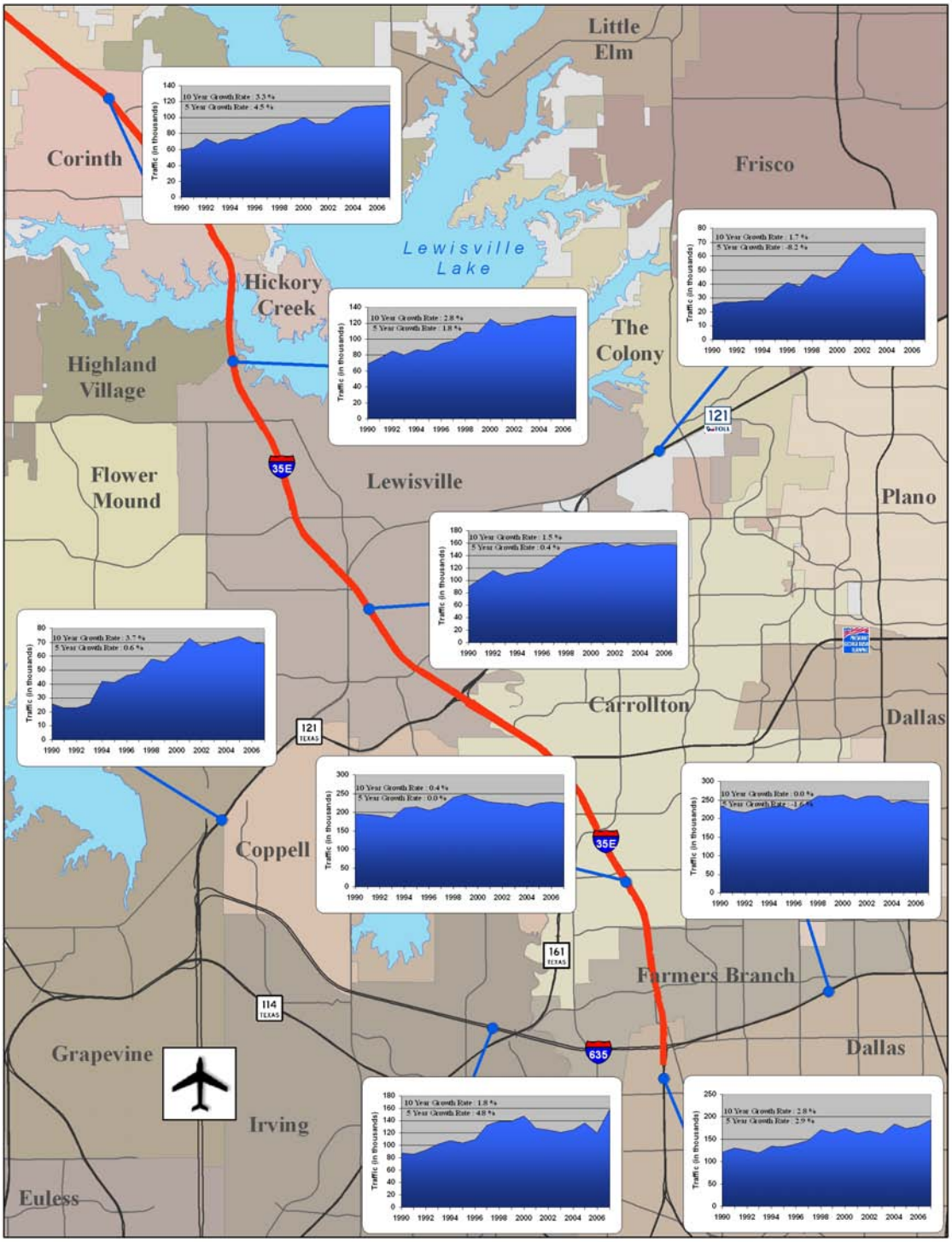
Most traffic along IH 35E has grown in excess of 2.0 percent annually from 1997-2007. Most notably, the growth of traffic north of SH 121 has been growing at annual compounded rates in excess of 3.0 percent over the last ten years. The location at Corinth Parkway has exhibited an even higher five-year growth and averaged close to 4.5 percent, which coincides with the socio-economic growth that has been occurring within this region. In general, traffic along IH 35E south of SH 121, while much larger in magnitude, has been growing at a slower pace and indicates a more mature demand.

The SH 121 (Sam Rayburn Tollway) and IH 635 (LBJ) are both high volume corridors that intersect with IH 35E and have both shown substantial growth trends over the last ten years. More specifically, the segments of SH 121 and IH 635 to the west of IH 35E have historically shown significant growth of traffic which is in keeping with the strong recent development experienced within the areas west of the corridor. The Loop 288 that feeds traffic from Denton to the IH 35E corridor in the north has also shown significant growth of more than 5 percent annually over the past ten year between 1997 and 2007.



Note: 10 Year Growth Rate – represents annual average growth rate between 1997 and 2007; 5 Year Growth Rate – represents annual average growth rate between 2002 and 2007;

Figure 2-1. Historical Traffic Growth (North)



Note: 10 Year Growth Rate – represents annual average growth rate between 1997 and 2007; 5 Year Growth Rate – represents annual average growth rate between 2002 and 2007;

Figure 2-2. Historical Traffic Growth (South)

IH 35E COUNT COLLECTION

Figure 2-3 highlights the count locations along the IH 35E mainlane and all the screenline count locations. Each ramp along the IH 35E study segment was also captured as part of the data collection; however, these locations are not specifically shown in the figure given their close proximity. Several counts along the screenline were also located along the North Texas Tollway Authority (NTTA) facilities and included SH 121 (Sam Rayburn Tollway), President George Bush Turnpike (PGBT), and Dallas North Tollway (DNT). The data along these facilities were requested from NTTA and the counts were provided in 15-min time periods for two interior weekdays of October 2008 to coincide with the period when the rest of the counts were being collected.

Traffic counts collected along IH 35E included volume counts at all entrance and exit ramps of IH 35E between IH 635 and US 380, and the IH 35E mainlanes, frontage road, and high occupancy vehicle (HOV) lanes (where applicable) at various select locations. In addition, occupancy counts and vehicle classification counts were also performed at select locations of the IH 35E mainlane. For a detailed description of methodology and procedures used to collect the ramp counts and direct connection counts with other freeways, please refer to the "IH 35E Data Collection Report" dated Feburary 2009.

Average ADT and Temporal Distribution

The count locations, duration and data collection dates of IH 35E mainlane, HOV lane and frontage road counts are summarized in **Table 2-1**. A total of twelve (12) locations, including both northbound and southbound, were selected to cover all the main segments along IH 35E within the study segment. Most of the counts were collected on October 14 and 15, 2008 with eight out of the twelve locations counted for seven days while the remaining four were undertaken for 48 hours. Several locations required recounting in subsequent weeks to ensure the capture of normal traffic patterns, and the counts at all the locations were completed prior to the Thanksgiving Holiday.

The average weekday traffic collected at the various IH 35E locations is summarized in **Figure 2-4**. The HOV lanes between IH 635 and SH 121 typically carry approximately 5,000 daily vehicles in a normal weekday with the exception of the northbound HOV lane at Luna Road, which currently captures around 7,000 daily HOV vehicles. The IH 35E at Frankford Road was shown to capture the highest mainlane daily volumes of approximately 160,000 AADT (in both directions) as shown in **Figure 2-4**. The two locations south of PGBT have an average daily traffic that ranges between 140,000 and 160,000, with traffic steadily decreasing towards the north. The IH 35E crossing at the Lewisville Lake Bridge captures approximately 95,000 daily vehicles. The section at North Texas Boulevard just south of the IH 35E/IH 35W intersection attracts a daily traffic of approximately 61,000 vehicles in both directions while the daily traffic at Denton Drive and US 380 averages around 90,000 daily vehicles.

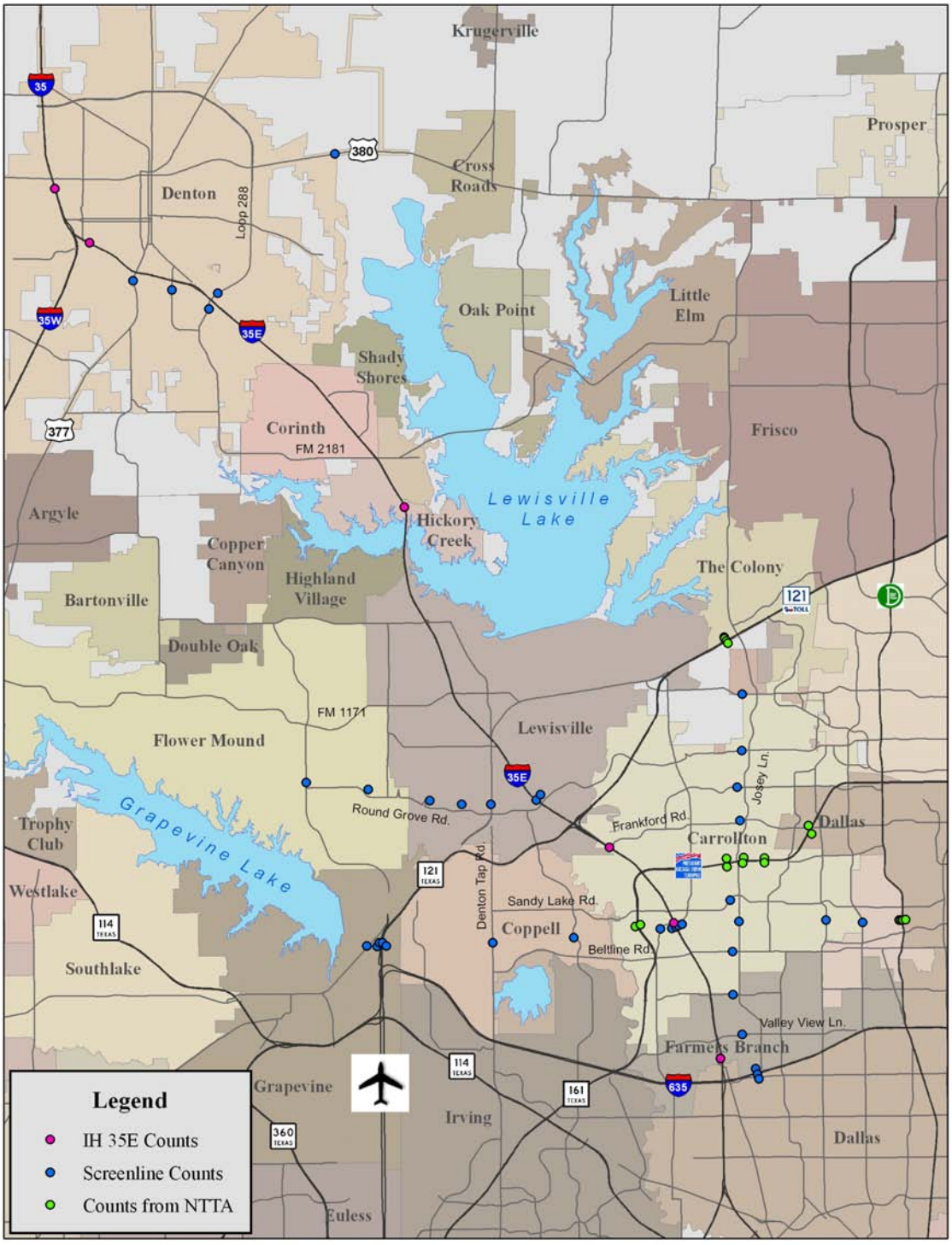


Figure 2-3. 2008 Traffic Count Locations

Table 2-1
IH 35E Mainlane, HOV Lane and Frontage Road Count Locations

Count Number	Location Description	Duration (hours)	Collection Start Date
F1	Northbound Frontage Road north of Harry Hines	168	10/13/2008
M1	Northbound Mainlanes north of entrance from eastbound IH 635	168	10/14/2008
H1	Northbound HOV Lane north of entrance from eastbound IH 635	168	10/14/2008
H2	Southbound HOV Lane north of entrance from eastbound IH 635	168	10/13/2008
M2	Southbound Mainlanes north of entrance from eastbound IH 635	168	10/13/2008
F2	Southbound Frontage Road north of Harry Hines	168	10/13/2008
F3	Northbound Frontage Road south of Luna Road	168	10/14/2008
M3	Northbound Mainlanes south of Luna Road	168	11/15/2008
H3	Northbound HOV Lane south of Luna Road	168	11/15/2008
H4	Southbound HOV Lane south of Luna Road	168	11/3/2008
M4	Southbound Mainlanes south of Luna Road	168	11/3/2008
F4	Southbound Frontage Road south of Luna Road	168	10/13/2008
F5	Northbound Frontage Road at Frankford Road	168	10/18/2008
M5	Northbound Mainlanes at Frankford Road (classification count)	168	10/14/2008
H5	Northbound HOV Lane at Frankford Road	168	10/14/2008
H6	Southbound HOV Lane at Frankford Road	168	10/14/2008
M6	Southbound Mainlanes at Frankford Road (classification count)	168	10/14/2008
F6	Southbound Frontage Road at Frankford Road	168	11/6/2008
F7	Northbound Frontage Road at Denton Drive South Bridge	48	10/14/2008
M7	Northbound Mainlanes at Denton Drive South Bridge (classification count)	48	10/14/2008
M8	Southbound Mainlanes at Denton Drive South Bridge (classification count)	48	10/14/2008
F8	Southbound Frontage Road at Denton Drive South Bridge	48	10/14/2008
F9	Northbound Frontage Road south of North Texas Boulevard / Avenue D	48	10/14/2008
M9	Northbound Mainlanes at North Texas Boulevard / Avenue D	48	10/14/2008
M10	Southbound Mainlanes at North Texas Boulevard / Avenue D	48	10/14/2008
F10	Southbound Frontage Road south of North Texas Boulevard / Avenue D	48	10/14/2008
F11	Northbound Frontage Road south of entrance from US 380	168	11/6/2008
M11	Northbound Mainlanes south of exit to US 380	168	10/13/2008
M12	Southbound Mainlanes south of exit to US 380	168	10/13/2008
F12	Southbound Frontage Road south of entrance from US 380	168	11/7/2008

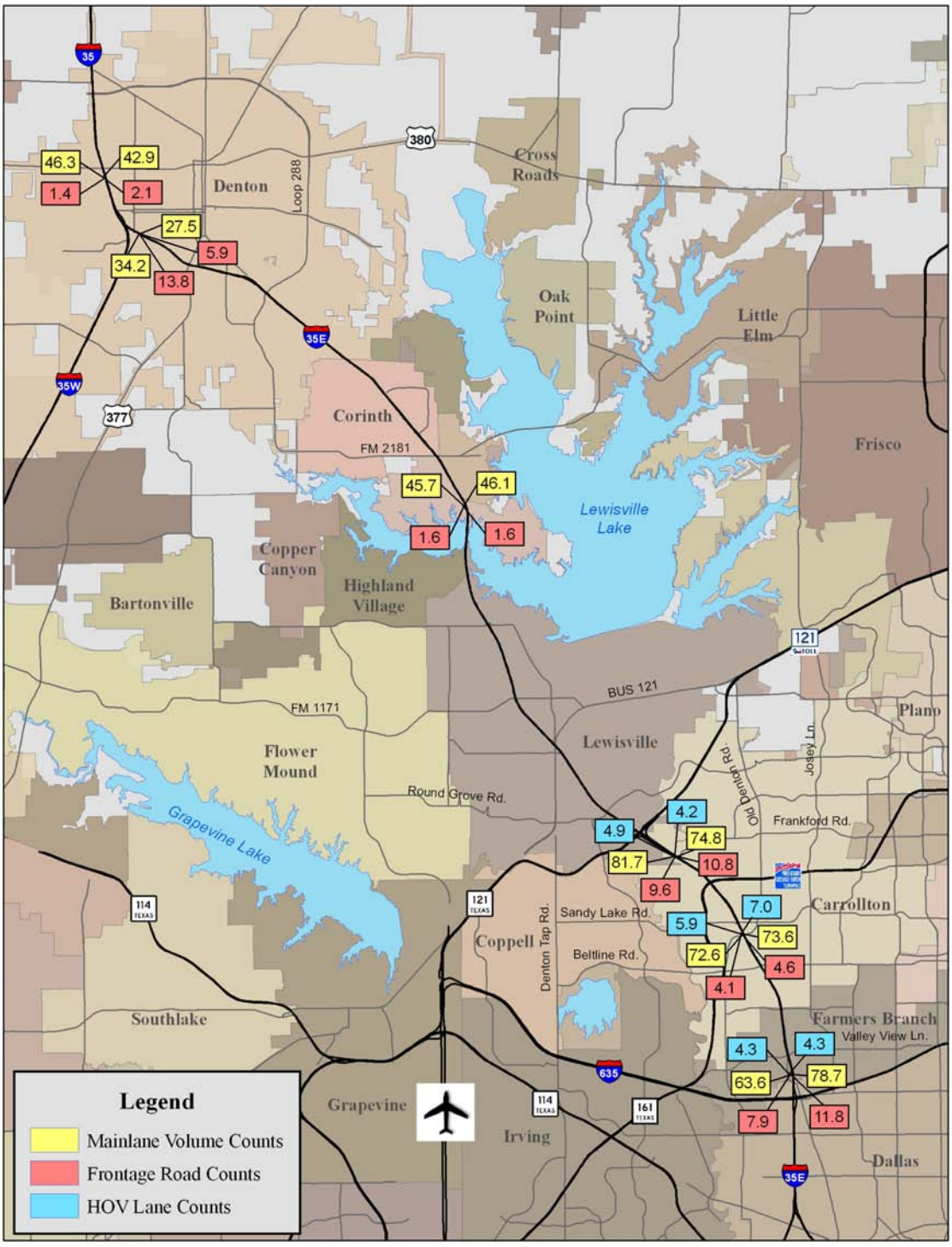


Figure 2-4. Average Weekday Traffic Volume

Traffic Profile

In addition to the average daily volumes, the temporal distributions of the mainlane volumes (not including HOV lanes) at these locations were reviewed and are summarized in **Figures 2-5** and **2-6**. The 15-min traffic counts were displayed as hourly volumes by simply multiplying the 15-min volumes by four for illustrative purposes. As shown, most locations displayed peak traffic in the morning in the southbound direction and in the northbound in the afternoon. In general, the maximum morning peak traffic was somewhat higher than afternoon peak traffic. Several locations showed simultaneous morning and afternoon peaks in the same direction, particularly as one is approaching IH 635. The highest hourly equivalent traffic occurred in the southbound direction at Frankford Road and reached 8,000 vehicles per hour (2,000 vehicles within 15 minutes). The lowest hourly equivalent traffic during peak period in the peak direction occurred for the northbound direction within the vicinity of North Texas Road, where volumes ranged between 2,200 vehicles per hour (550 vehicles within 15 minutes) over the 2 general purpose lanes.

Traffic profile graphics were also developed to show the average hourly volume along the IH 35E between IH 635 and US 380, for the four time periods in both the northbound and southbound directions. The comprehensive mainlane and ramp counts collected along the IH 35E were used to generate an overall profile along the entire corridor. The traffic was summarized into four time periods that were consistent with NCTCOG's official trip tables as shown below:

- AM Peak Period – 6:30 AM to 9:00 AM;
- Midday Period – 9:00 AM to 3:00 PM;
- PM Peak Period – 3:00 PM to 6:30 PM; and
- Night Period – 6:30 PM to 6:30 AM.

The average weekday hourly traffic was obtained by dividing the total counts by the number of hours in each respective period as summarized in **Figures 2-7** and **2-8** for each respective travel direction along IH 35E and by period. The northbound hourly traffic volumes along IH 35E were the highest between Valley View Lane and Belt Line Road, while the southbound hourly traffic volumes along IH 35E were shown to be the highest in the morning peak in the vicinity of Frankford Road.

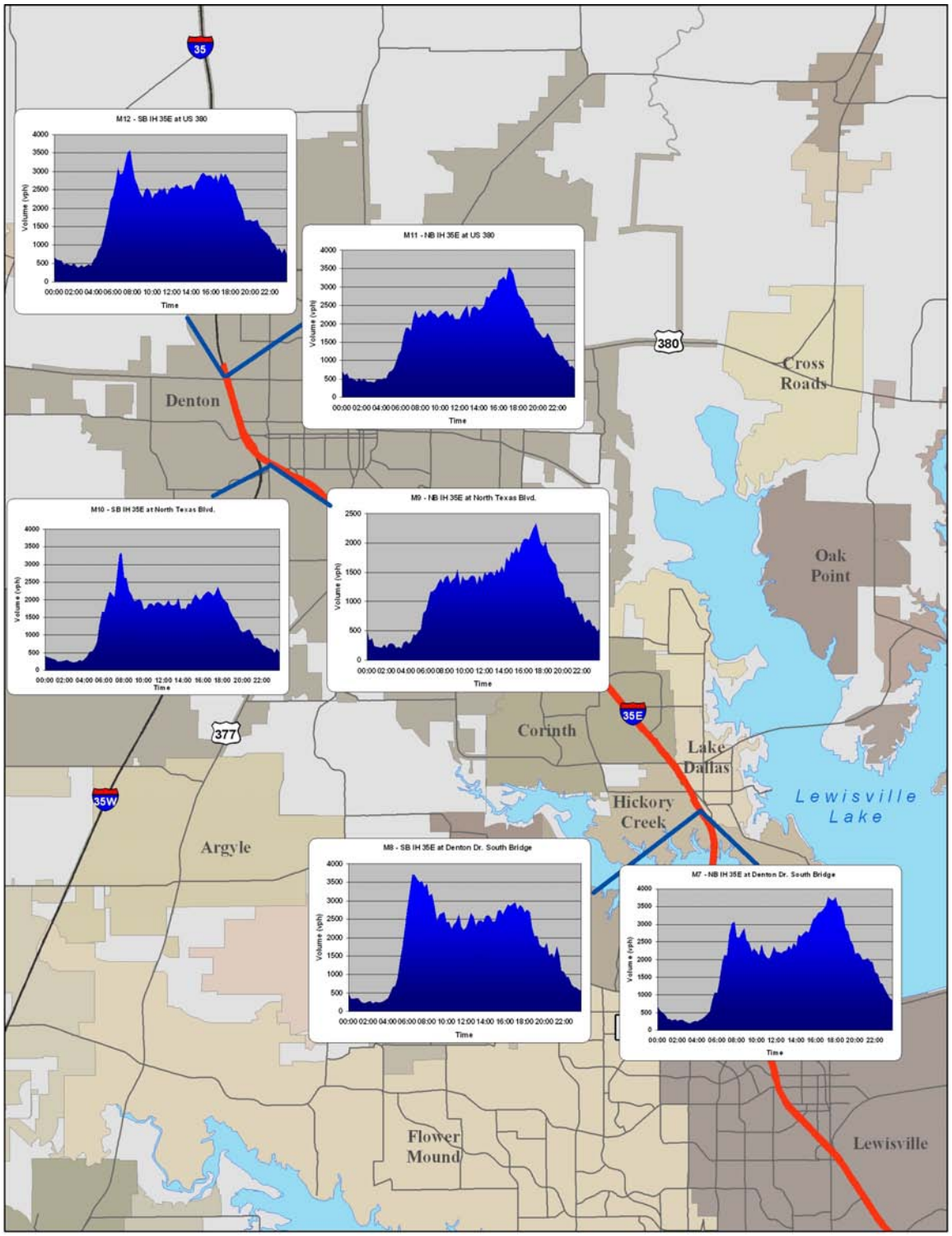


Figure 2-5. Traffic Temporal Distribution (North)

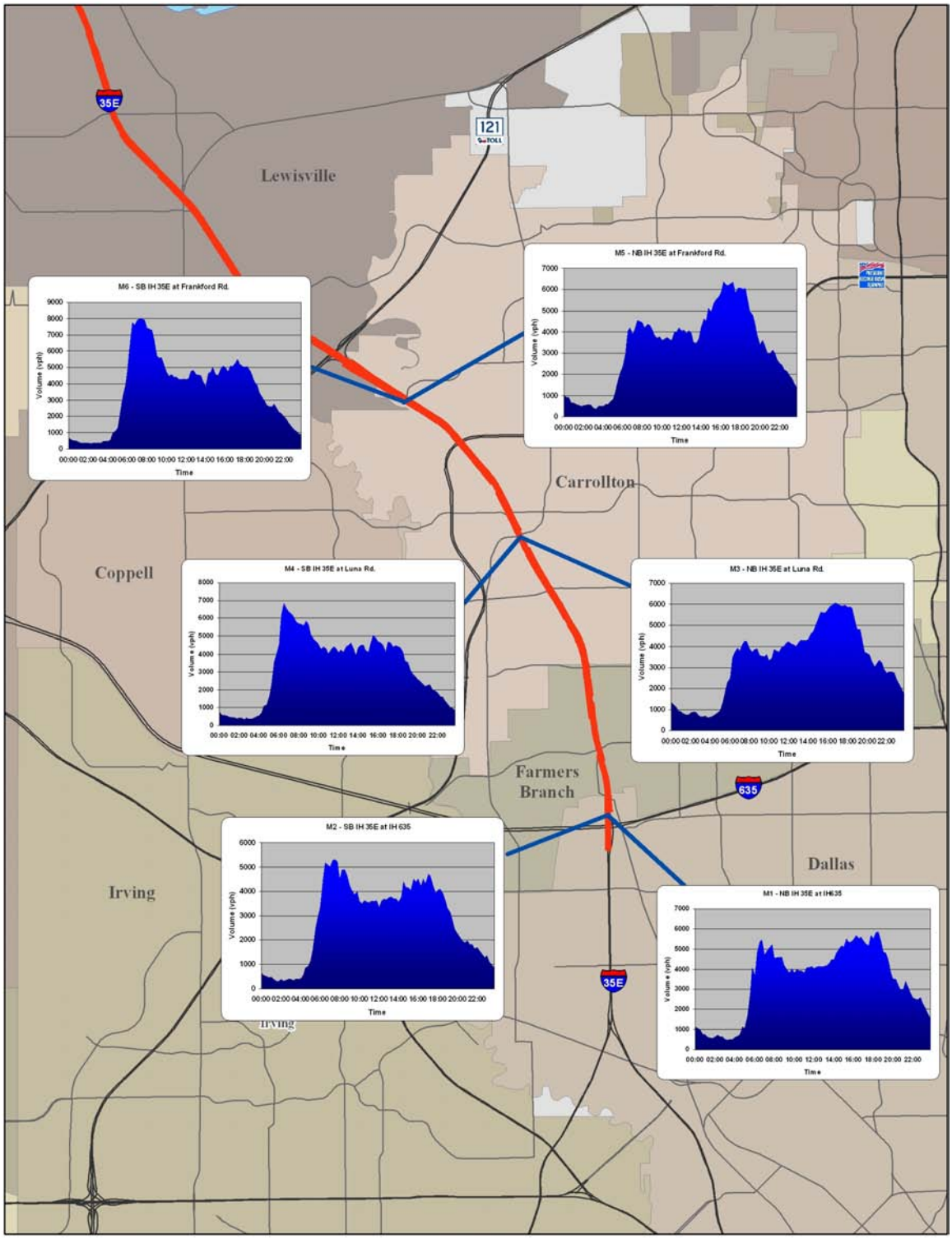


Figure 2-6. IH 35E Traffic Temporal Distribution (South)

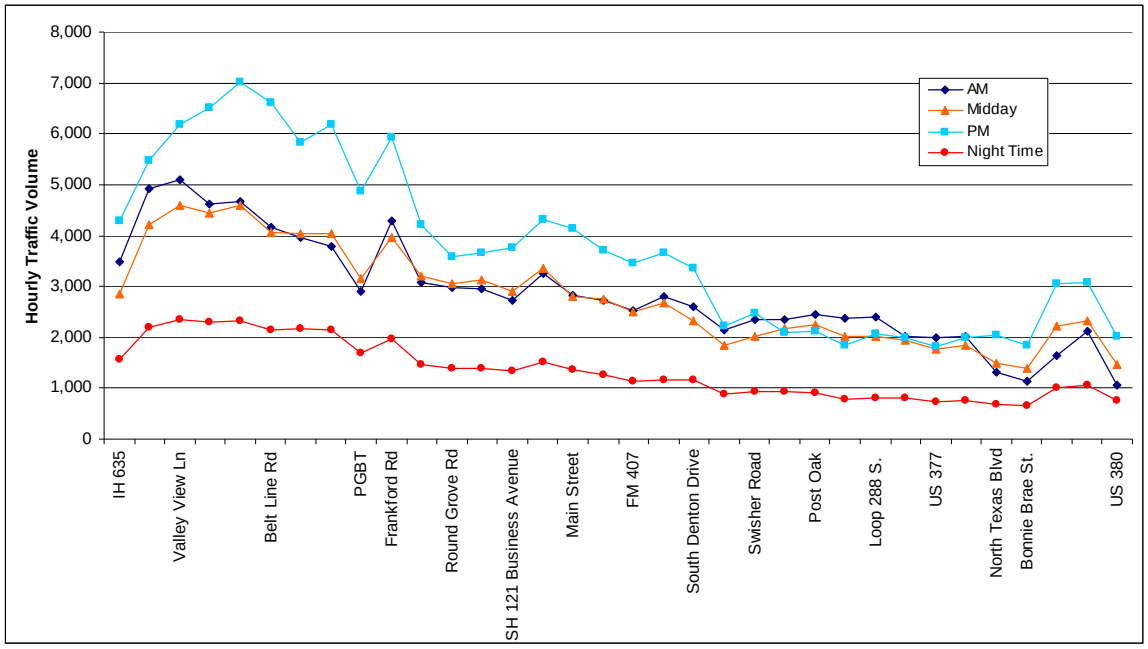


Figure 2-7. Northbound IH 35E 2008 Traffic Profile

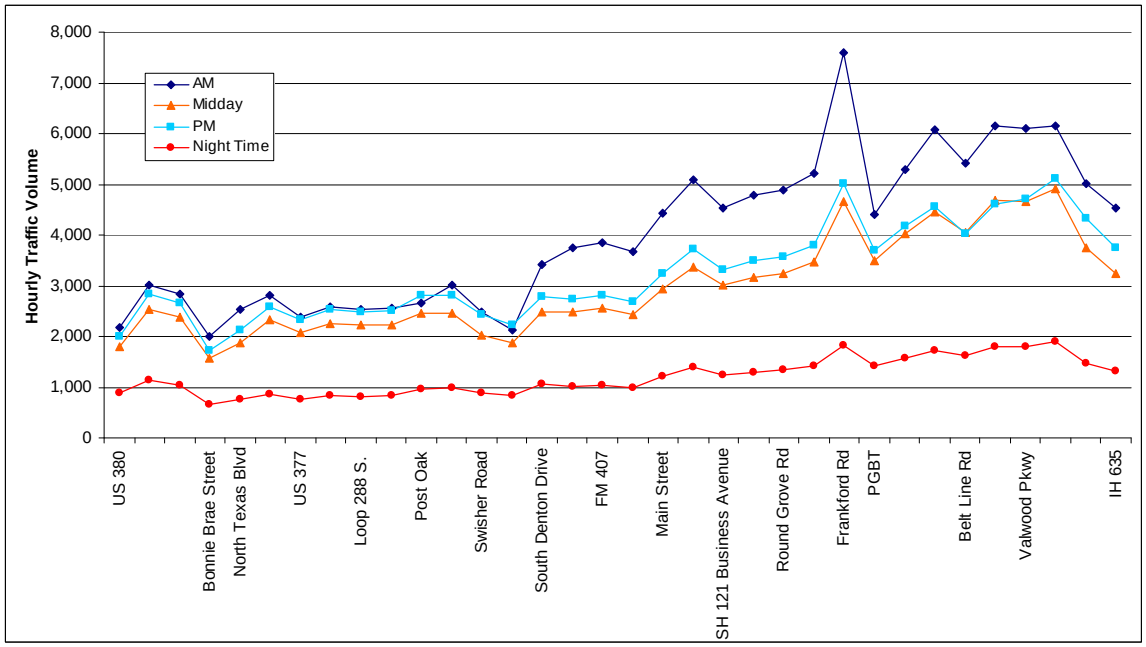


Figure 2-8. Southbound IH 35E 2008 Traffic Profile

Manual Vehicle Occupancy Counts

Manual vehicle occupancy counts were also obtained along the IH 35E corridor to complement the automatic traffic counts. The manual counts were performed using roadside observation techniques to measure the existing carpooling characteristics within the corridor. All the counts were conducted during the daylight hours from 6:00 AM to 12:00 PM in the morning and from 1:00 PM to 6:00 PM in the evening on a mid-week day in both directions of the corridor. The selected locations where the manual occupancy counts were performed are listed below:

- Location 1: IH 35E south of Luna Road, and
- Location 2: IH 35E south of Denton Drive South.

The collected vehicle occupancy counts were reviewed to ensure that the data was of good quality and the results from this effort are summarized in **Table 2-2**. The captured single-occupant vehicle share at Luna Road was approximately 85 percent of the traffic counted during the daylight hours while the remaining 15 percent of the traffic counted had more than one occupant (with approximately 85 percent of this remaining traffic had 2 occupants while 15 percent had 3 or more occupants). The high-occupant vehicle share at the Denton Drive location was only approximately 6 percent of the total traffic counted, with over 94 percent of traffic traveling comprised of single occupancy vehicles.

Table 2-2
Manual Vehicle Occupancy Counts

Location	Direction	Single Occupant Vehicle		2 occupants per Vehicle		3 or more occupants per Vehicle		Total Vehicle
		Volume	Percentage	Volume	Percentage	Volume	Percentage	
South of Luna Road	Northbound	45,483	86.4%	6,687	12.7%	456	0.9%	52,626
	Southbound	37,152	84.8%	5,686	13.0%	997	2.3%	43,835
South of Denton Drive	Northbound	31,898	94.5%	1,698	5.0%	148	0.4%	33,744
	Southbound	31,935	92.8%	2,354	6.8%	134	0.4%	34,423

Vehicle Classification Counts

Vehicle classification counts were originally planned to be made at Denton Drive and Luna Road; however, due to the wide roadway footprint (5 lanes per direction) and the stalled traffic during peak period at Luna Road, the data quality collected at this location was not acceptable such that the classification count was later collected at Frankford Road. **Figure 2-7** summarizes the daily average auto and truck percentages at these two locations. Truck traffic on IH 35E at Frankford Road accounts for approximately 7 percent of the total traffic at this location. The truck percentage is approximately 11 percent at Denton Drive, which is slightly higher than the Frankford Road location.

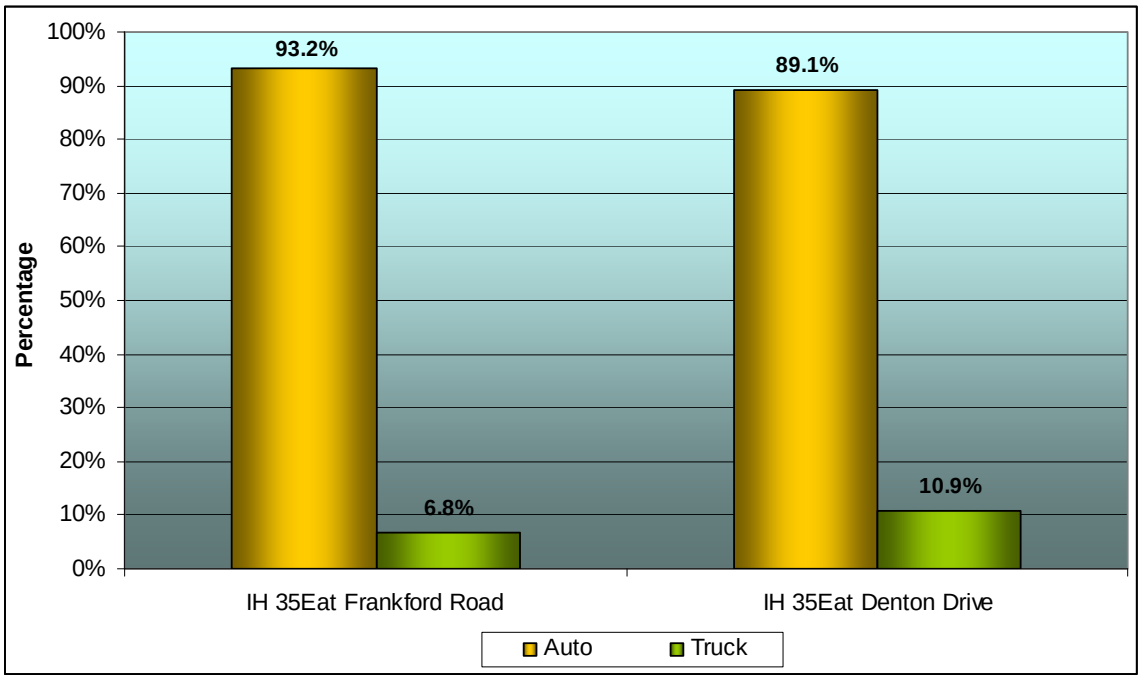


Figure 2-9. Truck Percentage along IH 35E

SCREENLINE COUNTS

Four key screenlines were selected to capture the existing traffic characteristics in the study area and establish a reliable base condition from which to calibrate the travel demand model. The four screenlines were selected to capture the full demand within the entire study corridor.

- Screenline 1: west of Josey Lane between SH 121 and IH 635;
- Screenline 2: north of Flower Mound Road between FM 2499 and IH 35E;
- Screenline 3: north of Belt Line Road and Bass Pro Drive between SH 26 and Dallas North Tollway (DNT); and
- Screenline 4: some spot counts in Denton.

A total of 56 count locations along four screenlines were collected to quantify the total potential demand along the IH 35E corridor. The counts were obtained for a continuous 48 hours on each major street as listed in **Tables 2-3** through **Table 2-6** and illustrated in **Figure 2-8**. The majority of the screenline counts were made as scheduled with the exception of two locations that required a recount on November 4, 2008. **Figures 2-9** and **2-10** display the two-day average daily volume for all the locations along the four screenlines.

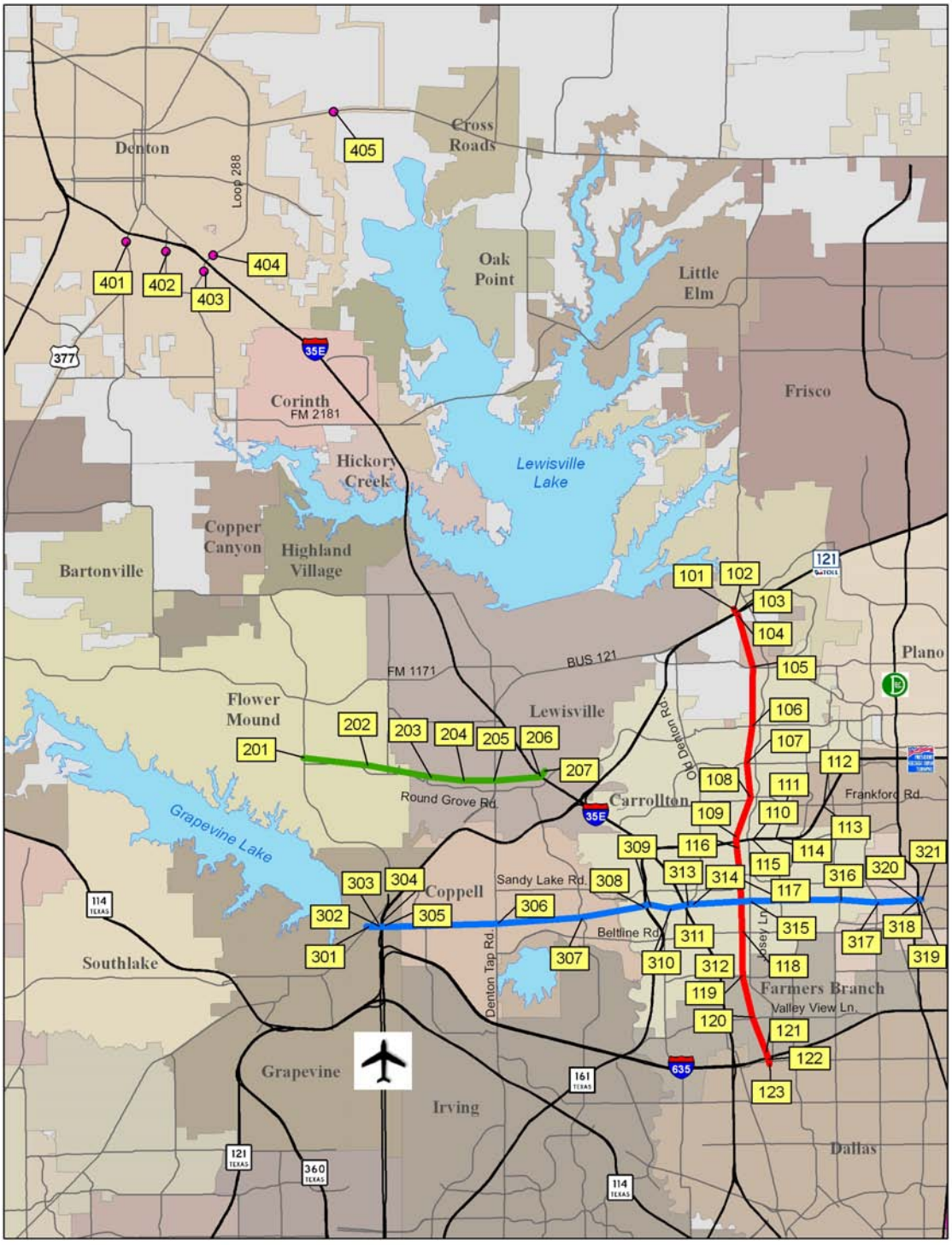


Figure 2-10. Screenline Counts Location

Table 2-3
Screenline 1: West of Josey Lane

Count Number	Location Description	Duration (hours)	Collection Start Date
101	Westbound SH 121 Frontage Road west of Josey Lane	48	10/21/2008
102	Westbound SH 121 Main Lane Toll Plaza west of Josey Lane	48	10/15/2008
103	Eastbound SH 121 Main Lane Toll Plaza west of Josey Lane	48	10/15/2008
104	Eastbound SH 121 Frontage Road west of Josey Lane	48	10/21/2008
105	Parker Road west of Josey Lane	48	10/21/2008
106	Hebron Parkway west of Josey Lane	48	10/21/2008
107	Rosemeade Parkway west of Josey Lane	48	10/21/2008
108	Frankford Road west of Josey Lane	48	10/21/2008
109	Westbound PGBT Frontage Road west of Josey Lane	48	10/21/2008
110	Westbound PGBT Exit Ramp to Josey Lane	48	10/21/2008
111	Westbound PGBT Entrance Ramp from Kelley Boulevard	48	10/21/2008
112	Westbound PGBT Main Lane Toll Plaza 8 (MLP 8)	48	10/15/2008
113	Eastbound PGBT Main Lane Toll Plaza 8 (MLP 8)	48	10/15/2008
114	Eastbound PGBT Exit Ramp to Kelley Boulevard	48	10/21/2008
115	Eastbound PGBT Entrance Ramp from Josey Lane	48	10/21/2008
116	Eastbound PGBT Frontage Road west of Josey Lane	48	10/21/2008
117	Keller Springs Road west of Josey Lane	48	10/21/2008
118	Beltline Road west of Josey Lane	48	10/21/2008
119	Valwood Parkway west of Josey Lane	48	11/4/2008
120	Valley View Lane west of Josey Lane	48	10/21/2008
121	Westbound IH 635 Frontage Road west of Josey Lane	48	11/4/2008
122	Westbound IH 635 Mainlanes west of Josey Lane	48	10/22/2008
123	Eastbound IH 635 Mainlanes west of Josey Lane	48	10/22/2008

Table 2-4
Screenline 2: Counts in Lewisville

Count Number	Location Description	Duration (hours)	Collection Start Date
201	SH 2499 Long Prairie Boulevard north of Flower Mound Road	48	10/22/2008
202	Morris Road north of Flower Mound Road	48	10/22/2008
203	Valley Parkway north of Round Grove Road	48	10/22/2008
204	Edmonds Lane north of Round Grove Road	48	10/22/2008
205	Business 121 North of Round Grove Road	48	10/22/2008
206	Southbound IH 35E Frontage Road north of Round Grove Road	48	10/22/2008
207	Northbound IH 35E Frontage Road north of Hebron Parkway	48	10/22/2008

Table 2-5
Screenline 3: North of Beltline / Bass Pro Drive

Count Number	Location Description	Duration (hours)	Collection Start Date
301	SH 26 north of Bass Pro Drive	48	10/22/2008
302	Southbound SH 121 Frontage Road north of exit to Bass Pro Drive	48	10/22/2008
303	Southbound SH 121 Mainlanes north of exit to Bass Pro Drive	48	10/22/2008
304	Northbound SH 121 Mainlanes north of entrance from Bass Pro Drive	48	10/22/2008
305	Northbound SH 121 Frontage Road north of entrance from Bass Pro Drive	48	10/22/2008
306	Denton Tap Road north of Bethel Road	48	10/22/2008
307	MacArthur Boulevard north of Beltline Road	48	10/22/2008
308	Southbound PGBT Main Lane Toll Plaza 9 (MLP 9)	48	10/15/2008
309	Northbound PGBT Main Lane Toll Plaza 9 (MLP 9)	48	10/15/2008
310	Luna Road north of Beltline Road and Northbound entrance ramp to PGBT	48	10/22/2008
311	Southbound IH 35E Frontage Road south of Luna Road	168	10/13/2008
312	Southbound IH 35E Mainlanes and HOV Lane south of Luna Road	168	11/15/2008
313	Northbound IH 35E Mainlanes and HOV Lane south of Luna Road	168	11/3/2008
314	Northbound IH 35E Frontage Road south of Luna Road	168	10/14/2008
315	Josey Lane north of Beltline Road	48	10/21/2008
316	Marsh Lane north of Arapaho Road	48	10/22/2008
317	Midway Road north of Arapaho Road	48	10/22/2008
318	Southbound Dallas Parkway north of Arapaho Road	48	10/22/2008
319	Southbound DNT Main Lane Toll Plaza 2 (MLP 2)	48	10/15/2008
320	Northbound DNT Main Lane Toll Plaza 2 (MLP 2)	48	10/15/2008
321	Northbound Dallas Parkway north of Arapaho Road	48	10/22/2008

Table 2-6
Screenline 4: Counts in Denton

Count Number	Location Description	Duration (hours)	Collection Start Date
401	US 377 south of IH 35E	48	10/21/2008
402	Lillian Miller Parkway south of IH 35E	48	10/21/2008
403	Teasley Lane south of IH 35E	48	10/21/2008
404	Loop 288 north of IH 35E	48	10/21/2008
405	US 380 east of Lakeview Boulevard	48	10/21/2008

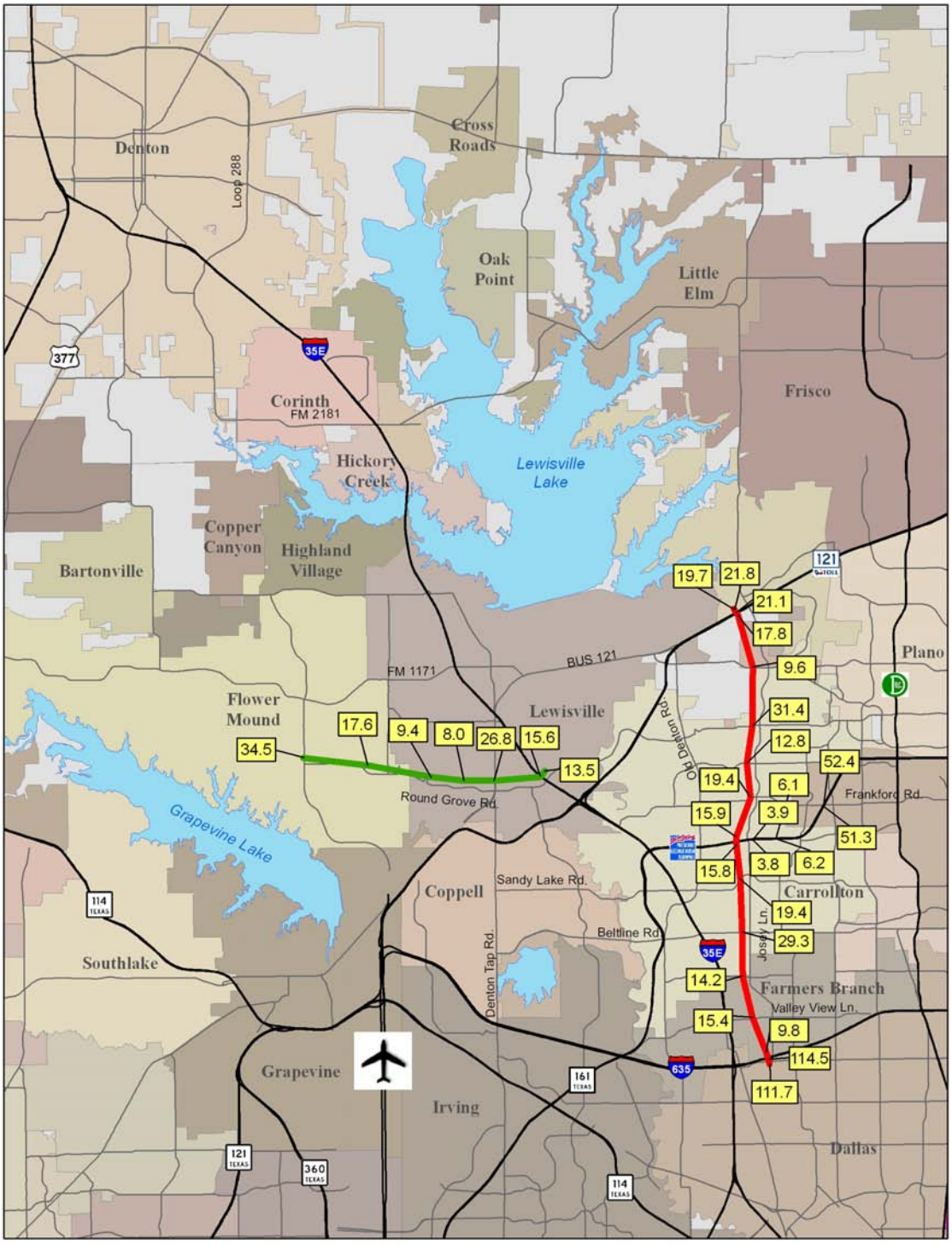


Figure 2-11. Average Weekday Traffic Volume of Screenline 1 and 3

Figure 2-12. Average Weekday Traffic Volume of Screenline 2 and 4

SPEED AND DELAY INFORMATION

One of the crucial inputs for a managed lane project is the current operating characteristics of the project corridor and any competing facilities. Speed and delay information was gathered in the field by using Global Positioning System (GPS) technology during peak and midday periods. Cumulative time and distance was gathered using GPS units every one-tenth of a mile, and the operating speed was calculated. Speed and delay information was collected for two consecutive days on the main routes of IH 35E and for a single day on the alternative major arterial routes identified within the study corridor.

ROUTE SELECTION

Seven routes were selected for collection of speed and delay information. The first three routes were along alternative routes to the IH 35E study corridor, and were collected during one weekday for each route by a single driver. Given that the study corridor on the existing IH 35E between IH 635 and US 380 is 28 miles long, this route was split into four separate routes to ensure that each respective single drive was able to collect sufficient speed and delay data during the peaks. The four selected routes along IH 35E as listed below were each collected for two consecutive days and are illustrated in **Figure 2-13**:

- Route 1: US 380 via Dallas North Tollway (DNT) between Denton and IH 635 (LBJ);
- Route 2: IH 35W via SH 114 between Denton and IH 635 (LBJ);
- Route 3: US 377 between Denton and SH 114;
- Route 4: IH 35E between IH 35W and FM 2181;
- Route 5: IH 35E between FM 2181 and SH 121 Business;
- Route 6: IH 35E between SH 121 Business and PGBT; and
- Route 7: IH 35E between PGBT and IH 635 (LBJ);

For each route, runs were made during both morning and afternoon peak periods and the midday off-peak period. All the speed and delay runs were made as initially scheduled during the weeks of October 13 and October 20, 2008. **Figures 2-14 and 2-15** illustrate the average speed along the seven routes for both the AM peak and PM peak periods. The majority of the route showed free-flow traffic conditions for both AM and PM peaks. The section of US 380 west of Loop 288 exhibited some slow down along segments within the vicinity of the city of Denton. The DNT to the south of SH 121 exhibited congestion in the southbound direction during the morning peak and in the northbound direction during the afternoon.

The Route 2 speed and delay runs showed that the IH 35W portion and the majority part of SH 114 always showed near free flow traffic conditions, with minor congestion along the section of SH 114 near Dallas-Fort Worth International airport. The Route 3 speed

and delay runs along US 377 from IH 35E until SH 114 showed the speeds ranging from 41 to 50 mph during the morning peak with even higher average speeds observed during the PM peak.

The speed information collected along the four IH 35E routes illustrated that congestion occurred mostly in southbound direction during the morning peak period and in the northbound direction during the afternoon peak periods. The segment between Business 121 and FM 2181 showed free flow traffic conditions during both the morning and afternoon peaks. Congestion was shown to build up along the segments to the north of FM 2181 in both directions during the afternoon peak, with only slight congestion patterns demonstrated during the morning peak period in both directions. This speed and delay observation conforms to the captured traffic volume temporal distribution and showed that the peak directional distribution of traffic is not significant along the northern segments of the corridor. Conversely, IH 35E south of SH 121 showed strong directional traffic that causes severe congestion conditions in the southbound direction in the morning and the northbound direction in the afternoon.

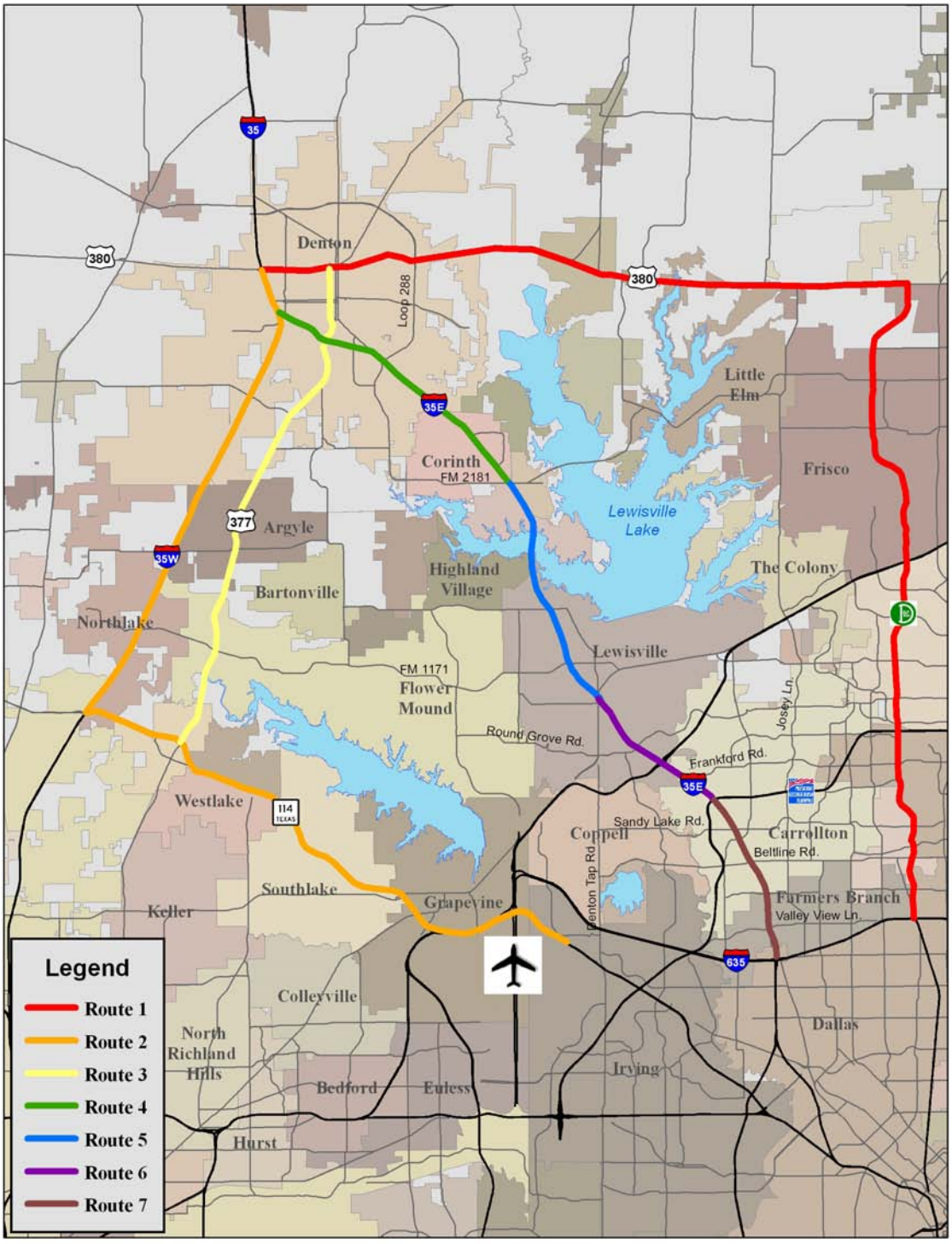


Figure 2-13. Speed and Delay Run Routes

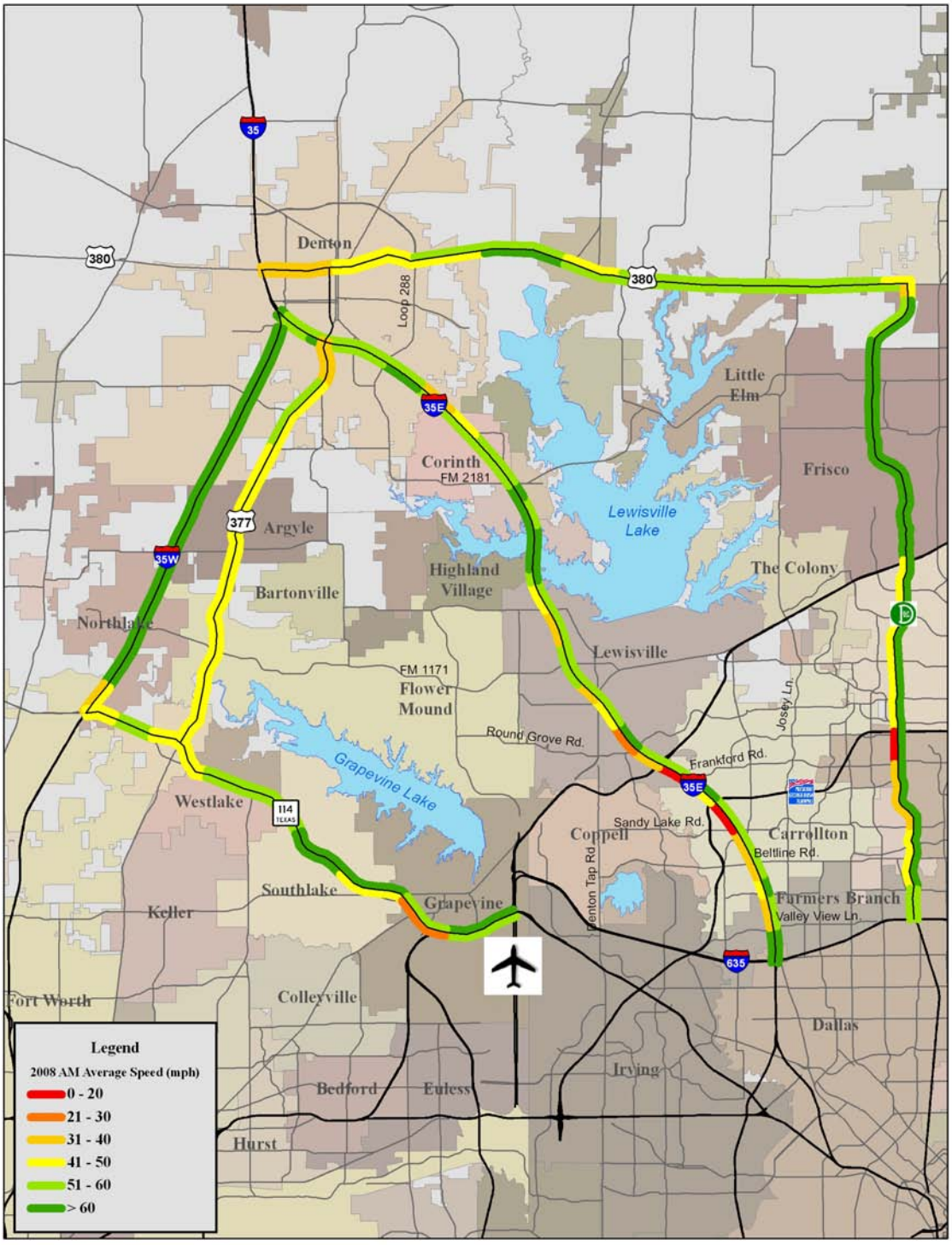


Figure 2-14. Travel Speed Reconnaissance – AM Peak

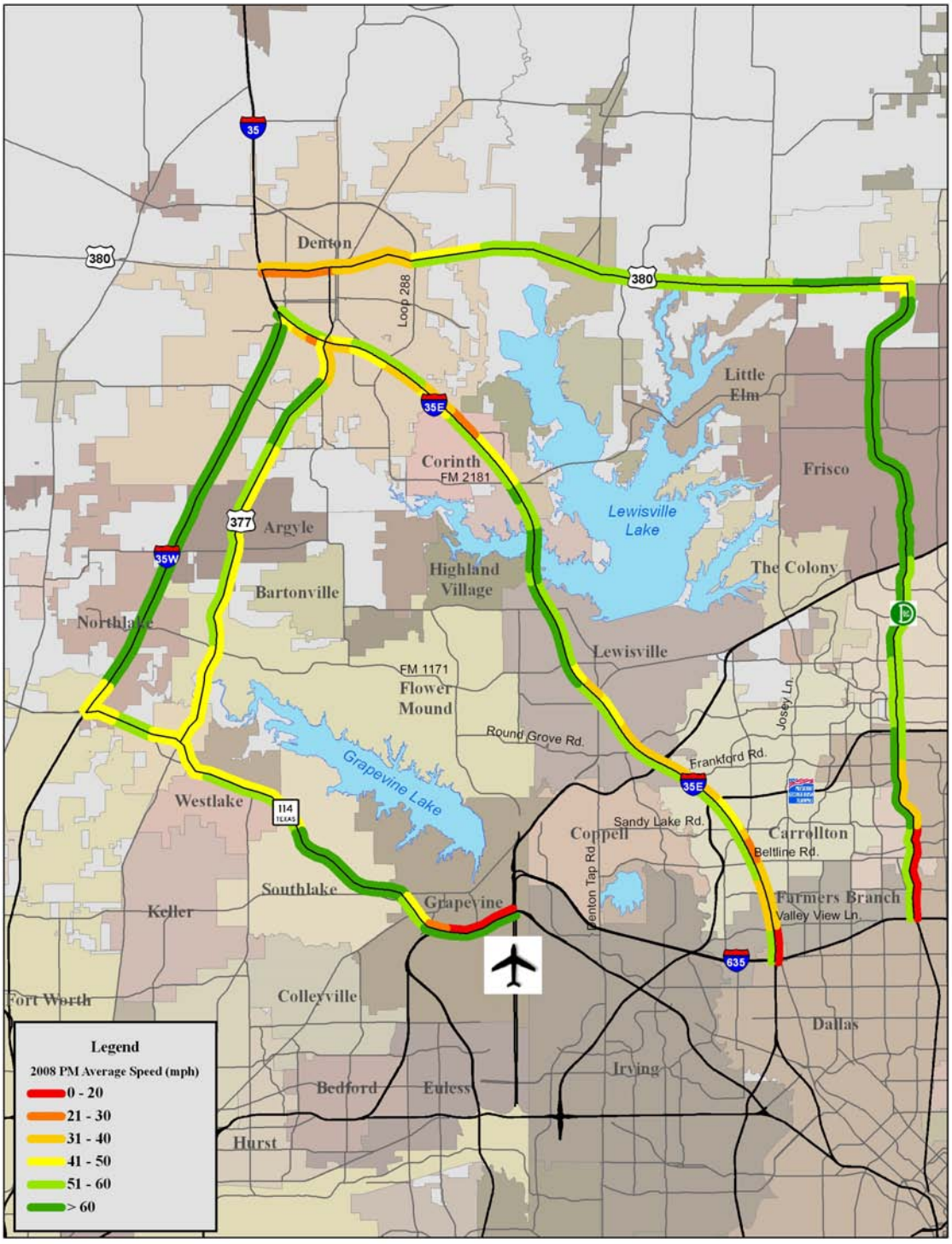


Figure 2-15. Travel Speed Reconnaissance – PM Peak

STATED PREFERENCE SURVEY

An important element of the travel demand model development of this study is the estimation of the potential willingness-to-pay characteristics of the markets to be serviced by the IH 35E managed lanes. This behavioral characteristic provides a gauge that helps determine likely market shares that may be captured by the IH 35E managed lanes. The primary tool used to make these types of estimates is a stated preference survey, which allows the development of estimates of toll sensitivity through value of time estimates using trade-off variable testing. A stated preference survey focusing on the IH 35E corridor between IH 635 and US 380 was conducted in the late fall and early winter of 2008.

The stated preference survey was performed by Resource Systems Group (RSG) and was implemented through a multiple-method sampling approach that consisted of field intercept surveys using stand-alone laptop computers as well as internet capture via an email distribution to identified targeted audiences. Approximately 1,006 surveys were completed in field and another 1,185 responses were collected from the internet survey (which included 813 email accounts obtained from the origin-destination survey sample and 372 from the business recruiting efforts) for a total sample of 2,193 respondents. The number of useable records was reduced to 1,619 after performing data checks and removing outliers during the value of time estimation tasks.

Sampling errors in the process were minimized by screening survey respondents to ensure that they used the existing study corridor. Outliers in the survey data were identified from extreme values in the input data. The data were screened for inconsistencies regarding unusually long travel times and unusually short distances traveled on the study roads, and between reported travel times and times presented in the choice experiments.

Several utility equation structures were tested using the variables included in the stated preference scenarios, as well as trip characteristics and demographic variables. The general structure of these equations, or specifications, was similar to the final specifications used, however, several other variables were introduced, one at a time, to test potential interactions with time and cost. These model specifications were developed to determine if respondents' responses for items other than travel time and cost may significantly influence their choices in the stated preference scenarios.

Multinomial logit models were estimated for the complete sample, as well as several segments that the total samples were divided into to get the model estimation of specific traveler markets that included:

- Peak Direction Commute to/from Work
- Peak Direction Work-Related Business Trips

- Peak Direction Non-Work Trips
- Off-Peak Direction Commute to Work Trips
- Off-Peak Direction Work Related Business Trips
- Off-Peak Direction Non-Work Trips

The mean values of time (VOT) for all the trips and the six segments are shown in **Table 2-7**. The value of time estimated based on the all weekday trip model was approximately $11.0, which is consistent with the VOT results observed from other projects in the DFW region. The peak direction work related business trips had the highest VOT of $13.44. The VOTs for the off-peak direction work and non-work trips exhibited slightly higher VOTs than those of the peak direction; however, the differences are not statistically significant. The off-peak direction work related business trips were shown to have a low VOT, which may be a result of the relatively small sample size. The average VOT of all weekday trips was chosen for the travel demand modeling purpose by taking into consideration the volatility of VOTs for the various markets during the off-peak direction.

Table 2-7
Values of Time

Segment	VOT ($/hour)
All Weekday Trips	$10.96
Peak Direction Commute to/from Work Trips	$10.29
Peak Direction Work Related Business Trips	$13.44
Peak Direction Non-Work Trips	$10.12
Off-Peak Direction Commute to/from Work Trips	$11.18
Off-Peak Direction Work Related Business Trips	$7.88
Off-Peak Direction Non-Work Trips	$11.48

ORIGIN/DESTINATION SURVEY

An origin-destination (O-D) survey is generally performed to validate trip making patterns within the study corridor and identify the main characteristics of the traveling markets. The survey was conducted using a mail-out survey technique. Travelers along the IH 35E corridor were surveyed by capturing their license plate numbers while driving along the IH 35E corridor. These license plate numbers were used to identify motorists' addresses using an anonymous process and the mail-back surveys were then distributed. The survey effort was undertaken to provide some insight into the existing travel patterns of the motorists using the study corridor.

LICENSE PLATE CAPTURE

The locations for the license plate capture were determined taking into account location feasibility, visibility, and the maximum potential for traffic video capture rates. Four survey locations were selected along the IH 35E corridor in order to obtain a representative sample of the traffic using the entire facility. The license plate information was collected in both directions at the four locations to allow for both a license plate matching and mail-back capture of the origin-destination patterns through the corridor.

The following four strategic locations were identified for the license plate data collection and are outlined in **Figure 2-16**:

- Site 1: Avenue D in Denton;
- Site 2: Denton Drive South in Lake Dallas;
- Site 3: West Frankford Road in Carrollton; and
- Site 4: Luna Road in Carrollton.

GRAM Traffic Counting Inc (GRAM) undertook the license plate data capture on October 16, 2008. The license plate recording was conducted during daylight hours between 7:30 AM and 7:00 PM and traffic counts were collected along the IH 35E mainlanes at the identical license plate collection locations for validation and confirmation of captured data. The license plate numbers were read manually from the recorded video. The license plate data collected was then used to create a database of license plate records. A series of post-processing steps were undertaken to clean the database, removing the duplicate plates, as well as out-of region (approximately 14 percent) and out-of-state plates (around 5 percent with the majority of travelers from Oklahoma State).

The clean database was supplied to TTA for cross-referencing with the Department of Public Safety master address file to obtain the names and addresses of the registered vehicle owners. A total of 94,896 addresses were obtained from the license plates database for use as part of the mail-out survey. An additional filtering of these addresses was undertaken to remove those addresses found to belong to rental car agencies, leasing

companies and car dealerships. Once all necessary processing had been performed, a total of 70,500 final records were used as part of the O-D survey mail-out.

SURVEY DISTRIBUTION

Surveys were mailed to motorists who traveled on the study corridor. The corridor location map and the main body of the survey questionnaire are shown in **Figures 2-17** and **2-18** respectively. The survey was designed to solicit specific information regarding the O/D of the travelers' specific trip as well as information related to their trip purpose, frequency, occupancy and other characteristics. The mail-out survey was distributed to 70,491 addresses and a total of 4,521 valid surveys responses were captured. The surveys were reviewed to ensure the information provided was reasonable and the origin and destination from each valid survey was geocoded into ArcGIS for further analysis. Approximately 95 percent of the collected surveys comprising of approximately 4,200 valid O/D pairs were geocoded for further use.

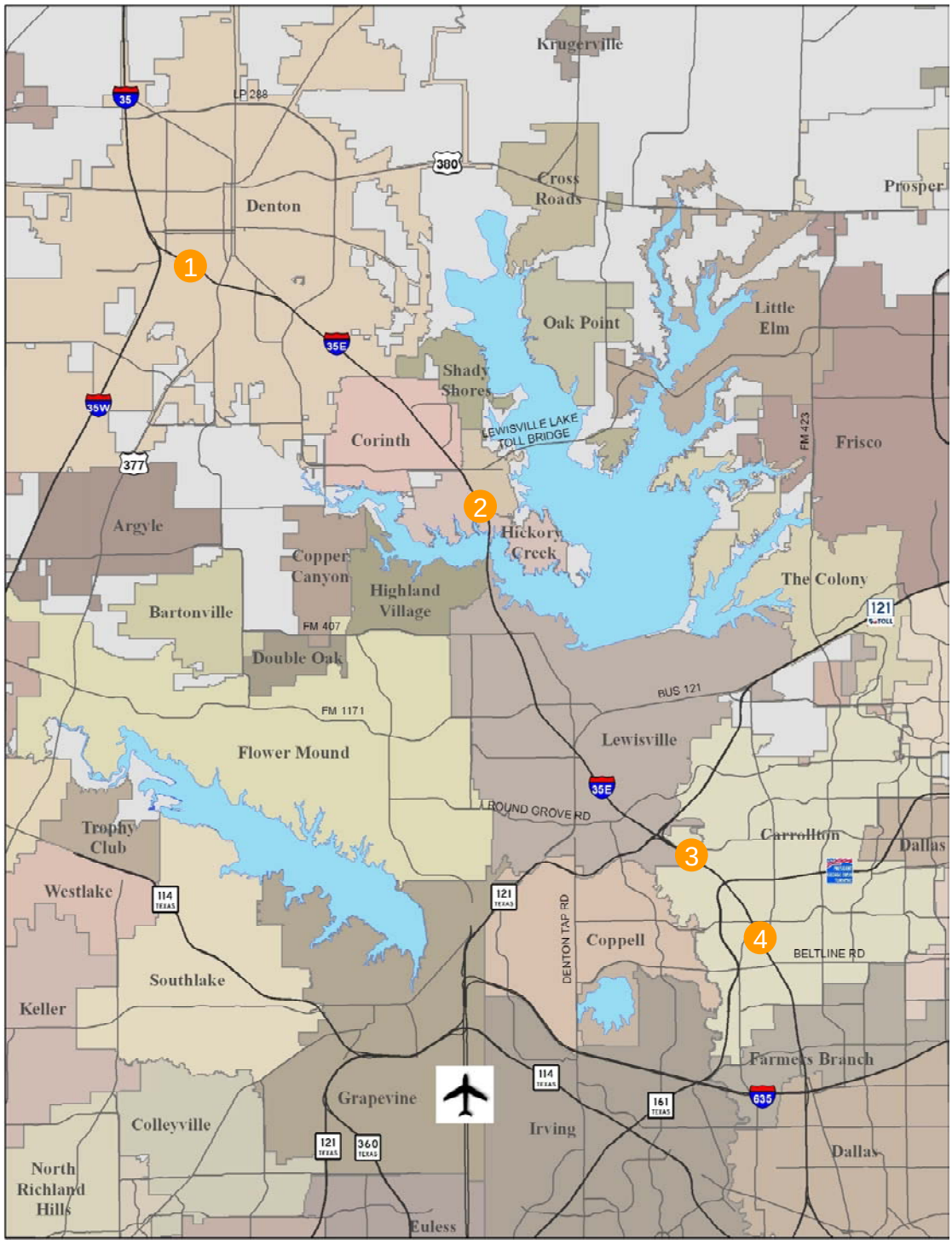


Figure 2-16. License Plate Capture Sites

TRAVEL PATTERN SURVEY - 2008

Dear Motorist:

The Texas Department of Transportation (TxDOT) is embarking on important transportation initiatives aimed at improving mobility along IH 35E. A key element of the planning process is to obtain information regarding travel patterns and trip characteristics of motorists using IH 35E.

To accomplish this effort, TxDOT is undertaking this important travel pattern and trip characteristic survey. TxDOT is soliciting your assistance by requesting information on one of your trips to effectively plan these transportation initiatives.

You have been selected to participate in this important survey. TxDOT is requesting information regarding recent weekday trips made on IH 35E between IH 635 and US 380 as part of the travel route. If you have not recently used IH 35E, please disregard this survey.

When you detach the survey form, there will be no way to associate your answers with your name and address. Your answers will be anonymous and used for planning purposes only. Please take a few minutes to answer the questions, detach the survey form and return it. No postage is necessary.

We will also be conducting a supplemental internet-based survey of transportation options. If you are interested in participating in this follow-up survey, please provide your e-mail address in the space provided on the questionnaire. Your participation in the follow-up internet survey is optional but would be greatly appreciated.

If you have any questions about this survey, please call 214-320-4483 on weekdays. Thank you for your participation.

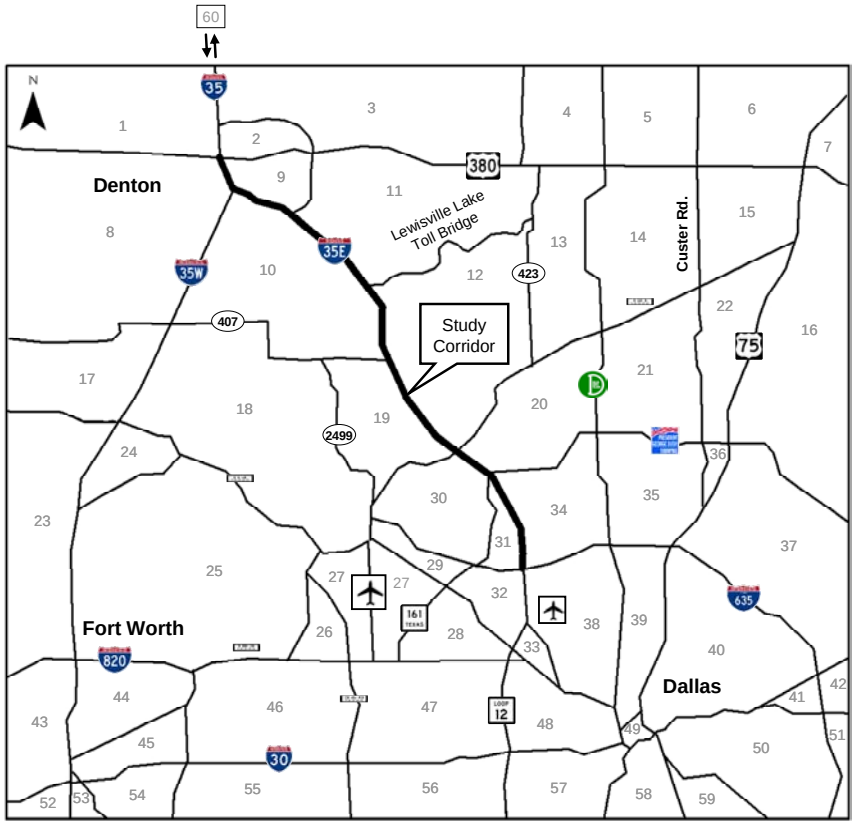


Figure 2-17. IH 35E O/D Survey Instrument (Page 1)

Dear Motorist:
As stated, you have been selected to participate in this important survey. Please answer the following questions about your most recent **weekday** trip that used **IH 35E** as part of your travel route. Please provide information regarding only one direction of this specific trip. Thank you.

A. Please indicate the time period in which this one-way trip was made. (Circle one)

1. 6:00am to 9:00am 2. 9:00am to 3:00pm 3. 3:00pm to 7:00pm 4. 7:00pm to 6:00am

B. In which direction were you traveling when making this one-way trip? (Circle one)

1. Northbound 2. Southbound

C. Please refer to the map included in this survey and indicate the area number (1 to 60) that corresponds to your starting and ending locations for this trip. (If locations fall outside of the map, please indicate the closest area.)

Starting Location Number _____ Ending Location Number _____

D. Where did you start this trip (in this direction)? Please be as specific as possible. (If you do not know the street address please, identify the nearest intersection, airport, shopping center, etc.)

_____
Street Address or Nearest Intersection

_____
City State Zip Code

E. Where did you end this trip (in this direction)? Please be as specific as possible. (If you do not know the street address, please identify the nearest intersection, airport, shopping center, etc.) This should not be the same as answer to Question D.

_____
Street Address or Nearest Intersection

_____
City State Zip Code

F. What was the purpose of this particular trip? (Circle one)

1. To / From Work 3. Personal Business 5. Shopping 7. Social
2. Company Business 4. School 6. Recreation 8. To / From Airport

G. How often do you make this trip in this direction? Choose one.

H. Including yourself, how many people were in your vehicle? Please include children. (Circle one)

1 2 3 4 5 6 or more

I. Please indicate the nearest street that you used to enter IH 35E:

_____

J. Please indicate the nearest street that you used to exit from IH 35E:

_____

K. If you use an alternative route to avoid congestion on IH 35E, please let us know which route you use:

1. IH 35W 2. US 377 3. Dallas North Tollway 4. PGBT 5. Other_____

L. Do you currently have a 1. TollTag 2. TxTag 3. EZ Tag 4. None?

M. If you would like to participate in the supplemental follow-up internet survey, please provide your e-mail address.

E-mail address (Optional) _____

November 2008

Figure 2-18. IH 35E O/D Survey Instrument (Page 2)

DATA ANALYSIS

A profile of trip characteristics was developed for survey respondents captured along the IH 35E corridor. Trip characteristics such as trip purpose, trip frequency and vehicle occupancy results are detailed in **Figure 2-19**. The majority (63 percent) of all motorists that were traveling along the IH 35E corridor facility were traveling to or from work during the peak periods. During the off-peak periods, 54 percent of all motorists were traveling to or from work. Social and recreational trips both had an increased share of trips during the off-peak periods.

As shown in **Figure 2-19**, 56 percent of all trips captured during the peak period were trips made 5 or more times per week. This portion decreased to 44 percent of the total traffic during the off-peak period. The occupancy rates for the various types of users along the IH 35E corridor showed that 80 percent of all travelers in the corridor drive alone during the peak periods and 73 percent during the off-peak periods. These occupancy rates are generally consistent with the manual occupancy counts at Luna Road, but relatively lower than the counts made at Denton Drive. One reason for this is that traffic south of SH 121 is much higher than traffic north of SH 121, which would result in more geocoded OD surveys in the south section than the north section. During both the peak and off-peak periods, a majority of the travelers (over 60 percent) were current TollTag users.

The existing trip tables were evaluated and compared to the collected survey data by geocoding the survey O/D pairs to the Traffic Analysis Planning (TAP) zone system. This data was used to create a representative trip table of the O/D survey data and was then converted to District 66 zones for review and comparison. Select link analyses were also used to estimate the matrices for the corresponding OD survey locations from NCTCOG triptables for each period. These resultant matrices were combined to a daily level matrix and checks were performed with skim matrix to eliminate duplicate OD pairs. The daily matrix was converted to a District 66 zone matrix and compared with the respective OD survey matrix. Comparison showed that the share of each zone from the OD survey was similar to the share of the NCTCOG triptables, and confirmed similar aggregate travel patterns between the OD survey and NCTCOG triptables.

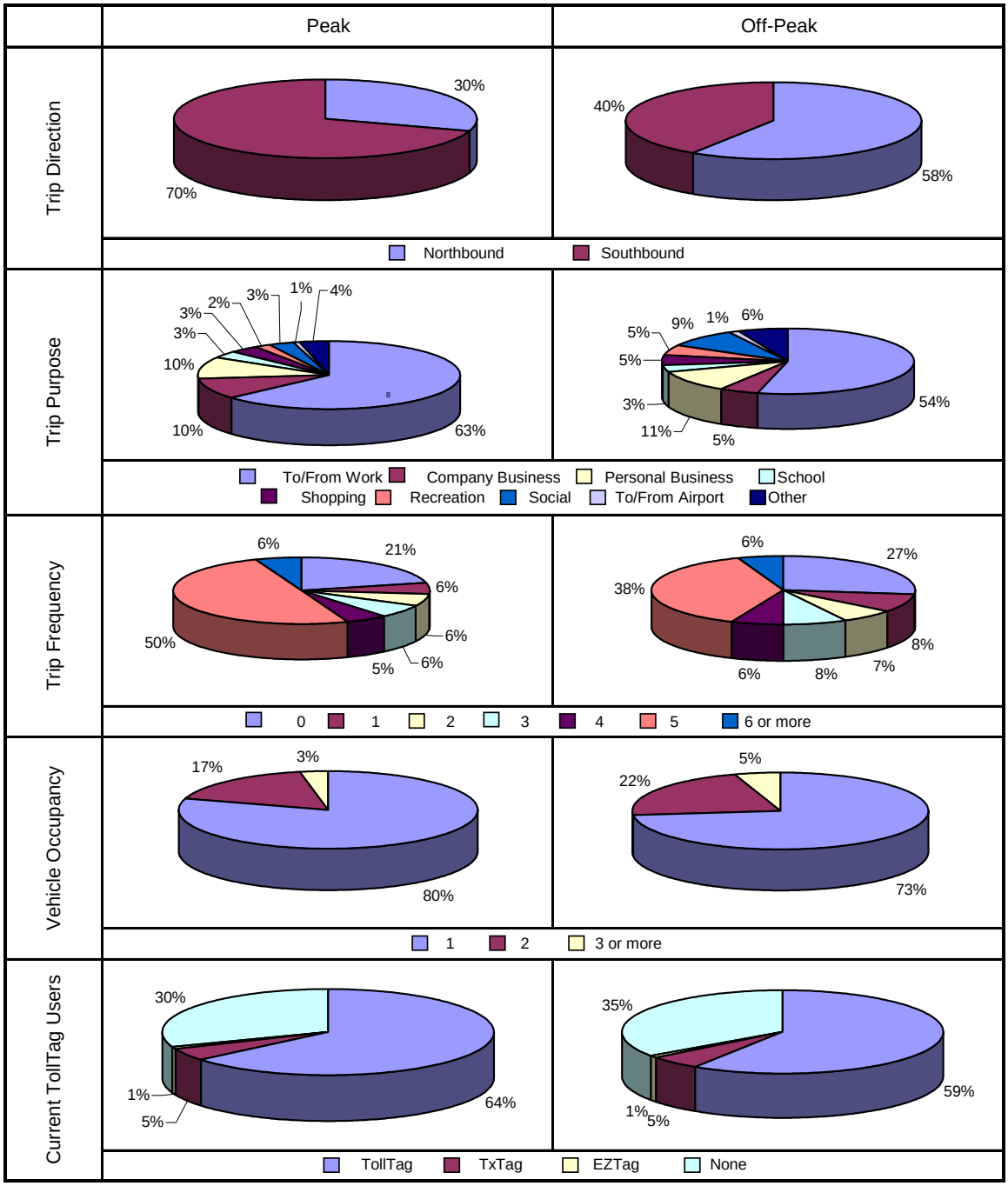


Figure 2-19. IH 35E O/D Survey Results

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 3

DALLAS – FORT WORTH AREA TRANSPORTATION CHARACTERISTICS

The following chapter provides some background of the existing and forecasted transportation characteristics surrounding the IH 35E corridor in the Dallas-Fort Worth Metropolitan Area (DFWMA). The information described herein draws from the Mobility Transportation Plan 2030 (MTP) and its 2009 Amendment developed by the North Central Texas Council of Governments (NCTCOG) – the metropolitan planning organization for the DFWMA. The NCTCOG is primarily responsible for conducting the multimodal long-range regional planning process for transportation within the DFWMA region.

The MTP is a comprehensive, multimodal transportation strategy that is developed by NCTCOG to address the mobility needs of the DFWMA. It serves as a guideline for the region's planned investment in the transportation infrastructure and services over the next two decades. As indicated, the MTP is financially constrained and balanced to the region anticipated revenue streams over this period. Building upon the previous MTPs, the 2030 MTP was approved in January 2007 by the Regional Transportation Council (RTC) of NCTCOG. The 2009 Amendment to the 2030 MTP was adopted in April 2009. The 2030 MTP and the 2009 Amendment outlines nearly $71 billion expenditure through 2030 for transportation infrastructure investment in freeway, tollway, transit, bicycle and pedestrian facilities, congestion mitigation strategies, HOV lanes, and many other mobility projects.

The DFWMA is the fourth largest metropolitan area in the country with a population of over 6 million according to the latest Population Estimates from the U.S. Census in July 2008. The region's population is forecasted by NCTCOG to grow to 9 million by 2030. Total employment is also expected to increase from 3.1 million in 2000 to 5.4 million by 2030.

TRAFFIC CONGESTION TRENDS

The continuing growth of population in the DFWMA will place a great strain on the existing transportation infrastructure which will likely cause severe traffic congestion along many facilities within the region. **Figure 3-1**, adapted from the 2030 MTP report, provides an illustration of the areas that historically experienced congested traffic conditions during the peak periods in 2007, and the expected congestion levels in 2030 even with the recommended fiscally constrained transportation infrastructure improvements in place. As shown, the proposed managed lanes project is located within an area that currently has overall moderate traffic congestion levels and a significant part of the corridor is forecasted to experience severe traffic congestion by 2030. The expected traffic congestion along the general purpose lanes of the IH 35E corridor will likely not be sufficient to sustain the expected growth in travel demand and the proposed managed lanes will likely be a transportation management facility that will help to provide some reliability and efficiency in alleviating traffic congestion for travelers that most need it.

The 2030 MTP estimated that the region-wide cost of congestion during 2007 was approximately $4.2 billion and will likely reach $6.6 billion by 2030. This is an increase of more than 50 percent from the 2007 levels and already includes the $71 billion in infrastructure investment anticipated over the next 20 years.

FREEWAY AND TOLLWAY SYSTEM

A number of highway capacity improvements in the form of new freeway and tollway facilities were identified in the MTP to be constructed over the next 20 years. **Figure 3-2** highlights the funded roadway recommendations in the DFWMA, which include the proposed IH 35E managed lane project, and several competing and complementary projects within the study area. The identification of these facilities is very important to this study because additional freeway and arterial improvements may materially impact the traffic and toll revenue on the proposed managed lane facility.

New or expanded facilities providing improved accessibility to the proposed managed lane corridor may provide positive impacts while competing alternative routes have the potential to dampen the managed lanes' toll potential. Capacity improvements to existing highways and arterials, along with new freeway facilities that may affect the traffic and toll revenue potential of the proposed managed lane facility are shown in **Figure 3-2** in blue and purple and include:

- IH 35 corridor between FM 3022 and IH 35E/IH 35W;
- US 380 corridor between Metropolitan Planning Area (MPA) boundary and US 377;

- Loop 288 west, an extension of Loop 2008 around the western side of the City of Denton between IH 35 and US 377;
- SH 121 capacity improvement between Dallas North Tollway and Business 121;
- President George Bush Turnpike (PGBT) widening of segment I, II, III and V;
- The DFW connector; and
- IH 35E northwest corridor between Loop 12 and SH 183.

The NCTCOG in cooperation with local decision makers, may in the future designate additional freeway facilities in the region which may have an impact on the traffic and toll revenue of the proposed IH 35E managed lanes. **Figure 3-3** highlights the planned future toll facilities and future HOV/managed lane facilities in blue and orange respectively. In addition to the Lewisville Lake Toll Bridge that was opened to traffic on August 1, 2009 as a tolled facility, several other HOV/managed lane facilities have been proposed within the IH 35E managed lane study area to provide an extensive system of HOV/managed lane facilities. Most of these will improve the accessibility to the proposed IH 35E managed lane and include:

- Outer loop in Denton County which may provide better accessibility to the IH 35E for the traffic originate/destined to areas north of US 380;
- The planned HOV/managed lane between US 380 and outer loop which may directly feed traffic into the planned managed lane;
- The planned HOV/managed lane along IH 35W which to some extent is expected to compete with IH 35E managed lane;
- The HOV/managed lane along IH 635 which may improve accessibility to the IH 35E managed lane at the southern termini of the project;
- Managed lanes along SH 114 between SH 121/International Parkway and Loop 12 and SH 183 HOV/managed lane between SH 161 and IH 35E which will provide linkages for a planned HOV/managed lane network system and help funnel traffic to the proposed IH 35E managed lane facility; and
- Loop 12/IH 35E HOV/managed lane corridor which will encompass the portion from IH 635 to Loop 12 as well as the Loop 12 from IH 35E to Spur 408. This corridor directly connects to the IH 35E corridor at the south terminus to IH 635 and brings traffic from further south of the corridor.

RAIL TRANSIT SYSTEM

Transit service in the DFWMA is provided by Dallas Area Rapid Transit (DART), the Fort Worth Transportation Authority (The T) and the Denton County Transportation Authority.

The high socioeconomic growth warrants that alternative modes of transportation be incorporated as part of the overall regional transportation plan. **Figure 3-4** illustrates the future proposed rail system as developed by NCTCOG in cooperation with the transit agencies in the region as part of the 2009 Amendment. Approximately 500 miles of rail were identified in these recommendations, of which, 83 miles are currently in service, 128 miles are programmed projects or projects currently under development, an additional 38 miles that consist of projects identified within the transit authority planning studies, and the remaining 251 miles consisting of projects that may utilize funding identified through the Rail North Texas efforts. Of particular interest to the IH 35E managed lane project is the northwest corridor DART green line expansion from downtown Dallas to City of Carrollton. This line, running parallel to IH 35E, is currently under construction and is expected to be operational by December 2010. In the future, this line that parallels the IH 35E, will be extended into Denton as a commuter rail and will be operated by Denton County Transportation Authority (DCTA) and will likely compete for the markets using the IH 35E corridor.

The transportation system defined in the 2009 Amendment of 2030 MTP and described above is reflected in networks and trip tables used to estimate the traffic and toll revenue for the proposed managed lanes project. The trip tables and networks were obtained from NCTCOG and reflect all the planned transportation infrastructural development over the next 20 years.

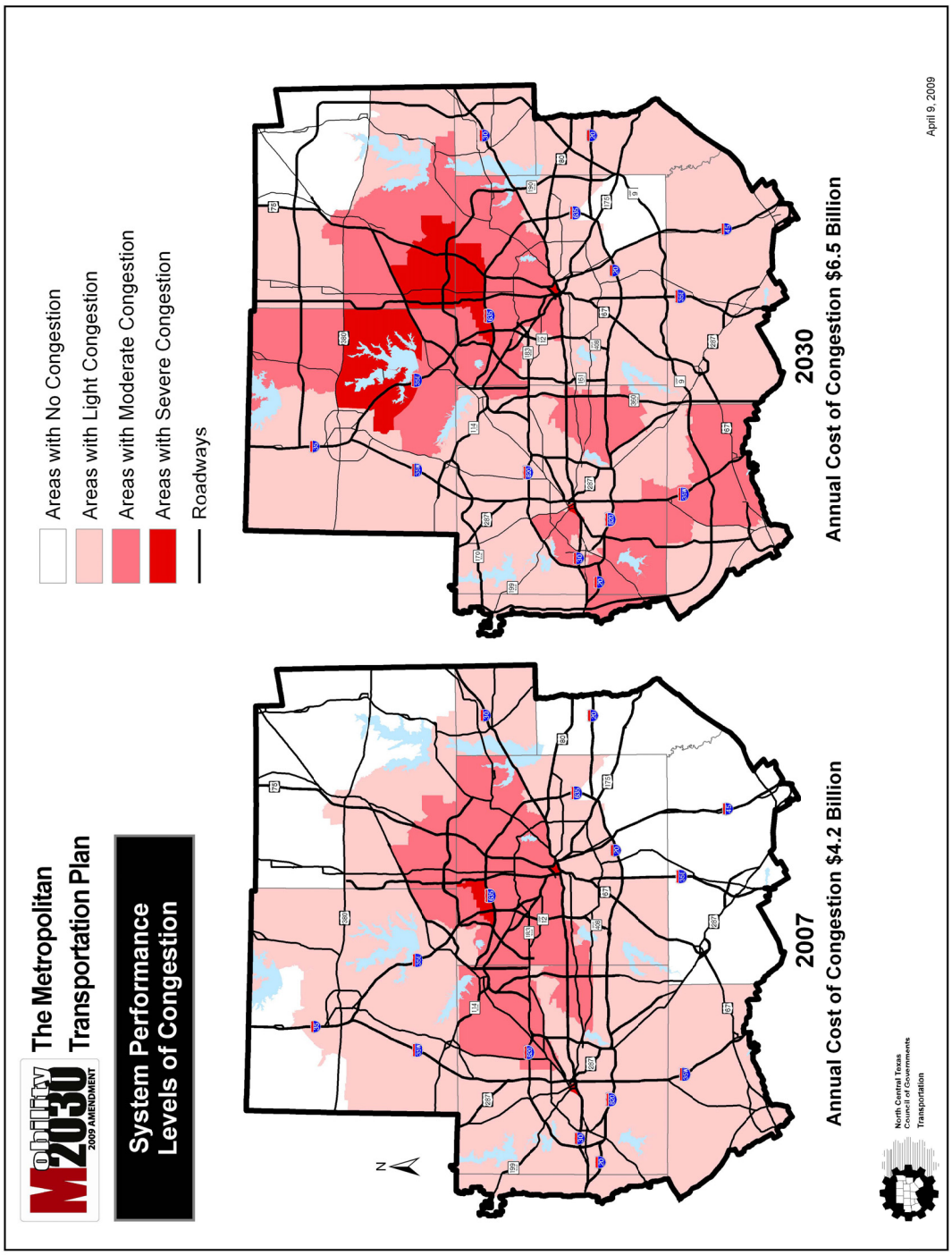


Figure 3-1. Traffic Congestion Level of 2007 and 2030
Source: North Central Texas Council of Governments

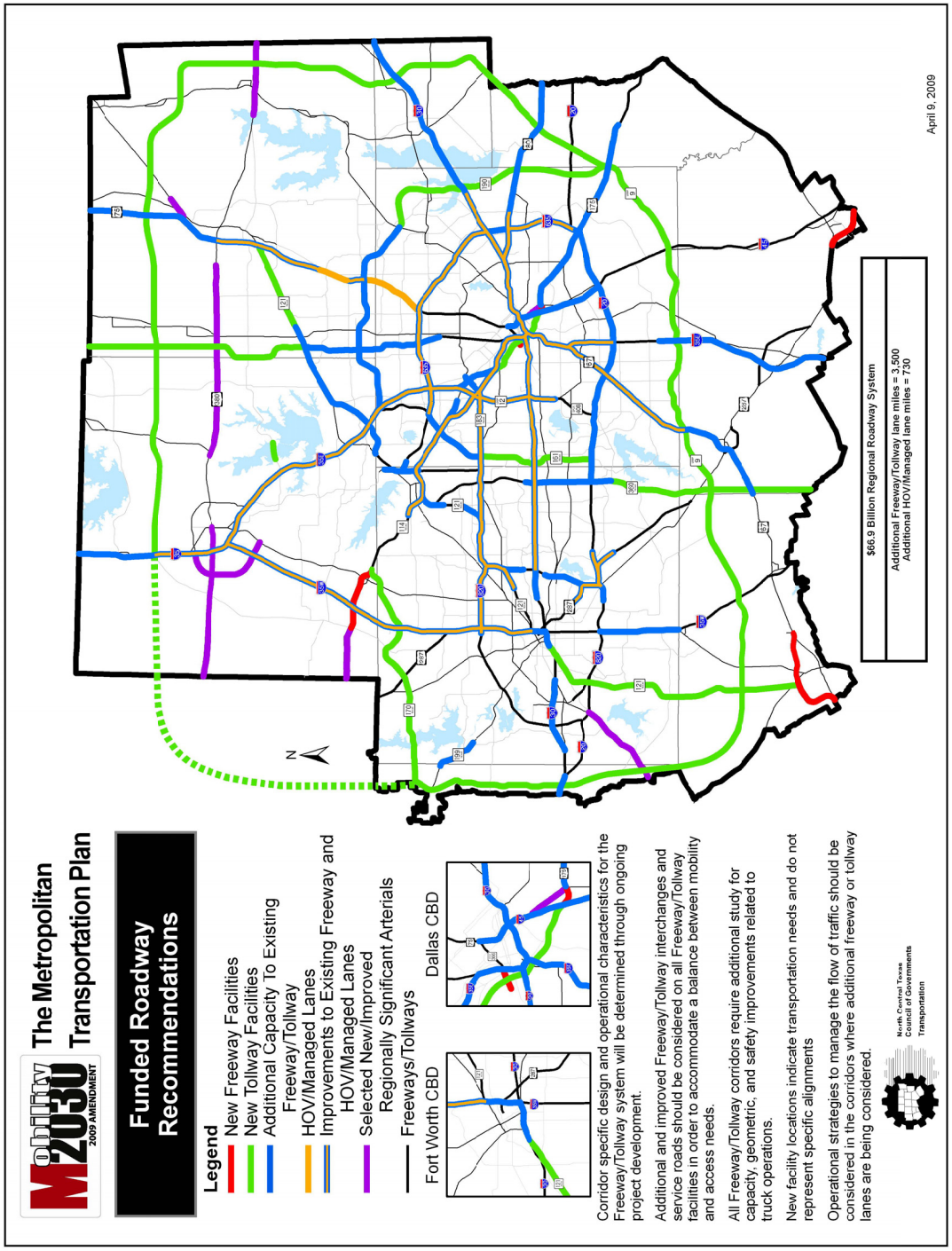


Figure 3-2. Funded Roadway Recommendations in 2030 MTP 2009 Amendment
Source: North Central Texas Council of Governments

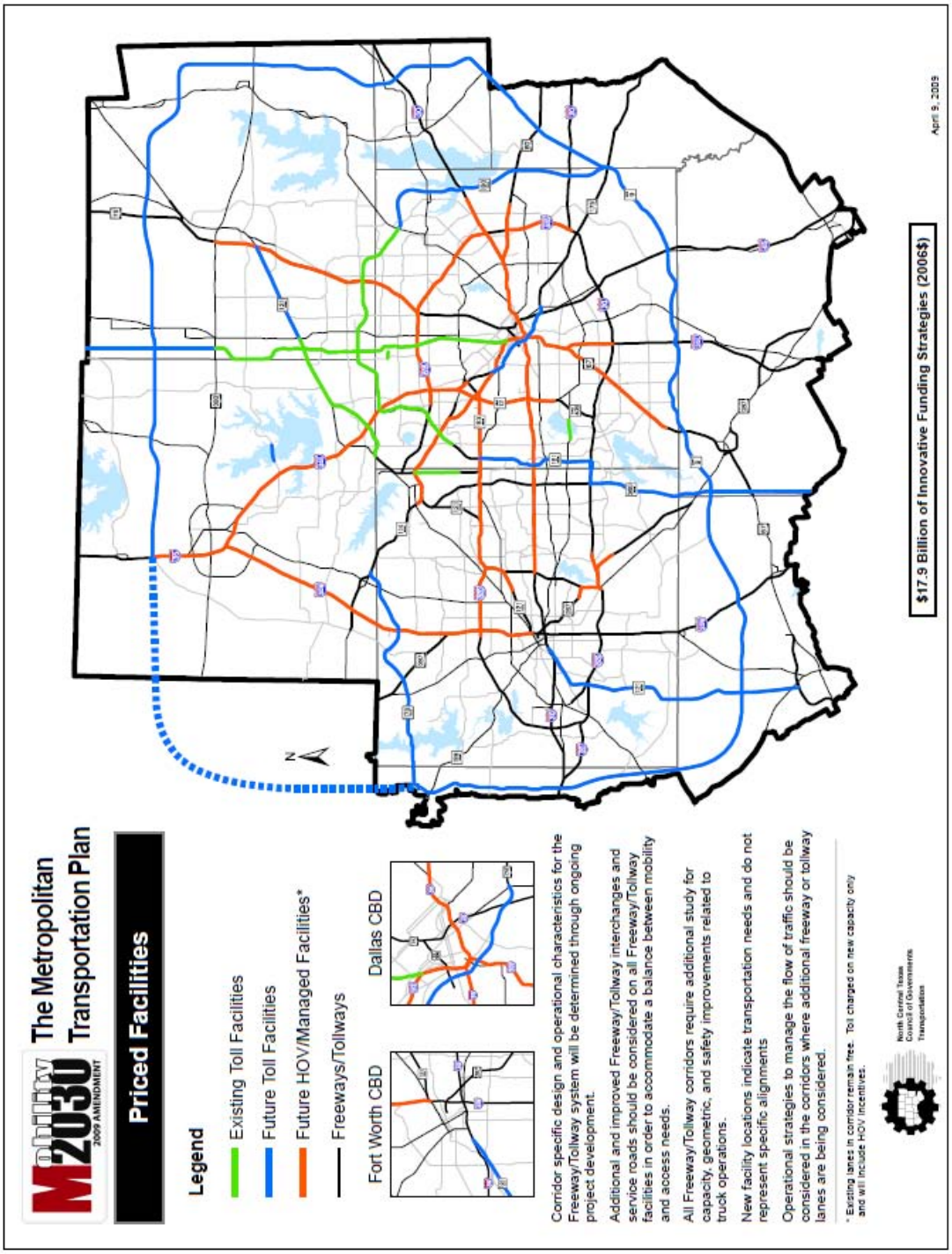


Figure 3-3. Priced Facilities Planned in 2030 MTP 2009 Amendment
Source: North Central Texas Council of Governments

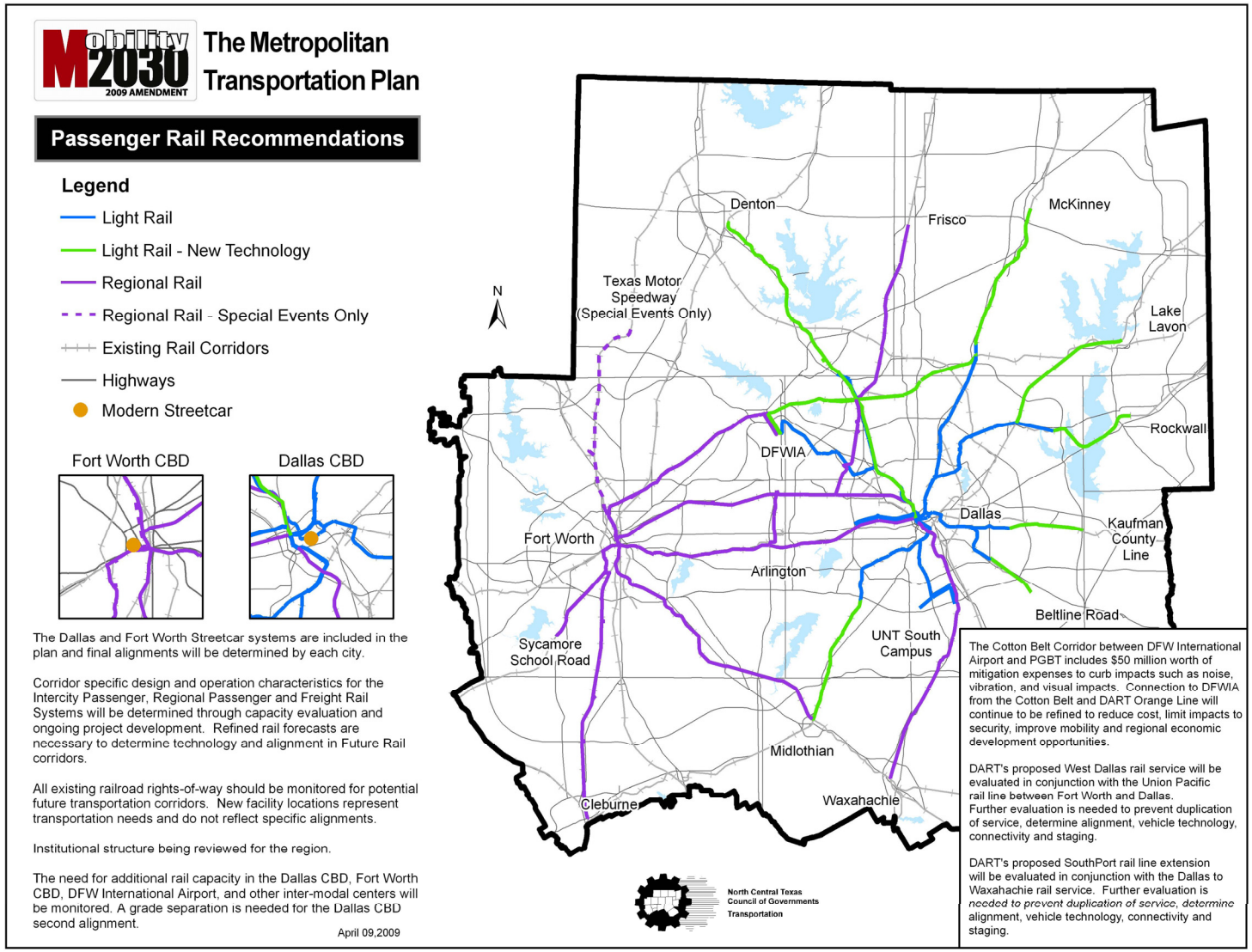


Figure 3-4. Passenger Rail Recommendations
Source: North Central Texas Council of Governments

CHAPTER 4

ECONOMIC GROWTH ANALYSIS

As part of this study, a review was made of the historical and projected demographic characteristics used by the North Central Texas Council of Governments (NCTCOG) to develop its traffic modeling trip tables in addition to other sources such as the Texas State Data Center, and U.S Census Bureau. This chapter describes the major socioeconomic characteristics of the Dallas-Fort Worth Metropolitan Area (DFWMA) including both regional and corridor specific trends within the IH 35E managed lane study area. The current official NCTCOG forecasted regional demographics were approved by its Executive Board in April 2003 for the ten counties that comprise the DFWMA: Dallas, Tarrant, Collin, Denton, Johnson, Ellis, Kaufman, Rockwall, Parker and Wise. This database was used by NCTCOG as the baseline to generate future trip patterns in the DFWMA.

The first section of this chapter describes the NCTCOG forecast process used to generate the base official demographics. The second section details the county regional historical and future growth patterns within the ten-county area. The historical and future growths in the key individual municipalities within the study corridor are then described in the third section of the chapter. The last section describes the corridor-level demographic characteristics within the IH 35E managed lane study area.

The demographic descriptions included in this chapter range from the macroscopic level (the region) to the corridor-level (five-mile buffer along each side of IH 35E). This demographic information is used by the trip generation model to estimate total trips allocated within the travel demand model and serves as the foundation to forecast demand along the proposed managed lane facilities.

NCTCOG FORECAST PROCESS

As required by federal legislation, NCTCOG periodically develops future demographics based on county and region control totals created by the Texas State Data Center (TSDC) and other independent consultants. The TSDC is part of the State Data Center System,

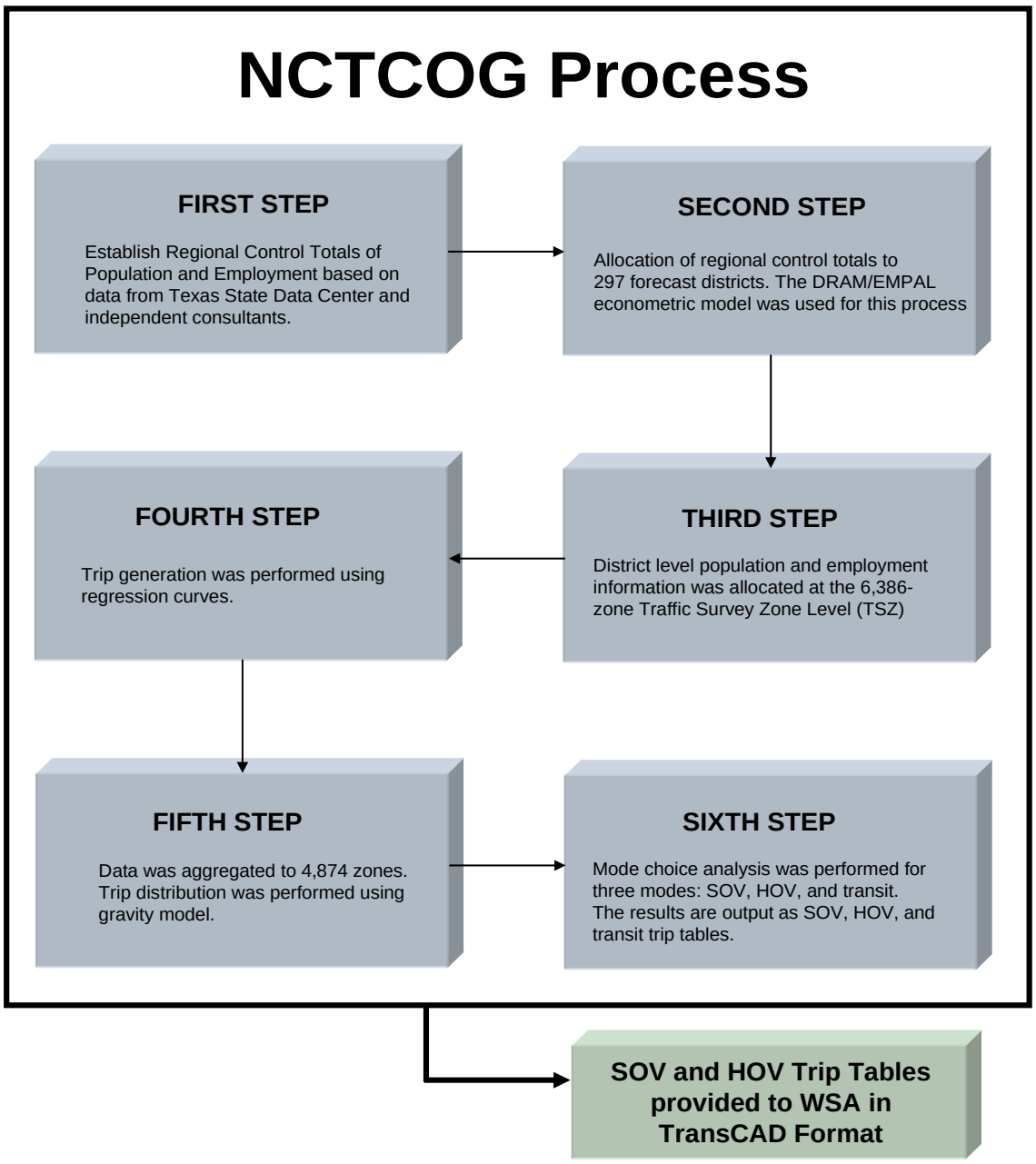


Figure 4-1. NCTCOG Forecast Process

with a national network of 52 centers (all 50 states, Puerto Rico and the Virgin Islands) in charge of disseminating demographic information (as further described at http://txsdc.utsa.edu/). The demographics adopted by NCTCOG are considered official demographics that support the metropolitan planning process and travel demand modeling.

The demographic forecast process and development of trip tables implemented by NCTCOG were developed in six steps as illustrated in **Figure 4-1**. In the first step, regional control totals of population and employment were developed in five-year increments from a base year (2000) through the forecast year (2030). These regional totals originated from the TSDC and were complemented with forecasts developed by the Perryman Group, an independent local economist firm. A task force of local officials from city, county, and transportation entities acted as a governing body for the process and endorsed the forecast for approval by NCTCOG's Executive Board.

The TSDC population forecast process includes the rate of regional migration as a key element. Three scenarios with different rates of migration are usually developed. **Table 4-1** shows the control totals that were considered during the forecasting process. The 2030 population forecast range from 6.1 million under the zero percent migration scenario, to 12.1 million under the 1.0 percent migration scenario. The population control totals adopted by NCTCOG for the region are shown in bold in **Table 4-1**. They reflect similar trends to those developed by the Perryman Group, and fall between the 0.5 and 1.0 migration scenarios from the TDSC, and represent a middle ground.

Table 4-1
Population Control Totals

	2000	2010	2020	2030	Actual Growth (2000 -2030)	Average Annual Growth Rate
TSDS Scenario 0.0	5,079,600	5,576,147	5,924,157	6,150,687	21.1%	0.6%
TSDC Scenario 0.5	5,079,600	6,075,653	7,172,447	8,403,478	65.4%	1.7%
TSDC Scenario 1.0	5,079,600	6,670,036	8,937,884	12,132,893	138.9%	2.9%
The Perryman Group	5,079,600	6,336,947	7,728,399	9,216,601	81.4%	2.0%
NCTCOG Adopted Forecast	**5,067,400**	**6,328,200**	**7,646,600**	**9,107,900**	**79.7%**	**2.0%**

Source: North Central Texas Council of Governments, Research and Information Services.

The employment control totals were generated by NCTCOG with input from its Employment Estimates program, which monitors non-construction job counts by place of work for municipalities within the North Central Texas Metropolitan Planning Area. The employment control totals in **Table 4-2** show that the total employment in the ten-county area will increase from 3.2 million in 2000 to 5.4 million by 2030.

Table 4-2
Employment Control Totals

	2000	2010	2020	2030	Actual Growth (2000 -2030)	Average Annual Growth Rate
NCTCOG Adopted Forecast	**3,158,200**	**3,897,000**	**4,658,700**	**5,416,700**	**71.5%**	**1.8%**

Source: North Central Texas Council of Governments, Research and Information Services.

The second step of the forecasting process involved allocating the regional control totals to 297 forecast districts for each five-year interval. The DRAM/EMPAL econometric model, the most widely accepted model by metropolitan planning organizations in the country, was used for this process. Key variables for the DRAM/EMPAL model include current employment locations by sector, household locations by income quartile, land use inventories, travel time matrices, and number of workers per household.

In the third step, the district level information was disaggregated to the Traffic Survey Zone (TSZ) level (6,386 TSZs in the ten-county area) which is the smallest zone size used in the travel demand process. The critical variables used in this process were: district level household change, acres of vacant land, density of future residential development, and proximity to transportation infrastructure. Output from this process was closely reviewed by the member cities and approved by the Regional Demographic Task Force before being presented and approved by the NCTCOG Executive Board.

The fourth step involves performing trip generation by using regression curves. This process estimates the total number of trips generated and attracted for each TSZ. In the fifth step, the data was aggregated into 4,874 zones and trip distribution was then performed using the gravity model. In the sixth and final step, mode choice analysis was performed to create trip tables for single occupant vehicles (SOV), high occupancy vehicles (HOV), and transit modes.

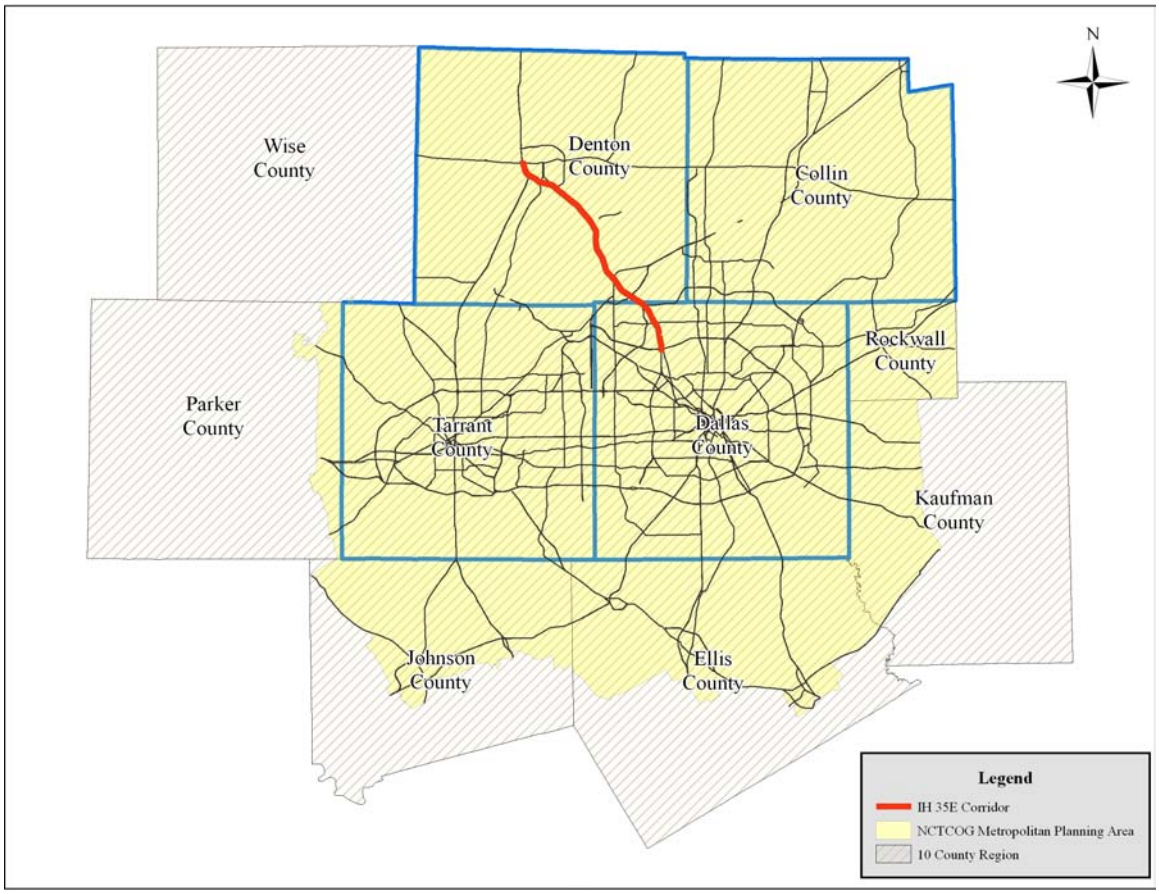


Figure 4-2. Ten-County Area Location

HISTORICAL AND FUTURE REGIONAL GROWTH

The DFWMA wholly encompasses Collin, Dallas, Denton, Rockwall and Tarrant Counties and portions of Ellis, Johnson, Kaufman, Parker, and Wise Counties. The analysis of historical and future demographic growth from a regional perspective is based on county-level information pertaining to population, employment, and income.

HISTORICAL REGIONAL POPULATION TRENDS

Table 4-3 shows the historical population trends for counties in the DFWMA, Texas and the United States, and **Figure 4-2** illustrates the spatial relationship of each county encompassed within the DFWMA. The total population in the ten-county area has increased by an annual rate of 2.6 percent from 1970 to 2000, equivalent to 2.7 million additional residents. This population growth trend exceeded the state and national growth trends between 1970 and 2000, which were 2.1 percent and 1.1 percent per year, respectively.

Table 4-3
Countywide Population Trends and Projections

County	Year 1970	Year 1980	Year 1990	Year 2000	Year 2030	Annual Percent Growth (1970-2000)	Annual Percent Growth (2000-2030)	Percent Population Distribution		Percentage of New Residents Between 2000 and 2030
								2000	2030	
Collin	**66,920**	**144,576**	**264,036**	**491,675**	**1,166,645**	**6.9%**	**2.9%**	**9.7%**	**12.8%**	**16.8%**
Dallas	**1,327,696**	**1,556,419**	**1,852,810**	**2,218,899**	**2,817,191**	**1.7%**	**0.8%**	**43.7%**	**30.9%**	**14.9%**
Denton	**75,633**	**143,126**	**273,525**	**432,976**	**1,085,343**	**6.0%**	**3.1%**	**8.5%**	**11.9%**	**16.2%**
Ellis	46,638	59,743	85,167	111,360	448,588	2.9%	4.8%	2.2%	4.9%	8.4%
Johnson	45,769	67,649	97,165	127,793	444,151	3.5%	4.2%	2.5%	4.9%	7.9%
Kaufman	32,392	39,015	52,220	71,313	277,745	2.7%	4.6%	1.4%	3.0%	5.1%
Parker	33,888	44,609	64,785	88,495	328,418	3.3%	4.5%	1.7%	3.6%	6.0%
Rockwall	7,046	14,528	25,604	43,080	144,976	6.2%	4.1%	0.8%	1.6%	2.5%
Tarrant	**715,587**	**860,880**	**1,170,103**	**1,446,219**	**2,291,723**	**2.4%**	**1.5%**	**28.5%**	**25.2%**	**21.0%**
Wise	19,687	26,575	34,679	48,793	102,449	3.1%	2.5%	1.0%	1.1%	1.3%
Ten-County Area	2,371,256	2,957,120	3,920,094	5,080,603	9,107,229	2.6%	2.0%	100.0%	100.0%	100.0%
State of Texas	11,256,480	14,337,820	16,986,510	20,851,820	31,830,579	2.1%	1.4%	N/A	N/A	N/A
United States	203,982,310	227,225,620	248,709,873	281,421,906	362,880,000	1.1%	0.9%	N/A	N/A	N/A

Souce: NCTCOG, Texas State Data Center, U.S. Census Bureau.

Dallas County has the largest population in the ten-county area. Its population grew by 891,203 residents between 1970 and 2000 at an average annual growth rate of 1.7 percent such that by 2000, Dallas County had 2.2 million residents. Given the maturity of population growth in this county, this annual growth rate was lower than the rate of expansion experienced by the combined ten-county area during the same period, which grew at an average annual rate of 2.6 percent.

Tarrant County is the second largest county in the DFWMA. The population of Tarrant County increased at an average annual rate of 2.4 percent between 1970 and 2000, adding a total of 730,632 new residents to yield 1.4 million residents by 2000. The rate of population growth experienced in Tarrant County between 1970 and 2000 was slightly higher than the population growth seen in Texas and significantly higher than the nationwide population growth experienced during that same period.

The majority of the existing population in the DFWMA is concentrated within four counties. By 2000, Collin, Dallas, Denton and Tarrant Counties accounted for over 90 percent of the total population within the ten-county area, as demonstrated in **Table 4-3**. Dallas and Tarrant Counties combined, comprised of approximately 72.2 percent of the total population within the ten-county area.

FUTURE REGIONAL POPULATION GROWTH

Included in **Table 4-3** is the future 2030 population estimate developed by NCTCOG. Population in the ten-county area is currently expected to increase from 5.1 million in 2000 to 9.1 million by 2030, corresponding to an annual growth rate of 2.0 percent. This annual growth rate for the DFWMA is anticipated to be higher than the annual growth rate for both the state and the nation, which are expected to be 1.4 and 0.9 percent, respectively.

Tarrant County's population is expected to grow by an average annual rate of 1.5 percent between 2000 and 2030, from 1.4 million in 2000 to 2.3 million by 2030. The additional

845,504 residents expected in Tarrant County by 2030, would represent the highest number of additional residents (21.0 percent) for any county in the ten-county area followed by Collin (16.8 percent), Denton (16.2 percent), and Dallas (14.9 percent) during that period.

Recent (2000) and future year (2030) population distributions for each of the counties within the ten-county area are also presented in **Table 4-3**. As indicated, Tarrant and Dallas Counties will continue to comprise the largest population centers in the ten-county area. However, their overall shares are expected to decline as neighboring counties continue to grow at faster rates and absorb the majority of the new resident growth.

Figures 4-3 and 4-4 illustrate the future population by county and their annual historical and expected future percentage growth, respectively. A significant portion of the total area population resides in Dallas and Tarrant Counties as demonstrated in **Figure 4-3**.

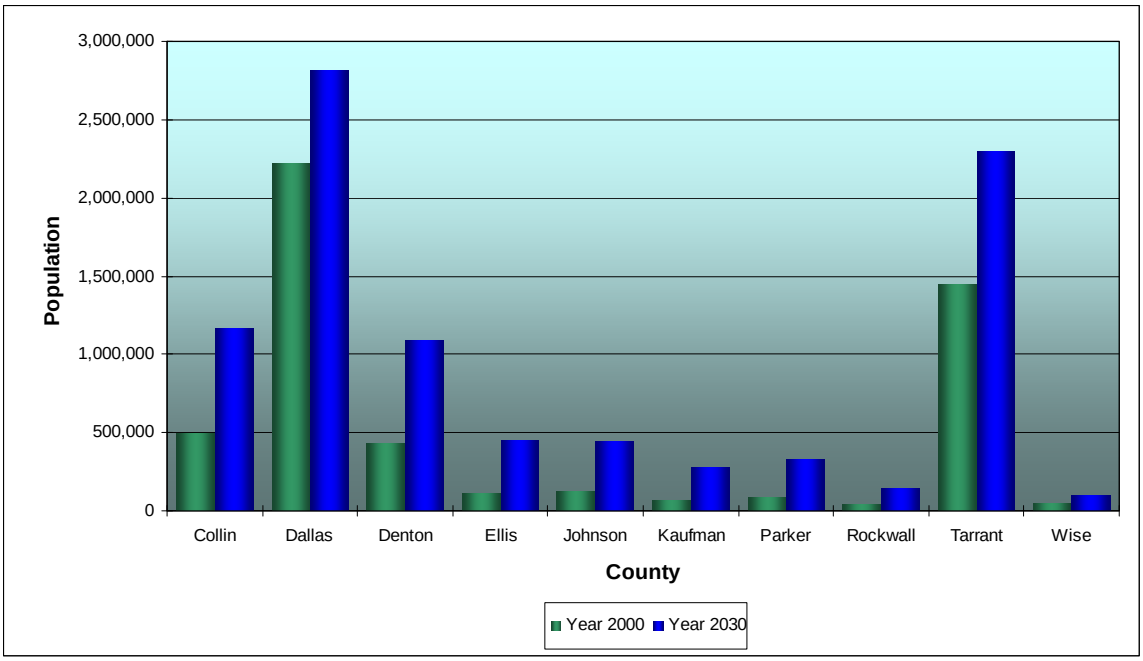


Figure 4-3. 2000 and 2030 Population

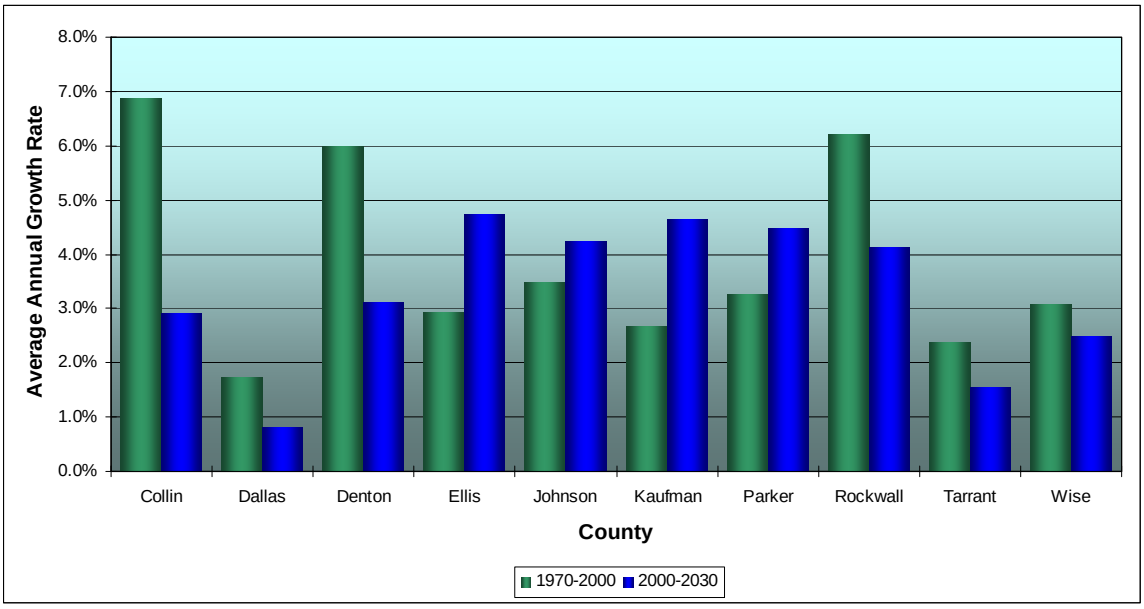


Figure 4-4. Population Annual Growth Rate

HISTORICAL REGIONAL EMPLOYMENT TRENDS

Employment statistics are another indication of the relative trip attractions to various counties within the study area. Intense employment growth in an area generally indicates the potential for increased demand for transportation infrastructure, especially if the level of employment is high relative to levels of population in those same areas. The countywide historical employment trends for the DFWMA are shown in **Table 4-4**. Between 1990 and 2000, employment in the ten-county area increased at an annual rate of 3.9 percent, which was higher than the employment growth rate of both the state and nation.

Dallas County continues to be the major employment center in the region. Its employment in 2000 comprised 55.3 percent of the ten-county area's total employment, and increased from 1.3 million in 1990 to 1.7 million by 2000.

Table 4-4
Countywide Employment Trends and Projections

County	Year 1990	Year 2000	Year 2030	Annual Percent Growth (1990-2000)	Annual Percent Growth (2000-2030)	Percent Employment Distribution By County		Percentage of New Employees Between 2000 and 2030
						2000	2030	
Collin	**93,729**	**204,057**	**517,264**	**8.1%**	**3.1%**	**6.5%**	**9.5%**	**13.8%**
Dallas	**1,254,974**	**1,745,109**	**2,529,371**	**3.4%**	**1.2%**	**55.3%**	**46.7%**	**34.7%**
Denton	**75,817**	**152,818**	**413,453**	**7.3%**	**3.4%**	**4.8%**	**7.6%**	**11.5%**
Ellis	27,789	49,071	162,769	5.9%	4.1%	1.6%	3.0%	5.0%
Johnson	26,214	45,071	142,544	5.6%	3.9%	1.4%	2.6%	4.3%
Kaufman	17,174	31,027	82,078	6.1%	3.3%	1.0%	1.5%	2.3%
Parker	16,173	29,816	94,703	6.3%	3.9%	0.9%	1.7%	2.9%
Rockwall	7,492	17,025	48,466	8.6%	3.5%	0.5%	0.9%	1.4%
Tarrant	**586,058**	**864,360**	**1,388,247**	**4.0%**	**1.6%**	**27.4%**	**25.6%**	**23.1%**
Wise	N/A	19,848	37,823	N/A	2.2%	0.6%	0.7%	1.0%
Ten-County Area	2,105,420	3,158,202	5,416,718	4.1%	1.8%	100.0%	100.0%	100.0%
State of Texas	6,983,170	9,289,286	16,743,000	2.9%	2.0%	N/A	N/A	N/A
United States	108,657,200	129,877,063	202,431,000	1.8%	1.5%	N/A	N/A	N/A

Souce: NCTCOG, Texas State Data Center, U.S. Census Bureau.

Collin and Denton Counties experienced the highest average annual growth rates in employment from 1990 to 2000. Collin County grew at an average annual rate of 8.1 percent while Denton County grew at an average annual rate of 7.3 percent. This growth accounted for more than 110,000 new jobs in Collin County and over 75,000 new jobs in Denton County.

Employment distributions by county are summarized in **Table 4-4**. Dallas and Tarrant Counties account for the bulk of the employment centers within the ten-county area, and encompassed 82.7 percent of the region's total employment in 2000.

FUTURE REGIONAL EMPLOYMENT GROWTH

Table 4-4 also shows the adopted NCTCOG employment estimates for 2030. Dallas County employment is expected to increase from 1.7 million in 2000 to 2.5 million by 2030, reflecting an annual growth rate of 1.2 percent. The 784,262 new jobs in Dallas County will represent 34.7 percent of the total additional jobs in the ten-county area.

Denton County will add 260,635 jobs between 2000 and 2030 and capture 11.5 percent of the regional job growth, thus increasing its share of regional employment from 4.8 percent to 7.6 percent. Ellis, Johnson, Kaufman, Parker, Rockwall, and Wise Counties together are expected to add 381,273 new jobs between 2000 and 2030 which accounts for 16.9 percent of the additional regional employment growth. Their combined employment by 2030 is projected to be 10.4 percent of total regional employment.

Between 2000 and 2030, 1,993,564 additional jobs are expected to be added in the ten-county area, at an annual average growth rate of 1.6 percent. Employment in Texas and in the nation is expected to grow at an annual rate of 2.0 percent and 1.5 percent from 2000 to 2030, respectively.

Table 4-4 also presents year 2000 and 2030 employment distributions for the ten-county area. The major employment concentrations are expected to continue to be located in Dallas and Tarrant. However, the projections anticipate much stronger job growth within suburban activity centers compared to the established central city activity centers throughout the DFWMA.

Figure 4-5 illustrates future employment by county. The historical and expected future annual growth rates for each county are shown in **Figure 4-6**. Similar to the population trends, the employment trends show that the majority of employment will continue to be in Dallas and Tarrant Counties (**Figure 4-6**), however, employment growth rates are expected to be higher in the peripheral counties.

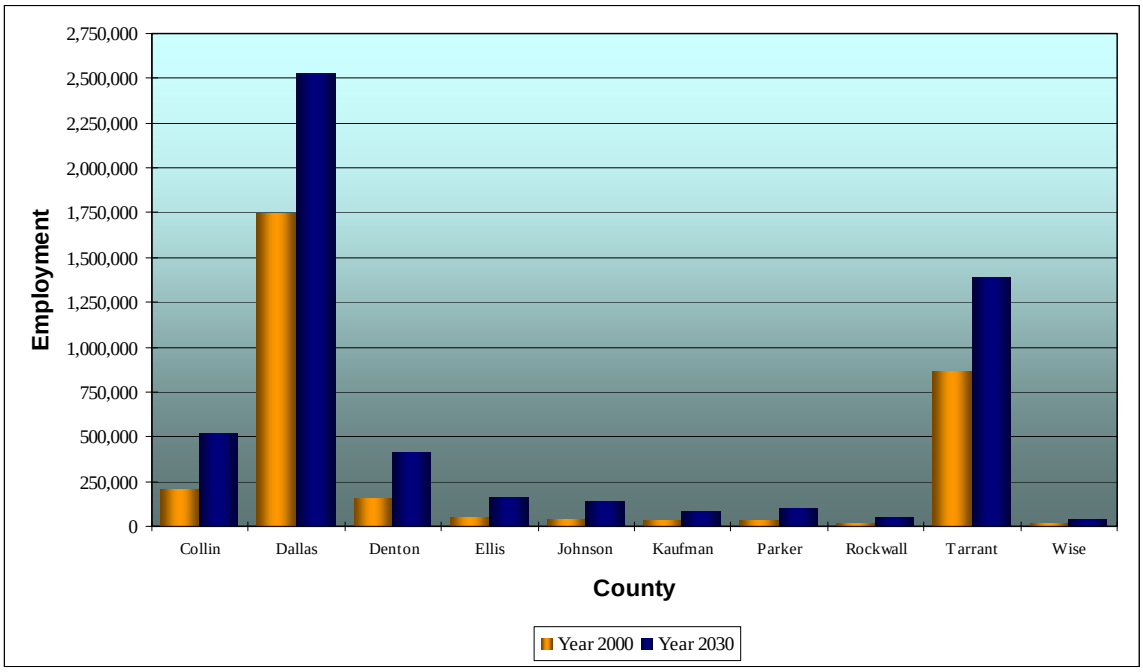


Figure 4-5. 2000 and 2030 Employment

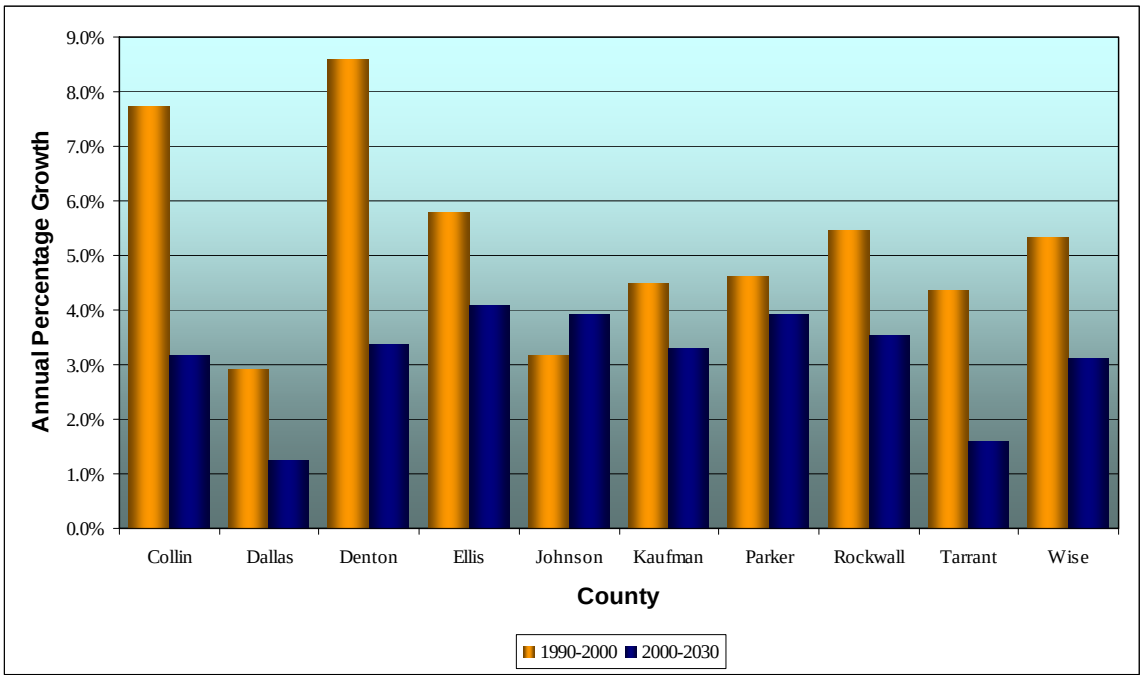


Figure 4-6. Employment Annual Growth Rate

REGIONAL MEDIAN HOUSEHOLD INCOME TRENDS

Travel demand, and more specifically demand for toll roads, is sensitive to the amount of disposable income available within a household. A reliable indicator of a household's propensity for trip-making, or a motorist's willingness to pay a toll, is median household income. Generally, households with higher incomes tend to make more trips than those with lower incomes due to higher disposable income. Value of time, a key factor in motorists' willingness to pay tolls, also tends to be higher in households with higher incomes.

A comparison of the nominal and real median household incomes for the ten-county area as well as the state and nation is provided in **Table 4-5**. The most recent median household income data from the 2007 American Community Survey was not available for Wise County but is provided for all the other counties. The median household income data presented in Table 4-5 indicates that when reported in real 2007 dollars, income in the region, the state, and the nation grew considerably between 1989 and 1999, but had declined somewhat by 2007. The 1999 median household incomes in Collin, Denton and Tarrant Counties were higher than those of the state and nation. Though Dallas County has an income similar to the statewide average, it includes a diverse range of sub-areas, including areas with very high incomes and areas with much lower incomes.

Table 4-5
Median Household Income

Politcal Division	Nominal			Average Annual Growth Rate (1989 - 2007)	Average Annual Growth Rate (1999 - 2007)	Real (adjusted to 2007 dollars using CPI)			Average Annual Growth Rate (1989 - 2007)	Average Annual Growth Rate (1999 - 2007)
	1989	1999	2007			1989	1999	2007		
Collin County	**$46,020**	**$70,835**	**$79,657**	**3.1%**	**1.5%**	**$74,420**	**$86,636**	**$79,657**	**0.4%**	**-1.0%**
Dallas County	**$31,605**	**$43,324**	**$46,372**	**2.2%**	**0.9%**	**$51,109**	**$52,988**	**$46,372**	**-0.5%**	**-1.7%**
Denton County	**$36,914**	**$58,216**	**$71,109**	**3.7%**	**2.5%**	**$59,694**	**$71,202**	**$71,109**	**1.0%**	**0.0%**
Ellis County	$30,553	$50,350	$54,330	3.2%	**1.0%**	$49,408	$61,582	$54,330	0.5%	**-1.6%**
Johnson County	$30,612	$44,621	$53,289	3.1%	**2.2%**	$49,503	$54,575	$53,289	0.4%	**-0.3%**
Kaufman County	$27,280	$44,783	$54,125	3.9%	**2.4%**	$44,115	$54,773	$54,125	1.1%	**-0.1%**
Parker County	$30,592	$45,487	$61,433	3.9%	**3.8%**	$49,471	$55,634	$61,433	1.2%	**1.2%**
Rockwall County	$42,417	$65,164	$77,861	3.4%	**2.3%**	$68,593	$79,700	$77,861	0.7%	**-0.3%**
Tarrant County	**$32,335**	**$46,179**	**$53,459**	**2.8%**	**1.8%**	**$52,289**	**$56,480**	**$53,459**	**0.1%**	**-0.7%**
Wise County	$25,885	$41,933	***	***	***	$41,859	$51,287	***	***	***
State of Texas	$27,016	$39,927	$50,740	3.6%	**3.0%**	$45,174	$49,691	$50,740	0.6%	**0.3%**
United States	$30,056	$41,994	$47,548	2.6%	**1.6%**	$50,257	$52,264	$47,548	-0.3%	**-1.2%**

Sources: 1990 and 2000 Decennial Census, 2007 American Community Survey, U.S. Census Bureau.

The 2007 estimates of median household income were published in the 2007 American Community Survey by the U.S. Census Bureau. The 2007 median household income estimates for Collin, Denton and Tarrant Counties are higher than the state and the nation median household income estimates. Dallas County has lower income areas in the southern areas of the city, but north Dallas, where the corridor will serve, is a much higher income area. **Figure 4-7** illustrates the median household income distribution among ten-county area counties, the State of Texas and the United States for 1989, 1999, and 2007.

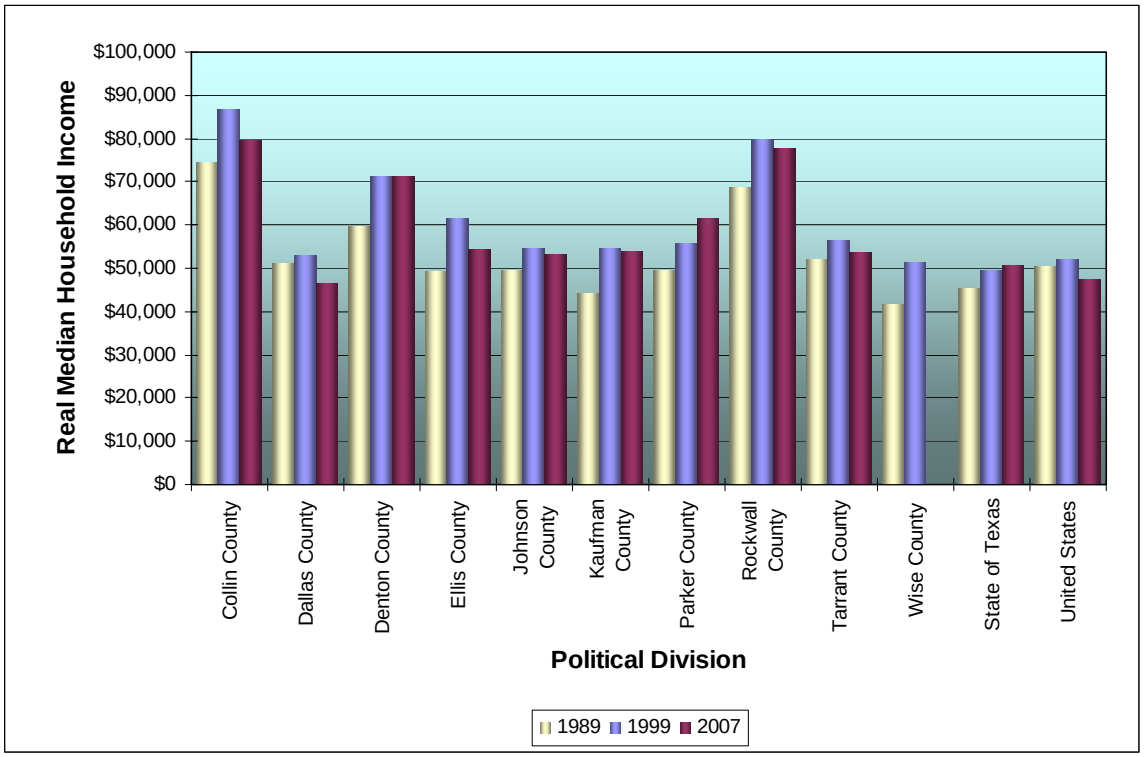


Figure 4-7. Median Household Income

The more recent 2008 median household income estimates, derived from the 2000 Census using CPI-U, for cities within the IH 35E managed lane corridor are listed in **Table 4-6**. As shown, many cities within the corridor have median household incomes that exceed $100,000, with the median household incomes in Double Oak, located west of the IH 35E and just south of SH 121, demonstrating the highest levels at $138,000. **Figure 4-8** illustrates the median household incomes for 2008 at the TSZ level. The 2008 median household income was calculated by using the inflation rate from CPI-U to inflate the 2000 median household incomes numbers to 2008 values. As shown, there are many high income areas within the corridor and include Lewisville Lake, Grapevine Lake, Coppell, and north Dallas.

Table 4-6
Median Household Income 2008

City	Median Household Income
Addison	$59,506
Argyle	$111,696
Carrollton	$76,463
Coppell	$118,770
Copper Canyon	$118,538
Corinth	$95,993
Dallas	$46,104
Denton	$43,401
Double Oak	$138,944
Farmers Branch	$67,063
Flower Mound	$116,909
Grapevine	$87,826
Hickory Creek	$84,926
Highland Village	$125,149
Irving	$55,083
Krum	$64,667
Lake Dallas	$63,297
Lewisville	$67,109
Little Elm	$61,607
Oak Point	$97,016
Shady Shores	$75,558
The Colony	$78,515

Source: Decennial Census (Inflated to 2008 numbers using CPI)

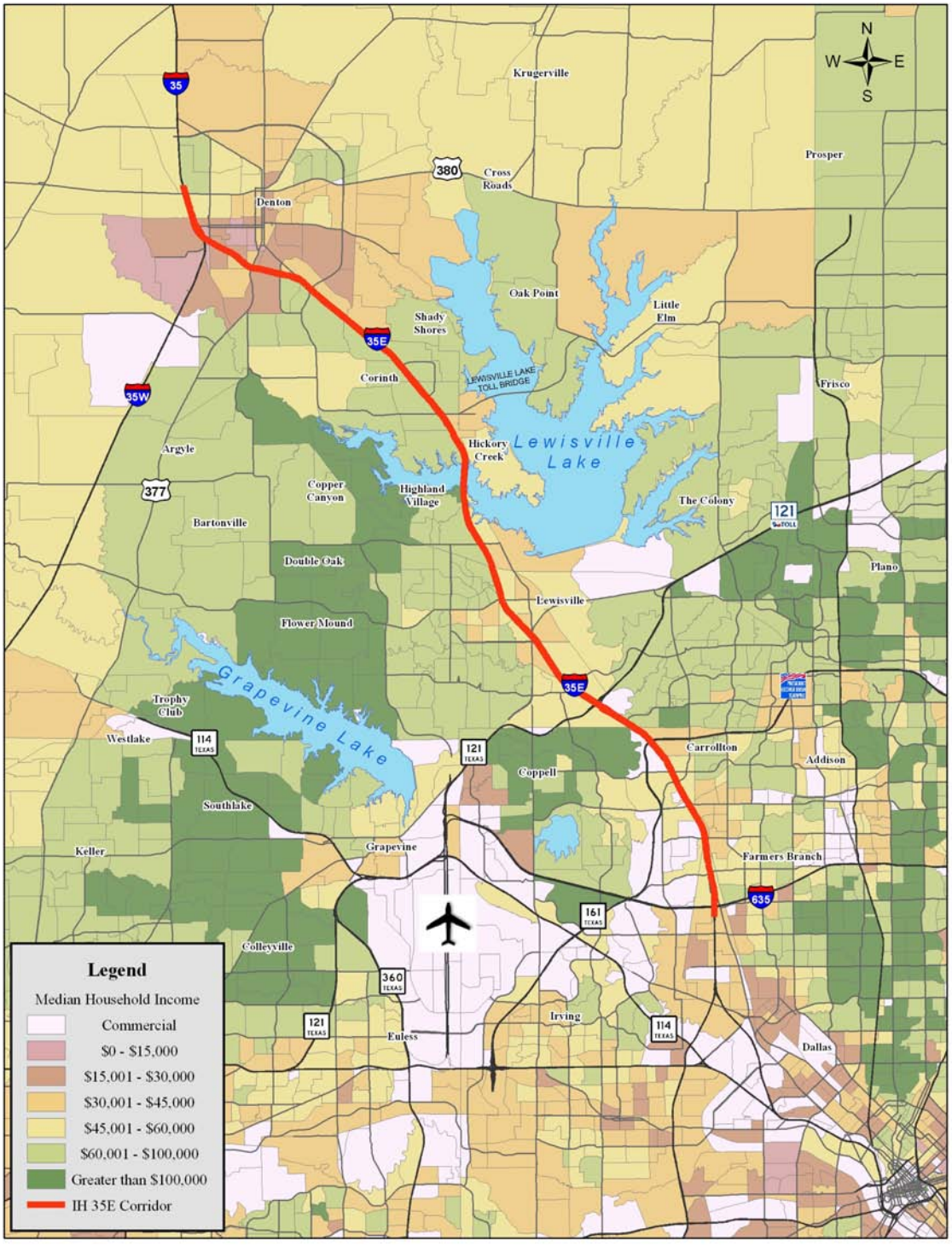


Figure 4-8. Median Household Income 2008

HISTORICAL AND FUTURE MUNICIPAL GROWTH

The historical and future demographic growth of municipalities in the study area for the proposed IH 35E managed lane corridor is described in this section, with focus on the underlying demographic characteristics of the specific municipalities that the facility will serve. The municipalities in the central portion of the study area were considered and include the cities of Addison, Argyle, Carrollton, Coppell, Copper Canyon, Corinth, Dallas, Denton, Double Oak, Farmers Branch, Flower Mound, Grapevine, Hickory Creek, Highland Village, Irving, Krum, Lake Dallas, Lewisville, Little Elm, Oak Point, Shady Shores, and The Colony. A map illustrating the municipalities evaluated is provided in **Figure 4-9**.

HISTORICAL MUNICIPAL POPULATION TRENDS

The historical and projected population trends of the municipalities in the study area are presented in **Table 4-7** using sources that include NCTCOG, Texas State Data Center, U.S Census Bureau. The 1970 Decennial Census Data was not available for the cities of Copper Canyon, Double Oak, Oak Point or The Colony.

Average annual population growth between 1970 and 2000 ranged from a low of 0.0 percent in the city of Farmers Branch to a high of 12.0 percent in the city of Flower Mound. The city of Dallas, which is the largest city in the study corridor, experienced an average annual population growth rate of 1.1 percent, adding 344,179 new residents during this time.

The cities of Addison, Corinth and Highland Village experienced very high average annual growth rates of 11.2, 11.3, and 11.1 percent respectively between 1970 and 2000. The city of Coppell also experienced significant growth during this time with an average annual growth rate of 10.6 percent.

The cities of Carrollton and Irving, located close to the southern termini of the study corridor, saw large incremental growth from 1970 to 2000. Carrollton gained 95,721 residents while Irving's population grew by 94,355. The city of Lewisville is another region that experienced high incremental growth, increasing by 68,473 residents during this time.

As a whole, the twenty-two municipalities that comprise the IH 35E study area grew at an average annual rate of 2.0 percent between 1970 and 2000, compared to an average annual population growth rate of 2.6 for the ten-county area, 2.1 percent for the state, and 1.1 percent for the nation. This growth brought 838,922 new residents to the area surrounding the study corridor over the thirty year period.

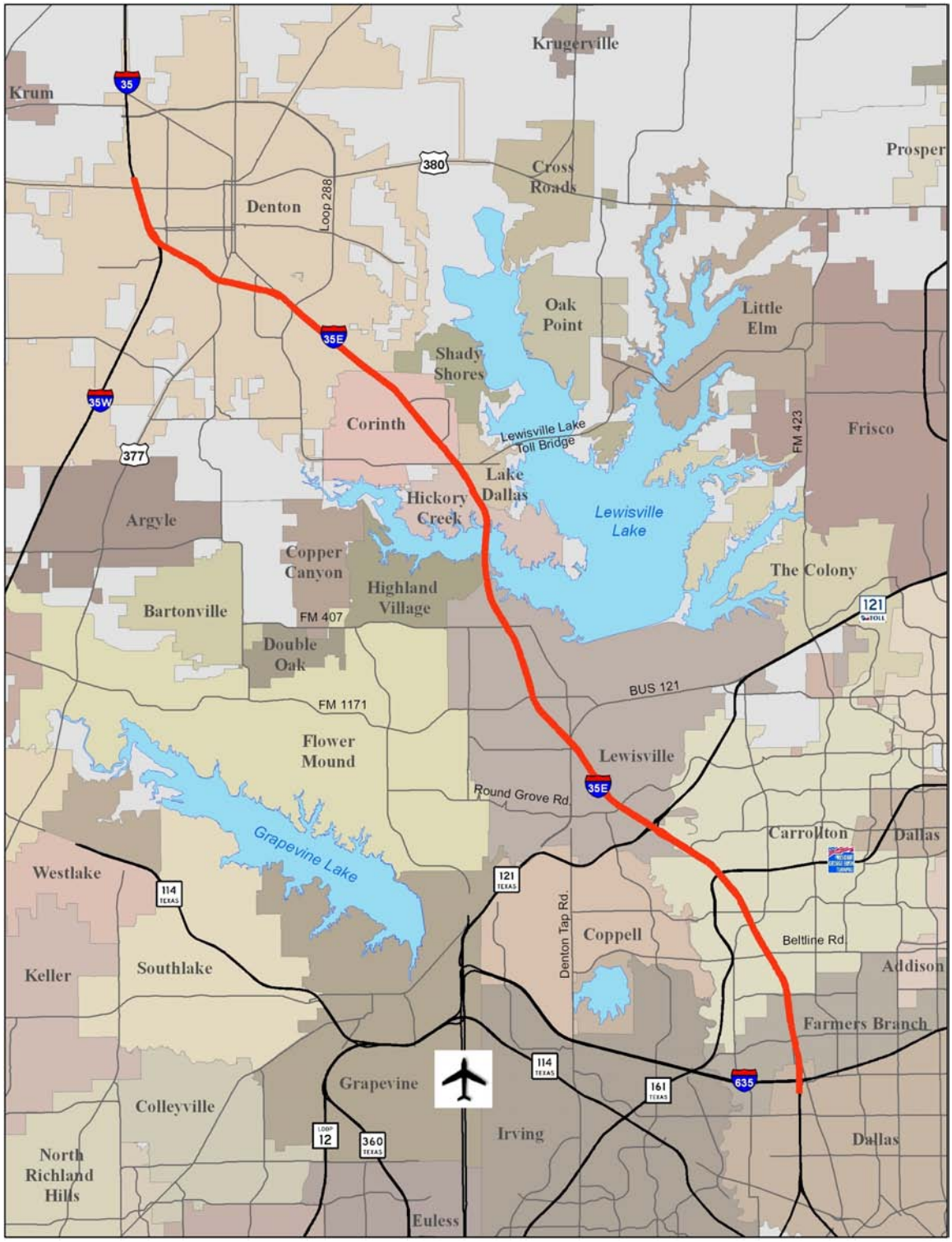


Figure 4-9. Municipality Locations

Table 4-7
Historical Municipal Population Trends and Projections
IH 35E Managed Lanes Corridor

Municipality	Year 1970	Year 1980	Year 1990	Year 2000	Year 2030	Annual Percent Growth (1970-2000)	Annual Percent Growth (2000-2030)	Number of New Residents (1970-2000)	Number of New Residents (2000-2030)	Percent Population Distribution By Municipality		Percentage of New Residents Between 2000 and 2030
										2000	2030	
Addison	593	5,553	8,783	14,166	19,303	**11.2%**	1.0%	13,573	5,137	0.7%	0.8%	0.9%
Argyle	443	1,111	1,575	2,365	11,810	5.7%	**5.5%**	1,922	9,445	0.1%	0.5%	1.6%
Carrollton	13,855	40,595	82,169	109,576	124,086	7.1%	0.4%	95,721	14,510	5.8%	5.0%	2.5%
Coppell	1,728	3,826	16,881	35,958	45,410	**10.6%**	0.8%	34,230	9,452	1.9%	1.8%	1.6%
Copper Canyon	N/A	465	978	1,216	2,433	N/A	2.3%	N/A	1,217	0.1%	0.1%	0.2%
Corinth	461	1,264	3,944	11,325	27,070	**11.3%**	2.9%	10,864	15,745	0.6%	1.1%	2.7%
Dallas	844,401	904,599	1,006,877	1,188,580	1,404,847	1.1%	0.6%	344,179	216,267	62.8%	56.6%	36.5%
Denton	39,874	48,063	66,270	80,537	190,719	2.4%	2.9%	40,663	110,182	4.3%	7.7%	18.6%
Double Oak	N/A	836	1,664	2,179	2,783	N/A	0.8%	N/A	604	0.1%	0.1%	0.1%
Farmers Branch	27,492	24,863	24,250	27,508	43,978	0.0%	1.6%	16	16,470	1.5%	1.8%	2.8%
Flower Mound	1,685	4,402	15,527	50,702	91,640	**12.0%**	2.0%	49,017	40,938	2.7%	3.7%	6.9%
Grapevine	11,801	7,049	29,202	42,059	49,484	4.3%	0.5%	30,258	7,425	2.2%	2.0%	1.3%
Hickory Creek	218	1,422	1,893	2,078	3,996	7.8%	2.2%	1,860	1,918	0.1%	0.2%	0.3%
Highland Village	516	3,246	7,027	12,173	18,624	**11.1%**	1.4%	11,657	6,451	0.6%	0.7%	1.1%
Irving	97,260	109,943	155,037	191,615	225,714	2.3%	0.5%	94,355	34,099	10.1%	9.1%	5.8%
Krum	454	917	1,542	1,979	3,580	5.0%	2.0%	1,525	1,601	0.1%	0.1%	0.3%
Lake Dallas	1,431	3,177	3,656	6,166	9,209	5.0%	1.3%	4,735	3,043	0.3%	0.4%	0.5%
Lewisville	9,264	24,273	46,521	77,737	111,168	7.3%	1.2%	68,473	33,431	4.1%	4.5%	5.6%
Little Elm	363	926	1,255	3,646	18,882	8.0%	**5.6%**	3,283	15,236	0.2%	0.8%	2.6%
Oak Point	N/A	387	645	1,747	10,438	N/A	**6.1%**	N/A	8,691	0.1%	0.4%	1.5%
Shady Shores	543	813	1,045	1,461	3,849	3.4%	3.3%	918	2,388	0.1%	0.2%	0.4%
The Colony	N/A	11,586	22,113	26,531	64,216	N/A	3.0%	N/A	37,685	1.4%	2.6%	6.4%
I35E Corridor	1,052,382	1,199,316	1,498,854	1,891,304	2,483,239	2.0%	0.9%	838,922	591,935	100.0%	100.0%	100.0%
Ten-County Area	2,371,256	2,957,120	3,920,094	5,080,603	9,107,229	2.6%	2.0%	2,709,347	4,026,626	N/A	N/A	N/A
State of Texas	11,258,480	14,337,820	16,986,510	20,851,820	31,830,579	2.1%	1.4%	9,593,340	10,978,759	N/A	N/A	N/A
United States	203,982,310	227,225,620	248,709,873	281,421,906	362,880,000	1.1%	0.9%	77,439,596	81,458,094	N/A	N/A	N/A

Source: NCTCOG, Texas State Data Center, U.S. Census Bureau

FUTURE MUNICIPAL POPULATION GROWTH

Population estimates for 2030 were developed by NCTCOG for the municipalities in the study corridor. As shown in **Table 4-7**, the population of the study corridor is expected to grow by 591,935 residents, or 31.1 percent over the next 30 year period. This average annual rate of 0.9 percent between 2000 and 2030 compares to an expected growth rate of 2.0 percent for the ten-county area, 1.4 percent for the state, and 0.9 percent for the nation.

The three cities that are expected to have the largest percentage growth rate are the cities of Argyle, Oak Point and Shady Shores. Argyle is expected to gain 9,445 residents between 2000 and 2030 at an average annual growth rate of 5.5 percent. Little Elm is expected to grow at an average annual growth rate of 5.6 percent which would result in more than 15,000 new residents. Oak Point is projected to experience the highest growth rate of 6.1 percent.

The city of Dallas is expected to see the largest incremental growth gaining 216,182 residents at an average annual rate of 0.6 percent from 2000 to 2030. The forecast shows that Denton will have the second largest incremental growth, adding 110,182 new residents at an average annual rate of 2.9 percent over the next thirty years. Of all the new residents expected to come to the study area, 36.5 percent are expected to be residents in Dallas while 18.6 percent are expected in Denton.

In 2000, the city of Dallas accounted for 62.8 percent of the population of the study area as a whole. By 2030, Dallas's share of the population is expected to decrease to 56.6 percent as population expands within areas surrounding Dallas. The city of Denton's share of the population is expected to increase from 4.3 in 2000 to 7.7 percent by 2030.

HISTORICAL MUNICIPAL EMPLOYMENT TRENDS

Historical employment trends for the municipalities in the proposed IH 35E managed lane corridor are presented in **Table 4-8**. The twenty-two municipalities have experienced average annual employment growth between 1990 and 2000 that has ranging from a low of 2.5 percent in the city of Dallas to a high of 12.7 percent in the city of Flower Mound. Employment information for 1990 was not available for the cities of Argyle, Copper Canyon, Double Oak, Hickory Creek, Highland Village, Krum, Lake Dallas, Little Elm, Oak Point, or Shady Shores.

Table 4-8
Historical Municipal Employment Trends and Projections
IH 35E Managed Lanes Corridor

Municipality	Year 1990	Year 2000	Year 2030	Annual Percent Growth (1990-2000)	Annual Percent Growth (2000-2030)	Number of New Employees (1990-2000)	Number of New Employees (2000-2030)	Percent Employment Distribution By Municipality		Percentage of New Employees Between 2000 and 2030
								2000	2030	
Addison	29,350	45,649	66,213	4.5%	1.2%	16,299	20,564	2.9%	2.9%	2.8%
Argyle	N/A	535	4,024	N/A	**7.0%**	N/A	3,489	0.0%	0.2%	0.5%
Carrollton	45,250	68,199	83,148	4.2%	0.7%	22,949	14,949	4.3%	3.6%	2.0%
Coppell	6,350	18,401	29,380	**11.2%**	1.6%	12,051	10,979	1.2%	1.3%	1.5%
Copper Canyon	N/A	348	1,173	N/A	4.1%	N/A	825	0.0%	0.1%	0.1%
Corinth	1,000	2,213	3,225	**8.3%**	1.3%	1,213	1,012	0.1%	0.1%	0.1%
Dallas	809,650	1,038,314	1,390,219	2.5%	1.0%	228,664	351,905	66.0%	60.3%	48.1%
Denton	37,050	58,581	107,572	4.7%	2.0%	21,531	48,991	3.7%	4.7%	6.7%
Double Oak	N/A	89	567	N/A	**6.4%**	N/A	478	0.0%	0.0%	0.1%
Farmers Branch	50,150	75,013	156,798	4.1%	2.5%	24,863	81,785	4.8%	6.8%	11.2%
Flower Mound	1,550	5,130	12,993	**12.7%**	3.1%	3,580	7,863	0.3%	0.6%	1.1%
Grapevine	27,100	49,565	85,475	6.2%	1.8%	22,465	35,910	3.2%	3.7%	4.9%
Hickory Creek	N/A	494	1,115	N/A	2.8%	N/A	621	0.0%	0.0%	0.1%
Highland Village	N/A	1,065	1,796	N/A	1.8%	N/A	731	0.1%	0.1%	0.1%
Irving	106,600	165,435	276,941	4.5%	1.7%	58,835	111,506	10.5%	12.0%	15.3%
Krum	N/A	377	2,223	N/A	**6.1%**	N/A	1,846	0.0%	0.1%	0.3%
Lake Dallas	N/A	1,683	2,384	N/A	1.2%	N/A	701	0.1%	0.1%	0.1%
Lewisville	15,650	37,145	62,603	**9.0%**	1.8%	21,495	25,458	2.4%	2.7%	3.5%
Little Elm	N/A	672	1,377	N/A	2.4%	N/A	705	0.0%	0.1%	0.1%
Oak Point	N/A	72	484	N/A	**6.6%**	N/A	412	0.0%	0.0%	0.1%
Shady Shores	N/A	188	889	N/A	5.3%	N/A	701	0.0%	0.0%	0.1%
The Colony	1,650	3,510	13,002	7.8%	4.5%	1,860	9,492	0.2%	0.6%	1.3%
I35E Corridor	1,131,350	1,572,678	2,303,601	3.3%	1.3%	441,328	730,923	100.0%	100.0%	100.0%
Ten-County Area	2,105,420	3,158,202	5,416,718	4.1%	1.8%	1,052,782	2,258,516	N/A	N/A	N/A
State of Texas	6,983,170	9,283,286	16,743,000	2.9%	2.0%	2,300,116	7,459,714	N/A	N/A	N/A
United States	108,657,200	129,877,063	202,431,000	1.8%	1.5%	21,219,863	72,553,937	N/A	N/A	N/A

Source: NCTCOG, Texas State Data Center, U.S. Census Bureau

The cities of Flower Mound, Coppell, and Lewisville saw the highest average annual growth rates between 1990 and 2000. Employment in Flower Mound grew at an average annual rate of 12.7 resulting in over 3,500 new employees. Coppell experienced an average annual growth rate of 11.2 percent gaining 12,051 employees. Lewisville's employment grew by nearly 21,495 at an average annual rate of 9.0 percent.

The city of Dallas experienced the largest incremental growth from 1990 to 2000 gaining 228,664 employees at an average annual rate of 2.5 percent. The city of Irving gained 58,835 employees at an average annual rate of 4.5 percent.

As a whole, employment along the IH 35E managed lane corridor grew by 441,328 employees at an average annual rate of 3.3 percent. This compares to average annual growth rates of 3.9, 2.9 and 1.8 percent for the ten-county area, state of Texas, and the United States respectively.

FUTURE MUNICIPAL EMPLOYMENT GROWTH

Also presented in **Table 4-8** are estimates of future employment growth through 2030, as estimated by NCTCOG. The IH 35E managed lane study area is expected to grow at an average annual rate of 1.3 percent between 2000 and 2030 which would add 730,923 employees. This compares to average annual growth rates of 1.8 percent for the ten-county area, 2.0 percent for the state of Texas, and 1.5 percent for the United States. The city of Dallas is expected to add more than 351,905 employees at an average annual growth rate of 1.0 percent from 2000 through 2030. This accounts for 48.1 percent of all new employment to the IH 35E managed lane corridor during this time.

The city of Argyle is expected to see the highest average annual growth rate of 7.0 percent from 2000 to 2030 bringing 3,489 employees to this city. The cities of Double Oak, Krum, and Oak Point are all projected to experience average annual growth rates above 6 percent during this time. In total, this will only however, add approximately 2,700 new employees during the next thirty years.

The city of Irving is expected to house 15.3 percent of all new employees along the corridor between 2000 and 2030. It is projected that Irving will add 111,506 employees at an average annual rate of 1.7 percent. The city of Farmers Branch is also expected to add 81,785 employees at an average annual rate of 2.5 percent. This will account for 11.2 percent of all new employment within the IH 35E managed lane corridor during this time.

The city of Dallas is expected to maintain its large share of employment in the study corridor with a share of 60.3 percent by 2030. This compares to an employment share of 66.0 percent that Dallas held in 2000. It is projected that the city of Farmers Branch's share of employment will increase by 4.4 percent while the city of Irving's share will increase by 3.3 percent.

IH 35E MANAGED LANE CORRIDOR
CURRENT AND FUTURE DEVELOPMENT GROWTH

The current and future economic development potential along the IH 35E managed lane corridor is described in this section. Much the analysis of future development potential is based on the identification of major employment establishments located within the study corridor and potential new developments to the study area. This includes an examination of the demographic forecasts for the area immediately adjacent to and within the proposed IH 35E managed lane corridor, which is defined as the area within a five-mile distance from the IH 35E centerline alignment.

MAJOR EMPLOYMENT ESTABLISHMENTS

The Dallas Morning News ranks the top 150 major corporations in the Dallas-Fort Worth metropolitan area (2008 Business Scorecard) every year. The ranking is based on the total revenue generated by each corporation in the previous year. From the 2008 rankings, 54 of those corporations are located within an approximate five-mile distance of the proposed managed lane facility. A list of those corporations is presented in **Table 4-9** and their locations are illustrated in **Figure 4-10**.

Exxon Mobil Corp. in Irving is ranked 1st with $358.6 billion in revenue in 2007. Kimberly-Clark Corp and Fluor Corp., also in Irving, ranked 5th and 6th respectively with $18.3 and $16.7 billion in 2007 revenue. In Dallas, Southwest Airlines Co. and Tenet Healthcare Corp. ranked 12th and 13th respectively with $9.8 and $8.9 billion in 2007 revenue. These high ranked businesses are specifically highlighted in **Figure 4-10**.

In 2006, NCTCOG compiled a list of major employment establishments with 1000 or more full-time employees. **Table 4-10** shows the 44 establishments that are located within 5 miles of the IH 35E managed lane corridor and their respective locations are illustrated in **Figure 4-11**, specifically highlighting the establishments with 2,500 employers or more.

Table 4-9
Major Corporations Ranked by the Dallas Morning News
IH 35E Managed Lanes Corridor

Name	City	2008 Rank	2007 Revenue
Exxon Mobil Corp.	Irving	1	$358,600,000,000
Kimberly-Clark Corp.	Irving	5	$18,266,000,000
Fluor Corp.	Irving	6	$16,691,030,000
Southwest Airlines Co.	Dallas	12	$9,861,000,000
Tenet Healthcare Corp.	Dallas	13	$8,852,000,000
Commercial Metals Co.	Irving	14	$8,329,020,000
Celanese Corp.	Farmers Branch	17	$6,444,000,000
Atmos Energy Corp.	Dallas	18	$5,898,430,000
Flowserve Corp.	Irving	29	$3,762,690,000
Sally Beauty Holdings Inc.	Denton	35	$2,513,770,000
Zale Corp.	Irving	36	$2,437,070,000
Pioneer Natural Resources Co.	Irving	41	$1,740,850,000
Valhi Inc.	Dallas	46	$1,492,200,000
Kronos Worldwide Inc.	Dallas	48	$1,310,300,000
Titanium Metals Corp.	Dallas	49	$1,278,900,000
Ashford Hospitality Trust Inc.	Dallas	52	$1,131,940,000
FelCor Lodging Trust Inc.	Irving	53	$1,021,880,000
Palm Harbor Homes Inc.	Addison	63	$661,250,000
Darling International Inc.	Irving	64	$645,310,000
Affirmative Insurance Holdings In	Addison	68	$500,030,000
Keystone Consolidated Industries	Dallas	71	$451,178,000
Dynamex Inc.	Dallas	73	$413,770,000
Mannatech Inc.	Coppell	74	$412,680,000
Diodes Inc.	Dallas	78	$401,160,000
Carbo Ceramics Inc.	Irving	80	$340,350,000
Nexstar Broadcasting Group Inc.	Irving	86	$266,800,000
I2 Technologies Inc.	Farmers Branch	88	$260,310,000
Sport Supply Group	Farmers Branch	89	$236,850,000
Heelys Inc.	Carrollton	96	$183,470,000
American Realty Investors Inc.	Farmers Branch	97	$183,090,000
NL Industries Inc.	Dallas	98	$177,680,000
CompX International Inc.	Dallas	99	$177,680,000
EFJ Inc.	Irving	100	$154,610,000
Transcontinental Realty Investors	Farmers Branch	101	$136,750,000
United States Lime & Minerals Inc	Dallas	104	$125,240,000
US Home Systems Inc.	Lewisville	105	$123,280,000
Universal Power Group Inc.	Carrollton	110	$108,520,000
Craftmade International Inc.	Coppell	112	$103,350,000
Entrust Inc.	Addison	113	$99,670,000
DG FastChannel Inc.	Irving	114	$97,690,000
NewMarket Technology Inc.	Dallas	116	$93,110,000
Natural Health Trends Corp.	Farmers Branch	121	$76,500,000
Peerless Manufacturing Co.	Dallas	122	$75,140,000
American Community Newspapers Inc	Addison	123	$74,303,161
DGSE Cos.	Dallas	125	$62,970,000
RF Monolithics Inc.	Farmers Branch	127	$56,370,000
Thomas Group Inc.	Irving	128	$55,870,000
Ascendant Solutions Inc.	Irving	130	$50,820,000
GVI Security Solutions Inc.	Carrollton	133	$45,020,000
Crdentia Corp.	Dallas	140	$32,473,000
Uranium Resources Inc.	Lewisville	141	$31,140,000
RBC Life Sciences Inc.	Irving	144	$27,030,000
Carrington Laboratories Inc.	Irving	149	$21,800,000
North American Technologies Group	Irving	150	$21,660,000

Source: Dallas Morning News 2008 Business Scorecard

Figure 4-10. DFW Scorecard 2008

Table 4-10
Major Employment Establishments with 1000 or more Full-Time Employees

Name	City	Number of Employees
University of North Texas	Denton	7,400
Citigroup	Irving	5,000
United Parcel Service Inc.	Dallas	4,300
Verizon Communications Inc.	Irving	4,000
Southwest Airlines	Dallas	3,200
Nations Broadband Inc.	Dallas	2,500
Citicorp Credit Services Inc.	Irving	2,500
Nokia	Irving	2,400
Texas Woman's University	Denton	2,200
Peterbilt Motors Co.	Denton	2,000
JP Morgan Chase	Dallas	1,700
North Texas Mail Processing Center	Coppell	1,695
MBNA Information Services Inc.	Addison	1,550
IBM Corp.	Farmers Branch	1,500
Mary Kay Cosmetics Headquarters	Addison	1,500
Abbott Laboratories	Irving	1,500
Denton County (County Government)	Denton	1,470
STMicroelectrics	Carrollton	1,450
Denton State School	Denton	1,432
Citigroup	Irving	1,430
Denton County (Commissioners Court)	Denton	1,409
Centex Home Equity Company, LLC	Lewisville	1,400
Microsoft (Sierra VI)	Irving	1,400
Valor Telecom Enterprise LLC	Irving	1,300
Accenture LLP	Irving	1,275
Geico Insurance	Farmers Branch	1,225
Dallas Semiconductor	Dallas	1,200
Verizon Logistics	Irving	1,200
Federal Government - Local IRS	Farmers Branch	1,200
JPI Lifestyle Apartment Communities	Irving	1,199
City of Denton (Municipal Building)	Denton	1,125
Halliburton Energy Services	Carrollton	1,125
Greyhound Lines Inc.	Dallas	1,100
Verizon Service Center	Coppell	1,060
Xerox Corp.	Irving	1,030
Central Freight Lines Inc.	Irving	1,020
Cingular Wireless	Farmers Branch	1,018
Verizon	Irving	1,000
NEC America Inc.	Irving	1,000
Zale Corp.	Irving	1,000
EMC Mortgage Corp.	Lewisville	1,000
AT&T Corp.	Dallas	1,000
Haggar Clothing Co.	Dallas	1,000
EMC Mortgage Corp.	Irving	1,000

Source: North Central Texas Council of Governments

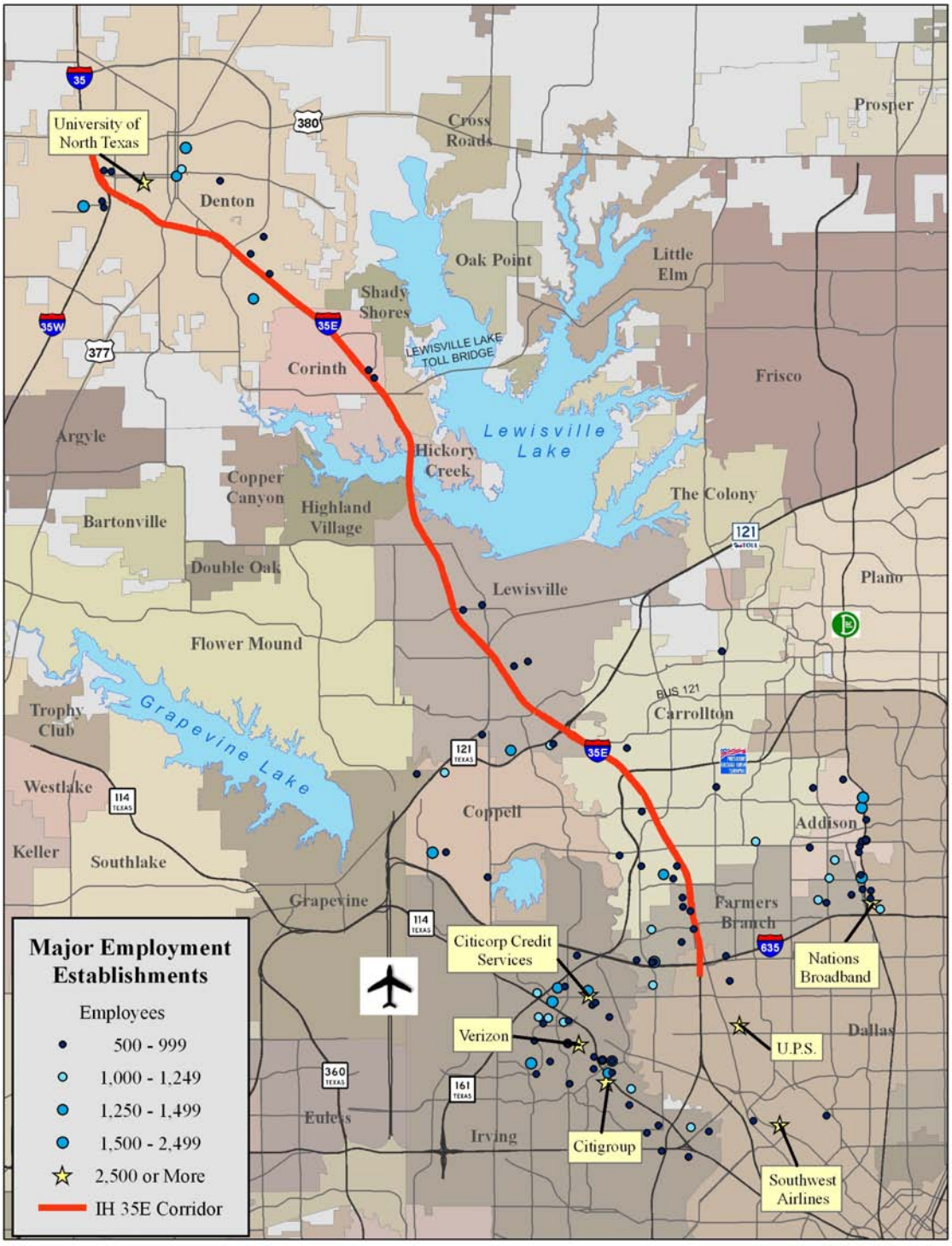


Figure 4-11. Major Employment Establishments

FUTURE POPULATION AND EMPLOYMENT ALONG THE PROPOSED IH 35E MANAGED LANE CORRIDOR

The population and employment growth between 2000 and 2030 for an approximate five-mile corridor centered around the proposed IH 35E managed lane corridor disaggregated at the Traffic Survey Zone (TSZ) level is highlighted in **Figures 4-12** through **4-19**.

POPULATION GROWTH ESTIMATES

Figure 4-12 identifies the estimated incremental population growth between 2000 and 2030 by TSZ, as provided by NCTCOG. There is expected to be a large amount of incremental population growth in the northern area of the study corridor. Many of the zones just east of Lewisville Lake are expected to grow by more than 5,000 residents over the next thirty years.

Most of the zones to the south of the corridor are only expected to grow by 1 to 500 residents during this same time period. This in part reflects the mature state of residency in Irving and Dallas, both of which already have high population densities and therefore less capacity to absorb additional growth. Several zones show no growth and reflect either uninhabitable areas such as industrial parks or the DFW Airport.

The compounded annual population percentage growth rates between 2000 and 2030 are presented in **Figure 4-13**. The northern region of the study corridor is expected to experience the highest average annual growth rates from 2000 to 2030. Several zones west of IH 35W, directly north of Dallas County along IH 35E, and east of Lewisville rate are expected to grow at average annual rates in excess of 10 percent during this forecast period.

As with incremental population growth, the zones in the southern portion of the study area are expected experience lower average annual growth rates. Most of these zones will grow at rates less than 2.5 percent annually.

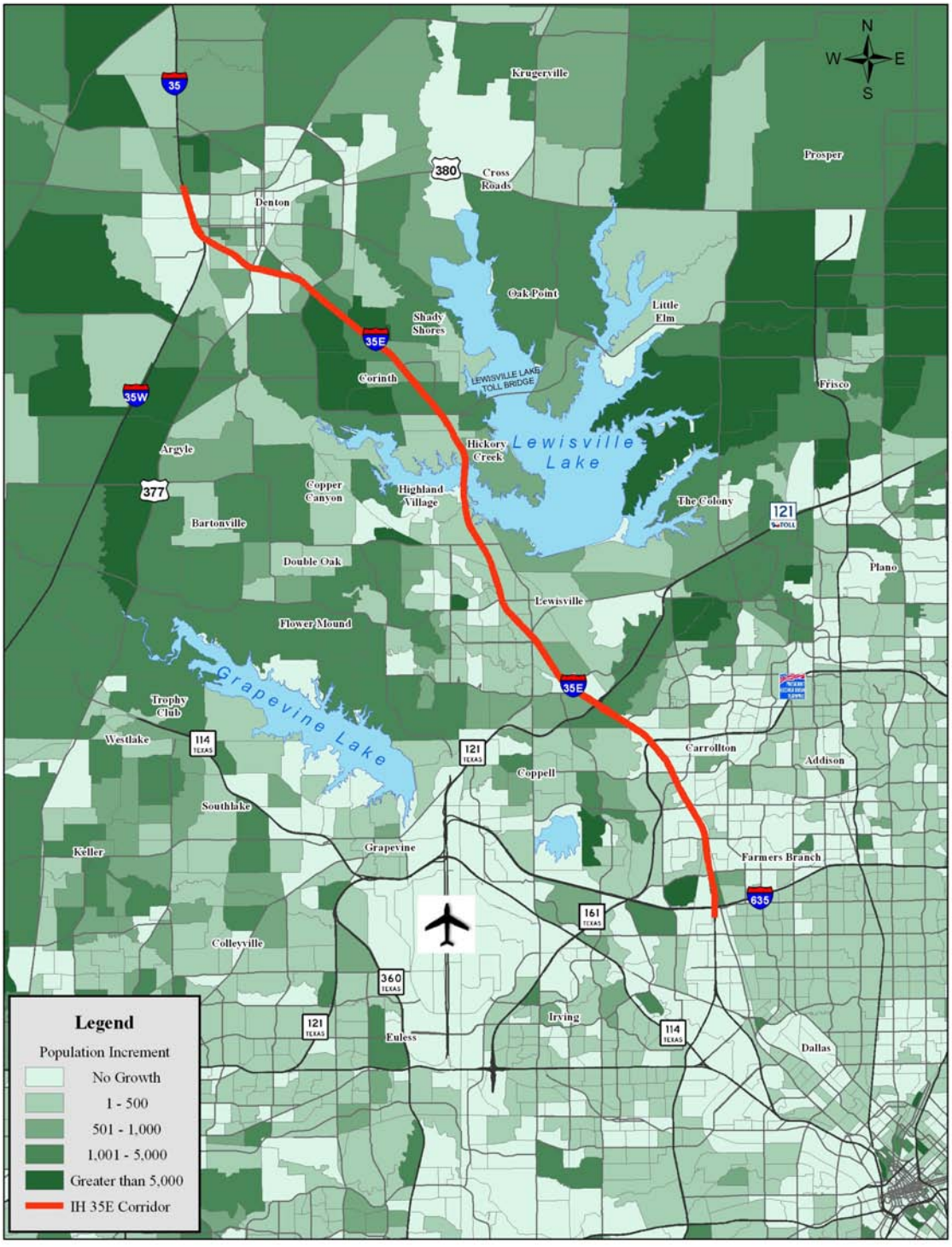


Figure 4-12. Population Increment (2000 to 2030)

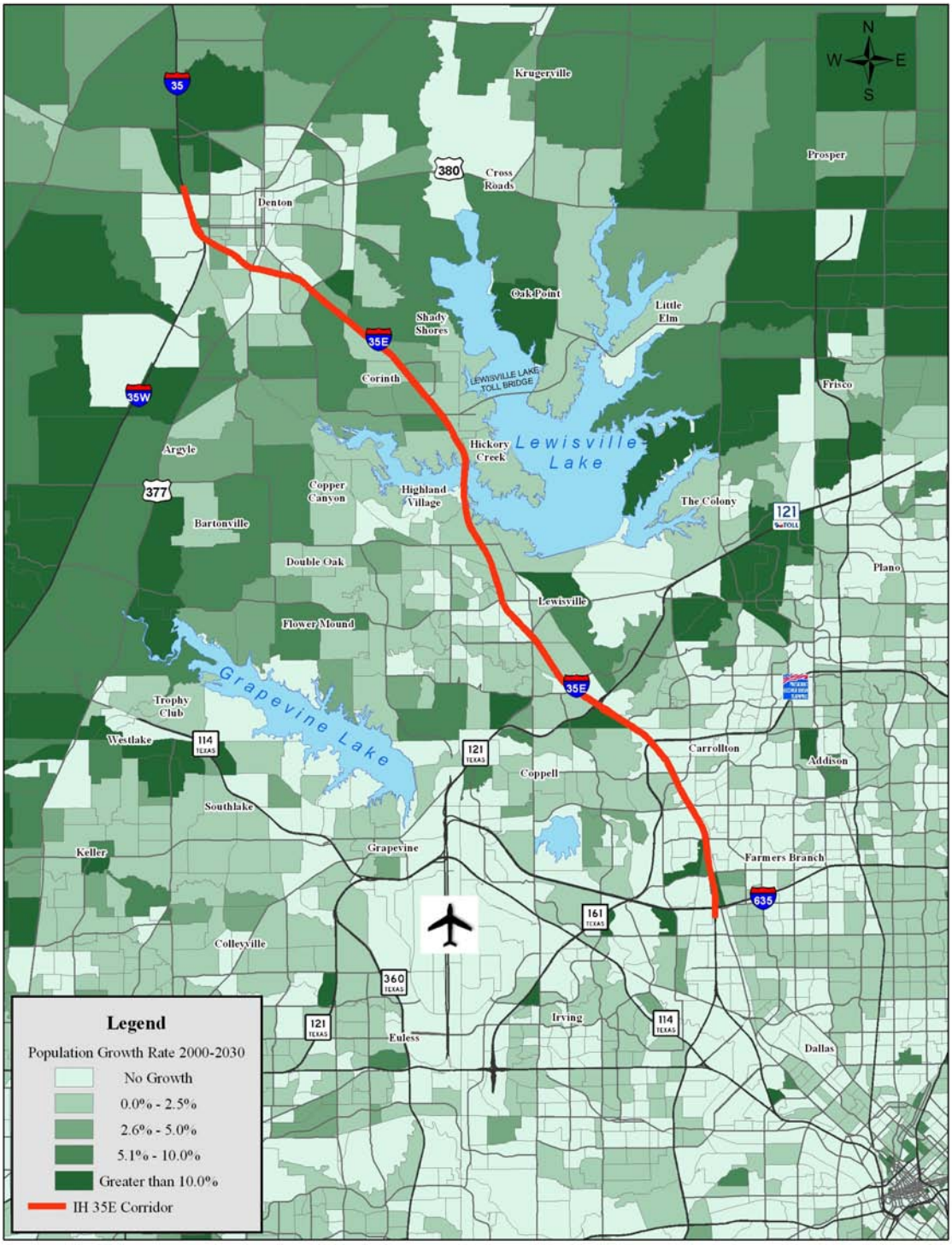


Figure 4-13. Population Annual Growth (2000 to 2030)

Figures 4-14 and **4-15** show the population densities for TSZ's within five miles of the IH 35E managed lane corridor for the years 2000 and 2030 respectively. The population density reflects the number of residents per acre within each zone. The population density is expected to increase within zones located along the corridor and to the west of the corridor. The cities surround Denton are also projected to greatly increase their overall population densities over the next thirty years.

In 2000, the population density was highest in zones to the east of IH 35E, and south of SH 121 with high densities exhibited within the cities of Irving. Several other dense zones were also located along the northern part of the study area and included zones in the cities of Denton, Lewisville, Colleyville, and Grapevine. Most of the zones to the west of the corridor and just north and northeast of Lewisville Lake, had population densities of less than 1 person per acre in 2000.

By 2030, many of the zones to the west of the study corridor are expected to increase to populations densities of 1.1 to 2.5 persons per acre. There is one large zone directly northwest of the northern tip of the study corridor that is expected to go from a density of 0.0 – 1.0 persons per acre in 2000, to a density of greater than 10.0 persons per acre by 2030. Many of the zones just east of Lewisville Lake are also projected to greatly increase in population density by 2030.

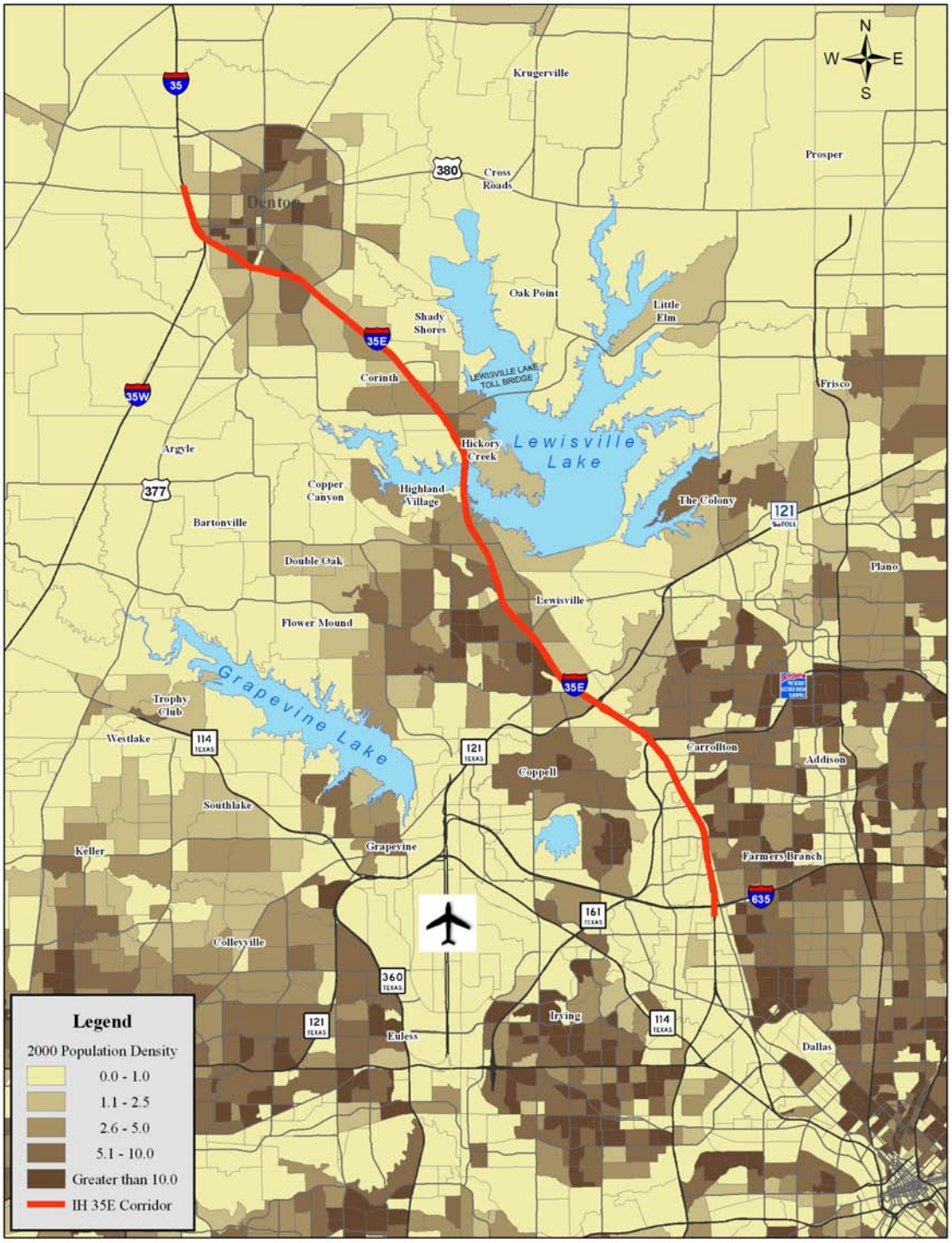


Figure 4-14. 2000 Population Density

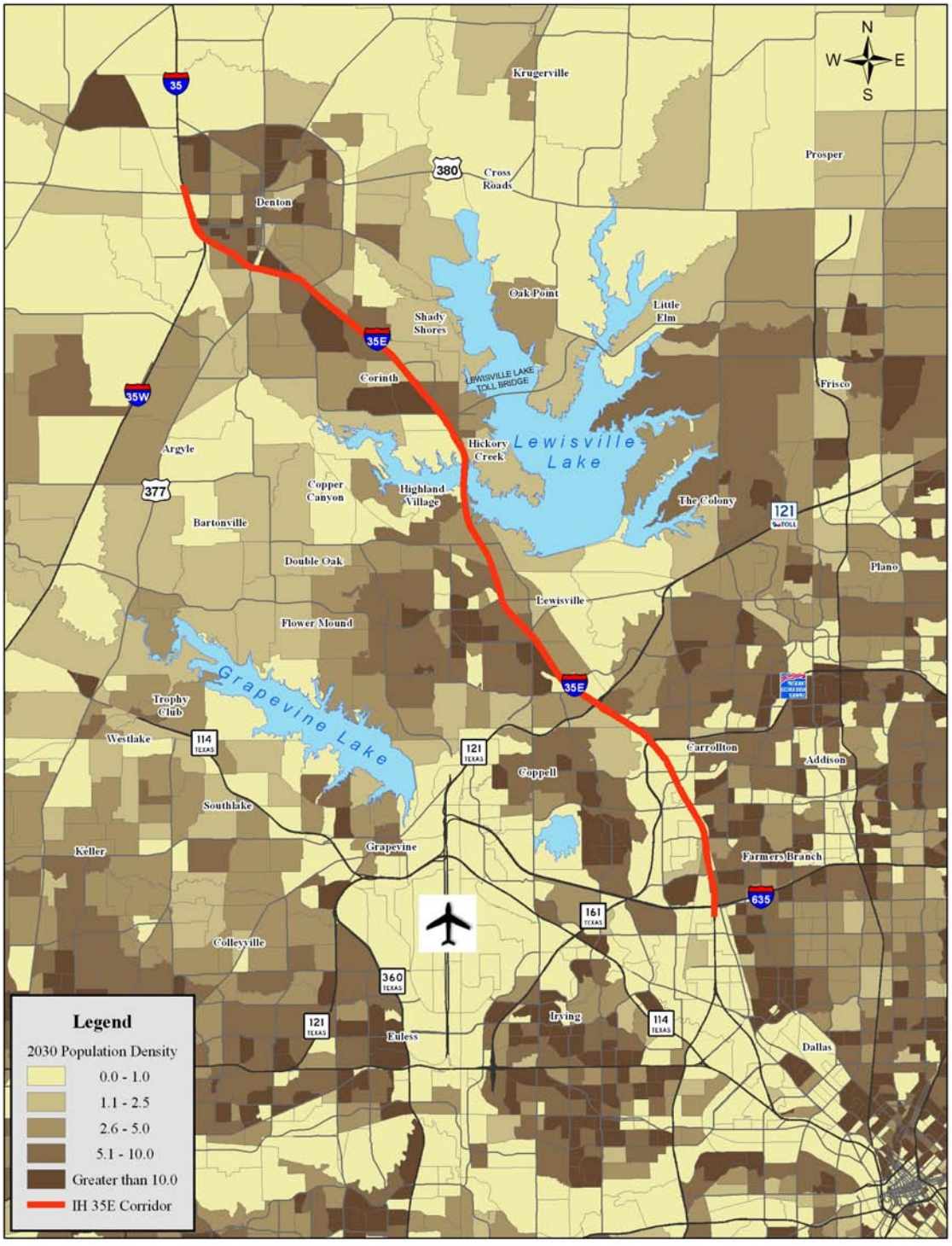


Figure 4-15. 2030 Population Density

EMPLOYMENT GROWTH ESTIMATES

Figure 4-16 identifies the estimated incremental employment growth between 2000 and 2030, as provided by NCTCOG. Like with population, many of the zones to the west of the corridor are expected to see very high incremental employment growth. The northeast region of the study area is also expected to experience high incremental employment growth over the next thirty years.

There is a large group of zones at the southeast edge of the IH 35E corridor that are expected to see incremental employment growth of greater than 1,000 jobs per zone. This cluster of new employment at the southern base of the corridor may result in significant traffic generation to and from the region. As more residents move to areas northwest of the corridor, new jobs are also expected to be created in those regions to cater to the new residents.

The compounded annual employment percentage growth rate from 2000 to 2030 is presented in **Figure 4-17**. A large number of zones in the northern portion of the corridor are expected to experience average annual growth rates of greater than 10 percent by 2030. The zones where employment is already high, such as around downtown Dallas, are expected to experience much lower annual growth rates due to their mature states and limited capacity to absorb additional demand.

Figures 4-18 and **4-19** show the employment densities for TSZ's within five miles of the IH 35E managed lane corridor for the years 2000 and 2030 respectively. The employment density reflects the number of employees per acre in each zone. Zones surround the city of Denton are expected to increase the most in employment density over the next thirty years while zones just south of the corridor that are already very dense with employment are projected to continue to increase in density by 2030.

In 2000, the zones with the highest employment density were located towards the southern portion of the IH 35E corridor, especially for zones surrounding the cities of Dallas, Irving and Farmer's Branch. The majority of zones to the north and west exhibited an employment density of 0.0 to 1.0 employees per acre in 2000.

By 2030, the zones in the southeast region of the study area are expected to become even denser. When comparing **Figure 4-18** with **Figure 4-19**, one can see the trend of the projected employment density is expected to spread outwards to zones that are located outside of the central employment areas of Dallas, Irving and Farmers Branch as the regional employment continues to grow.

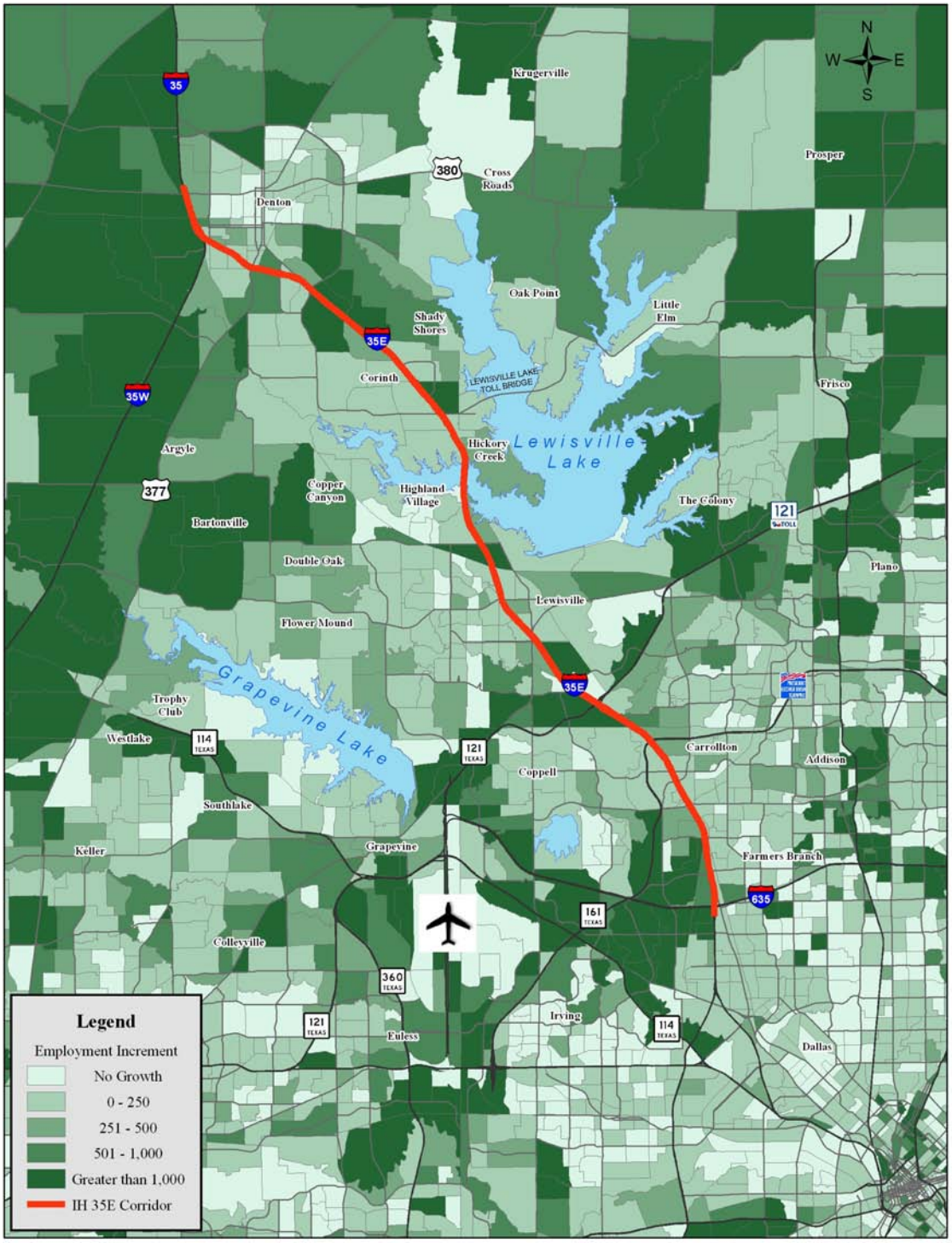


Figure 4-16. Employment Increment (2000 to 2030)

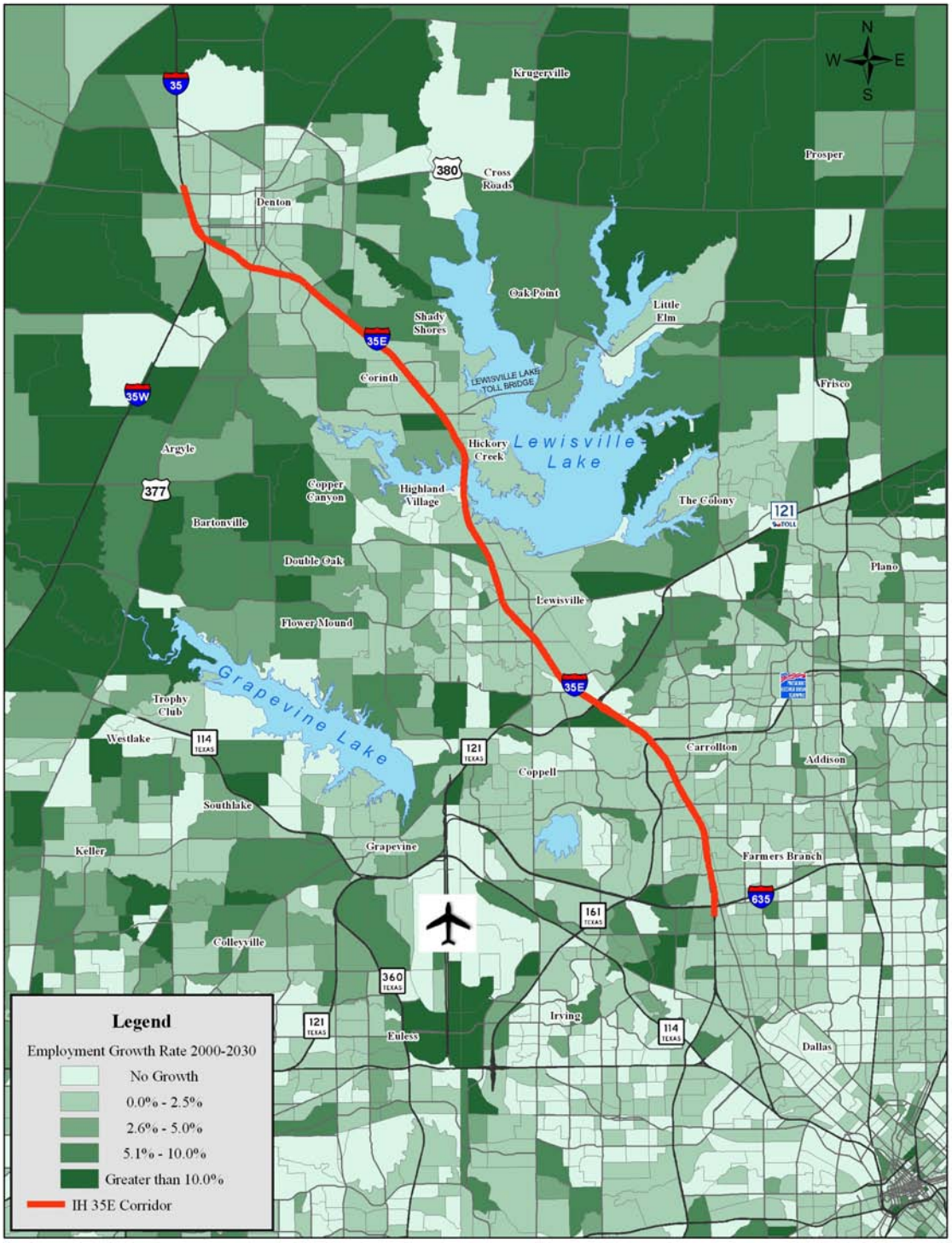


Figure 4-17. Employment Annual Growth (2000 to 2030)

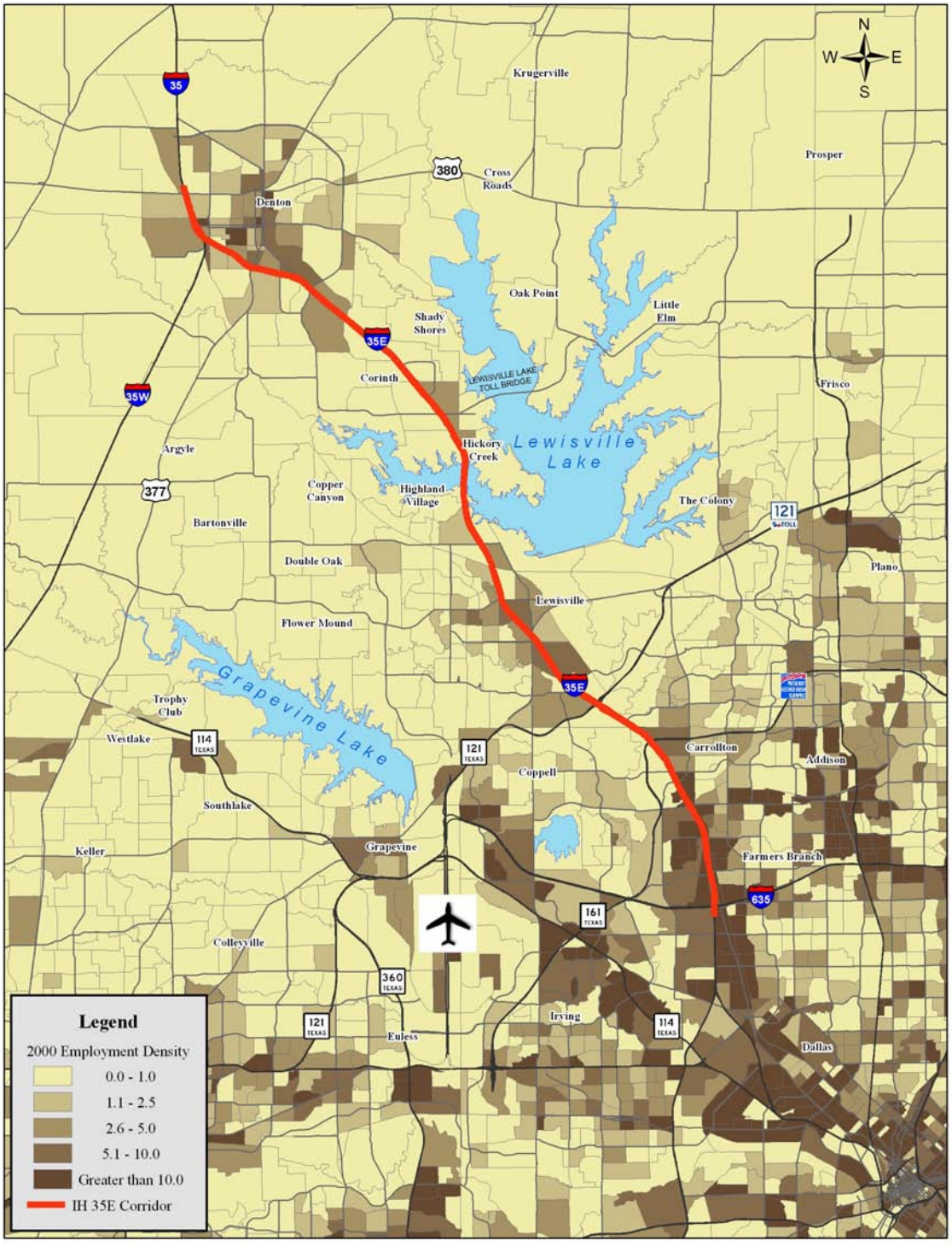


Figure 4-18. 2000 Employment Density

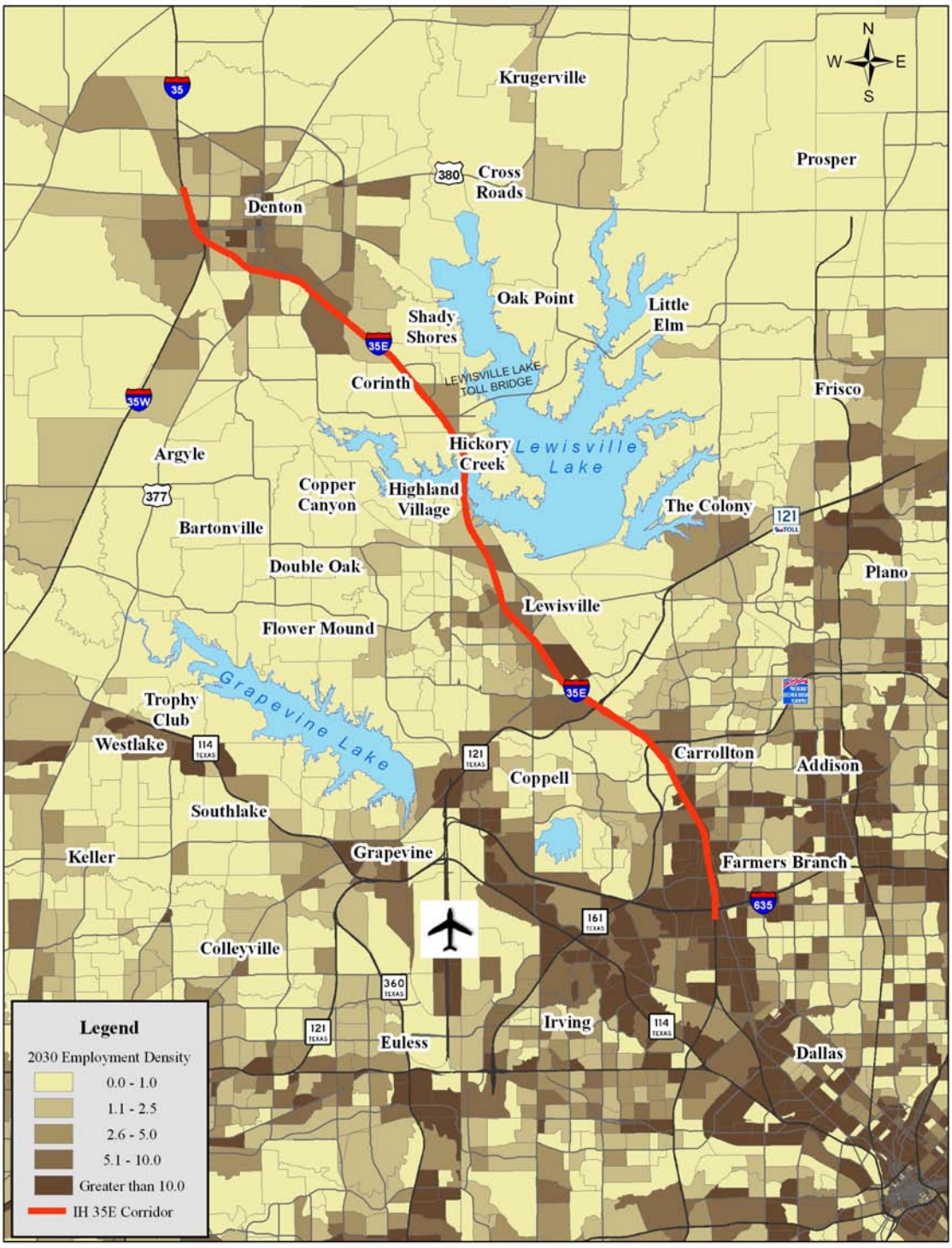


Figure 4-19. 2030 Employment Density

OTHER ECONOMIC INDICATORS

CONSUMER PRICE INDEX

The consumer price index for all urban consumers (CPI-U) is the most widely used measure of inflation and serves as an economic indicator. The CPI-U determines the aggregate price level of a specific market basket of goods and services that are consumed by typical urban households. This is done by calculating the average going price of each item in the market basket. Food, clothing, housing, transportation (including tolls) and entertainment are all included in the basket. Not included are income taxes and investment items such as stocks and bonds. The Bureau of Labor and Statistics of the U.S. Department of Labor calculates the CPI-U every month.

$$CPI - U \ \ for \ \ a \ \ given \ \ time \ \ frame = \frac{Cost \ \ of \ \ market \ \ basket \ \ in \ \ given \ \ time \ \ frame}{Cost \ \ of \ \ market \ \ basket \ \ in \ base \ \ time \ \ frame} \times 100$$

The consumer price index for the base time frame (1982-1984) is 100. Inflation is determined by finding the percentage change in the CPI-U from one year to the next. **Table 4-11** gives the historical trends for CPI-U from 1998 through May of 2009 for the Dallas-Fort Worth Metro Area. Annual inflation is show in two different ways: the change in the yearly average CPI-U and the change in the May CPI-U from year-to-year.

As seen in **Table 4-11**, inflation has recently experienced a steep decrease. With the economy being in a recession, demand is dropping which results in a reduction in prices. From May 2008 to May 2009, the CPI-U actually decreased by 1.5 percent. This compares to a much higher increase of 5.0 percent from May 2007 to May 2008. The CPI-U was 206.4 in July of 2008 but has been decreasing since to a rate of 199.3 in May of this year.

Figure 4-20 illustrates the CPI-U from 1967 to 2008 for the Dallas-Fort Worth MSA, the Southern Region, and the United States. The average annual growth rates have consistently been similar for all three areas. **Figure 4-21** illustrates the inflation rate for the Dallas-Fort Worth metropolitan area. It is clear that inflation spiked in the late 1970's but has since maintained moderate levels.

Table 4-11
Consumer Price Index for the Dallas-Fort Worth Metro Area

Year	January	March	May	July	September	November	Annual Average	Inflation (Avg to Avg)	Inflation (Jan to Jan)
1998	152.1	153.0	153.0	154.2	154.5	154.0	153.6	***	***
1999	155.0	156.4	157.2	158.3	159.8	160.1	158.0	2.9%	2.7%
2000	160.4	163.1	163.2	166.2	166.9	166.8	164.7	4.2%	3.8%
2001	167.3	168.9	169.4	171.5	172.8	171.5	170.4	3.5%	3.8%
2002	170.6	172.1	172.9	172.9	173.2	173.6	172.7	1.3%	2.1%
2003	174.0	176.8	176.9	176.5	177.0	175.9	176.2	2.0%	2.3%
2004	175.7	177.7	179.1	179.1	179.7	179.9	178.7	1.4%	1.2%
2005	180.0	181.3	183.5	184.3	188.9	187.8	184.7	3.4%	2.5%
2006	188.6	188.4	191.2	191.7	192.0	188.4	190.1	2.9%	4.2%
2007	188.9	190.2	192.8	194.3	194.8	196.5	193.2	1.7%	0.8%
2008	197.1	198.6	202.4	206.4	205.9	200.1	201.8	4.4%	5.0%
2009	198.6	200.0	199.3	***	***	***	***	***	-1.5%

Source: Bureau of Labor Statistics

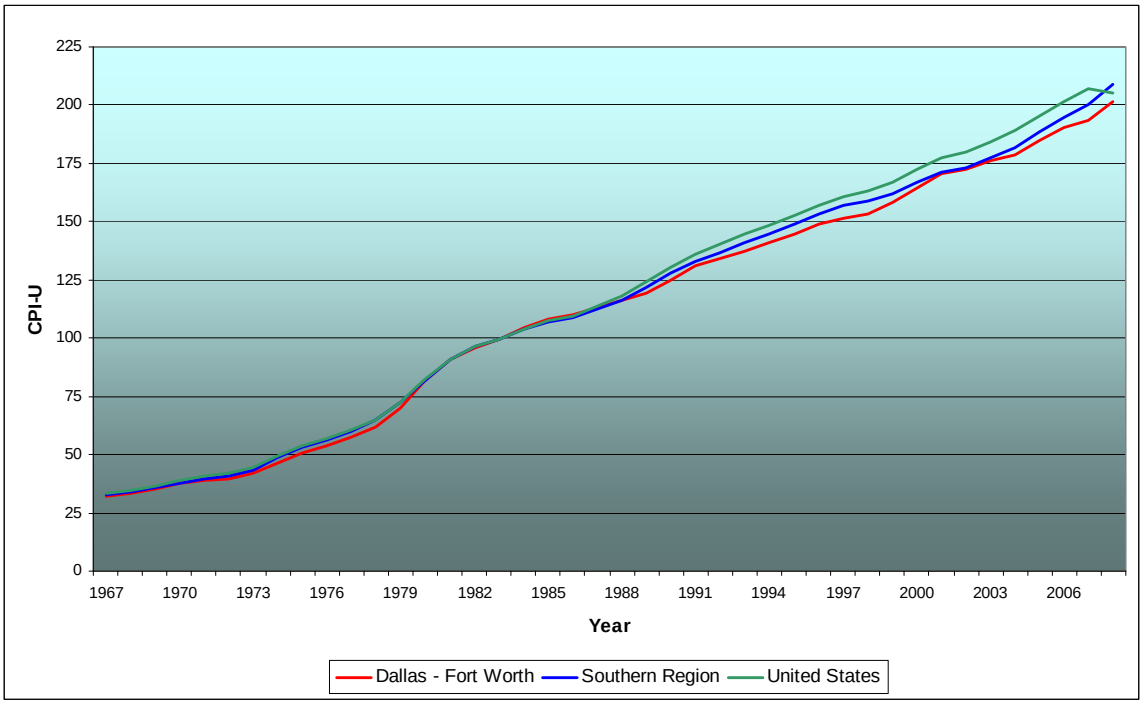


Figure 4-20. CPI-U (1967 – 2008)

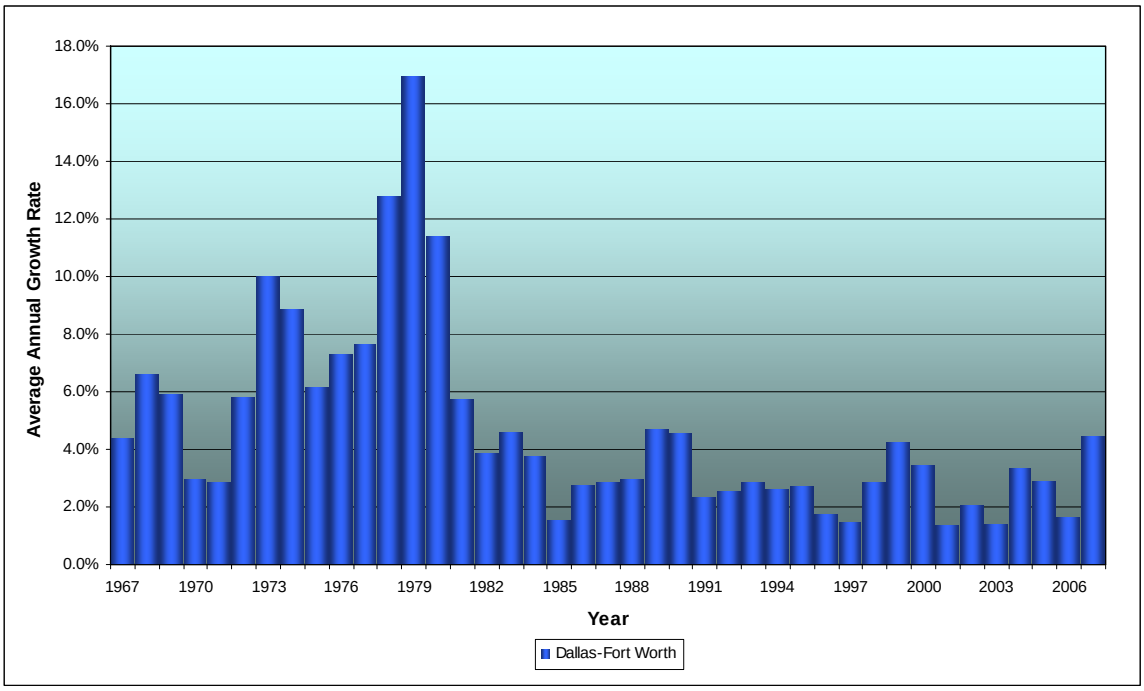


Figure 4-21. DFW Inflation Rate (1967 – 2008)

RESIDENTIAL HOUSING ACTIVITY

The number of homes that are sold and the amount of time that those homes are on the market is typically indicative of the strength of the economy. Sustained growth in the number of homes sold in combination with declining inventories indicates a strong housing market and serves as an indicator of regional economic strength. Trends in residential housing activity, including the number of homes sold, the median price, and the average monthly inventories are presented for the Dallas Multiple Listing Service (MLS) Area and for the state of Texas in **Table 4-12**.

In 1990, homes stayed on the market for an average of 14.1 months in the Dallas MLS. By 2008, the average months inventory had dropped to only 6.3 months. The most recent 2009 monthly data have shown that the average months inventory have increased from 2008 average of 6.3 months to 7.0 months in May and slightly dropped during June and July. Similar numbers were seen for the state of Texas with an average of 11.6 months inventory in 1990 dropping to 6.6 months in 2008. This figure has gone up to 7.4 months in July 2009 due to the economy turmoil. It should be noted that the average months inventory has increased from 2006 to 2008 by 0.7 percent in the Dallas MLS and 1.6 percent in the state of Texas.

The number of homes sold in the Dallas MLS increased at an average annual rate of 6.1 percent from 1990 to 2008 while the median price of homes sold increased at an average annual rate of 3.4 percent. In Texas, the number of homes sold increased at an average

annual rate of 4.8 percent and the median price increased at an average annual rate of 4.3 percent.

Table 4-12
Residential Housing Activity
Home Sale and Market Inventory Trends

Year	Dallas MLS			State of Texas		
	Number of Homes Sold	Average Months Inventory [1]	Median Price	Number of Homes Sold	Average Months Inventory [1]	Median Price
1990	17,528	14.1	$86,100	100,047	11.6	$68,100
1991	16,858	13.8	$85,700	99,619	10.5	$71,200
1992	19,742	11.3	$88,350	107,107	9.6	$75,200
1993	21,406	9.2	$92,300	116,604	8.5	$78,200
1994	22,999	7.9	$93,450	122,134	7.0	$80,000
1995	24,968	7.8	$94,350	121,823	7.6	$81,600
1996	30,128	6.3	$101,100	138,123	7.3	$86,400
1997	33,884	5.3	$108,350	146,395	6.8	$90,600
1998	40,051	4.1	$114,750	170,638	5.2	$96,200
1999	43,199	4.0	$120,800	184,056	4.6	$100,900
2000	45,446	3.8	$134,550	188,738	4.5	$112,100
2001	46,992	4.6	$142,000	196,401	5.1	$119,400
2002	47,199	5.5	$145,000	201,528	5.4	$124,500
2003	49,278	6.5	$147,000	216,099	6.1	$127,700
2004	54,514	6.3	$148,900	240,895	5.9	$130,000
2005	59,980	5.8	$154,800	266,193	5.4	$136,800
2006	64,226	5.6	$154,900	292,805	5.0	$141,550
2007	59,695	6.0	$157,850	275,582	5.6	$146,450
2008	50,477	6.3	$155,850	231,604	6.6	$145,800
AAPC [2]	6.1%	***	3.4%	4.8%	***	4.3%

[1] Average number of months homes are on the market.
[2] Average Annual Percentage Change

Source: Real Estate Center at Texas A&M University

TRENDS IN BUILDING PERMITS

The housing industry accounts for a large percentage of investment spending. Building permits are one of the leading economic indicators as they help predict what the economy will be like in the near future. Sustained declines in building permits can slow the economy and can be indicative of a potential recession. Likewise, increases in this leading indicator can potentially indicate or trigger economic growth. Building permit activity provides insight into housing and overall economic activity in the upcoming months.

Building permits are also useful for creating revised demographics. New homes being built indicate potential population growth in the area. **Figure 4-22** illustrates the

historical trend in single family building permits from 1980 to 2007 for Collin, Dallas, Denton and Tarrant Counties. Tarrant County has experienced very strong growth in single family building permits and has issued more permits than Collin, Dallas or Denton Counties since 2000. All four counties have experienced a decrease in single family permits issued from 2006 to 2007.

A comparison of the annual growth rate year-to-year from 1980 to 2007 is illustrated in **Figure 4-23** for Collin, Dallas, Denton, and Tarrant Counties as well as the state of Texas and the United States. With the exception of Denton County, all areas saw a negative growth rate from 2006 to 2007. This growth in Denton County can potentially provide more traffic along the IH 35E corridor.

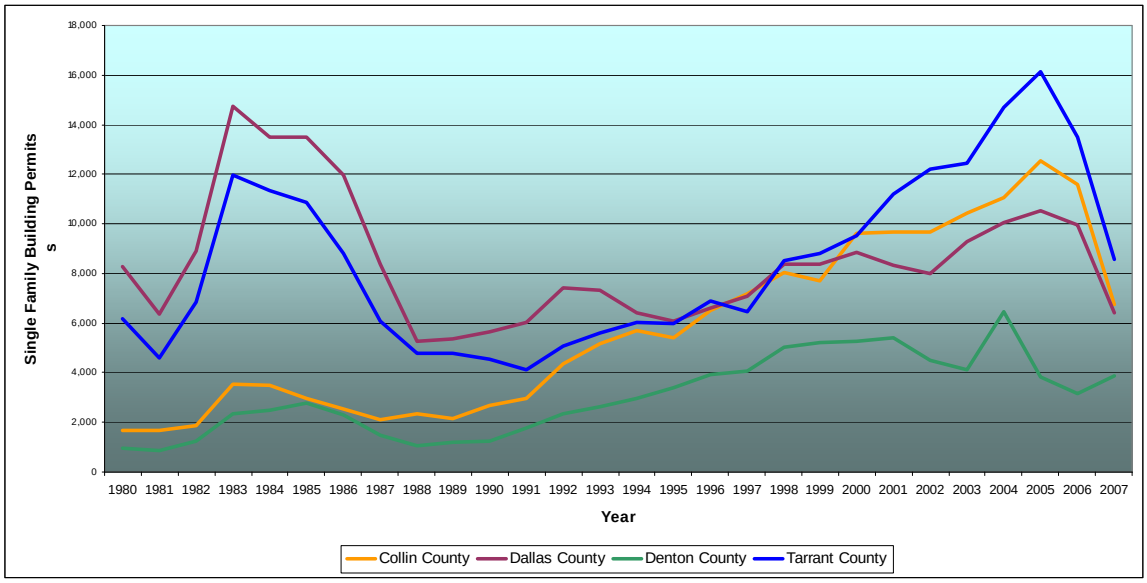


Figure 4-22. Single Family Building Permits by County

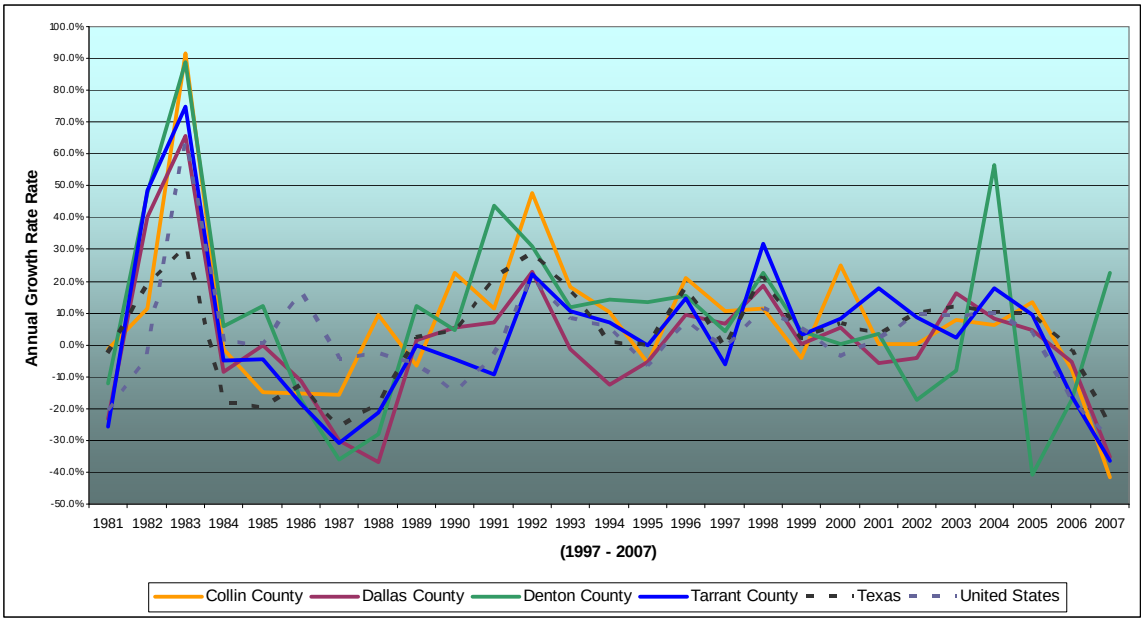


Figure 4-23. Annual Growth Rate in Single Family Building Permits

REVISED DEMOGRAPHICS

The travel demand models developed by NCTCOG as part of the 2030 Mobility Plan – utilized as the baseline for this study – are based on the demographic forecasts developed in 2003 using the Census 2000 survey. The NCTCOG is in the process of developing the 2040 demographic forecast, which will use 2005 data as the new baseline. The 2005 base data was published in 2008, however, the demographic forecasts for other years are still under the internal review and were not available for use in this study. As part of the economic growth analysis and demographic forecast review, revised demographics were created to take into account the more recent economic and demographic data since 2003 and to incorporate any changes of growth trends within the region made from the recent 2005 base data.

The process employed to develop the revised demographic included reviewing the recent developments along the study corridor, updating the future year forecasts based on the 2005 base data to reflect any potential changes to the growth trend within the region, evaluating the county and regional control totals of NCTCOG's demographic forecast by comparing these to forecasts from other sources, modifying the county population forecast control totals based on the evaluation, allocating the county control totals into the traffic analysis zone (TAZ) level based on NCTCOG's forecasts and performing various checks to ensure the reasonableness of population forecasts in the TAZ level. The employment forecast at the TAZ level was modified based on the revised population forecast by considering the population/employment ratio will remain similar to

NCTCOG's forecasts and was then reviewed for reasonableness. The demographic forecast sources reviewed as part of the revised demographic process included the Texas State Data Center (TSDC), the Texas Water Development Board (TWDB), the North Central Texas Council of Governments (NCTCOG), and Woods and Poole (W&P).

The qualifier "official" is used to refer to the NCTCOG demographics datasets, which were prepared by NCTCOG in 2003. The population and employment forecasts developed by WSA to update the NCTCOG official demographic datasets in the counties surrounding the IH 35E corridor are referred to as the "revised" demographic datasets. The baseline traffic and revenue estimates for the IH 35E managed lane project included in this report were developed using the developed revised demographics datasets.

Tables 4-13 and **4-14** show a comparison of the official and revised demographic (population and total employment) projections for Collin, Dallas, Denton and Tarrant Counties for year 2010, 2020 and 2030 respectively. The revised population and employment estimates are in general higher than the official demographics developed by NCTCOG. The population from 1990 and 2000 Census survey and the 2005 base data are added to the population comparison table to show the historical population growth in these counties. Population in Collin County has been growing at an annual average growth rate of 6.4 percent from 1990 to 2000 and 5.7 percent from 2000 to 2005. Recent development within this county indicates that it is still experiencing strong growth. Given these recent trends, it is more reasonable to assume a higher population growth rate for the period of 2005 to 2010 than the 2.9 percent growth rate estimated by NCTCOG. This increased growth rate, however, was gradually decreased in the following decades. Similar trends were found for the other three counties that were evaluated. The employment forecasts were also adjusted upward for the revised demographics in the range of 14 to 20 percent for Collin and Denton counties and 6 to 9 percent for Dallas and Tarrant counties respectively to reflect the observed current trends.

Table 4-13
Comparison of Official and Revised Population Projections

Year	Collin County		Dallas County		Denton County		Tarrant County	
	Official	Revised	Official	Revised	Official	Revised	Official	Revised
1990	264,036	264,036	1,852,810	1,852,810	273,525	273,525	1,170,103	1,170,103
2000	491,675	491,675	2,218,899	2,218,899	432,976	432,976	1,446,219	1,446,219
2005	649,089	649,089	2,365,652	2,365,652	554,452	554,452	1,631,704	1,631,704
2010	749,343	792,345	2,486,989	2,512,225	643,572	691,428	1,746,082	1,812,914
2020	938,681	1,120,523	2,624,989	2,729,729	862,332	1,013,078	2,047,553	2,188,782
2030	1,166,645	1,482,055	2,817,191	2,930,268	1,085,343	1,322,222	2,291,723	2,509,999
Annual Average Growth Rate								
1990-2000	6.4%	6.4%	1.8%	1.8%	4.7%	4.7%	2.1%	2.1%
2000-2005	5.7%	5.7%	1.3%	1.3%	5.1%	5.1%	2.4%	2.4%
2005-2010	2.9%	4.1%	1.0%	1.2%	3.0%	4.5%	1.4%	2.1%
2010-2020	2.3%	3.5%	0.5%	0.8%	3.0%	3.9%	1.6%	1.9%
2020-2030	2.2%	2.8%	0.7%	0.7%	2.3%	2.7%	1.1%	1.4%

Note: 1. Official data represent NCTCOG demographic forecast; revised represent revised demographic developed by WSA.
2. 1990 and 2000 represent census actual; 2005 data were summarized from the base data developed by NCTCOG as part of the 2040 demographic forecase.

Table 4-14
Comparison of Official and Revised Employment Projections

Year	Collin County		Dallas County		Denton County		Tarrant County	
	Official	Revised	Official	Revised	Official	Revised	Official	Revised
2010	291,456	355,096	2,052,703	2,205,415	227,394	254,555	1,072,516	1,165,659
2020	414,402	482,121	2,351,172	2,499,047	327,180	373,178	1,264,095	1,370,246
2030	527,853	612,763	2,540,076	2,706,060	423,293	494,339	1,393,459	1,511,928
Annual Average Growth Rate								
2010-2020	3.6%	3.1%	1.4%	1.3%	3.7%	3.9%	1.7%	1.6%
2020-2030	2.4%	2.4%	0.8%	0.8%	2.6%	2.9%	1.0%	1.0%

Note: Official data represent NCTCOG demographic forecast; revised represent revised demographic developed by WSA.

Figures 4-24 illustrate a four-county comparison of the WSA revised population forecasts with the population forecasts of various sources that include Woods and Poole (W&P), Texas State Data Center (TSDC) forecasts with three migration scenarios and 2000-2004 update, namely TSDC 0.0, TSDC 0.5, TSDC 1.0 and TSDC 2000-2004, Texas Water Development Board (TWDB), and the North Central Texas Council of Governments (NCTCOG) 2030 mobility plan demographic forecast (COG 2030 MP). As shown, revised demographics are in general higher than NCTCOG's demographic forecast with slight upward adjustment for Dallas and Tarrant County and relatively larger adjustment for Collin and Denton Counties. The revised demographic represents a moderate to high growth expectation compared to other sources of forecasts. The revised demographics were applied to the NCTCOG travel demand model to develop another set of trip tables, which are referred to as the "revised trip tables" in the following chapters and serve as the basis for the baseline traffic and revenue estimates.

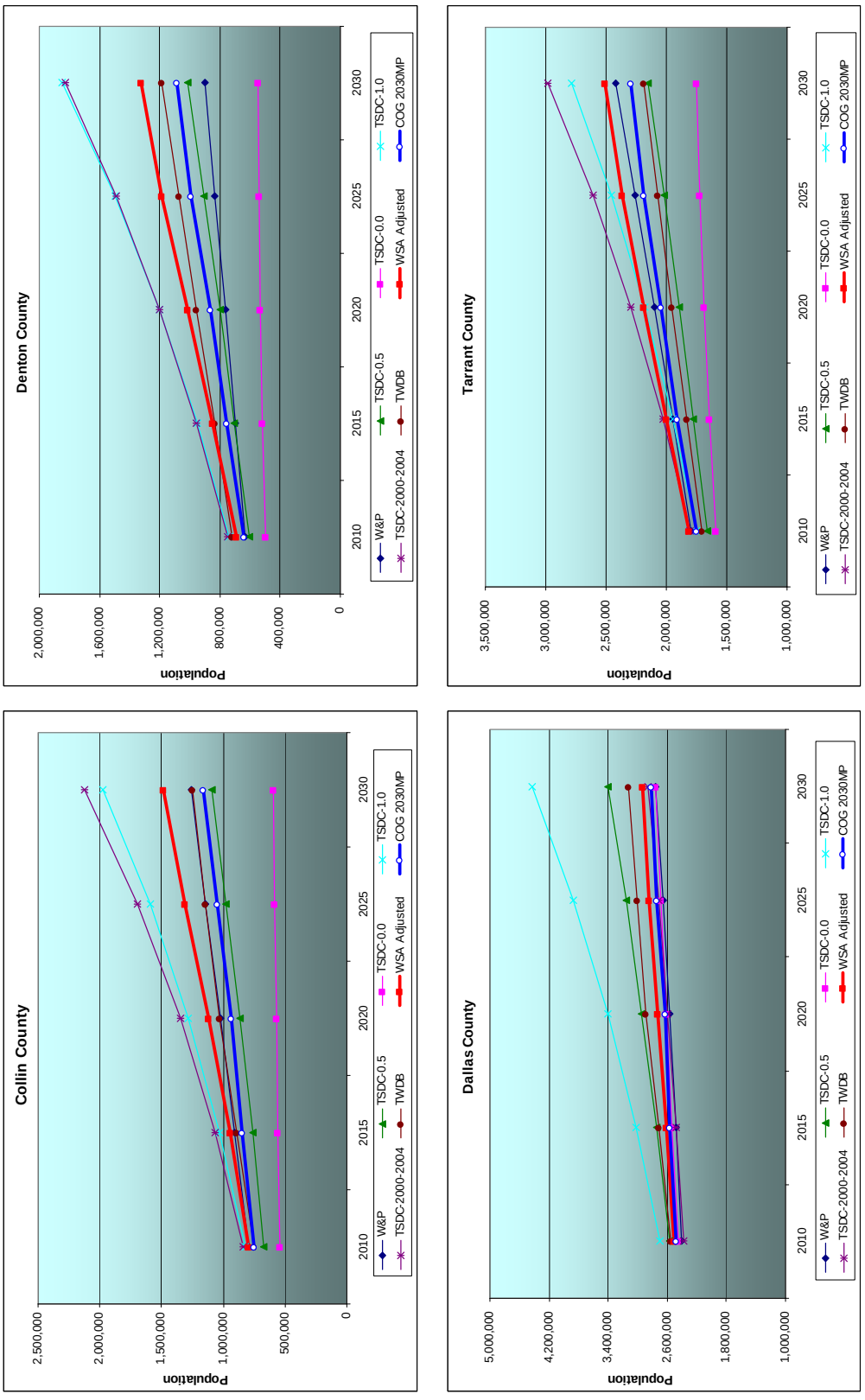


Figure 4-24. Comparison of Revised Demographic Projections

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 5

MODELING APPROACH

This chapter describes the development of the travel demand model to evaluate the managed lane facility and the model calibration processes. **Figure 5-1** illustrates the travel demand methodology that was used to develop the traffic and toll revenue forecasts for the IH 35E managed lanes. This methodology ensures that the forecast results remain consistent with previous analyses conducted for managed lane facilities within the Dallas/Fort Worth area. Most traffic and revenue studies attempt to answer three fundamental questions:

- How much demand currently exists in the corridor;
- How much will demand grow in the future; and
- What share of traffic can be expected to use the managed lane facility and what will drivers be willing to pay?

A detailed profile of the existing demand collected as part of this study is presented in Chapter 2 and included detailed traffic profiles along the current IH 35E facility and selected screenlines, travel time surveys along IH 35E and potential competing routes, vehicle occupancy counts, and many other travel characteristics. These became the foundation upon which the travel demand models were developed and calibrated. The model development for the traffic and revenue estimation process involved three levels of analysis:

- ***Global Demand Estimates*** - The global demand is an estimate of the amount of total traffic demand that will likely use the IH 35E corridor under existing and improved conditions. An economic assessment of the regional demographics was performed as part of this study to provide a gauge of what the total global demands will be in the future within the corridor. Regional highway networks, obtained from NCTCOG, were reviewed to correctly reflect the future planned improvements in the IH 35E study area and were updated to incorporate the latest schematic design of the proposed IH 35E general purpose and managed lanes. The official trip tables from NCTCOG were analyzed and compared with the

information collected from the origin-destination survey and were updated with the new socioeconomic data developed as part of this study.

- ***Travel Time Simulation Model*** - A traffic simulation model of the IH 35E corridor was developed using the VISSIM micro-simulation program to identify changes in the travel time and delay on different segments along the general purpose lanes in future years under the proposed corridor configuration. This simulation model provides a disaggregated indication of the delay conditions that may be experienced along the general purpose lanes related to both the magnitude of demand and the project configuration. These delay patterns play an important role in evaluating the time savings that the managed lane may provide which can then when combined with the motorists' willingness-to-pay a toll, serve to determine the expected use for the un-congested managed lanes; and

- ***Market Share Micro-Model*** - The market share micro-model is used to estimate the traffic that will choose the managed lanes under varying geometric configurations and toll levels. The share of corridor traffic in the managed lanes is based on several factors that include the location of access points and general purpose lane configurations between scenarios, the time savings offered by the managed lanes, and the toll rate levels.

The flow chart in **Figure 5-1** shows the general relationship between these three analysis components.

MODEL VALIDATION

Before considering the future travel demand forecast, the base-year model has to be validated and calibrated to the acceptable range. The model calibration process involves comparing the 2008 traffic assignment output volumes against traffic counts obtained for this study. Output travel time and speeds from the travel demand model were also compared to the actual travel time information collected. This process was performed for each of the time periods, AM Peak, PM Peak, and Off-Peak, to reflect the same period definitions as the NCTCOG official trip tables. The calibration was conducted on a region-wide basis, with specific focus on the area within which the IH 35E managed lane project is located. The traffic counts collected in late 2008 were used to calibrate the model outputs and adjust the network characteristics where needed. Four screenlines were developed along the corridor, as shown in **Figure 5-2**, to analyze the total corridor traffic trends and to compare the base model outputs to the current traffic characteristics within the IH 35E managed lane corridor. Three of the screenlines (screenlines 2 to 4) were selected to cross the IH 35E while, Screenline 1 runs parallel to IH 35E and is located west of Josey Lane from SH 121 till IH 635 to gauge the current magnitude of east-west traffic funneling into the study area.

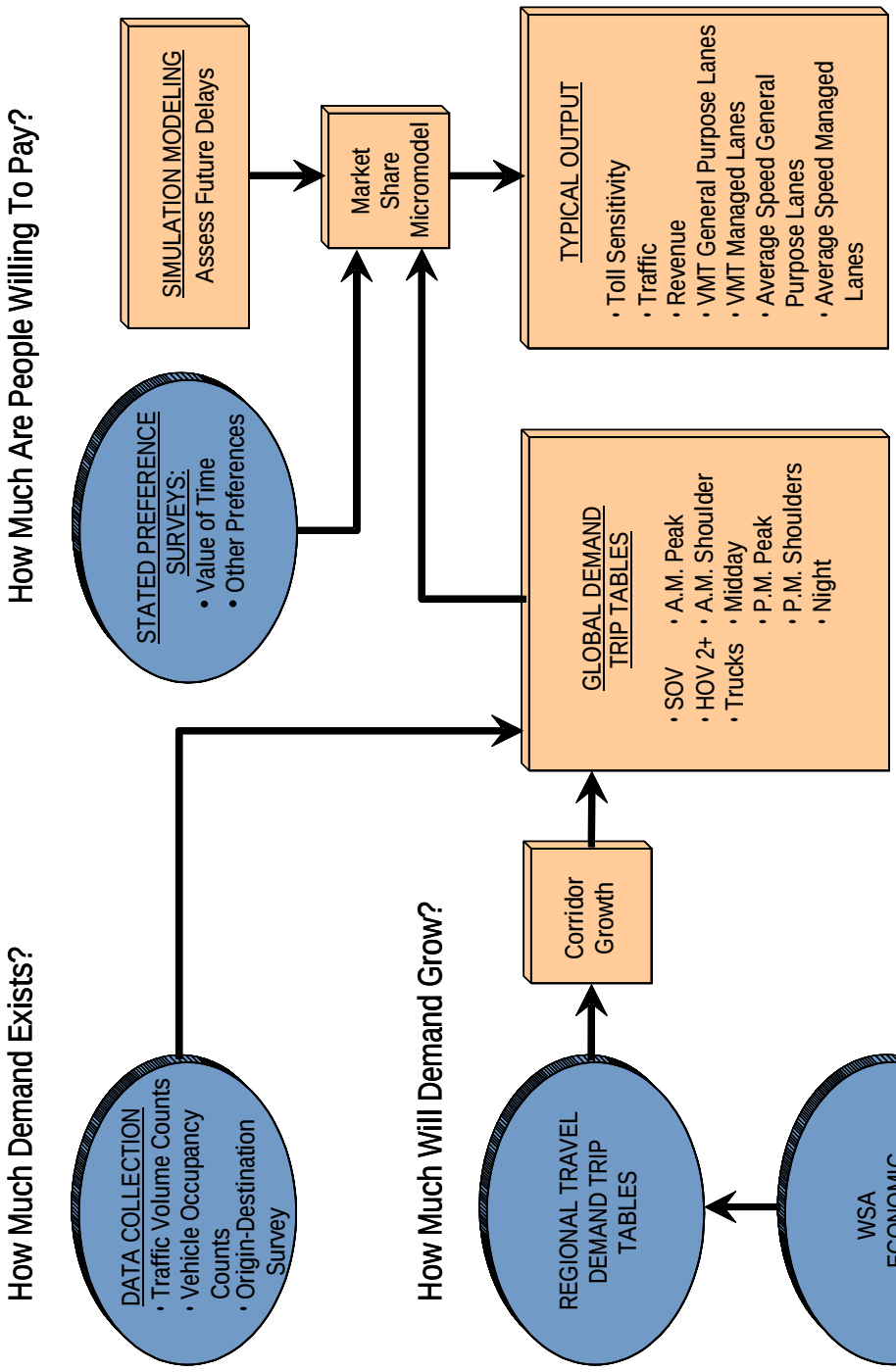


Figure 5-1. Travel Demand Model Process

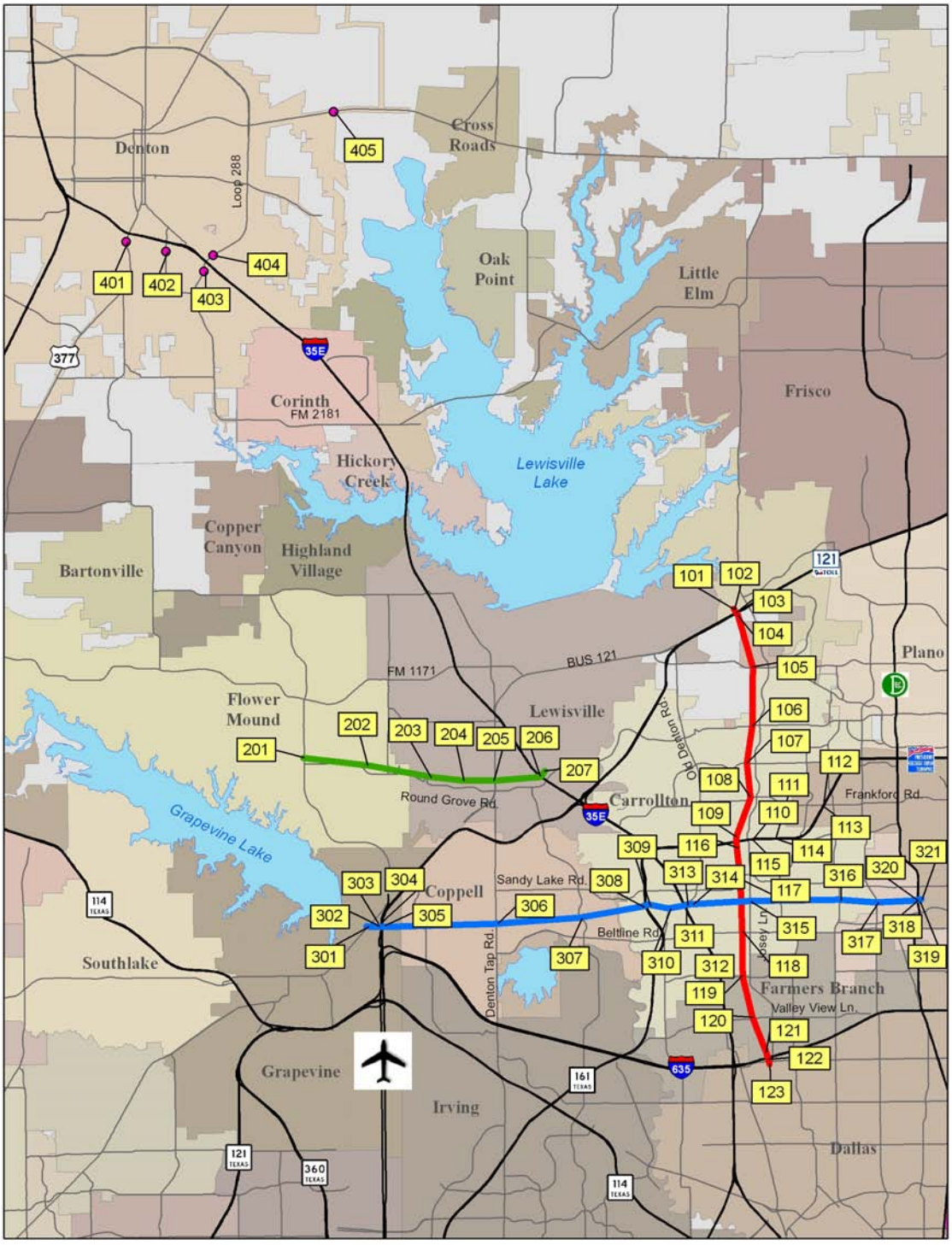


Figure 5-2. Screenline Locations

Figure 5-3 shows the percent deviation of modeled traffic volumes compared to the observed traffic volumes by direction and time period for the four screenlines. The maximum desirable deviation curve for screenlines was adapted from the "NCHRP 255: Highway Traffic Data For Urbanized Area Project Planning and Design," published by the Transportation Research Board to check the reasonableness of the validation process. This ballpark reasonableness check range has been widely used in the travel demand modeling practice. As shown, the percentage differences between the model volumes and traffic counts were all within acceptable ranges for each of the four screenlines and by direction.

Figure 5-4 shows the comparison of the modeled traffic volume with the observed traffic volume for individual locations along the four screenlines and by the three time periods. It is shown that almost all the points scatter closely around the diagonal line with slight variation from the regression line slope. This again indicates the base-year model is well calibrated to reflect the existing traffic conditions.

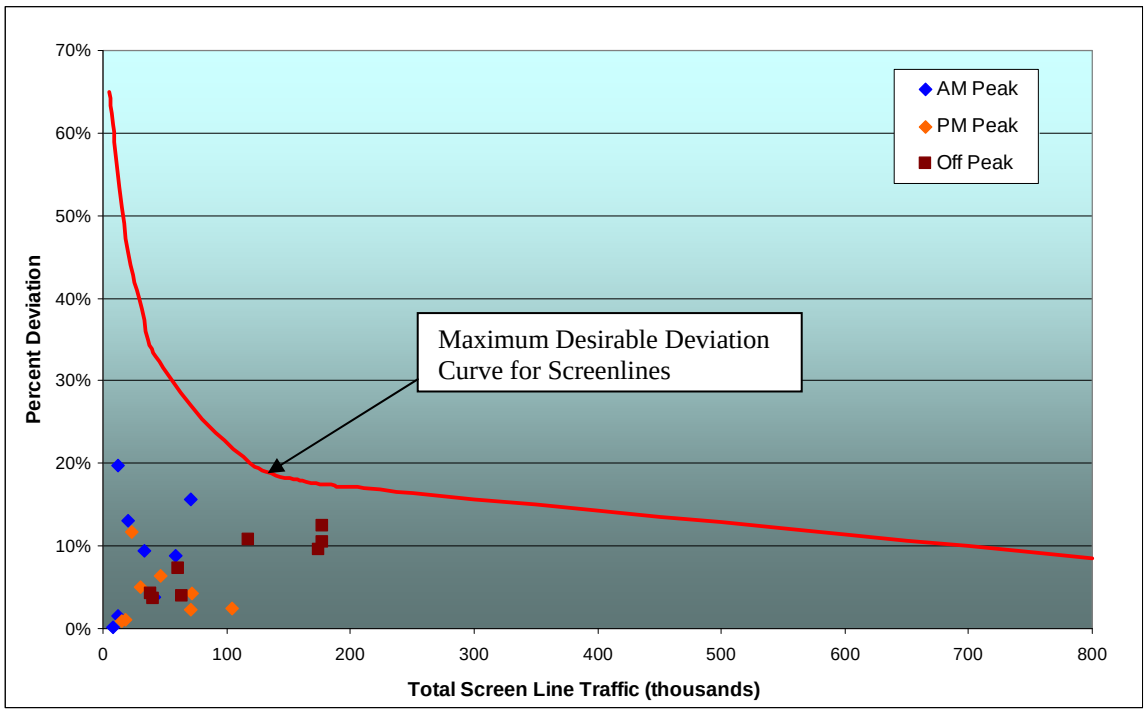


Figure 5-3. Model Calibration Results in Screenline Total

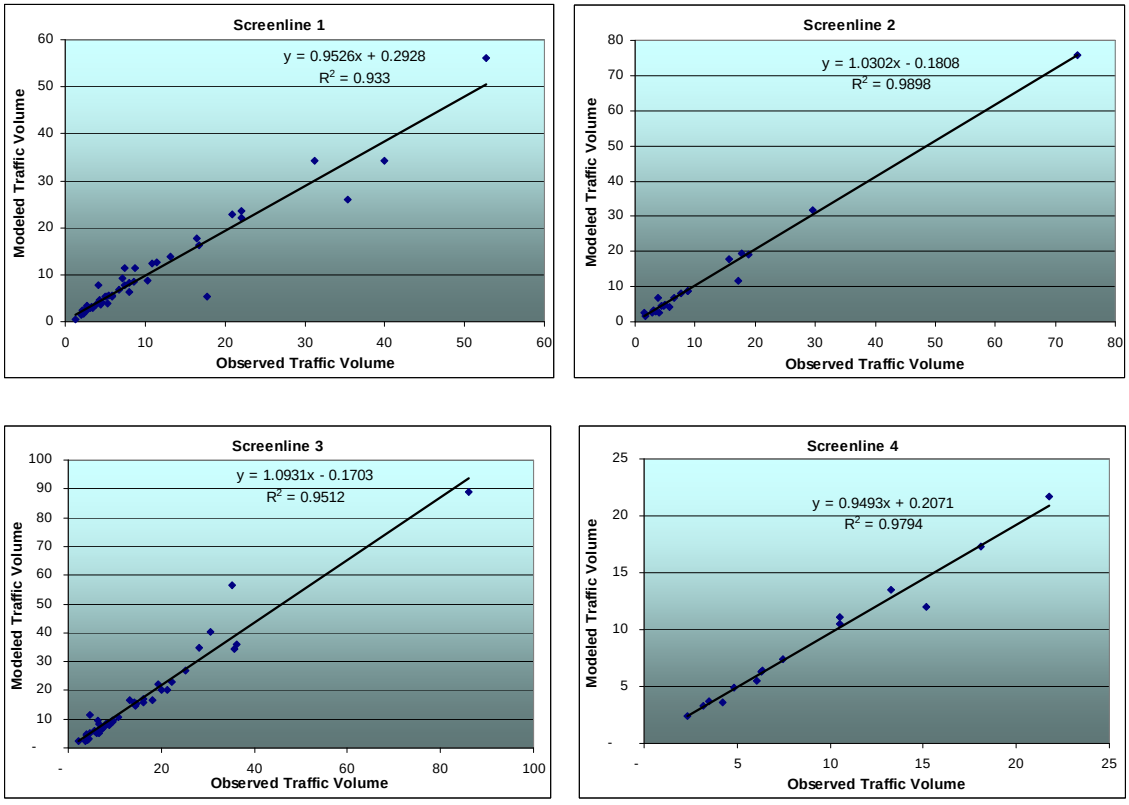


Figure 5-4. Model Calibration Results of Individual Road

GLOBAL DEMAND ESTIMATES

The corridor global traffic demand is defined as the total potential traffic traveling in the IH 35E corridor including frontage roads, general purpose lanes, and managed lanes. For this study, a micro-model was developed to encompass the corridor and consisted of a small windowed section of the overall regional model. This sub-area model was developed to include the major competitive routes and arterial networks in the study area. The global demand for the model reflected the trip table distributions through the corridor and was determined using the modified socioeconomic forecasts from the NCTCOG regional travel demand model (as described in Chapter 4).

The regional travel demand model was used in two ways: 1) to provide the base travel patterns for the micro-model sub-area, and 2) to develop traffic growth characteristics for the micro-model sub-area.

The calibration process for the regional model used for this study included the following steps:

- The development of trip tables for the years 2008, 2015, 2025, and 2030 levels for

AM, Midday, PM, and Night periods. The trip tables were segmented into SOV (single-occupant vehicle), HOV2+ components for a more detailed analysis of each market segment, and Trucks.

- The adjustment of assignment parameters including link speeds and capacities, and speed/flow relationships to reflect the current travel characteristics in the corridor. This process used the extensive traffic data collection program to ensure that the model accounted for current traffic volumes and speeds along the corridor and major routes in the study area.

- Extraction of the micro-model sub-area travel information for base and future years.

The model development for future global demand estimates involved the highway network update, the development of the socioeconomic database, and trip table modifications, which are further described below.

Highway Network

The Dallas-Fort Worth regional highway network based on the 2030 MTP was used as the base network for this study. The networks within the IH 35E managed lane project study area were reviewed and updated with the network changes outlined in the 2009 Amendment (the networks from the 2009 Amendment were not made available until April 2009 after the model development for the study had already been performed). The IH 35E corridor was edited to incorporate the latest schematic design of the project including the ramp configuration, link length, and number of lanes.

The travel speeds in the original network were reviewed and edited as necessary according to the speed and delay information collected as part of this study. The updated networks were first tested to ensure all the network characteristics were correctly coded. The managed lane typically requires a lot of traffic assignment runs due to the further divided time periods and various project scenarios. Thus the sub-area analysis technique was used to extract a windowed area around the IH 35E managed lane project. The subarea network was developed to include the potential competing routes, feeding roadways and other important connecting roads. The defined subarea consisted of a total of 1,275 centroids (the original network has 4,874 traffic analysis zones), of which 1,113 were internal and 162 were external stations. The use of the subarea network significantly reduced the model running time of the traffic assignment, while conserving all the important traffic characteristics in the study area such as total demand, and trip distribution.

Socioeconomic Assumptions

The future year demographic forecasts as part of the 2030 MTP developed by NCTCOG, uses the 2000 census data as the baseline data. The development of the 2035 MTP by NCTCOG is currently underway and is not expected to be available until sometime in

2010. The NCTCOG released the baseline 2005 updated demographic data in early 2008, however, the future year demographic forecasts were still under internal review while this study was being conducted. In order to the reflect potential changes in the socioeconomic data between 2000 and 2005, the original 2030 MTP demographic forecasts of 2008 (interpolated based on 2007 and 2009) were updated based on the 2005 baseline data.

Another important element used to review the revised socioeconomic database is the regional and county level control totals for the population and employment forecasts. Population forecasts from several other sources including Texas State Data Center, Texas Water Development Board, and Woods & Poole, were reviewed and compared with the NCTCOG demographic forecast. Adjustments to the county population and employment forecasts of NCTCOG were then made based on this review. The revised county demographic forecasts were then assigned to the TAZ level based on the updated 2008 forecast and the original 2030 MTP future year demographic forecasts in each TAZ. A detailed description of the development of the revised socioeconomic database is provided in Chapter 4.

Base-Year Trip Tables

The sub-area trip tables used in the micro-model were initially extracted from region-wide traffic assignments at base-year (2008) levels. The hourly traffic volume profiles and speed and delay runs summarized in Chapter 2 were used to identify appropriate analysis intervals for use in this study. The trip tables were also compared to vehicle occupancy and classification counts to ensure that the correct distributions of HOVs and trucks were represented. The analysis periods used in the sub-area model and the micro-model are defined as follows:

- AM Peak period: 6:30 AM – 8:00 AM;
- AM Shoulder period: 8:00 AM – 9:00 AM;
- Midday period: 9:00 AM – 3:00 PM;
- PM Pre-peak Shoulder period: 3:00 PM – 4:30 PM;
- PM Peak period: 4:30 – 6:30 PM; and
- PM Post-Peak Shoulder period: 6:30 PM – 7:30 PM.

Trip tables for the analysis periods were used as seed matrices in a matrix estimation process that adjusted the trip tables to traffic volumes for IH 35E general purpose lanes, ramps, frontage roads, and arterials along the four screenlines. These adjustments, based on the matrix estimation methodology, were used to ensure that the assignment volume from the adjusted base-year sub-area trip tables matched the traffic counts.

These period segmentations also fell within the Regional Transportation Council (RTC) managed lane policy guidelines related to the definitions of peak versus off-peak periods. The overnight period from 7:30 PM to 6:30 AM was not analyzed explicitly. The traffic and toll revenue forecasts presented in Chapter 6 assumed a small fixed percentage of

traffic and revenue will occur during the overnight hours, as well as on weekends. These trips account for vanity trips that will use managed lanes regardless of travel time savings.

Future-Year Trip Tables

The regional model was used to develop the micro-model sub-area trip tables for all the future years. Future-year (2012, 2015, and 2025) traffic assignments using the regional model were performed to identify potential changes in travel patterns in the corridor. Among other things, these travel patterns are likely to be affected by:

- Forecasted growth in the region;
- The addition of new capacity to the freeway in the form of the managed lanes being studied herein;
- Highway improvements to other freeways in the region; and
- Changes to the ramp configurations as part of the proposed IH 35E improvements.

Trip tables representing the micro-model sub-area were extracted from each set of runs and compared to those developed for the base-year to estimate zonal growth rates, which were then applied to the calibrated base-year sub-area matrices.

TRAVEL TIME SIMULATION MODEL (VISSIM)

Traditional traffic assignment models do not adequately replicate the impact of merging and weaving maneuvers on freeway capacity, nor can they reflect the impact of downstream queuing on freeway segments. A microscopic simulation software called VISSIM was used to assist in estimating the impacts of travel speeds on different segments of the freeway. VISSIM attempts to model each vehicle as a separate entity and introduces a certain level of randomness to the vehicles' behavior. The roadway geometry and interaction with other vehicles then influences the behavior of each vehicle in the model.

A series of VISSIM runs were performed using differing assumptions on possible traffic shifts to the managed lanes for each of the six time periods identified for the analysis, at 2030 levels and at different toll rates. These volumes were a result of several iterations reaching equilibrium between toll rates, speeds, and traffic shares. As congestion increases across general purposed lanes, traffic shifts into the managed lanes resulting in lower congestion levels in the general purpose lanes. With lower congestion, traffic shifts back into general purposed lanes resulting in increased congestion. The increased congestion along general purposed lanes then diverts traffic back to the managed lanes. This process is repeated through several iterations until equilibrium is reached. Several runs were made for the six primary analysis periods for each direction. Within each time period, for each link, a relationship was developed between the "traffic demand" on the

link and its modeled travel speed. By graphing the relationship between traffic demand and travel speed for all runs for each general purpose lane segment, scenario-specific volume-delay curves were developed for each link on the general purpose lanes.

Each link in the micro-model was then tagged with a user code to identify a unique curve to be used to estimate travel speeds for that link during the micro-model assignment process. Links with less weaving and merging characteristics tended to be able to accommodate higher traffic volumes at higher speeds before breaking down. Links with large entry ramp volumes or a high density of ramp interactions, tended to break down at lower demand levels, and more quickly. Other sections of the freeway could possibly break down at relatively low levels of demand as a result of downstream congestion and queuing from these bottleneck locations.

MARKET SHARE MICRO-MODEL

The extracted micro-model sub-area used for this study is the area surrounded by several major highways that include IH 35W, SH 183, IH 635, US 380, and the Dallas North Tollway (DNT). The micro-model package included six alternative networks that were used to estimate traffic and revenue under the six project alternatives described in Chapter 1.

MARKET SHARE ANALYSIS

In the micro-model, travel time between a path using the tolled managed lanes was compared to the travel time along a path using the next best free routes (most likely the general purpose lanes or frontage roads). For each travel movement, the proportion of motorists expected to use the managed lanes is a function of the computed time savings and the cost to use the lanes (cost-per-minute saved) versus the value placed on time savings by the motorist (value of time or VOT).

The share of each traffic movement that is captured by the managed lanes is based on an estimate of the distribution of VOT, also developed from the stated preference surveys collected in the corridor. It was estimated that motorists with a VOT greater than the cost per minute saved will tend to choose the managed lanes while those with a lower VOT would tend not to choose the lanes.

The VOT used in this study were based on an analysis of the responses to stated preference surveys conducted within the corridor in November 2008. Details of the survey process can be found in the report "Data Collection Project - IH 35E" dated February 2009. The median VOT used for this analysis was $10.96 per hour (in 2008 Dollars) for both peak and off peak trips.

The micro-model relies on developing an equilibrium condition between the toll cost and the estimated time savings. If more traffic uses the managed lanes, there is less congestion in the free lanes and lower time savings. Less time savings will in turn result

in less traffic choosing the managed lanes. For each toll rate level, there exists an equilibrium point between the level of traffic congestion in the free lanes (time savings) and the amount of traffic willing to pay a toll to save that same amount of time.

At low toll levels, there is a higher propensity to use the managed lanes, and thus there are lower congestion levels in the general purpose lanes. At higher toll levels, there is less traffic in the managed lanes and consequently more congestion in the general purpose lanes.

A full range of toll rates were tested, from $0.00 per mile to $0.80 per mile, for each time period and travel direction. The toll rates chosen for use in the traffic and revenue analysis generally reflect those that maximized revenues for each individual time period and optimize revenue to match policy objectives. Given the proximity of the managed and general purposed lanes, operating cost was not used in the analysis.

Vehicle Categories

The micro-model trip tables were separated into three components: SOV, HOV2+, and Trucks. Each trip table was assigned simultaneously until an equilibrium condition was reached for that particular toll rate. Trucks are allowed to use the IH 35E managed lanes at a higher toll than SOVs. These toll rates were determined to fall in line with the RTC managed lane toll policy regulations and truck toll rate factors were determined using the existing axle counts collected along the corridor.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 6

TRAFFIC AND TOLL REVENUE ESTIMATES

The following chapter presents the traffic and toll revenue estimates for the proposed IH 35E managed lanes project. The estimates are based on the planned general purpose and managed lane configurations described in Chapter 1, and are based on the modeling procedures and calibrated travel demand model as outlined in Chapter 5. A brief description of the six traffic and toll revenue alternatives that were estimated for this study are also summarized herein along with their respective toll rate sensitivity analysis and results, highlighting the optimal toll rate for the various alternatives. The estimated average daily transactions and toll revenues and the expected travel time savings are summarized under the defined baseline assumptions. The annual transaction and toll revenue estimates were developed for a 52 year time horizon under the assumed opening year of 2015.

PROJECT DESCRIPTION AND MODELING ALTERNATIVES

The IH 35E study corridor extends from IH 635 in Dallas in the south to a north terminus at US 380 in Denton. The corridor is approximately 28.0 miles and is located within Dallas County and Denton County. Its southern termini begins at the northwest corner of city of Dallas and passes through several major high-growth cities that include the cities of Farmers Branch, Carrollton, Coppell, Lewisville, Hickory Creek, Highland Village, Lake Dallas, Corinth and Denton. The corridor is divided into three segments: the south segment from IH 635 to PGBT, the middle segment from PGBT to FM 2181, and the north segment from FM 2181 to US 380, as shown in **Figure 6-1**. In general, the area around the south segment has experienced high growth over the past several decades and the developments are now relatively mature within this area. The cities along the middle and north segments have been growing at a faster pace over the past 10 years and will continue to be among the high growth cities within the Dallas/Denton region.

The study corridor has the highest traffic in the southern segment and steadily decreases further north along the corridor. The current IH 35E facility has three lanes in each

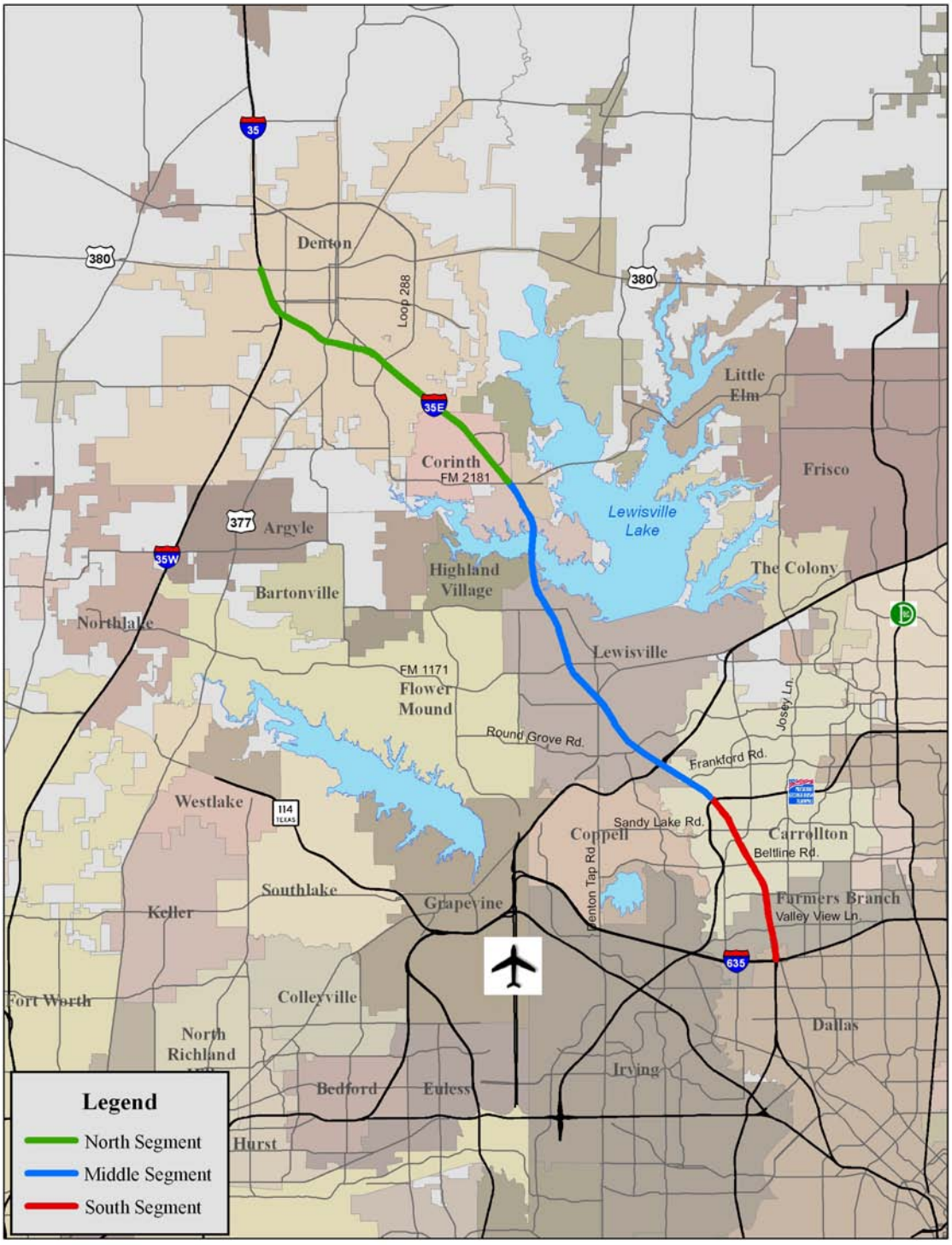


Figure 6-1. IH 35E Managed Lane Project Location and Segments

direction between IH 635 and FM 2181, and two lanes in each direction from FM 2181 to the merge with IH 35W. A single concurrent HOV lane per direction currently runs from IH 635 to SH 121 in Lewisville. Directional traffic during the peaks currently exists along the entire corridor with heavy demand in the southbound direction during the morning peak and in the northbound direction during the afternoon peak. The south segment and a portion of the middle segment, just south of SH 121, currently experience significant congestion during the peak periods. The middle segment north of Business SH 121 operates mostly in free-flow condition, while the north segment experiences congestion during the peak hours and more so in the afternoon peak northbound direction.

The strong population and employment growth along most of the corridor continues to place additional travel demand pressures on the existing facility. The proposed corridor enhancements that are currently planned include a widening of both the service road and freeway general purpose lanes to accommodate future traffic needs. In addition, new managed lanes with two lanes in each direction are also proposed to be constructed in the median along the entire study corridor. The expanded capacity is expected to improve mobility and travel time reliability along the corridor and facilitate the forecasted development within the area.

Six unique project alternatives developed to encompass several financing alternatives were modeled to evaluate the revenue generation potentials of the proposed managed lanes as outlined in **Figure 6-2**. These alternatives reflect a combination of proposed phased opening years for the various corridor segments along with variations in the overall corridor configuration. In addition to the three project segments discussed above, another two early or temporary projects (sub-segments) were also defined to form various project alternatives. The "north early project" is a breakout of the north segment from Bonnie Brae Street to Loop 288. The "temporary north widening" represents the temporary widening of the existing general purpose lanes to 3 lanes per direction, between Loop 288 to FM 2181, that is expected to be built to help transition traffic from the middle segments under the alternatives where the north segment is not built. The six alternatives analyzed as part of this study included:

- *Alternative 1* reflects the most optimistic and base case construction plan with managed lanes and general purpose and frontage road expansions along the south, middle and north segments assumed to open in 2020, 2015 and 2018 respectively. The existing HOV lanes along the south segment will be converted to HOT lanes prior to the full managed lanes being built.

- *Alternative 2* defers the construction of the south and north segments until 2030, with the middle segment being built by 2015.

- *Alternative 3* is a slight variation of Alternative 2 and includes the construction of the north early project and temporary north widening as defined above.

- *Alternative 4* reflects the same construction time plan as Alternative 1, but defers the south segment until 2040.

- *Alternative 5* evaluates the deferral of the north segment until 2040, with the south and middle segments constructed as planned in Alternative 1.

- *Alternative 6* reflects the deferral of both the south and north segments by five years compared to Alternative 1, with the middle segment assumed to open in 2015.

The north early project and temporary north widening are assumed to be in place for both Alternative 5 and 6 with the deferral of the north segment.

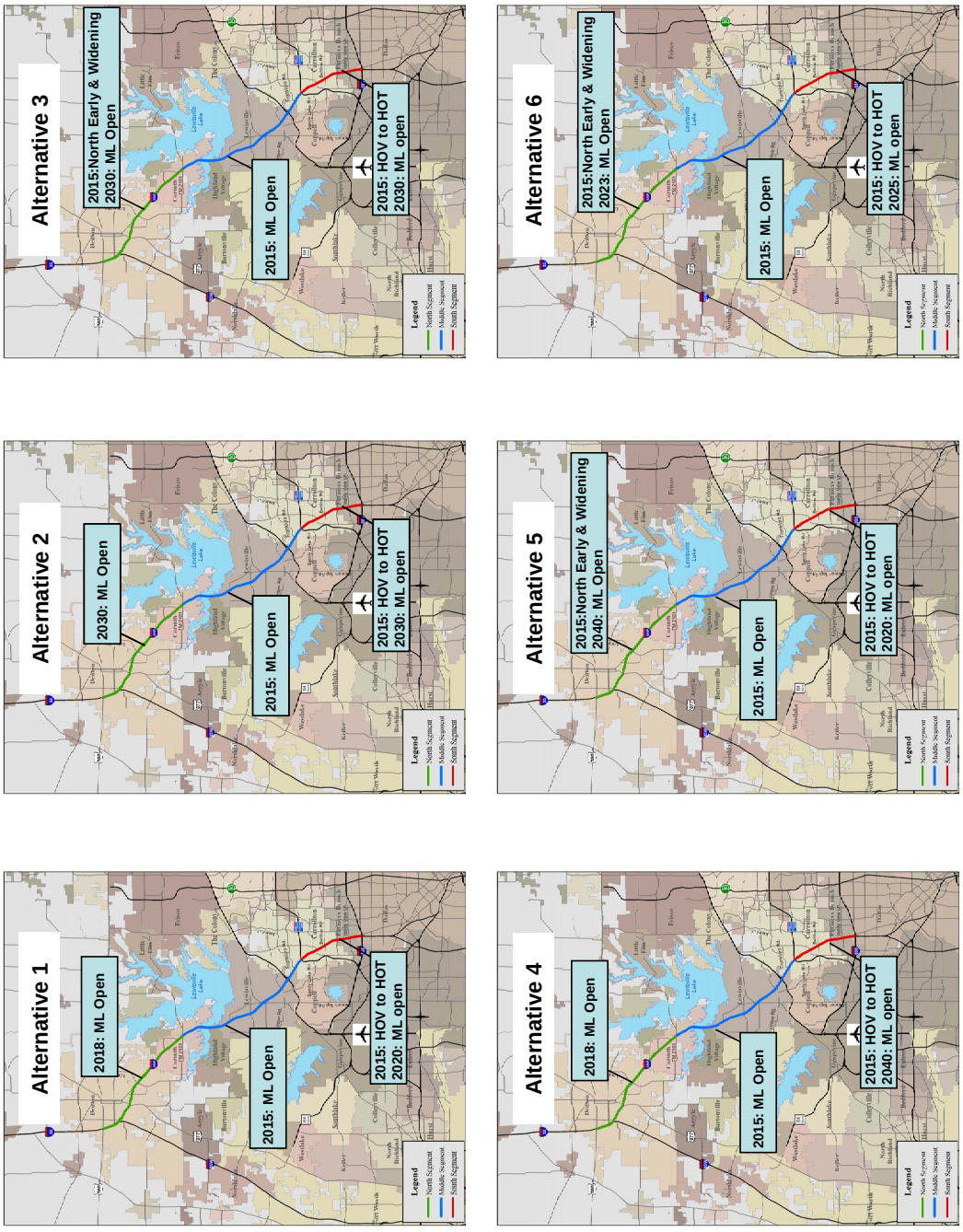


Figure 6-2. Project Alternatives

CONCEPTUAL TOLL COLLECTION PLAN

A conceptual toll collection plan was designed as outlined in **Figure 6-3** to reflect the potential capture of the various movements along the proposed managed lane facility. Six mainlane toll gantry locations were identified along the entire corridor along with a single ramp gantry on the IH 35W direct connection to ensure the capture of all travelers along the facility. The six mainlane gantries virtually divide the entire study facility into toll collection sub-sections as follows:

- Section 1: from IH 635 to Belt Line Road;
- Section 2: from Belt Line Road to PGBT;
- Section 3: from PGBT to Corporate Drive;
- Section 4: from Corporate Drive to Valley Ridge Boulevard;
- Section 5: from Valley Ridge Boulevard to FM 2181/Swisher Road;
- Section 6: from FM 2181 to Teasley Lane; and
- Section 7: from Teasley Lane to US 380.

The sub-toll collection sections were defined also to facilitate the phased analysis for the three project segments. The toll collection sections 1 and 2 reflect the full length of the south segment, while the toll collection sections 3 to 5 are for the middle segment, and sections 6 and 7 capture the north segment. The toll collection plan discussed herein is for the full build-out of the ultimate plan and these toll gantry locations may require some interim temporary gantries to accommodate the phased opening of the different segments.

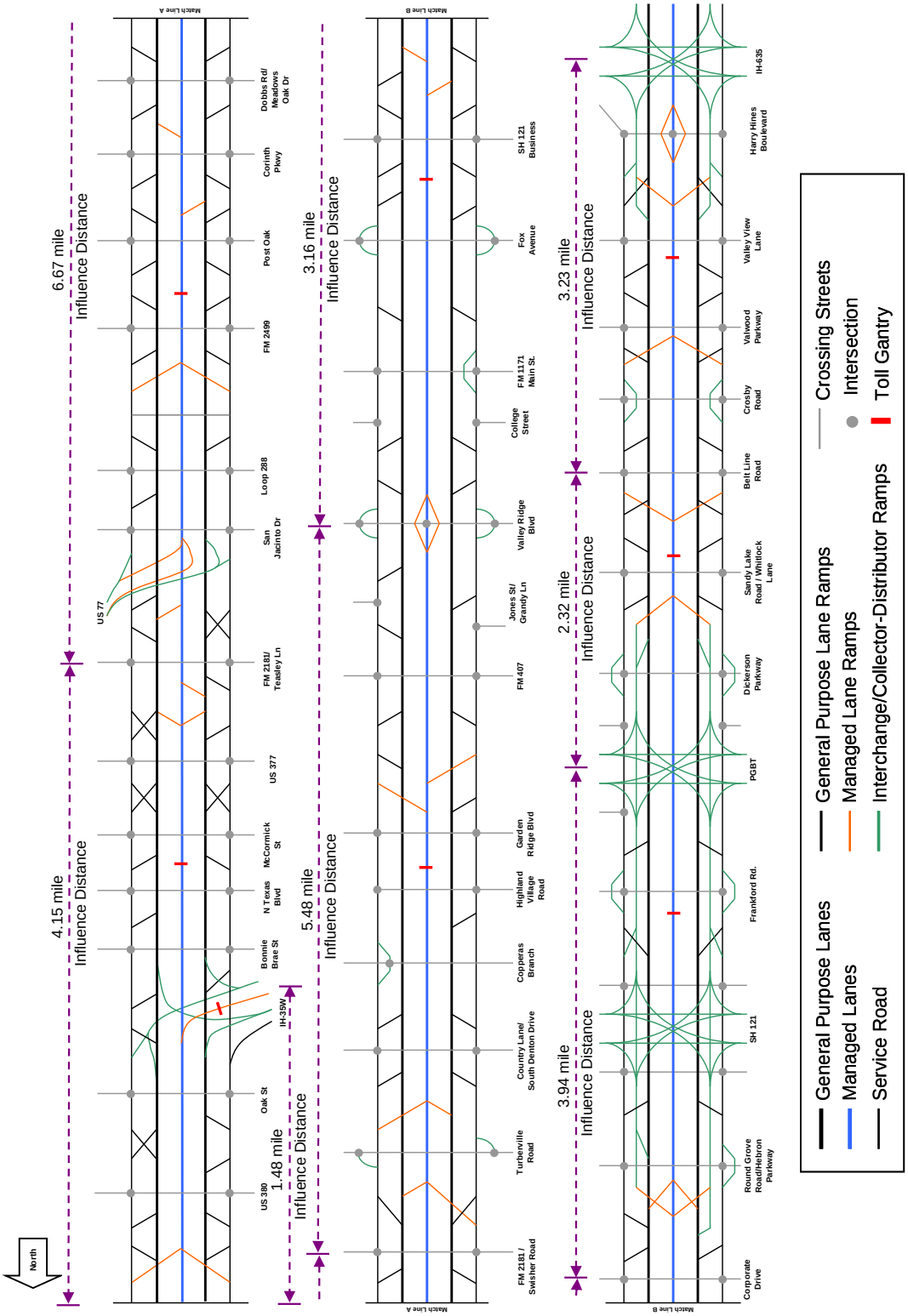


Figure 6-3. Conceptual Toll Collection Plan

WilburSmith ASSOCIATES

TRAFFIC AND REVENUE ESTIMATE BASIC ASSUMPTIONS

The 52-year traffic and toll revenue estimates for the six alternatives were calculated based on the project configuration described in Chapter 1, the corridor growth discussed in Chapter 4, the toll collection plan discussed above, and the following additional basic assumptions:

- The segments of the proposed managed lanes are assumed to open to traffic no earlier than January 1, 2015 and will occur in phases as depicted by the defined six alternatives;

- The configuration, vehicle type eligibility, targeted operating speeds of the managed lanes, proposed access locations, and per mile toll rates will be implemented as described in this report;

- The tolls will be collected using electronic toll collection (ETC) with revenue-neutral video tolling based on distance traveled with an assumed minimum toll, and no cash will be accepted. The ETC operations are assumed to be actively monitored and strictly enforced to minimize potential revenue loss due to toll evasion. *No toll evasion adjustments were made to the toll revenue estimates included in this report*;

- Transportation improvements as detailed in NCTCOG's Mobility Plan 2030: 2009 amendment will be implemented; no other competing routes or capacity improvements will be constructed within the forecast period and no additional general purpose lane capacity, outside the proposed MTP expansions, will be provided along the IH 35E corridor;

- Commercial vehicles/trucks with more than two-axles will have access to the managed lanes and will be charged 3.5 times the normal toll rate as derived from the average truck axle distribution along the corridor;

- Estimates of annual toll revenue included in this report have been adjusted to reflect "ramp-up" during the first three years of operation. The ramp-up volume was assumed to be 80 percent of the model estimate in the opening year, 90 percent in the following year, and 100 percent for all subsequent years;

- HOV2+ vehicles will receive a 50 percent discount during the AM and PM peak periods until 2025, to conform with the current Regional Transportation Council (RTC) managed lane policy;

- The IH 35E managed lanes will be well maintained, efficiently operated and effectively signed and promoted to encourage maximum usage;

- The value of time was increased at an average rate of 2.75 percent per year for the forecast period based on an economic analysis of the corridor;

- Annual revenues were calculated using an estimated 275 equivalent revenue days based on observed count characteristics in the corridor. Besides 250 working days, previous managed lanes' studies recommend a maximum of 30 revenue days for the weekend periods. With the weekend to weekday traffic ratio calculated as 82 percent, 25 revenue days were used for the weekends;

- Traffic during night time (7:30 p.m. - 6:30 a.m.) was not directly modeled in the travel demand model. Instead, the potential revenue generation during the night time was assumed to be 2 percent of the total daily revenue;

- Economic growth in the study corridor is based upon projections and growth patterns as described in Chapter 4;

- Motor fuel will remain in adequate supply and increases in price will not substantially exceed overall inflation over the long term; and

- No local, regional, or national emergency will arise that may abnormally restrict the use of motor vehicles.

Any significant departure from the above basic assumptions could materially affect the estimated traffic and toll revenue for the proposed IH 35E managed lanes facility.

TOLL RATE/OPERATIONS PROFILES

Unlike a typical toll road, managed lanes lie in the same corridor as their direct competition. Because of this, the managed lane traffic and revenue has a high degree of sensitivity to the operating conditions in the general purpose lanes. Typically, as toll rates in the managed lanes are reduced, a higher share of the general purpose lane users will choose to use the managed lanes. The resulting reduction in traffic on the general purpose lanes will then decrease congestion on the free facility. However, as congestion decreases in the general purpose lanes, the time savings associated with using the managed lanes will also decrease, resulting in reduced use of the managed lanes. This series of trade-offs continues until an equilibrium is reached between the operating conditions in the general purpose lanes, the managed lanes, and the toll rates set to use the managed lanes.

To depict these trade-offs, toll rate/operations profiles were developed for the AM peak, AM shoulder, midday, PM pre-shoulder, PM peak and PM post-shoulder conditions. The analysis was conducted for each alternative for the opening-year 2015 and the future-year 2030 levels for each of the following periods:

- AM Peak period: 6:30 AM – 8:00 AM;
- AM Shoulder period: 8:00 AM – 9:00 AM;
- Midday period: 9:00 AM – 3:00 PM;
- PM Pre-peak Shoulder period: 3:00 PM – 4:30 PM;
- PM Peak period: 4:30 – 6:30 PM; and
- PM Post-Peak Shoulder period: 6:30 PM – 7:30 PM.

The toll rate sensitivity analysis was conducted for each alternative ranging from $0.00 to $0.80 per mile. This analysis was performed for each model year and time interval to determine which rates will deliver the optimum revenues and ensure free flow operations in the managed lanes facility. The optimum rates were selected for each time period and travel direction by calculating the estimated traffic and revenue potential under the different alternatives. In general, optimum toll rates were selected based on revenue maximization unless different rates were necessary to maintain free-flow conditions in the managed lanes.

Table 6-1 shows the optimum per mile toll rate in 2015 for the six alternatives (note: several of the alternatives have phased openings that are beyond the 2015 timeframe however, for modeling purposes their equivalent toll rates are shown in this year). Among the six alternatives, the south segment exhibits the highest utilization of the managed lanes, especially since no additional general purpose lane capacity is provided in 2015. The middle segment under all the six alternatives is built to the ultimate configuration. The north segment in alternatives 1, 2 and 4, assumes that no managed lanes will be constructed and no capacity expansion will be performed while, under alternatives 3, 5 and 6, the north early project and temporary widening are assumed to be constructed. The high demand of the HOV traffic along the southern segment warranted the management of this demand to avoid the market impeding the flow of traffic in the lanes during the high demand peak periods. As such, the HOV lanes were converted to HOT lanes where the high-occupancy vehicles pay discount toll rate during peak period and full toll during off peak period to conform with the RTC managed lane toll policy. The toll rates shown in **Table 6-1** are a summary of two possible combinations whereby the north segment is either built or is not.

The south segment has an optimum per mile toll rate of $0.50 per mile in the southbound direction during the morning peak and the optimum per mile toll rate was found to be $0.55 per mile for the northbound direction during afternoon peak. The optimum toll rate of the middle segment reflects the construction of the two managed lanes in each direction along with the general-purpose lane capacity expansion from 3 lanes to 4 lanes. The toll sensitivity analysis indicates that the optimum toll rate for 2015 will be approximately $0.30 per mile in the morning peak direction and $0.35 per mile for northbound direction during the afternoon peak period. For the alternatives where the north early project is constructed, the optimum toll rate in the North segment is

approximately $0.20 per mile and $0.25 per mile for morning and afternoon peak directions.

The 2030 optimum per mile toll rates for the six alternatives are shown in **Table 6-2**. All three segments were assumed to be constructed under four of the six alternatives. The south segment was assumed to be converted to a HOT configuration in Alternative 4, while Alternative 5 reflects the north early project and temporary widening scenarios.

Table 6-1

2015 Optimum Per Mile Toll Rate

Segment	Direction	Period					
		AM1	AM2	MD	PM1	PM2	PM3
Alternatives 1, 2, 4							
South	NB	$0.10	$0.10	$0.15	$0.45	$0.55	$0.15
Middle	NB	$0.05	$0.05	$0.10	$0.30	$0.35	$0.10
North	NB						
South	SB	$0.50	$0.45	$0.15	$0.10	$0.10	$0.10
Middle	SB	$0.30	$0.25	$0.10	$0.05	$0.05	$0.05
North	SB						
Alternatives 3, 5, 6							
South	NB	$0.10	$0.10	$0.15	$0.45	$0.55	$0.15
Middle	NB	$0.05	$0.05	$0.10	$0.30	$0.35	$0.10
North	NB	$0.05	$0.05	$0.05	$0.15	$0.25	$0.10
South	SB	$0.50	$0.45	$0.15	$0.10	$0.10	$0.10
Middle	SB	$0.30	$0.25	$0.10	$0.05	$0.05	$0.05
North	SB	$0.20	$0.20	$0.05	$0.05	$0.05	$0.05

Table 6-2

2030 Optimum Per Mile Toll Rate

Segment	Direction	Period					
		AM1	AM2	MD	PM1	PM2	PM3
Alternatives 1, 2, 3, 5, 6							
South	NB	$0.15	$0.15	$0.15	$0.50	$0.55	$0.20
Middle	NB	$0.15	$0.15	$0.15	$0.40	$0.45	$0.20
North	NB	$0.10	$0.10	$0.10	$0.25	$0.30	$0.15
South	SB	$0.55	$0.50	$0.15	$0.15	$0.15	$0.15
Middle	SB	$0.45	$0.40	$0.15	$0.15	$0.15	$0.15
North	SB	$0.30	$0.25	$0.10	$0.10	$0.10	$0.10
Alternative 4							
South	NB	$0.15	$0.15	$0.20	$0.60	$0.70	$0.20
Middle	NB	$0.15	$0.15	$0.20	$0.40	$0.45	$0.20
North	NB	$0.10	$0.10	$0.15	$0.25	$0.30	$0.15
South	SB	$0.70	$0.60	$0.20	$0.15	$0.15	$0.15
Middle	SB	$0.45	$0.40	$0.20	$0.15	$0.15	$0.15
North	SB	$0.30	$0.25	$0.15	$0.10	$0.10	$0.10

Note: The toll rates per mile are shown in real dollars

The highest optimum per mile toll rates in 2015 were exhibited in the south segment with approximately $0.55 per mile for both morning and afternoon peak period (this applied to all the alternatives with the exception of Alternative 4). The optimum toll rate was shown to reach approximately $0.70 per mile along the south segment when it operates as a HOT facility. The middle segment has the optimum toll rate of $0.45 per mile for both morning and afternoon peak periods. The north segment is shown to have optimum toll rates that go as high as $0.30 per mile during peak direction.

Figures 6-4 through **6-11** show the toll sensitivity curves for the various alternatives. The figures illustrate the effects that toll rates have on revenue, vehicle miles traveled (VMT), and the average speed on both the managed lanes and general purpose lanes. The graphics are presented for the AM Peak, Midday, and PM Peak periods, and for the three defined segments. The revenues shown in the figures represent daily revenue, however, these numbers are for illustrative purposes and do not take into consideration several factors which are incorporated in the annual revenue calculation in the later sections of this chapter, such as ramp-up factors.

The first rows of graphs shown in each figure illustrate the relationship between toll rate and daily revenue. As the toll rate is increased from zero, revenue also increases until the maximum revenue is reached. This maximum point represents the optimum toll rate beyond which additional increases in toll rates will likely result in a larger reduction in traffic that diminishes the corridor's overall revenue potential.

The second row of graphs in each figure shows the estimated VMT (vehicle miles traveled) using the managed lane facility. The VMT in these graphs include all the modes considered in the demand modeling and reflect the demand across the entire length of each of the respective alternatives. As the toll rate increases, the VMT in the managed lanes also decreases accordingly.

The third row of graphs in each figure shows the average operating speeds in both the managed lanes and the adjacent sections of the general purpose lanes. These graphs show the operational trade-offs between revenue, optimal distribution of demand, and operating conditions along the IH 35E corridor.

Figures 6-4 to **6-5** depicts the toll operation profiles for Alternative 1, 2, and 4, where the south segment as HOT lanes in 2015 with the middle segment opening under the ultimate build-out configuration, and no construction of the north segment. **Figures 6-6** to **6-8** describe the toll operation profiles for Alternative 3, 5, and 6 in 2015 where the south segment operates as a HOT facility, the middle segment opening under the ultimate build-out configuration, and the north segment operating under the temporary widening and north early project as aforementioned. **Figures 6-9** to **6-11** show the toll operation profiles for Alternative 1, 2, 3, and 6 in 2030, with the ultimate build-out of all three segments.

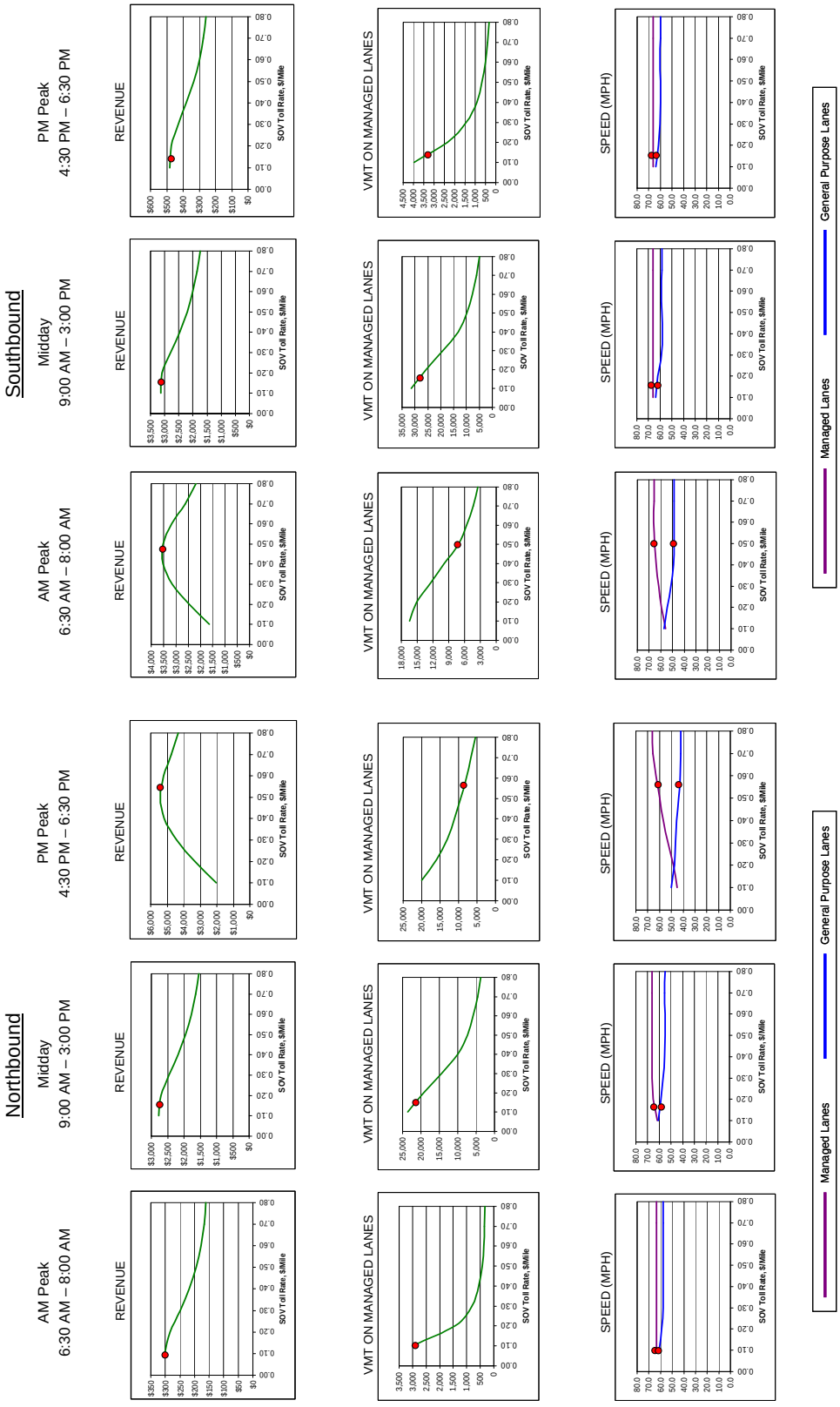


Figure 6-4. Alternative 1,2,4 : 2015 Toll Rate/Operations Profile – South Segment

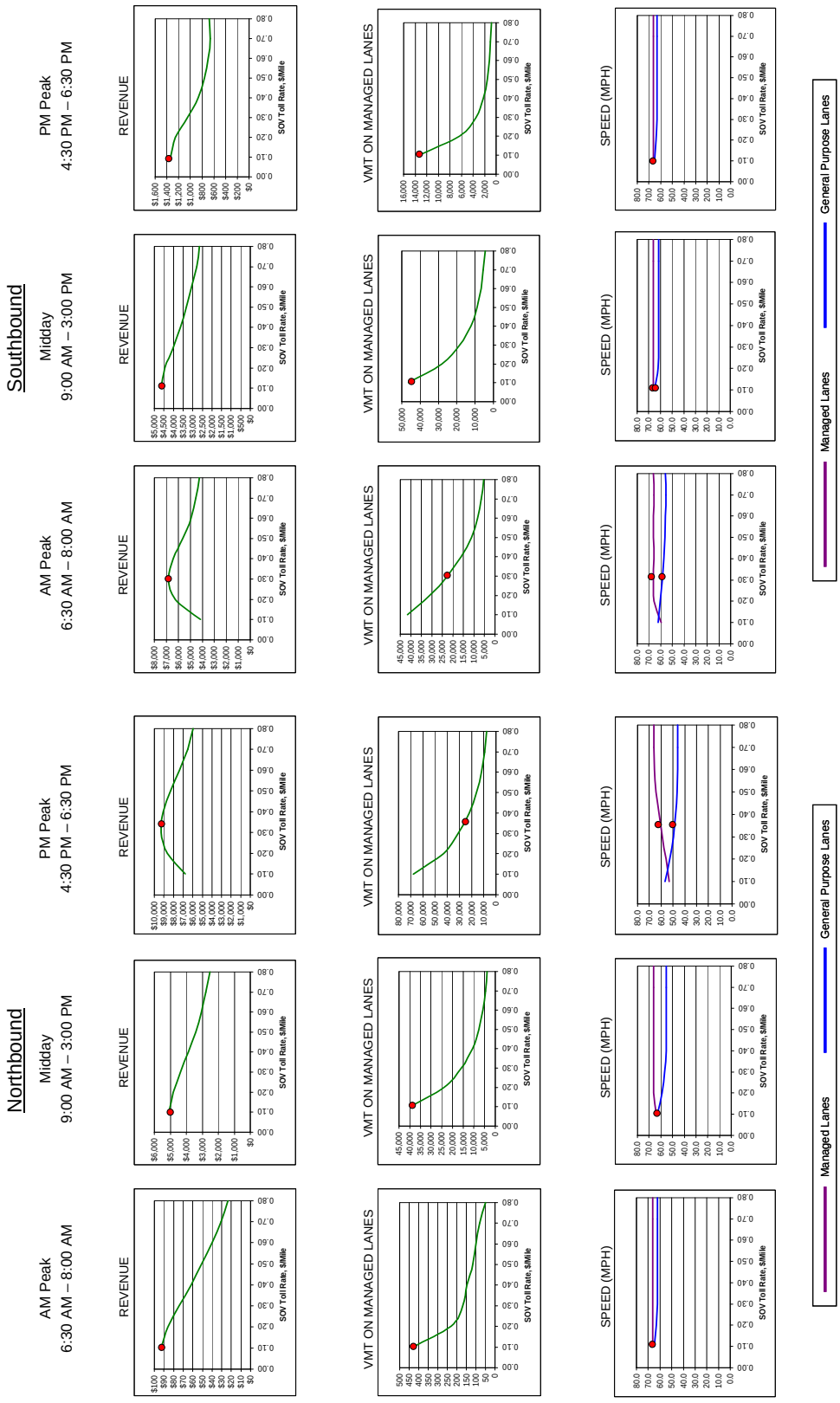


Figure 6-5. Alternative 1,2,4 : 2015 Toll Rate/Operations Profile – Middle Segment

WilburSmith ASSOCIATES

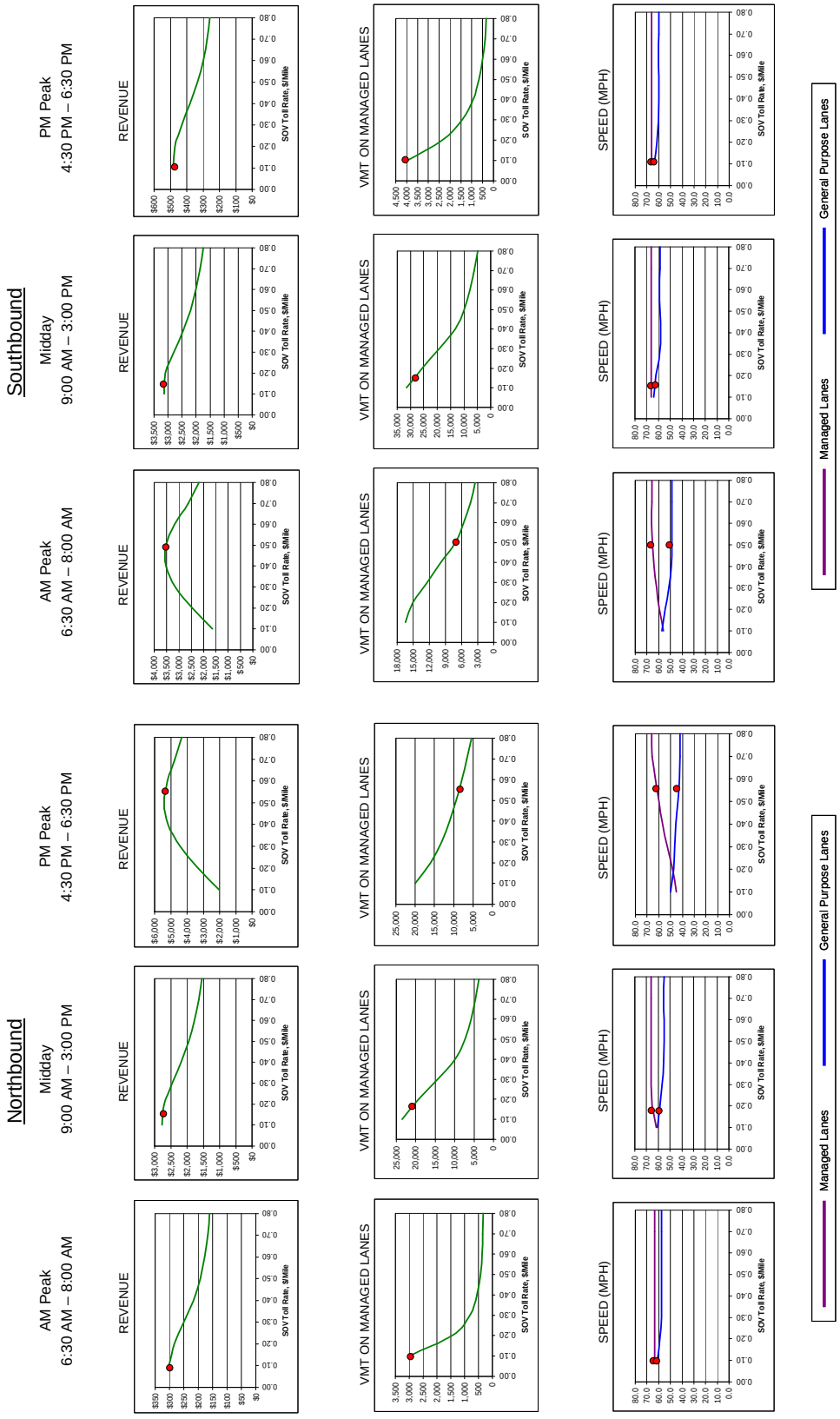


Figure 6-6. Alternative 3,5,6 : 2015 Toll Rate/Operations Profile – South Segment

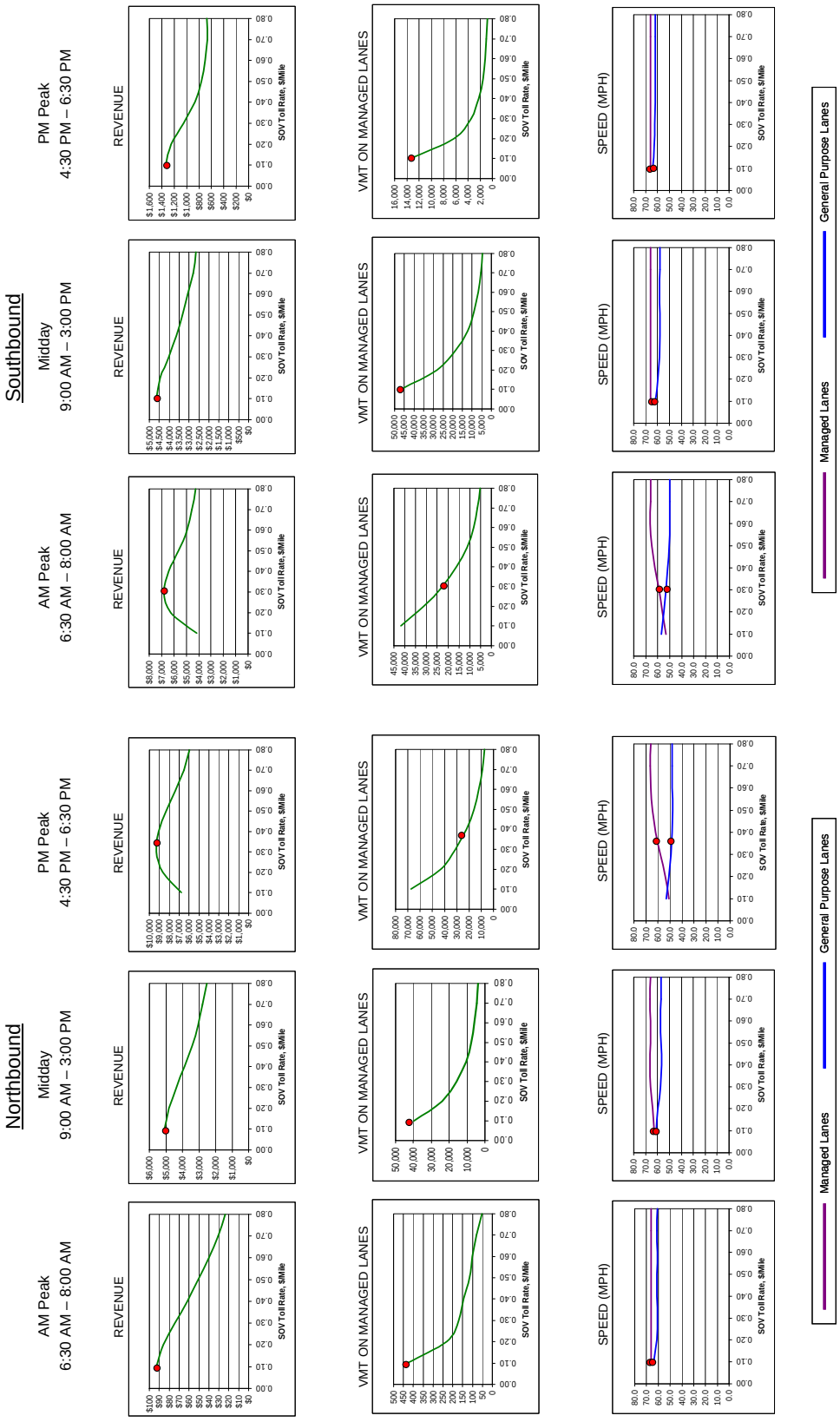


Figure 6-7. Alternative 3,5,6 : 2015 Toll Rate/Operations Profile – Middle Segment

WilburSmith ASSOCIATES

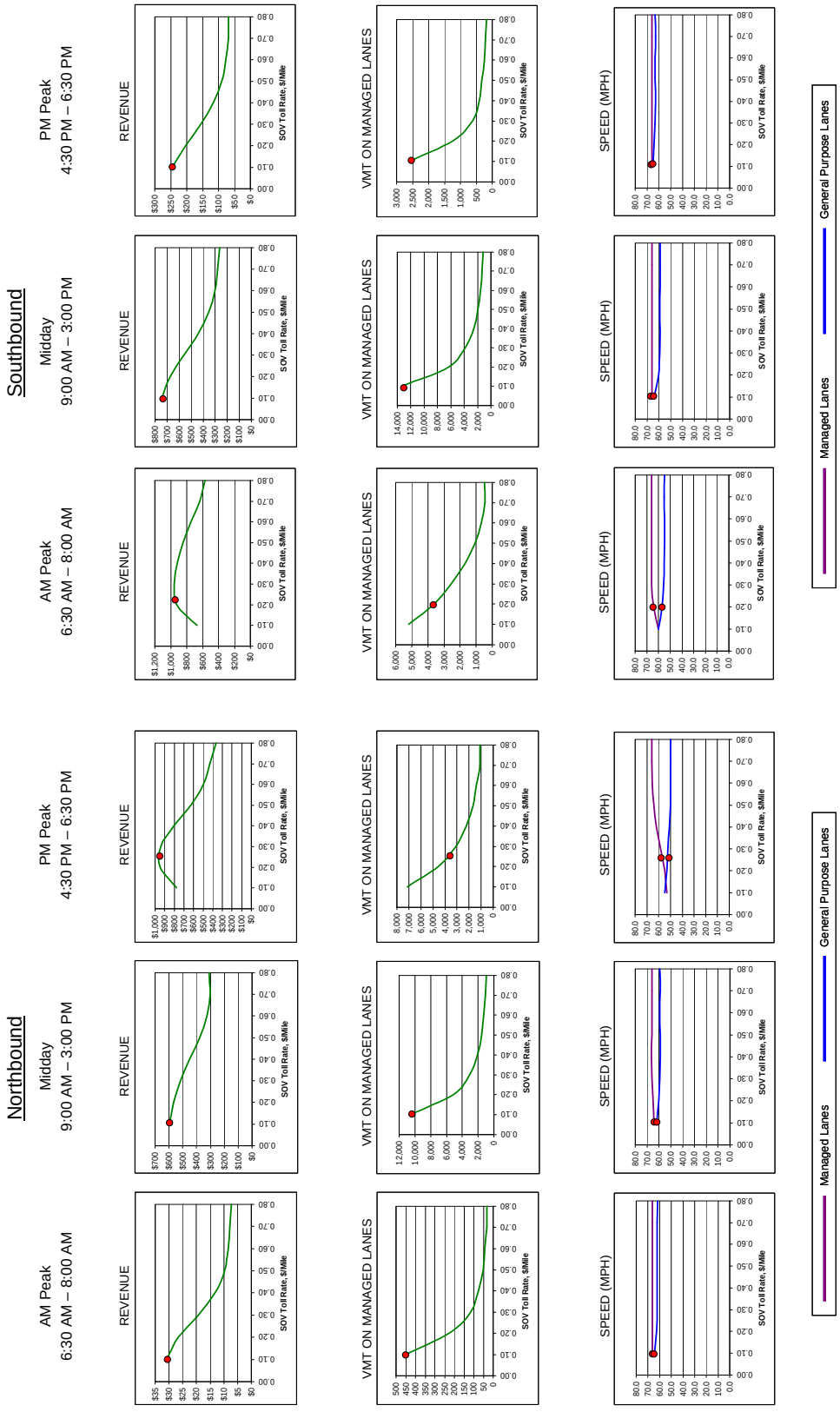


Figure 6-8. Alternative 3,5,6 : 2015 Toll Rate/Operations Profile – North Segment

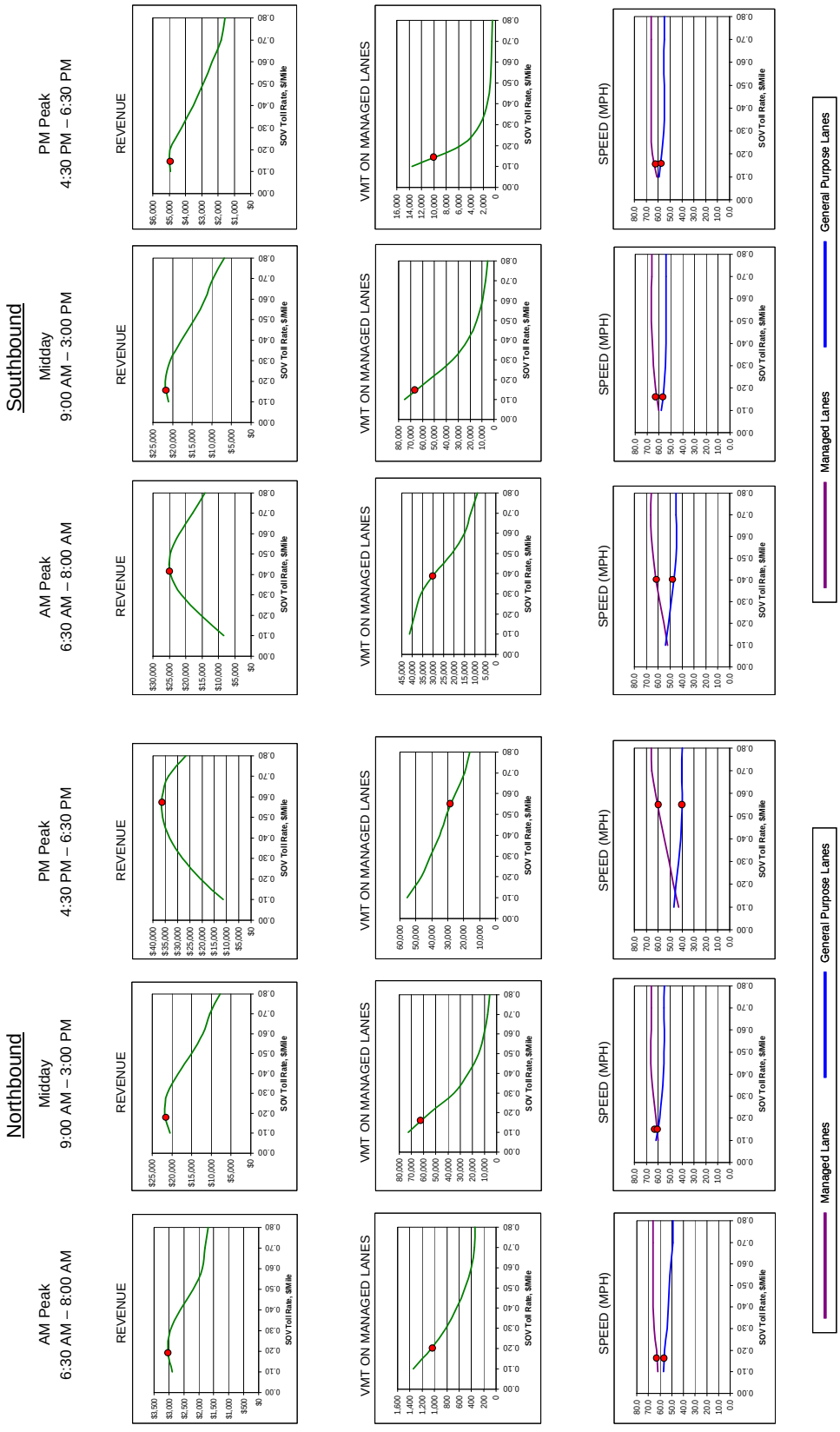


Figure 6-9. Alternative 1,2,3,6 : 2030 Toll Rate/Operations Profile – South Segment

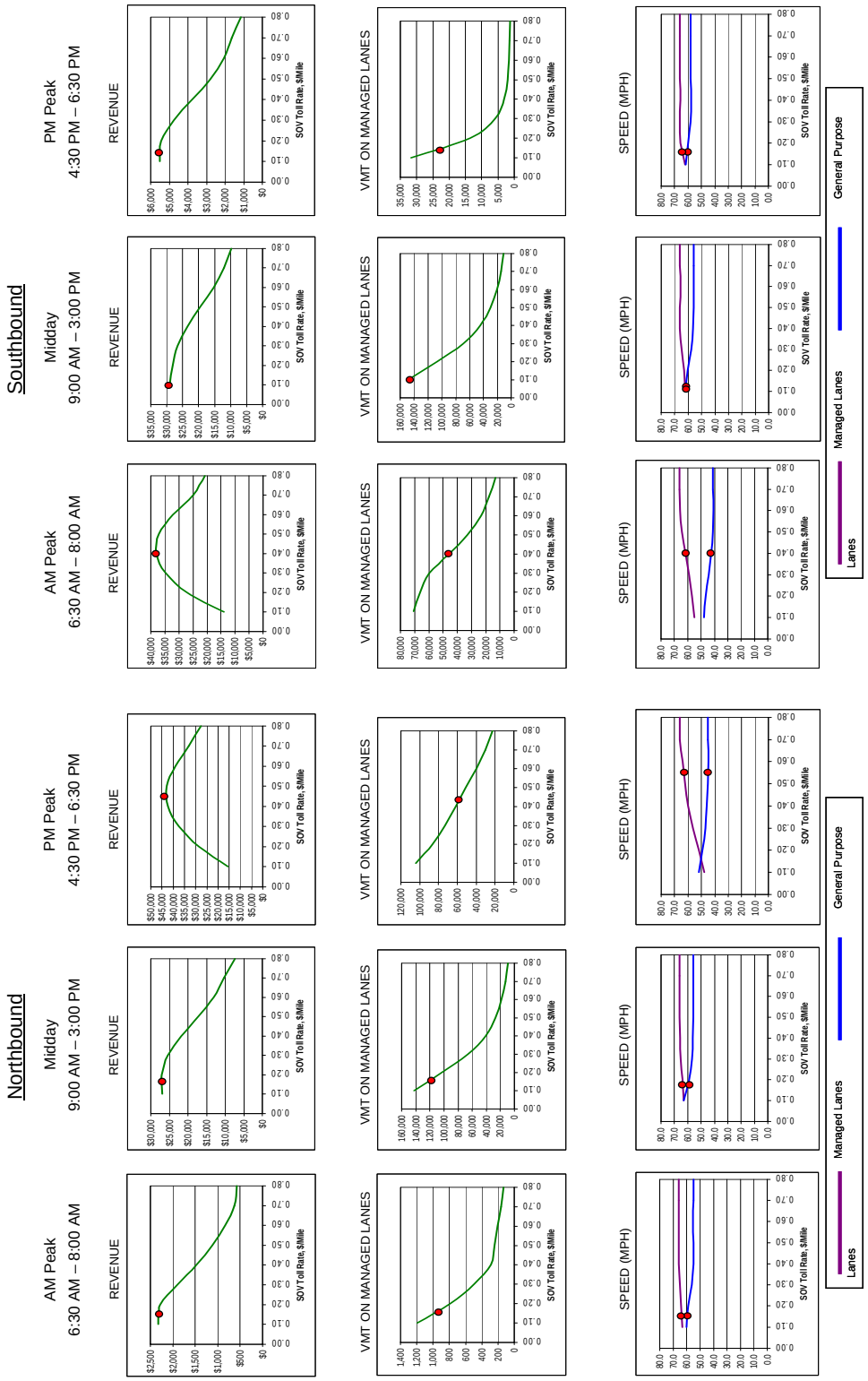


Figure 6-10. Alternative 1,2,3,6 : 2030 Toll Rate/Operations Profile – Middle Segment

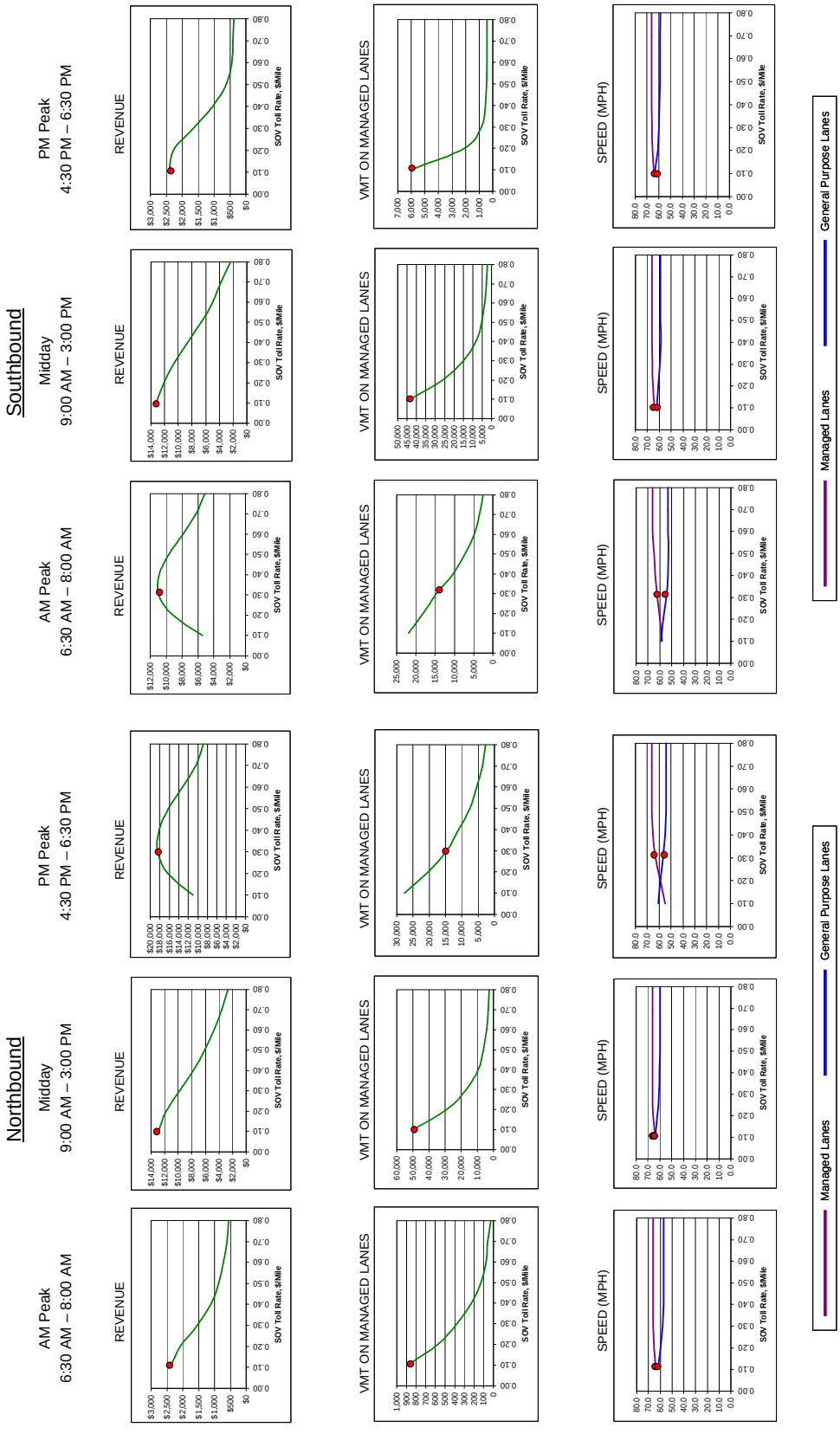


Figure 6-11. Alternative 1,2,3,6 : 2030 Toll Rate/Operations Profile – North Segment

WilburSmith ASSOCIATES

ESTIMATED WEEKDAY MANAGED LANE TRAFFIC

Figures 6-12 through **6-17** illustrate the estimated daily traffic on the managed lanes and general purpose lanes under the six alternatives. Each figure shows the access configuration for opening the year 2015 and future year 2030. The daily volumes are presented in thousands for the general purpose lanes, managed lanes, and access ramps to and from each of the respective lanes. The volumes on the managed lanes are broken down additionally by time period and vehicle type.

The 2015 daily traffic under Alternatives 1, 2 and 4 is displayed in **Figures 6-12** and **6-13**. These alternatives reflect the conversion of the existing HOV lanes to HOT lanes along the south segment in the opening year, the ultimate build-out along the middle segment, and no improvement for the north segment. Without any capacity improvements, the managed lane along the south segment has the highest daily traffic of 22,800 vehicles for both directions at Belt Line Road. The managed lane traffic at Frankford Road is estimated to be 26,700 daily vehicles for both directions with the traffic to/from PGBT and SH 121 carried by the collector-distributor road. The managed lane traffic is estimated to be 27,500 daily vehicles at Garden Ridge Boulevard.

Figures 6-14 and **6-15** depict the estimated 2015 daily traffic for Alternatives 3, 5 and 6. These alternatives have the same configuration along the south and middle segments as the previous alternatives with the exception that the north segment general purpose lanes are widened and north early project is constructed. Compared to Alternative 1, 2 and 4, the managed lane of the middle segment at the northern termini appears to capture some benefit from the widening in the north, with slight increases of traffic in that section. **Figure 6-15** summarizes the estimated traffic for the north early project section and shows that the managed lanes at North Texas Boulevard are estimated to capture approximately 10,200 daily vehicles in 2015.

The daily traffic in 2030 for Alternative 1, 2, 3, and 6 are summarized in **Figures 6-16** and **6-17**. Similar traffic patterns were observed in 2030 with the highest managed lane traffic occurring along the southern segments of the project between SH 121 and IH 635. The managed lane traffic at North Texas Boulevard is projected to capture 16,900 daily vehicles for both directions by 2030 and this demand increases to 26,600 daily vehicles at Post Oak Street. The managed lane at Garden Ridge Boulevard is expected to capture approximately 46,000 daily vehicles and this traffic increases to 53,500 daily vehicles at Sandy Lake Road for both directions.

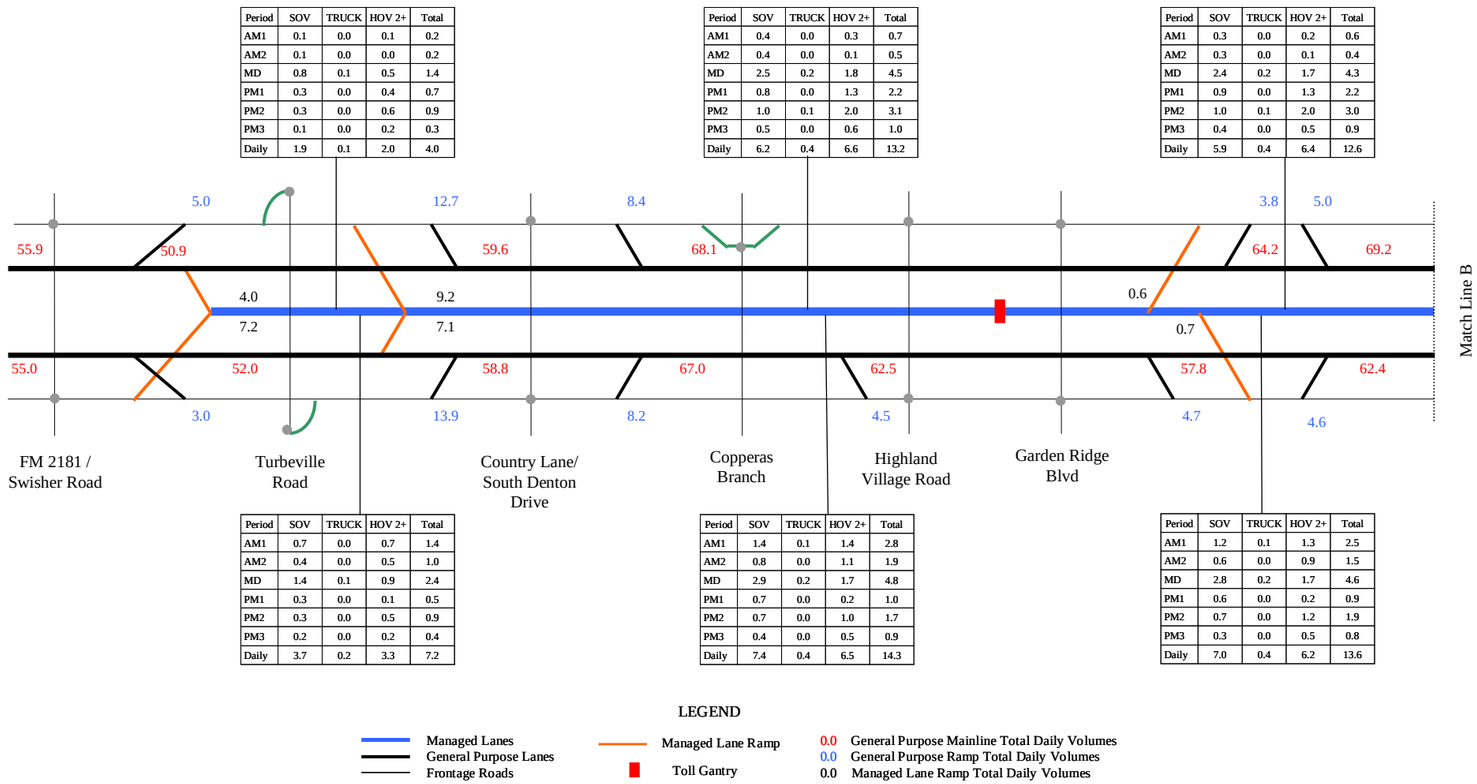
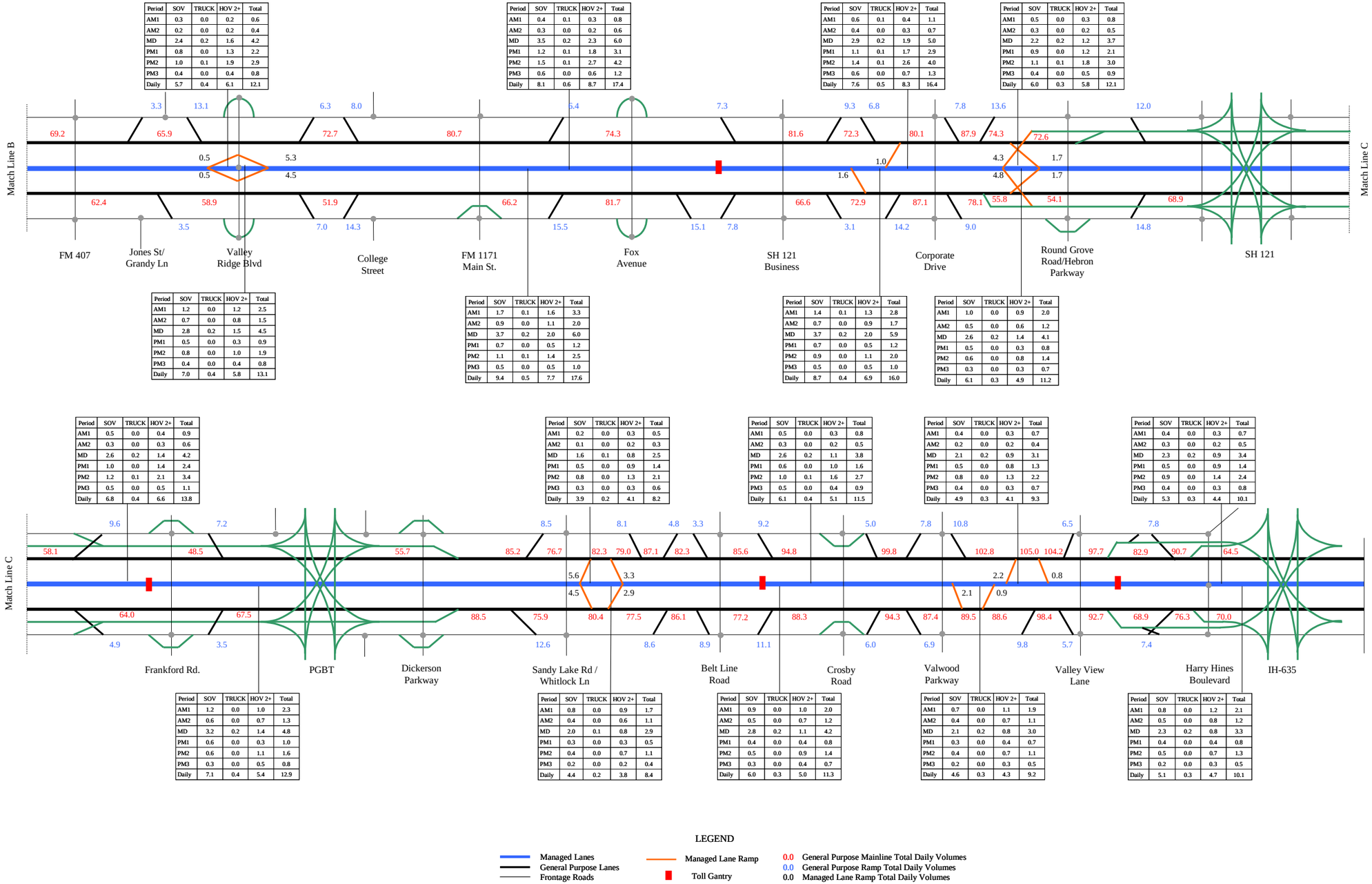


Figure 6-12 Alternative 1, 2, 4: 2015 Managed Lanes Daily Traffic (1 of 2)



Period	SOV	TRUCK	HOV 2+	Total
AM1	0.3	0.0	0.2	0.6
AM2	0.2	0.0	0.2	0.4
MD	2.4	0.2	1.6	4.2
PM1	0.8	0.0	1.3	2.2
PM2	1.0	0.1	1.9	2.9
PM3	0.4	0.0	0.4	0.8
Daily	5.7	0.4	6.1	12.1

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.4	0.1	0.3	0.8
AM2	0.3	0.0	0.2	0.6
MD	3.5	0.2	2.3	6.0
PM1	1.2	0.1	1.8	3.1
PM2	1.5	0.1	2.7	4.2
PM3	0.6	0.0	0.6	1.2
Daily	8.1	0.6	8.7	17.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.6	0.1	0.4	1.1
AM2	0.4	0.0	0.3	0.7
MD	2.9	0.2	1.9	5.0
PM1	1.1	0.1	1.7	2.9
PM2	1.4	0.1	2.6	4.0
PM3	0.6	0.0	0.7	1.3
Daily	7.6	0.5	8.3	16.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.5	0.0	0.3	0.8
AM2	0.3	0.0	0.2	0.5
MD	2.2	0.2	1.2	3.7
PM1	0.9	0.0	1.2	2.1
PM2	1.1	0.1	1.8	3.0
PM3	0.4	0.0	0.5	0.9
Daily	6.0	0.3	5.8	12.1

Period	SOV	TRUCK	HOV 2+	Total
AM1	1.2	0.0	1.2	2.5
AM2	0.7	0.0	0.8	1.5
MD	2.8	0.2	1.5	4.5
PM1	0.5	0.0	0.3	0.9
PM2	0.8	0.0	1.0	1.9
PM3	0.4	0.0	0.4	0.8
Daily	7.0	0.4	5.8	13.1

Period	SOV	TRUCK	HOV 2+	Total
AM1	1.7	0.1	1.6	3.3
AM2	0.9	0.0	1.1	2.0
MD	3.7	0.2	2.0	6.0
PM1	0.7	0.0	0.5	1.2
PM2	1.1	0.1	1.4	2.5
PM3	0.5	0.0	0.5	1.0
Daily	9.4	0.5	7.7	17.6

Period	SOV	TRUCK	HOV 2+	Total
AM1	1.4	0.1	1.3	2.8
AM2	0.7	0.0	0.9	1.7
MD	3.7	0.2	2.0	5.9
PM1	0.7	0.0	0.5	1.2
PM2	0.9	0.0	1.1	2.0
PM3	0.5	0.0	0.5	1.0
Daily	8.7	0.4	6.9	16.0

Period	SOV	TRUCK	HOV 2+	Total
AM1	1.0	0.0	0.9	2.0
AM2	0.5	0.0	0.6	1.2
MD	2.6	0.2	1.4	4.1
PM1	0.5	0.0	0.3	0.8
PM2	0.6	0.0	0.8	1.4
PM3	0.3	0.0	0.3	0.7
Daily	6.1	0.3	4.9	11.2

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.5	0.0	0.4	0.9
AM2	0.3	0.0	0.3	0.6
MD	2.6	0.2	1.4	4.2
PM1	1.0	0.0	1.4	2.4
PM2	1.2	0.1	2.1	3.4
PM3	0.5	0.0	0.5	1.1
Daily	6.8	0.4	6.6	13.8

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.2	0.0	0.3	0.5
AM2	0.1	0.0	0.2	0.3
MD	1.6	0.1	0.8	2.5
PM1	0.5	0.0	0.9	1.4
PM2	0.8	0.0	1.3	2.1
PM3	0.3	0.0	0.3	0.6
Daily	3.9	0.2	4.1	8.2

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.5	0.0	0.3	0.8
AM2	0.3	0.0	0.2	0.5
MD	2.6	0.2	1.1	3.8
PM1	0.6	0.0	1.0	1.6
PM2	1.0	0.1	1.6	2.7
PM3	0.5	0.0	0.4	0.9
Daily	6.1	0.4	5.1	11.5

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.4	0.0	0.3	0.7
AM2	0.2	0.0	0.2	0.4
MD	2.1	0.2	0.9	3.1
PM1	0.5	0.0	0.8	1.3
PM2	0.8	0.0	1.3	2.2
PM3	0.4	0.0	0.3	0.7
Daily	4.9	0.3	4.1	9.3

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.4	0.0	0.3	0.7
AM2	0.3	0.0	0.2	0.5
MD	2.3	0.2	0.9	3.4
PM1	0.5	0.0	0.9	1.4
PM2	0.9	0.0	1.4	2.4
PM3	0.4	0.0	0.3	0.8
Daily	5.3	0.3	4.4	10.1

Period	SOV	TRUCK	HOV 2+	Total
AM1	1.2	0.0	1.0	2.3
AM2	0.6	0.0	0.7	1.3
MD	3.2	0.2	1.4	4.8
PM1	0.6	0.0	0.3	1.0
PM2	0.6	0.0	1.1	1.6
PM3	0.3	0.0	0.5	0.8
Daily	7.1	0.4	5.4	12.9

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.8	0.0	0.9	1.7
AM2	0.4	0.0	0.6	1.1
MD	2.0	0.1	0.8	2.9
PM1	0.3	0.0	0.3	0.5
PM2	0.4	0.0	0.7	1.1
PM3	0.2	0.0	0.2	0.4
Daily	4.4	0.2	3.8	8.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.9	0.0	1.0	2.0
AM2	0.5	0.0	0.7	1.2
MD	2.8	0.2	1.1	4.2
PM1	0.4	0.0	0.4	0.8
PM2	0.5	0.0	0.9	1.4
PM3	0.3	0.0	0.4	0.7
Daily	6.0	0.3	5.0	11.3

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.7	0.0	1.1	1.9
AM2	0.4	0.0	0.7	1.1
MD	2.1	0.2	0.8	3.0
PM1	0.3	0.0	0.4	0.7
PM2	0.4	0.0	0.7	1.1
PM3	0.2	0.0	0.3	0.5
Daily	4.6	0.3	4.3	9.2

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.8	0.0	1.2	2.1
AM2	0.5	0.0	0.8	1.2
MD	2.3	0.2	0.8	3.3
PM1	0.4	0.0	0.4	0.8
PM2	0.5	0.0	0.7	1.3
PM3	0.2	0.0	0.3	0.5
Daily	5.1	0.3	4.7	10.1

Figure 6-13 Alternative 1, 2, 4: 2015 Managed Lanes Daily Traffic (2 of 2)

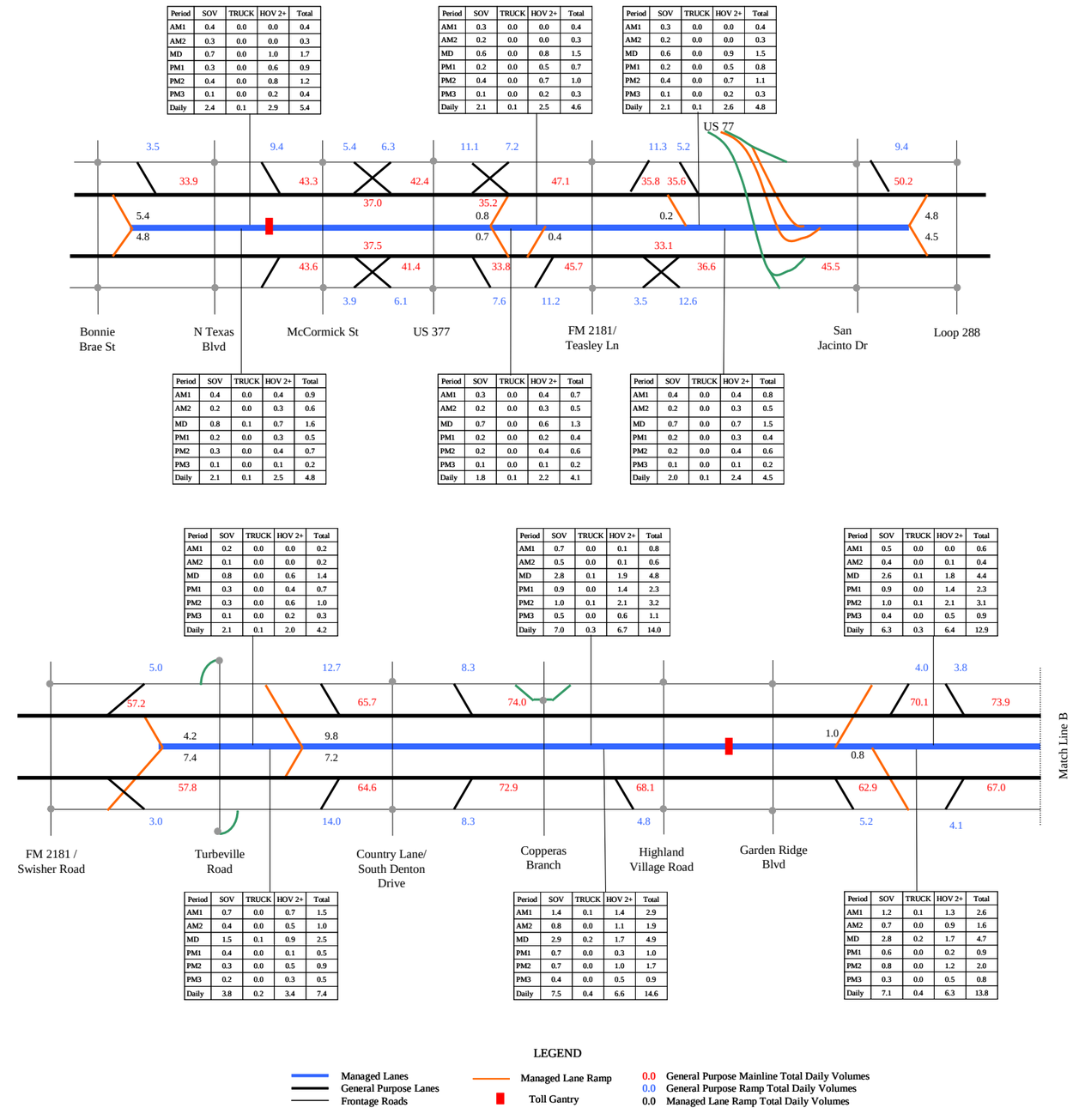
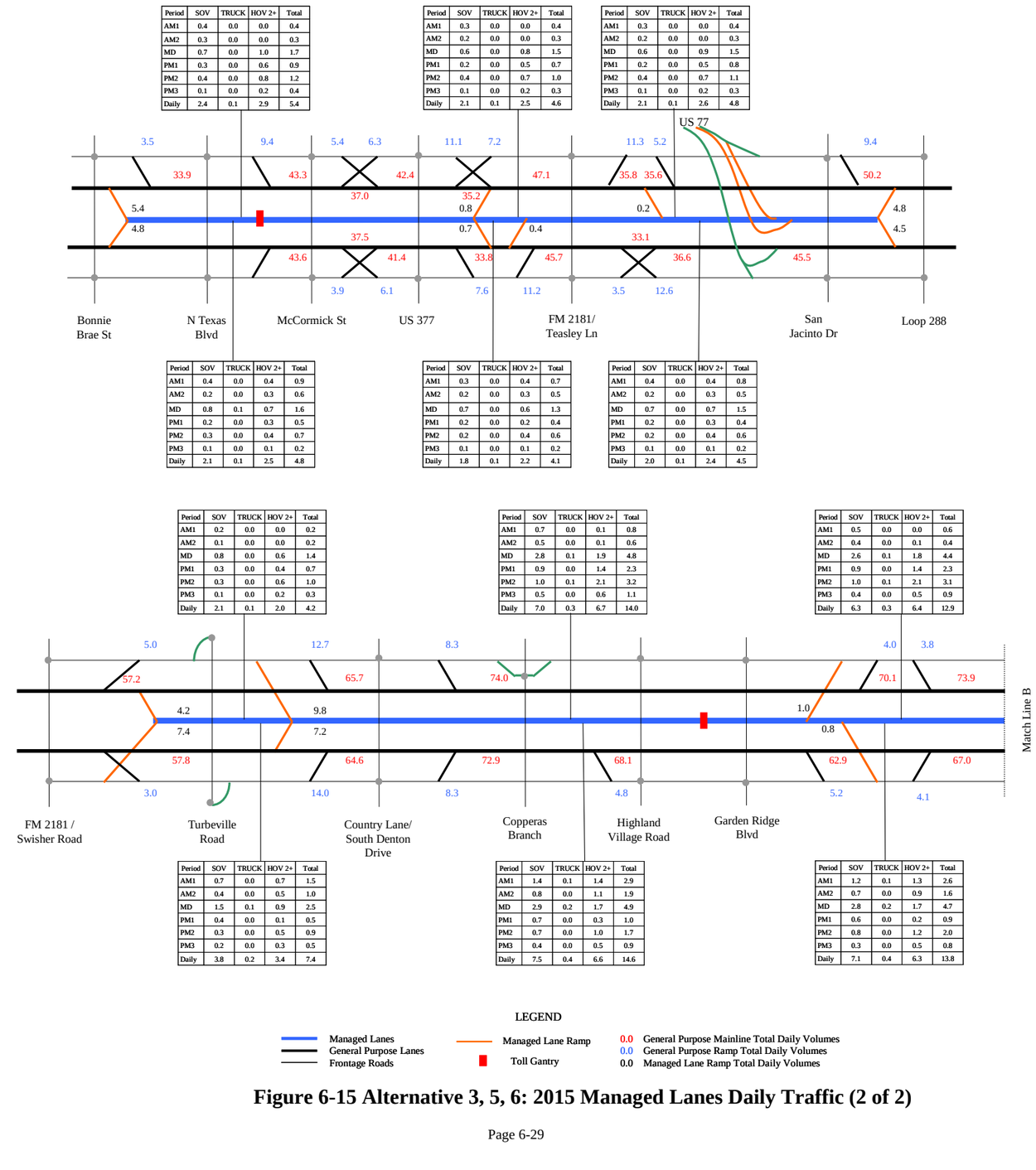


Figure 6-14 Alternative 3, 5, 6: 2015 Managed Lanes Daily Traffic (1 of 2)



Period	SOV	TRUCK	HOV 2+	Total
AM1	0.4	0.0	0.0	0.4
AM2	0.3	0.0	0.0	0.3
MD	0.7	0.0	1.0	1.7
PM1	0.3	0.0	0.6	0.9
PM2	0.4	0.0	0.8	1.2
PM3	0.1	0.0	0.2	0.4
Daily	2.4	0.1	2.9	5.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.3	0.0	0.0	0.4
AM2	0.2	0.0	0.0	0.3
MD	0.6	0.0	0.8	1.5
PM1	0.2	0.0	0.5	0.7
PM2	0.4	0.0	0.7	1.0
PM3	0.1	0.0	0.2	0.3
Daily	2.1	0.1	2.5	4.6

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.3	0.0	0.0	0.4
AM2	0.2	0.0	0.0	0.3
MD	0.6	0.0	0.9	1.5
PM1	0.2	0.0	0.5	0.8
PM2	0.4	0.0	0.7	1.1
PM3	0.1	0.0	0.2	0.3
Daily	2.1	0.1	2.6	4.8

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.4	0.0	0.4	0.9
AM2	0.2	0.0	0.3	0.6
MD	0.8	0.1	0.7	1.6
PM1	0.2	0.0	0.3	0.5
PM2	0.3	0.0	0.4	0.7
PM3	0.1	0.0	0.1	0.2
Daily	2.1	0.1	2.5	4.8

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.3	0.0	0.4	0.7
AM2	0.2	0.0	0.3	0.5
MD	0.7	0.0	0.6	1.3
PM1	0.2	0.0	0.2	0.4
PM2	0.2	0.0	0.4	0.6
PM3	0.1	0.0	0.1	0.2
Daily	1.8	0.1	2.2	4.1

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.4	0.0	0.4	0.8
AM2	0.2	0.0	0.3	0.5
MD	0.7	0.0	0.7	1.5
PM1	0.2	0.0	0.3	0.4
PM2	0.2	0.0	0.4	0.6
PM3	0.1	0.0	0.1	0.2
Daily	2.0	0.1	2.4	4.5

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.2	0.0	0.0	0.2
AM2	0.1	0.0	0.0	0.2
MD	0.8	0.0	0.6	1.4
PM1	0.3	0.0	0.4	0.7
PM2	0.3	0.0	0.6	1.0
PM3	0.1	0.0	0.2	0.3
Daily	2.1	0.1	2.0	4.2

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.7	0.0	0.1	0.8
AM2	0.5	0.0	0.1	0.6
MD	2.8	0.1	1.9	4.8
PM1	0.9	0.0	1.4	2.3
PM2	1.0	0.1	2.1	3.2
PM3	0.5	0.0	0.6	1.1
Daily	7.0	0.3	6.7	14.0

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.5	0.0	0.0	0.6
AM2	0.4	0.0	0.1	0.4
MD	2.6	0.1	1.8	4.4
PM1	0.9	0.0	1.4	2.3
PM2	1.0	0.1	2.1	3.1
PM3	0.4	0.0	0.5	0.9
Daily	6.3	0.3	6.4	12.9

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.7	0.0	0.7	1.5
AM2	0.4	0.0	0.5	1.0
MD	1.5	0.1	0.9	2.5
PM1	0.4	0.0	0.1	0.5
PM2	0.3	0.0	0.5	0.9
PM3	0.2	0.0	0.3	0.5
Daily	3.8	0.2	3.4	7.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	1.4	0.1	1.4	2.9
AM2	0.8	0.0	1.1	1.9
MD	2.9	0.2	1.7	4.9
PM1	0.7	0.0	0.3	1.0
PM2	0.7	0.0	1.0	1.7
PM3	0.4	0.0	0.5	0.9
Daily	7.5	0.4	6.6	14.6

Period	SOV	TRUCK	HOV 2+	Total
AM1	1.2	0.1	1.3	2.6
AM2	0.7	0.0	0.9	1.6
MD	2.8	0.2	1.7	4.7
PM1	0.6	0.0	0.2	0.9
PM2	0.8	0.0	1.2	2.0
PM3	0.3	0.0	0.5	0.8
Daily	7.1	0.4	6.3	13.8

Figure 6-15 Alternative 3, 5, 6: 2015 Managed Lanes Daily Traffic (2 of 2)

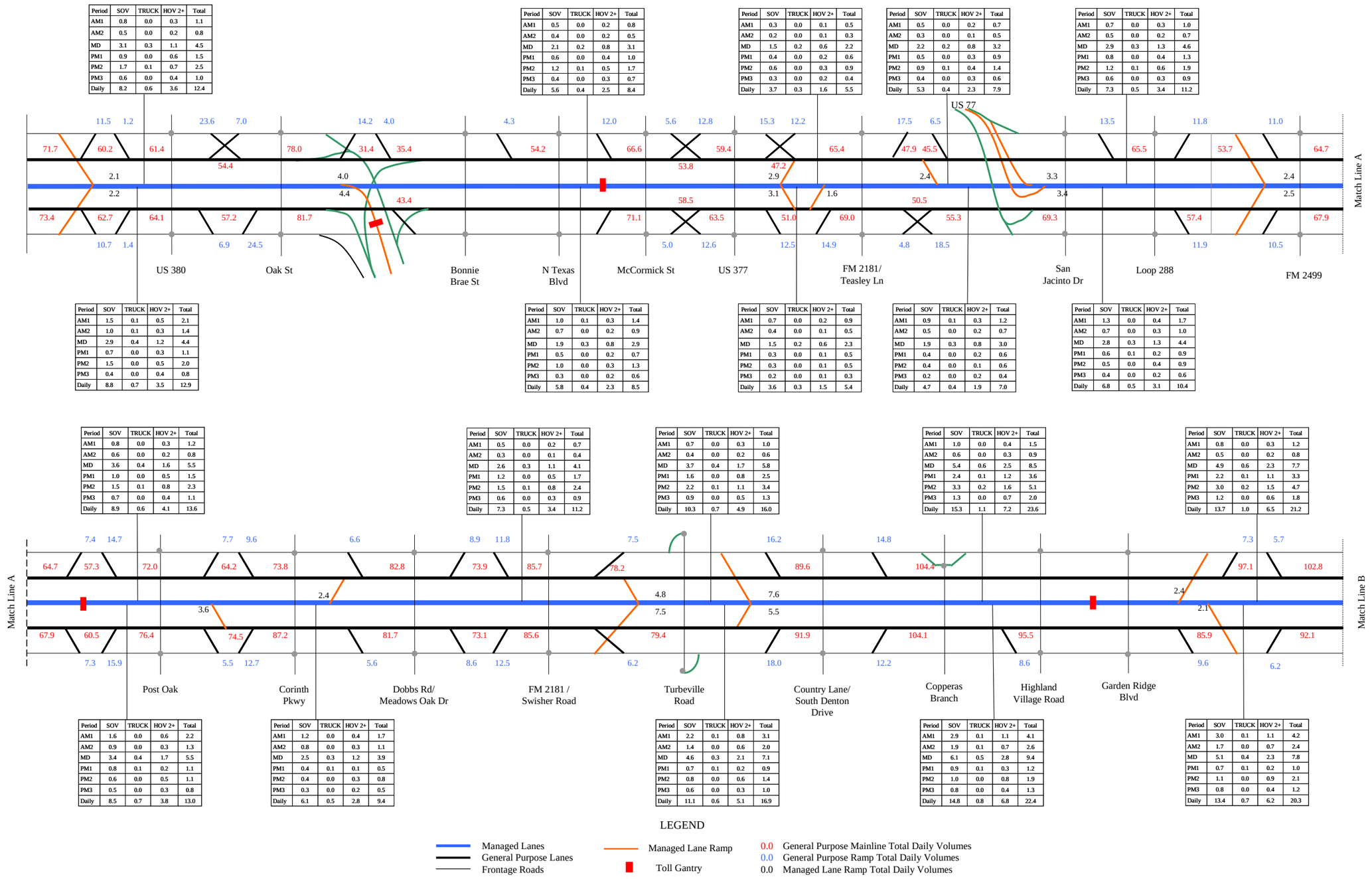
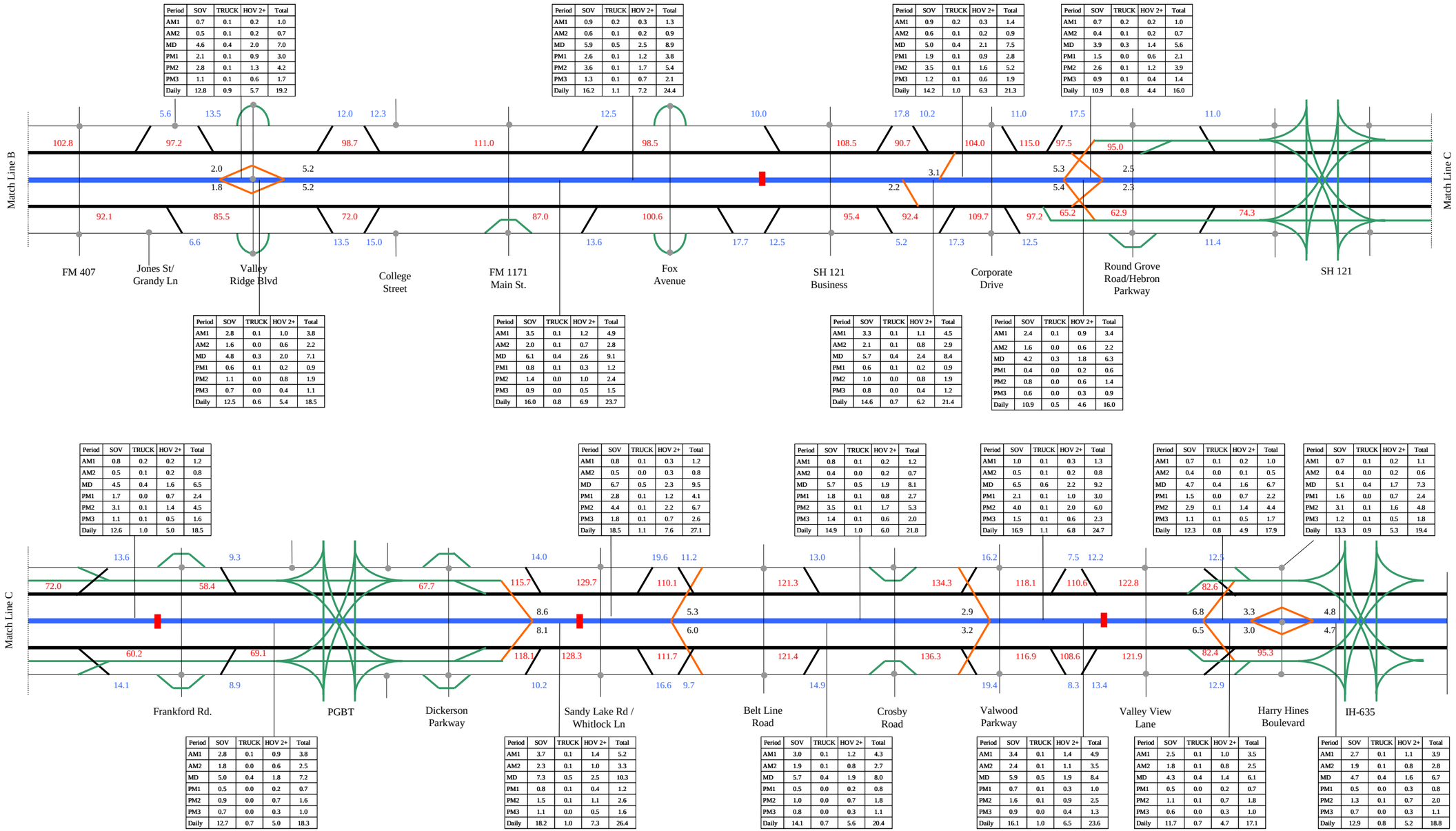


Figure 6-16 Alternative 1, 2, 3, 6: 2030 Managed Lanes Daily Traffic (1 of 2)



Period	SOV	TRUCK	HOV 2+	Total
AM1	0.7	0.1	0.2	1.0
AM2	0.5	0.1	0.2	0.7
MD	4.6	0.4	2.0	7.0
PM1	2.1	0.1	0.9	3.0
PM2	2.8	0.1	1.3	4.2
PM3	1.1	0.1	0.6	1.7
Daily	12.8	0.9	5.7	19.2

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.9	0.2	0.3	1.3
AM2	0.6	0.1	0.2	0.9
MD	5.9	0.5	2.5	8.9
PM1	2.6	0.1	1.2	3.8
PM2	3.6	0.1	1.7	5.4
PM3	1.3	0.1	0.7	2.1
Daily	16.2	1.1	7.2	24.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.9	0.2	0.3	1.4
AM2	0.6	0.1	0.2	0.9
MD	5.0	0.4	2.1	7.5
PM1	1.9	0.1	0.9	2.8
PM2	3.5	0.1	1.6	5.2
PM3	1.2	0.1	0.6	1.9
Daily	14.2	1.0	6.3	21.3

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.7	0.2	0.2	1.0
AM2	0.4	0.1	0.2	0.7
MD	3.9	0.3	1.4	5.6
PM1	1.5	0.0	0.6	2.1
PM2	2.6	0.1	1.2	3.9
PM3	0.9	0.1	0.4	1.4
Daily	10.9	0.8	4.4	16.0

Period	SOV	TRUCK	HOV 2+	Total
AM1	2.8	0.1	1.0	3.8
AM2	1.6	0.0	0.6	2.2
MD	4.8	0.3	2.0	7.1
PM1	0.6	0.1	0.2	0.9
PM2	1.1	0.0	0.8	1.9
PM3	0.7	0.0	0.4	1.1
Daily	12.5	0.6	5.4	18.5

Period	SOV	TRUCK	HOV 2+	Total
AM1	3.5	0.1	1.2	4.9
AM2	2.0	0.1	0.7	2.8
MD	6.1	0.4	2.6	9.1
PM1	0.8	0.1	0.3	1.2
PM2	1.4	0.0	1.0	2.4
PM3	0.9	0.0	0.5	1.5
Daily	16.0	0.8	6.9	23.7

Period	SOV	TRUCK	HOV 2+	Total
AM1	3.3	0.1	1.1	4.5
AM2	2.1	0.1	0.8	2.9
MD	5.7	0.4	2.4	8.4
PM1	0.6	0.1	0.2	0.9
PM2	1.0	0.0	0.8	1.9
PM3	0.8	0.0	0.4	1.2
Daily	14.6	0.7	6.2	21.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	2.4	0.1	0.9	3.4
AM2	1.6	0.0	0.6	2.2
MD	4.2	0.3	1.8	6.3
PM1	0.4	0.0	0.2	0.6
PM2	0.8	0.0	0.6	1.4
PM3	0.6	0.0	0.3	0.9
Daily	10.9	0.5	4.6	16.0

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.8	0.2	0.2	1.2
AM2	0.5	0.1	0.2	0.8
MD	4.5	0.4	1.6	6.5
PM1	1.7	0.0	0.7	2.4
PM2	3.1	0.1	1.4	4.5
PM3	1.1	0.1	0.5	1.6
Daily	12.6	1.0	5.0	18.5

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.8	0.1	0.3	1.2
AM2	0.5	0.0	0.3	0.8
MD	6.7	0.5	2.3	9.5
PM1	2.8	0.1	1.2	4.1
PM2	4.4	0.1	2.2	6.7
PM3	1.8	0.1	0.7	2.6
Daily	18.5	1.1	7.6	27.1

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.8	0.1	0.2	1.2
AM2	0.4	0.0	0.2	0.7
MD	5.7	0.5	1.9	8.1
PM1	1.8	0.1	0.8	2.7
PM2	3.5	0.1	1.7	5.3
PM3	1.4	0.1	0.6	2.0
Daily	14.9	1.0	6.0	21.8

Period	SOV	TRUCK	HOV 2+	Total
AM1	1.0	0.1	0.3	1.3
AM2	0.5	0.1	0.2	0.8
MD	6.5	0.6	2.2	9.2
PM1	2.1	0.1	1.0	3.0
PM2	4.0	0.1	2.0	6.0
PM3	1.5	0.1	0.6	2.3
Daily	16.9	1.1	6.8	24.7

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.7	0.1	0.2	1.0
AM2	0.4	0.0	0.1	0.5
MD	4.7	0.4	1.6	6.7
PM1	1.5	0.0	0.7	2.2
PM2	2.9	0.1	1.4	4.4
PM3	1.1	0.1	0.5	1.7
Daily	12.3	0.8	4.9	17.9

Period	SOV	TRUCK	HOV 2+	Total
AM1	0.7	0.1	0.2	1.1
AM2	0.4	0.0	0.2	0.6
MD	5.1	0.4	1.7	7.3
PM1	1.6	0.0	0.7	2.4
PM2	3.1	0.1	1.6	4.8
PM3	1.2	0.1	0.5	1.8
Daily	13.3	0.9	5.3	19.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	2.8	0.1	0.9	3.8
AM2	1.8	0.0	0.6	2.5
MD	5.0	0.4	1.8	7.2
PM1	0.5	0.0	0.2	0.7
PM2	0.9	0.0	0.7	1.6
PM3	0.7	0.0	0.3	1.0
Daily	12.7	0.7	5.0	18.3

Period	SOV	TRUCK	HOV 2+	Total
AM1	3.7	0.1	1.4	5.2
AM2	2.3	0.1	1.0	3.3
MD	7.3	0.5	2.5	10.3
PM1	0.8	0.1	0.4	1.2
PM2	1.5	0.1	1.1	2.6
PM3	1.1	0.0	0.5	1.6
Daily	18.2	1.0	7.3	26.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	3.0	0.1	1.2	4.3
AM2	1.9	0.1	0.8	2.7
MD	5.7	0.4	1.9	8.0
PM1	0.5	0.0	0.2	0.8
PM2	1.0	0.0	0.7	1.8
PM3	0.8	0.0	0.3	1.1
Daily	14.1	0.7	5.6	20.4

Period	SOV	TRUCK	HOV 2+	Total
AM1	3.4	0.1	1.4	4.9
AM2	2.4	0.1	1.1	3.5
MD	5.9	0.5	1.9	8.4
PM1	0.7	0.1	0.3	1.0
PM2	1.6	0.1	0.9	2.5
PM3	0.9	0.0	0.4	1.3
Daily	16.1	1.0	6.5	23.6

Period	SOV	TRUCK	HOV 2+	Total
AM1	2.5	0.1	1.0	3.5
AM2	1.8	0.1	0.8	2.5
MD	4.3	0.4	1.4	6.1
PM1	0.5	0.0	0.2	0.7
PM2	1.1	0.1	0.7	1.8
PM3	0.6	0.0	0.3	1.0
Daily	11.7	0.7	4.7	17.1

Period	SOV	TRUCK	HOV 2+	Total
AM1	2.7	0.1	1.1	3.9
AM2	1.9	0.1	0.8	2.8
MD	4.7	0.4	1.6	6.7
PM1	0.5	0.0	0.3	0.8
PM2	1.3	0.1	0.7	2.0
PM3	0.7	0.0	0.3	1.1
Daily	12.9	0.8	5.2	18.8

Figure 6-17. Alternative 1, 2, 3, 6: 2030 Managed Lanes Daily Traffic (2 of 2)

MANAGED LANES TRAFFIC SHARE

Table 6-3 shows the traffic share of managed lanes in 2030 for the alternatives that assume the ultimate build-out of all the three segments of the project. These alternatives include Alternative 1, 2, 3, and 6, since the other alternatives in 2030 and all alternatives in 2015 have only one or two segments built with phased general purpose lane expansion. The managed lane traffic shares are presented in **Table 6-3** and provides summarized results for the peak directions during peak period and peak shoulder period.

Among the three segments, the south segment has the highest traffic share while the less congested north segment has the least, which is consistent with the traffic volume pattern along the corridor. For the AM 1 period, managed lanes in both south and middle segments capture a traffic share of approximately 23.1/23.3 percent while the north segment captures a share of approximately 19.3 percent. The managed lane shares during the morning peak shoulder time (AM 2) are slightly lower than AM 1 given the relatively lower traffic demand in these periods while the managed lane share during PM peak period (PM2) reaches 24.6 percent in south segment and 16.5 percent along the north segment. These shares are higher than those during PM peak shoulder period (PM 1).

Table 6-3
2030 Managed Lane Share

Period	Direction	Segment	GPL Volume	ML Volume	Total Volume	ML share
AM 1	Southbound	South	16,520	5,010	21,530	23.3%
		Middle	13,960	4,200	18,160	23.1%
		North	7,780	1,860	9,640	19.3%
AM 2	Southbound	South	11,870	3,420	15,290	22.4%
		Middle	9,920	2,620	12,540	20.9%
		North	5,750	1,150	6,900	16.7%
PM 1	Northbound	South	13,040	3,480	16,520	21.1%
		Middle	13,290	3,300	16,590	19.9%
		North	6,940	1,320	8,260	16.0%
PM 2	Northbound	South	19,300	6,300	25,600	24.6%
		Middle	17,920	4,960	22,880	21.7%
		North	10,640	2,100	12,740	16.5%

Note: 1. The traffic volume in this table reflects the alternatives that the three segments are fully build-out as the schematic design shows.
2. GP – General Purpose Lanes; ML – Managed Lanes

TRAVEL TIME SAVINGS ANALYSIS

The primary factor influencing travelers' decisions to use a managed lanes facility is travel time savings. An analysis of the travel time savings offered by using the IH 35E

managed lanes is summarized in **Table 6-4** for the peak direction during both AM and PM peak periods, under the ultimate build-out of all the three segments in 2030 (Alternatives 1, 2, 3 and 6). The results include the modeled travel times on both the general purpose and managed lanes, the respective travel time savings in minutes, and the savings as a percentage of the general purpose lanes travel time. As shown in the table, the time savings offered by the managed lanes are expected to be significant. A trip on the southbound managed lanes between PGBT to IH 635 will be approximately 45 percent shorter than an equivalent trip on the general purpose lanes during the AM peak. The northbound traffic during PM peak also exhibited a similar time saving percentage as the southbound in the AM peak. The time savings to travel the entire managed lane project from US 380 to IH 635 is expected to be approximately 34 percent of the travel time on the general purpose lanes and will average approximately 13 minutes (it is worth noting that these travel time savings are an average overall summary under the equilibrium assignment, and thus individual trips may experience significantly higher travel time savings).

Table 6-4

2030 Travel Time Saving Analysis

Period	Direction	Segment	Travel Time (min)			Time Savings (%)
			GP Lanes	Managed Lanes	Time Savings	
AM Peak	Southbound	South	9.6	5.4	4.3	44.1%
		Middle	19.1	12.0	7.1	37.2%
		North	10.6	8.6	2.1	19.5%
		Total	39.4	26.0	13.4	34.1%
PM Peak	Northbound	South	10.1	5.5	4.7	45.9%
		Middle	18.9	12.2	6.7	35.5%
		North	10.8	8.7	2.1	19.2%
		Total	39.8	26.4	13.4	33.8%

Note: Travel times reflect the average trip times

ESTIMATED AVERAGE WEEKDAY TRANSACTIONS AND ANNUAL TOLL REVENUE

Table 6-5 shows the estimated daily transaction and revenue for each of the time periods modeled and for both the opening year of 2015 and future year 2030.

The average transactions shown in **Table 6-5** for the different time periods reflect the directional traffic along the IH 35E corridor, and show that the southbound direction will capture higher volumes during the morning peak while the northbound direction captures higher volumes during the afternoon peak. The average toll rates were calculated by dividing toll revenue with the transactions, which represents the average toll rate charged for each transaction along the entire corridor. Under Alternative 1, 2, and 4 in 2015 (where the south segment is HOT lanes, middle segment is the ultimate

build-out, and there are no improvement on north segment), the total daily transactions are estimated to be 127,000 for both directions, and is expected to generate daily toll revenues of approximately $65,000 yielding an average toll rate of $0.52. The total daily transactions are expected to grow to 263,000 by 2030 yielding daily toll revenues of approximately $500,000 at an average toll rate of $1.90 per transaction.

Table 6-5
Estimated Daily Transactions and Revenue

Time Period	Northbound			Southbound			Both Directions		
	Transactions	Revenue	Average Toll	Transactions	Revenue	Average Toll	Transactions	Revenue	Average Toll
Year 2015 - Alternatives 1, 2, 4									
AM Peak	4,005	$904	$0.23	13,113	$12,432	$0.95	17,118	$13,336	$0.78
AM Peak Shoulder	2,724	$596	$0.22	7,755	$6,083	$0.78	10,479	$6,678	$0.64
Midday	22,055	$5,435	$0.25	23,211	$5,808	$0.25	45,266	$11,243	$0.25
PM Pre-Peak Shoulder	11,554	$10,420	$0.90	5,086	$1,151	$0.23	16,640	$11,570	$0.70
PM Peak	16,897	$16,974	$1.00	8,876	$1,676	$0.19	25,773	$18,650	$0.72
PM Post-Peak Shoulder	5,222	$1,945	$0.37	3,993	$796	$0.20	9,215	$2,740	$0.30
Daily Total	63,707	$36,999	$0.58	63,275	$28,503	$0.45	126,981	$65,502	$0.52
Year 2015 - Alternatives 3, 5, 6									
AM Peak	4,641	$1,012	$0.22	14,517	$13,004	$0.90	19,157	$14,015	$0.73
AM Peak Shoulder	3,206	$673	$0.21	8,704	$6,333	$0.73	11,909	$7,007	$0.59
Midday	25,195	$5,896	$0.23	25,817	$6,183	$0.24	51,012	$12,079	$0.24
PM Pre-Peak Shoulder	13,124	$11,077	$0.84	5,775	$1,250	$0.22	18,899	$12,327	$0.65
PM Peak	19,136	$18,167	$0.95	10,013	$1,809	$0.18	29,149	$19,976	$0.69
PM Post-Peak Shoulder	5,933	$2,131	$0.36	4,451	$853	$0.19	10,384	$2,984	$0.29
Daily Total	72,660	$39,735	$0.55	70,661	$30,021	$0.42	143,321	$69,756	$0.49
Year 2030 - Alternative 1, 2, 3, 6									
AM Peak	8,744	$11,383	$1.30	26,413	$85,693	$3.24	35,158	$97,076	$2.76
AM Peak Shoulder	5,619	$7,187	$1.28	16,805	$48,724	$2.90	22,424	$55,911	$2.49
Midday	52,062	$63,428	$1.22	53,966	$64,529	$1.20	106,027	$127,957	$1.21
PM Pre-Peak Shoulder	19,891	$56,947	$2.86	7,499	$8,570	$1.14	27,390	$65,517	$2.39
PM Peak	32,388	$103,901	$3.21	13,889	$13,805	$0.99	46,278	$117,706	$2.54
PM Post-Peak Shoulder	12,591	$18,212	$1.45	8,189	$8,573	$1.05	20,781	$26,786	$1.29
Daily Total	133,922	$266,281	$1.99	129,297	$234,492	$1.81	263,219	$500,772	$1.90

Note: The average toll rates shown in the above table are calculated for all the transactions along the entire corridor and are in nominal dollars.

The annual toll revenue together with the average weekday traffic along the corridor for each of the Alternatives is shown in **Table 6-6** for the 52-year forecast period**. Figure 6-18** highlights the annual revenue of the three model years of 2015, 2025 and 2030 for all six alternatives. The average traffic column reflects the average volumes along the entire corridor (Total VMT/Length). The managed lanes are expected to generate approximately $18.0 million in the opening year for Alternatives 1, 2, 4 and $19.2 million for Alternatives 3, 5, 6 which includes the revenue from the north early project as described in the first section of this chapter. The year 2025 revenue reflects various combinations of the project construction scenarios. Alternative 1 represents the full build-out of the entire corridor and thus generates the highest revenue of around $89.6 million. The revenue is estimated to grow to $137.7 by 2030 under Alternative 1 project construction assumptions. All six alternatives assume the entire corridor will ultimately be built by 2040. With the ramp up factors applied to 2040 and 2041 on several alternatives, the total revenue shows some variations among alternatives, however, revenue will be same after 2042 for all the alternatives. The IH 35E managed lanes are expected to generate around $558.2 million toll revenue by 2060, which reflects a quadrupling of the 2030 revenues under Alternative 1 scenario.

Table 6-6
Estimated Daily Transaction and Annual Revenue

Year	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6	
	Weekday Traffic	Annual Revenue	Weekday Traffic	Annual Revenue	Weekday Traffic	Annual Revenue	Weekday Traffic	Annual Revenue	Weekday Traffic	Annual Revenue	Weekday Traffic	Annual Revenue
2015	12,350	$18,013,100	12,350	$18,013,100	18,160	$19,182,800	12,350	$18,013,100	18,160	$19,182,800	18,160	$19,182,800
2016	14,310	$22,666,600	14,310	$22,666,600	21,070	$24,132,500	14,310	$22,666,600	21,070	$24,132,500	21,070	$24,132,500
2017	16,300	$28,362,900	16,300	$28,362,900	24,010	$30,158,200	16,300	$28,362,900	24,010	$30,158,200	24,010	$30,158,200
2018	22,410	$37,860,900	16,780	$31,509,400	24,730	$33,510,800	22,410	$37,860,900	24,730	$33,510,800	24,730	$33,510,800
2019	23,720	$42,722,700	17,260	$34,933,100	25,450	$37,130,700	23,720	$42,722,700	25,450	$37,130,700	25,450	$37,130,700
2020	26,390	$49,723,100	17,740	$38,680,900	26,170	$41,104,700	25,070	$48,145,500	27,920	$42,682,300	26,170	$41,104,700
2021	28,030	$56,621,500	18,270	$42,586,300	26,960	$45,242,100	25,860	$53,052,200	29,840	$48,811,500	26,960	$45,242,100
2022	29,700	$64,195,200	18,800	$46,726,800	27,750	$49,624,700	26,650	$58,257,900	31,810	$55,562,100	27,750	$49,624,700
2023	30,640	$70,352,400	19,330	$51,229,700	28,540	$54,398,900	27,440	$63,881,000	32,790	$60,870,400	25,970	$61,727,200
2024	31,570	$76,695,700	19,840	$55,899,300	29,310	$59,347,500	28,210	$69,779,100	33,770	$66,264,100	27,440	$68,601,300
2025	27,550	$89,592,300	18,000	$65,703,800	26,320	$69,497,400	24,890	$81,205,600	29,860	$77,884,100	26,120	$83,915,500
2026	28,550	$98,235,000	18,400	$72,283,500	27,020	$76,757,800	25,660	$89,981,900	30,860	$85,011,000	27,810	$95,139,100
2027	29,540	$107,469,700	18,790	$79,246,200	27,700	$84,432,300	26,410	$99,322,100	31,860	$92,579,800	29,540	$107,469,700
2028	30,540	$117,158,300	19,170	$86,479,700	28,380	$92,431,400	27,160	$109,057,000	32,870	$100,532,600	30,540	$117,158,300
2029	31,530	$127,347,000	19,550	$94,138,400	29,050	$100,898,000	27,910	$119,419,100	33,860	$108,825,900	31,530	$127,347,000
2030	32,480	$137,712,400	29,310	$124,432,700	29,310	$124,432,700	28,650	$130,000,400	34,790	$117,312,600	32,480	$137,712,400
2031	33,240	$146,286,700	31,680	$139,213,600	31,680	$139,213,600	29,320	$138,269,900	35,600	$124,466,300	33,240	$146,286,700
2032	34,020	$155,476,600	34,020	$155,476,600	34,020	$155,476,600	30,000	$147,084,300	36,430	$132,101,000	34,020	$155,476,600
2033	34,820	$164,848,600	34,820	$164,848,600	34,820	$164,848,600	30,700	$156,266,400	37,270	$139,911,000	34,820	$164,848,600
2034	35,640	$174,899,800	35,640	$174,899,800	35,640	$174,899,800	31,410	$165,868,700	38,140	$148,243,200	35,640	$174,899,800
2035	36,320	$184,478,100	36,320	$184,478,100	36,320	$184,478,100	32,000	$175,131,000	38,840	$156,226,600	36,320	$184,478,100
2036	37,010	$194,536,300	37,010	$194,536,300	37,010	$194,536,300	32,590	$184,931,400	39,570	$164,516,800	37,010	$194,536,300
2037	37,710	$204,836,200	37,710	$204,836,200	37,710	$204,836,200	33,210	$194,981,900	40,300	$173,119,700	37,710	$204,836,200
2038	38,430	$215,825,200	38,430	$215,825,200	38,430	$215,825,200	33,830	$205,670,300	41,060	$182,165,200	38,430	$215,825,200
2039	39,160	$227,325,500	39,160	$227,325,500	39,160	$227,325,500	34,470	$216,786,700	41,830	$191,685,500	39,160	$227,325,500
2040	39,910	$239,147,700	39,910	$239,147,700	39,910	$239,147,700	38,170	$224,529,100	37,970	$230,130,500	39,910	$239,147,700
2041	40,470	$250,354,700	40,470	$250,354,700	40,470	$250,354,700	39,610	$242,699,600	39,490	$245,606,800	40,470	$250,354,700
2042	41,040	$262,060,000	41,040	$262,060,000	41,040	$262,060,000	41,040	$262,060,000	41,040	$262,060,000	41,040	$262,060,000
2043	41,610	$274,119,100	41,610	$274,119,100	41,610	$274,119,100	41,610	$274,119,100	41,610	$274,119,100	41,610	$274,119,100
2044	42,180	$286,770,500	42,180	$286,770,500	42,180	$286,770,500	42,180	$286,770,500	42,180	$286,770,500	42,180	$286,770,500
2045	42,770	$299,818,300	42,770	$299,818,300	42,770	$299,818,300	42,770	$299,818,300	42,770	$299,818,300	42,770	$299,818,300
2046	43,250	$313,115,600	43,250	$313,115,600	43,250	$313,115,600	43,250	$313,115,600	43,250	$313,115,600	43,250	$313,115,600
2047	43,740	$326,731,900	43,740	$326,731,900	43,740	$326,731,900	43,740	$326,731,900	43,740	$326,731,900	43,740	$326,731,900
2048	44,230	$340,647,400	44,230	$340,647,400	44,230	$340,647,400	44,230	$340,647,400	44,230	$340,647,400	44,230	$340,647,400
2049	44,720	$355,374,500	44,720	$355,374,500	44,720	$355,374,500	44,720	$355,374,500	44,720	$355,374,500	44,720	$355,374,500
2050	45,220	$370,508,700	45,220	$370,508,700	45,220	$370,508,700	45,220	$370,508,700	45,220	$370,508,700	45,220	$370,508,700
2051	45,730	$386,366,500	45,730	$386,366,500	45,730	$386,366,500	45,730	$386,366,500	45,730	$386,366,500	45,730	$386,366,500
2052	46,230	$402,749,800	46,230	$402,749,800	46,230	$402,749,800	46,230	$402,749,800	46,230	$402,749,800	46,230	$402,749,800
2053	46,730	$419,916,700	46,730	$419,916,700	46,730	$419,916,700	46,730	$419,916,700	46,730	$419,916,700	46,730	$419,916,700
2054	47,240	$437,595,100	47,240	$437,595,100	47,240	$437,595,100	47,240	$437,595,100	47,240	$437,595,100	47,240	$437,595,100
2055	47,750	$456,143,300	47,750	$456,143,300	47,750	$456,143,300	47,750	$456,143,300	47,750	$456,143,300	47,750	$456,143,300
2056	48,260	$474,935,500	48,260	$474,935,500	48,260	$474,935,500	48,260	$474,935,500	48,260	$474,935,500	48,260	$474,935,500
2057	48,780	$494,594,300	48,780	$494,594,300	48,780	$494,594,300	48,780	$494,594,300	48,780	$494,594,300	48,780	$494,594,300
2058	49,300	$514,994,700	49,300	$514,994,700	49,300	$514,994,700	49,300	$514,994,700	49,300	$514,994,700	49,300	$514,994,700
2059	49,830	$536,289,400	49,830	$536,289,400	49,830	$536,289,400	49,830	$536,289,400	49,830	$536,289,400	49,830	$536,289,400
2060	50,360	$558,204,200	50,360	$558,204,200	50,360	$558,204,200	50,360	$558,204,200	50,360	$558,204,200	50,360	$558,204,200
2061	50,900	$580,974,900	50,900	$580,974,900	50,900	$580,974,900	50,900	$580,974,900	50,900	$580,974,900	50,900	$580,974,900
2062	51,450	$604,595,100	51,450	$604,595,100	51,450	$604,595,100	51,450	$604,595,100	51,450	$604,595,100	51,450	$604,595,100
2063	51,990	$628,965,900	51,990	$628,965,900	51,990	$628,965,900	51,990	$628,965,900	51,990	$628,965,900	51,990	$628,965,900
2064	52,520	$654,584,800	52,520	$654,584,800	52,520	$654,584,800	52,520	$654,584,800	52,520	$654,584,800	52,520	$654,584,800
2065	53,060	$680,864,900	53,060	$680,864,900	53,060	$680,864,900	53,060	$680,864,900	53,060	$680,864,900	53,060	$680,864,900
2066	53,600	$708,420,300	53,600	$708,420,300	53,600	$708,420,300	53,600	$708,420,300	53,600	$708,420,300	53,600	$708,420,300

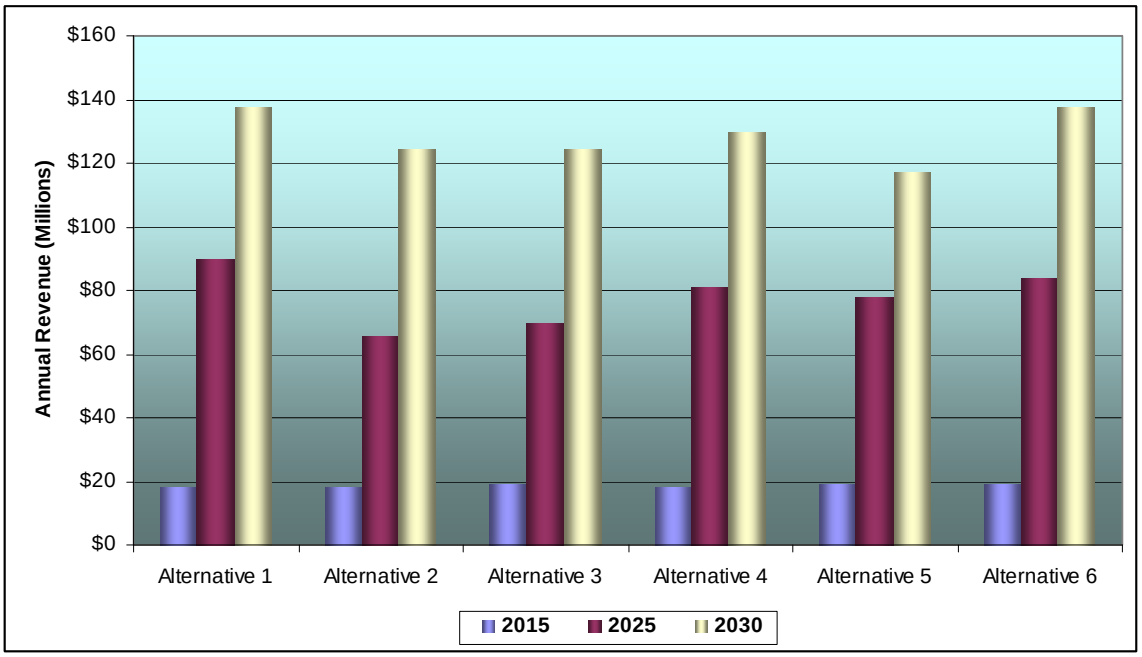


Figure 6-18. Annual Toll Revenue Profile

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 7

TOLL REVENUE RISK ANALYSIS

The forecast of future traffic demand on potential toll facilities has a certain level of uncertainty associated with multiple key variables, upon which the travel demand is dependent. Traffic and revenue forecasts are typically point forecasts that are generated based on assumptions developed from reasonable historical and forecasted averages that outline the most likely case future scenarios. However, the level of uncertainty around the average assumptions also needs to be taken into account for purposes of evaluating the potential range under which the toll revenue generation potential of the facility may fall. The level of upward or downward deviations from the mean, in concert with the likelihood of one variable occurrence over the other, is an important consideration in developing the full range of possible outcomes. While a full account of the overall risk associated with forecasting into the future is difficult to quantify, the following risk analysis undertaken as part of this study identifies some key variables whose influence and effect on the toll revenue generation of a corridor are significant enough to warrant further analysis and description.

This chapter describes the toll revenue risk analysis undertaken for the IH 35E managed lanes project that takes into consideration the variation of several key variables that may affect the travel demand and revenue forecast. The risk analysis of the toll revenue forecasts were performed for a modified case reflecting a higher risk profile and a midline case which employs the intermediate risk between the baseline and modified case.

RISK ANALYSIS METHODOLOGY

The sources of uncertainty in the traffic and revenue forecasting can, in general, be classified under two categories: the modeling methodology and the forecasted model variable inputs. The modeling methodology is typically addressed by using the state-of-the-art and best practices regarding the industry accepted methodologies. These are continuously evolving as both software, hardware and data becomes more advanced and

readily available for use within the modeling/forecasting community. The four-step travel demand models used as the base for this study were developed and maintained by NCTCOG and standard accepted practices were used and applied in developing these models. The model frameworks were therefore not analyzed quantitatively, however, they were reviewed for compliance with standard practices in their development, and reasonableness checks of the inputs and forecasts were also undertaken. The forecast model variable inputs to some extent can generate the largest uncertainty in the future forecast of the travel demand regionally, locally, and within the proposed study corridor. In the case of this study, the key model input variables investigated include the ramp-up factors, truck percentage shares, truck toll factors, revenue days, social economic forecasts, values of time, and toll diversion.

RISK ANALYSIS ASSUMPTIONS

The key variables that have been considered for the risk analysis of the toll revenue forecasts are discussed in this section and **Table 7-1** outlines the assumptions used of each of these variables for the three defined revenue risk scenarios.

Ramp-up Factor
Most new toll facilities experience a ramping up of their demand as travelers become accustomed to the benefits of the new facility in comparison to their current routes. In the case of a managed lane project, a significant amount of the attracted traffic generally comes directly from the demand that is currently using the corridor with the remaining coming from other parallel routes. Thus future managed lane users are typically expected to be very familiar with the travel characteristics of the facility. However, as the managed lanes concept is still relatively new to North Texas travelers, some travelers may still need to get used to the access/exit locations and the tolling policy, and therefore the baseline ramp-up factor assumptions of 80 percent and 90 percent were assumed for the first two years of the IH 35E managed lane operations. As a risk sensitivity, the fact that a managed lane will be opened during the same timeframe at the southern termini of the project and the possibility of a successful marketing and public outreach by both TxDOT and NTTA, may dampen the ramp-up in the corridor, especially in sections where congestion is already prevalent today. As such, a reasonably aggressive ramp up factor assumption for the modified case reflected a 90 percent and 95 percent for the first two years, and the midline revenue case falling at the middle point between baseline and modified cases.

Truck Percentage Share and Truck Toll Factors
As part of the eligibility, trucks are allowed to drive on the proposed IH 35E managed lanes at a higher toll rate. The classification counts collected as part of this study and described in Chapter 2 show that traffic along the IH 35E study corridor generally consists of 7 to 11 percent truck traffic. Trucks captured within the managed lanes are assumed to range between 2 and 4 percent for the baseline assumption, taking into

consideration the higher truck toll rate and the fact that most truck traffic currently travels during the off-peak periods when managed lanes do not provide any competitive time savings. However, as traffic continues to grow along the corridor with more peak spreading occurring into the off-peak periods, and with the increased focus on timely delivery of merchandise, more trucks may eventually be enticed to take the managed lanes. Seven (7) percent of truck traffic was assumed for the future years on the managed lane corridor for the modified cases and 5 percent was assumed for the midline cases to account for the likelihood of this occurrence in the future.

Similar to the truck toll rate policy on other North Texas toll facilities, trucks are typically charged using an axle-based classification that is typically modeled as a truck toll factor over and above the passenger car toll rate (N or N-1 classifications are typical with N representing the number of truck axles). An average truck toll factor was calculated as 3.5 for truck traffic along the IH 35E corridor based on the distribution of the existing truck axles obtained from the classification counts. Given that the IH 35E corridor also carries long haul freight through the corridor, several national freight initiatives may in the future make allowances for larger truck sizes or combinations that could potentially increase the distribution of the truck profile which would thus result in the need for a higher truck toll factor to account for this. The truck toll factor was assumed to grow to 4.0 for the modified case, as shown in **Table 7-1,** to account for the possible deviation from the existing distributions.

Night Time Share

Night time traffic expected on the managed lanes was not modeled due to the relatively small share of the total revenue and the difficulty to capture the willingness-to-pay characteristics of night time travelers. The night time period is defined as 7:30 p.m. – 6:30 a.m.. It is assumed that night time traffic will account for approximately 2 percent of the daily toll revenue for the base case revenue scenario based on current observed trends along other managed lane facilities. As travelers enjoy the benefits provided by the managed lanes other than time saving, for example conform and safety, more motorists may be willing to travel on the managed lane even during the night time. In addition, as corridors mature it has been shown that the shoulder periods become more heavily traveled as a result of peak spreading, especially in the morning 5:00 – 6:30 a.m. travel times and increased recreational travels especially during the 7:00 p.m. to 11:00 p.m. travel times. Thus night time revenue was assumed to account for 5 percent of the daily revenue under the modified case to account for the increases in this market.

Revenue Days

The baseline traffic profile for the corridor was determined using seven day count profiles collected at several locations along IH 35E as part of this study. An average equivalent revenue day of 275 is assumed for the baseline revenue calculation, which is typically in the acceptable range within the DFW urban area. However, toll facilities elsewhere have shown that a mature system can generate upwards of 345 revenue days. It is also expected that more traffic will use the managed lanes during the weekend in the

future as traffic further grows along the corridor. For the modified case, the revenue days were assumed to be 330 for the revenue projection. The midline revenue scenario uses 300 revenue days.

ETC Penetration Rate

The level of electronic toll collection penetration rates plays a key role in determining the share of traffic that will pay the ETC toll rates and higher video toll rates. The level of participation is a function of the number of toll tag users that constitute frequent users of the proposed corridor. The ETC penetration rates will likely be higher within this corridor given the numerous existing traditionally tolled facilities within the project area that include the DFW Airport toll road (International Parkway) and other NTTA system toll roads (PGBT, and SH 121) that intersect with the study corridor. The implementation of a system of managed lanes within the region will also likely increase the ETC participation rates, due to the familiarity of the users to the benefits of this system of managed lane facilities that will all become operational within the same time frame.

As such, the traveling market is expected to be well versed with toll road usage by the 2015 opening of the proposed IH 35E managed lane corridor. The ETC penetration rate is therefore expected to be in mature state. These levels, however, will be dependent, to a large extent, on the marketing that is implemented to encourage ETC usage and promote awareness of the advantages that the multiple toll facilities in the corridor study area provide to the potential users. In addition, the existing NTTA efforts to promote use of its system, along with the marketing efforts currently being undertaken by TxDOT to promote the statewide interoperability of TxTag, will no doubt accelerate the regional participation rates. In addition, the proposed facility may also benefit from the marketing efforts that may be undertaken for several other managed lane facilities that include IH 635 and North Tarrant Express (IH 35/SH 183).

An ETC penetration of 80 percent for the opening year in 2015, increasing to 85 percent by 2020, and 95 percent by 2025 and beyond is the baseline assumption used for this analysis. The ETC penetration rates for the intermediate years were interpolated. Even higher ETC penetration rates may become realized sooner with aggressive marketing strategies, and if vehicles become automatically equipped with transponders and/or with transponders, and/or as technological advances improve the ETC tag technology and its widespread implementation. Therefore, the ETC penetration of 85 percent for the opening year 2015 and 95 percent in 2020 and beyond was assumed for the modified revenue case. The current out-of-state traffic percentage accounts for approximately 5 percent along the IH 35E corridor and this market will likely remain video billed unless reciprocity and recapture policies with neighboring states are established.

Long Term Growth Trends

The long-term trends beyond 2030 were estimated to reflect forecasted average annual growth trend between 2015, 2025 and 2030. A review of the Denton, Collin, Dallas and

Tarrant county population growth in the past decades revealed an average annual growth rate of 3.1 percent between 1990 and 2000. Some other available long-term demographic forecasts in this region, such as Texas Water Board, were also reviewed to gauge the expected long-term growth profile of the IH 35E managed lane traffic. For the purpose of the 52-year revenue forecast, the average annual traffic growth rate was assumed to be 2.0 percent beyond 2030 and reduced by 0.5 percent every 5 years with 1.0 percent growth cap thereafter. To account for the potential higher long-term growth in this region, it is assumed that the average annual traffic growth rate to be 3.0 percent beyond 2030 and reduced by 0.5 percent every 5 years until a capped growth of 1.0 percent.

Some other key variables considered for the risk analysis include socioeconomic forecasts, which are discussed in Chapter 4 of this report, values of time, and toll diversion as also presented in **Table 7-1**.

Table 7-1

Baseline and Risk Assessment Traffic and Revenue Assumptions

Parameters	Baseline	Midline	Modified
Ramp Up Factor	80%, 90% for first two years, respectively	85%, 95% for first two years, respectively	90%, 95%, for first two years, respectively
Truck Percentage Share	2-4 percent	5 percent	7 percent
Truck Toll Factors	3.5	3.75	4.0
Night time Share	2 percent	3 percent	5 percent
Revenue Days per year	275	300	330
ETC Penetration Rates	80% in opening year	85% in opening year	85% in opening year
	85% in 2020	90% in 2020	95% in 2020+
	95% in 2025+	95% in 2025+	
Toll Leakage	No leakage assumed	No leakage assumed	No leakage assumed
Socioeconomic Data	Revised demographic for baseline assumptions (2.5% in 2015 and 7% in 2030)*	Mid point between baseline and risk assumptions	Risk analysis demographics assumptions (4% in 2015 and 16% in 2030)*
Traffic Growth Rates Beyond 2030	2.0% beyond 2030 and reducing by 0.5% every 5 years; with 1.0% constant beyond	2.5% beyond 2030 and reducing by 0.5% every 5 years; with 1.0% constant beyond	3.0% beyond 2030 and reducing by 0.5% every 5 years, with 1.0% constant beyond;
Value of Time	Baseline assumptions	Increasing with values of time by 30 percent.	Increasing with values of time by 60 percent.
Toll Diversion	Based on current observed sensitivities	Adjusted to provide a 5 percent toll road bias.	Adjusted to provide a 10 percent toll road bias.
Length of T&R Forecast	52 years	52 years	52 years

* The demographic adjustment was made by county and varies in each traffic analysis zone (TAZ). The percentages presented in this table are for illustration purpose only and represent the overall DFW region-wide demographic adjustment made in each alternative comparing to NCTCOG's official demographics.

RISK ANALYSIS TOLL REVENUE

The risk analysis toll revenue was estimated based on the various key variables described above for two scenarios of midline and modified. **Tables 7-2** and **7-3** show the risk analysis toll revenue for the 52-year forecast period. The baseline revenue discussed in Chapter 6 is also included for comparison purpose. The same risk assumptions and methodology were applied to create the risk toll revenue for various alternatives; therefore all the alternatives have similar risk profiles. Alternative 1 revenue results are used herein as the example for illustration purposes and are also shown in **Figure 7-1**.

The managed lanes are expected to generate $18.0 million in toll revenue in the opening year of 2015 under the baseline assumptions, while approximately $42.2 million in revenue is expected under the modified scenario assumptions, reflecting an approximate 2.3 factor increase over the baseline revenues. The toll revenue is estimated to grow to $137.7 million by 2030 for the baseline case, and $348.6 for the modified case, reflecting an approximate 2.5 factor over the baseline revenues. By 2060, the IH 35E managed lanes are expected to generate $558.2 million in toll revenue under the baseline assumptions, and $1,682.2 million in revenue under the modified revenue assumptions. As is expected, the uncertainty for managed lanes revenue forecast may be significantly higher than the traditional toll road given some unique operating characteristics of managed lanes that include the parallel competing alternatives, and more specifically the congestion pricing that needs to be implemented to effectively manage the demand along the managed facilities.

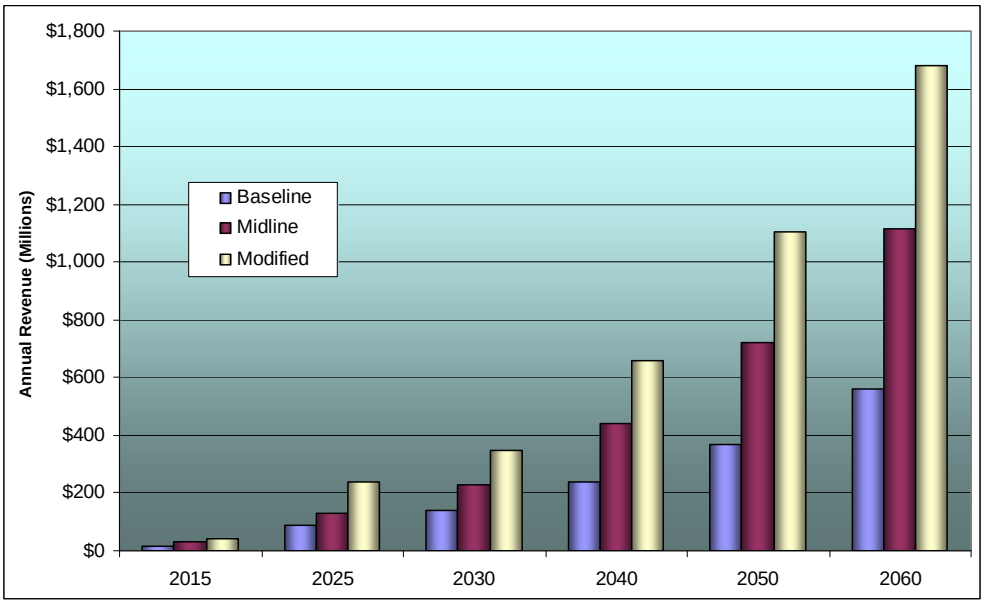


Figure 7-1 Risk Revenue Profile of Alternative 1

Table 7-2
Estimated Risk Analysis Annual Toll Revenue for Alternatives 1, 2 and 3

Year	Alternative 1			Alternative 2			Alternative 3		
	Baseline	Midline	Modified	Baseline	Midline	Modified	Baseline	Midline	Modified
2015	$18,013,100	$28,962,100	$42,224,000	$18,013,100	$28,962,100	$42,224,000	$19,182,800	$30,657,300	$45,511,200
2016	$22,666,600	$36,769,800	$52,266,700	$22,666,600	$36,769,800	$52,266,700	$24,132,500	$38,950,000	$56,354,100
2017	$28,362,900	$43,924,300	$64,567,800	$28,362,900	$43,924,300	$64,567,800	$30,158,200	$46,436,200	$69,573,600
2018	$37,860,900	$60,336,100	$93,759,600	$31,509,400	$49,185,800	$74,409,900	$33,510,800	$52,113,900	$80,143,500
2019	$42,722,700	$68,380,000	$108,323,200	$34,933,100	$54,739,900	$85,105,800	$37,130,700	$58,107,000	$91,672,900
2020	$49,723,100	$77,627,500	$128,062,700	$38,680,900	$60,758,500	$96,797,800	$41,104,700	$64,596,200	$104,269,900
2021	$56,621,500	$88,313,100	$146,881,100	$42,586,300	$67,179,400	$109,767,700	$45,242,100	$71,493,000	$118,225,200
2022	$64,195,200	$98,624,900	$168,298,800	$46,726,800	$74,057,500	$123,728,500	$49,624,700	$78,930,500	$133,261,100
2023	$70,352,400	$108,742,800	$189,270,700	$51,229,700	$81,619,400	$138,850,700	$54,398,900	$87,071,900	$149,551,500
2024	$76,695,700	$119,514,800	$212,293,200	$55,899,300	$89,356,700	$155,541,000	$59,347,500	$95,491,900	$167,508,000
2025	$89,592,300	$131,827,200	$240,801,800	$65,703,800	$98,979,100	$178,439,600	$69,497,400	$105,619,400	$191,635,000
2026	$98,235,000	$148,187,100	$259,817,600	$72,283,500	$112,822,200	$194,642,700	$76,757,800	$120,677,700	$209,309,900
2027	$107,469,700	$166,465,400	$280,605,000	$79,246,200	$127,620,800	$211,353,000	$84,432,300	$136,774,400	$227,600,300
2028	$117,158,300	$186,142,300	$302,418,400	$86,479,700	$143,160,800	$228,854,300	$92,431,400	$153,673,900	$246,692,300
2029	$127,347,000	$206,821,400	$325,230,000	$94,138,400	$159,400,000	$247,212,000	$100,898,000	$171,396,700	$266,802,800
2030	$137,712,400	$228,578,600	$348,619,600	$124,432,700	$207,724,200	$327,086,900	$124,432,700	$207,724,200	$327,086,900
2031	$146,286,700	$245,902,700	$372,722,000	$139,213,600	$238,302,500	$361,253,900	$139,213,600	$238,302,500	$361,253,900
2032	$155,476,600	$263,853,200	$398,339,100	$155,476,600	$263,853,200	$398,339,100	$155,476,600	$263,853,200	$398,339,100
2033	$164,848,600	$283,028,500	$425,881,900	$164,848,600	$283,028,500	$425,881,900	$164,848,600	$283,028,500	$425,881,900
2034	$174,899,800	$303,338,000	$455,671,900	$174,899,800	$303,338,000	$455,671,900	$174,899,800	$303,338,000	$455,671,900
2035	$184,478,100	$323,314,700	$484,871,100	$184,478,100	$323,314,700	$484,871,100	$184,478,100	$323,314,700	$484,871,100
2036	$194,536,300	$344,462,500	$515,775,300	$194,536,300	$344,462,500	$515,775,300	$194,536,300	$344,462,500	$515,775,300
2037	$204,836,200	$366,746,900	$548,915,500	$204,836,200	$366,746,900	$548,915,500	$204,836,200	$366,746,900	$548,915,500
2038	$215,825,200	$390,005,900	$584,089,400	$215,825,200	$390,005,900	$584,089,400	$215,825,200	$390,005,900	$584,089,400
2039	$227,325,500	$414,645,600	$621,287,300	$227,325,500	$414,645,600	$621,287,300	$227,325,500	$414,645,600	$621,287,300
2040	$239,147,700	$441,177,000	$660,547,000	$239,147,700	$441,177,000	$660,547,000	$239,147,700	$441,177,000	$660,547,000
2041	$250,354,700	$466,035,500	$698,080,000	$250,354,700	$466,035,500	$698,080,000	$250,354,700	$466,035,500	$698,080,000
2042	$262,060,000	$492,041,300	$738,079,900	$262,060,000	$492,041,300	$738,079,900	$262,060,000	$492,041,300	$738,079,900
2043	$274,119,100	$519,056,300	$779,865,800	$274,119,100	$519,056,300	$779,865,800	$274,119,100	$519,056,300	$779,865,800
2044	$286,770,500	$547,509,400	$823,902,400	$286,770,500	$547,509,400	$823,902,400	$286,770,500	$547,509,400	$823,902,400
2045	$299,818,300	$577,067,000	$870,395,500	$299,818,300	$577,067,000	$870,395,500	$299,818,300	$577,067,000	$870,395,500
2046	$313,115,600	$604,107,500	$913,070,700	$313,115,600	$604,107,500	$913,070,700	$313,115,600	$604,107,500	$913,070,700
2047	$326,731,900	$632,257,300	$958,199,900	$326,731,900	$632,257,300	$958,199,900	$326,731,900	$632,257,300	$958,199,900
2048	$340,647,400	$661,385,100	$1,005,154,300	$340,647,400	$661,385,100	$1,005,154,300	$340,647,400	$661,385,100	$1,005,154,300
2049	$355,374,500	$691,649,600	$1,053,814,200	$355,374,500	$691,649,600	$1,053,814,200	$355,374,500	$691,649,600	$1,053,814,200
2050	$370,508,700	$722,956,200	$1,104,599,400	$370,508,700	$722,956,200	$1,104,599,400	$370,508,700	$722,956,200	$1,104,599,400
2051	$386,366,500	$755,757,600	$1,152,449,800	$386,366,500	$755,757,600	$1,152,449,800	$386,366,500	$755,757,600	$1,152,449,800
2052	$402,749,800	$789,632,000	$1,201,978,400	$402,749,800	$789,632,000	$1,201,978,400	$402,749,800	$789,632,000	$1,201,978,400
2053	$419,916,700	$824,851,500	$1,253,547,500	$419,916,700	$824,851,500	$1,253,547,500	$419,916,700	$824,851,500	$1,253,547,500
2054	$437,595,100	$861,501,900	$1,307,244,000	$437,595,100	$861,501,900	$1,307,244,000	$437,595,100	$861,501,900	$1,307,244,000
2055	$456,143,300	$899,447,500	$1,364,352,700	$456,143,300	$899,447,500	$1,364,352,700	$456,143,300	$899,447,500	$1,364,352,700
2056	$474,935,500	$938,586,500	$1,422,766,600	$474,935,500	$938,586,500	$1,422,766,600	$474,935,500	$938,586,500	$1,422,766,600
2057	$494,594,300	$979,709,000	$1,483,639,200	$494,594,300	$979,709,000	$1,483,639,200	$494,594,300	$979,709,000	$1,483,639,200
2058	$514,994,700	$1,022,812,700	$1,546,952,300	$514,994,700	$1,022,812,700	$1,546,952,300	$514,994,700	$1,022,812,700	$1,546,952,300
2059	$536,289,400	$1,067,556,000	$1,612,719,700	$536,289,400	$1,067,556,000	$1,612,719,700	$536,289,400	$1,067,556,000	$1,612,719,700
2060	$558,204,200	$1,114,126,500	$1,682,154,100	$558,204,200	$1,114,126,500	$1,682,154,100	$558,204,200	$1,114,126,500	$1,682,154,100
2061	$580,974,900	$1,162,247,000	$1,754,378,700	$580,974,900	$1,162,247,000	$1,754,378,700	$580,974,900	$1,162,247,000	$1,754,378,700
2062	$604,595,100	$1,212,351,800	$1,829,674,900	$604,595,100	$1,212,351,800	$1,829,674,900	$604,595,100	$1,212,351,800	$1,829,674,900
2063	$628,965,900	$1,264,616,300	$1,909,229,100	$628,965,900	$1,264,616,300	$1,909,229,100	$628,965,900	$1,264,616,300	$1,909,229,100
2064	$654,584,800	$1,319,531,400	$1,992,126,700	$654,584,800	$1,319,531,400	$1,992,126,700	$654,584,800	$1,319,531,400	$1,992,126,700
2065	$680,864,900	$1,376,804,800	$2,082,381,700	$680,864,900	$1,376,804,800	$2,082,381,700	$680,864,900	$1,376,804,800	$2,082,381,700
2066	$708,420,300	$1,437,013,300	$2,177,797,100	$708,420,300	$1,437,013,300	$2,177,797,100	$708,420,300	$1,437,013,300	$2,177,797,100

Table 7-3
Estimated Risk Analysis Annual Toll Revenue for Alternatives 4, 5 and 6

Year	Alternative 4			Alternative 5			Alternative 6		
	Baseline	Midline	Modified	Baseline	Midline	Modified	Baseline	Midline	Modified
2015	$18,013,100	$28,962,100	$42,224,000	$19,182,800	$30,657,300	$45,511,200	$19,182,800	$30,657,300	$45,511,200
2016	$22,666,600	$36,769,800	$52,266,700	$24,132,500	$38,950,000	$56,354,100	$24,132,500	$38,950,000	$56,354,100
2017	$28,362,900	$43,924,300	$64,567,800	$30,158,200	$46,436,200	$69,573,600	$30,158,200	$46,436,200	$69,573,600
2018	$37,860,900	$60,336,100	$93,759,600	$33,510,800	$52,113,900	$80,143,500	$33,510,800	$52,113,900	$80,143,500
2019	$42,722,700	$68,380,000	$108,323,200	$37,130,700	$58,107,000	$91,672,900	$37,130,700	$58,107,000	$91,672,900
2020	$48,145,500	$76,595,000	$124,399,800	$42,682,300	$66,061,100	$107,932,900	$41,104,700	$64,596,200	$104,269,900
2021	$53,052,200	$84,688,200	$141,068,900	$48,811,500	$75,492,300	$124,037,400	$45,242,100	$71,493,000	$118,225,200
2022	$58,257,900	$93,371,000	$159,055,800	$55,562,100	$84,496,100	$142,504,100	$49,624,700	$78,930,500	$133,261,100
2023	$63,881,000	$102,835,500	$178,532,000	$60,870,400	$93,206,300	$160,290,200	$61,727,200	$100,074,100	$175,148,300
2024	$69,779,100	$112,649,300	$200,070,200	$66,264,100	$102,452,100	$179,731,000	$68,601,300	$111,689,900	$198,440,900
2025	$81,205,600	$123,732,200	$227,446,500	$77,884,100	$113,714,400	$204,990,400	$83,915,500	$125,554,200	$233,420,500
2026	$89,981,900	$141,587,400	$248,568,400	$85,011,000	$127,277,300	$220,559,100	$95,139,100	$145,855,600	$255,545,000
2027	$99,322,100	$160,720,100	$270,383,200	$92,579,800	$142,519,700	$237,822,100	$107,469,700	$166,465,400	$280,605,000
2028	$109,057,000	$180,871,600	$293,324,900	$100,532,600	$158,944,600	$255,785,800	$117,158,300	$186,142,300	$302,418,400
2029	$119,419,100	$202,090,700	$317,218,800	$108,825,900	$176,127,400	$274,814,000	$127,347,000	$206,821,400	$325,230,000
2030	$130,000,400	$224,394,000	$341,914,400	$117,312,600	$194,360,600	$294,273,100	$137,712,400	$228,578,600	$348,619,600
2031	$138,269,900	$241,159,900	$365,560,100	$124,466,300	$209,058,700	$314,809,300	$146,286,700	$245,902,700	$372,722,000
2032	$147,084,300	$258,574,400	$390,684,100	$132,101,000	$224,221,200	$336,417,800	$155,476,600	$263,853,200	$398,339,100
2033	$156,266,400	$277,174,000	$417,772,100	$139,911,000	$240,459,800	$359,609,800	$164,848,600	$283,028,500	$425,881,900
2034	$165,868,700	$296,909,700	$446,655,600	$148,243,200	$257,491,400	$384,653,600	$174,899,800	$303,338,000	$455,671,900
2035	$175,131,000	$316,109,500	$475,218,400	$156,226,600	$274,301,500	$409,349,300	$184,478,100	$323,314,700	$484,871,100
2036	$184,931,400	$336,740,100	$505,443,100	$164,516,800	$292,018,800	$435,769,100	$194,536,300	$344,462,500	$515,775,300
2037	$194,981,900	$358,492,400	$537,324,100	$173,119,700	$310,740,300	$464,222,800	$204,836,200	$366,746,900	$548,915,500
2038	$205,670,300	$381,298,100	$570,743,800	$182,165,200	$330,288,900	$494,533,600	$215,825,200	$390,005,900	$584,089,400
2039	$216,786,700	$405,283,300	$606,825,700	$191,685,500	$351,182,300	$526,521,500	$227,325,500	$414,645,600	$621,287,300
2040	$224,529,100	$411,867,000	$628,037,600	$230,130,500	$429,127,200	$648,573,200	$239,147,700	$441,177,000	$660,547,000
2041	$242,699,600	$454,945,500	$680,927,800	$245,606,800	$461,795,800	$691,772,000	$250,354,700	$466,035,500	$698,080,000
2042	$262,060,000	$492,041,300	$738,079,900	$262,060,000	$492,041,300	$738,079,900	$262,060,000	$492,041,300	$738,079,900
2043	$274,119,100	$519,056,300	$779,865,800	$274,119,100	$519,056,300	$779,865,800	$274,119,100	$519,056,300	$779,865,800
2044	$286,770,500	$547,509,400	$823,902,400	$286,770,500	$547,509,400	$823,902,400	$286,770,500	$547,509,400	$823,902,400
2045	$299,818,300	$577,067,000	$870,395,500	$299,818,300	$577,067,000	$870,395,500	$299,818,300	$577,067,000	$870,395,500
2046	$313,115,600	$604,107,500	$913,070,700	$313,115,600	$604,107,500	$913,070,700	$313,115,600	$604,107,500	$913,070,700
2047	$326,731,900	$632,257,300	$958,199,900	$326,731,900	$632,257,300	$958,199,900	$326,731,900	$632,257,300	$958,199,900
2048	$340,647,400	$661,385,100	$1,005,154,300	$340,647,400	$661,385,100	$1,005,154,300	$340,647,400	$661,385,100	$1,005,154,300
2049	$355,374,500	$691,649,600	$1,053,814,200	$355,374,500	$691,649,600	$1,053,814,200	$355,374,500	$691,649,600	$1,053,814,200
2050	$370,508,700	$722,956,200	$1,104,599,400	$370,508,700	$722,956,200	$1,104,599,400	$370,508,700	$722,956,200	$1,104,599,400
2051	$386,366,500	$755,757,600	$1,152,449,800	$386,366,500	$755,757,600	$1,152,449,800	$386,366,500	$755,757,600	$1,152,449,800
2052	$402,749,800	$789,632,000	$1,201,978,400	$402,749,800	$789,632,000	$1,201,978,400	$402,749,800	$789,632,000	$1,201,978,400
2053	$419,916,700	$824,851,500	$1,253,547,500	$419,916,700	$824,851,500	$1,253,547,500	$419,916,700	$824,851,500	$1,253,547,500
2054	$437,595,100	$861,501,900	$1,307,244,000	$437,595,100	$861,501,900	$1,307,244,000	$437,595,100	$861,501,900	$1,307,244,000
2055	$456,143,300	$899,447,500	$1,364,352,700	$456,143,300	$899,447,500	$1,364,352,700	$456,143,300	$899,447,500	$1,364,352,700
2056	$474,935,500	$938,586,500	$1,422,766,600	$474,935,500	$938,586,500	$1,422,766,600	$474,935,500	$938,586,500	$1,422,766,600
2057	$494,594,300	$979,709,000	$1,483,639,200	$494,594,300	$979,709,000	$1,483,639,200	$494,594,300	$979,709,000	$1,483,639,200
2058	$514,994,700	$1,022,812,700	$1,546,952,300	$514,994,700	$1,022,812,700	$1,546,952,300	$514,994,700	$1,022,812,700	$1,546,952,300
2059	$536,289,400	$1,067,556,000	$1,612,719,700	$536,289,400	$1,067,556,000	$1,612,719,700	$536,289,400	$1,067,556,000	$1,612,719,700
2060	$558,204,200	$1,114,126,500	$1,682,154,100	$558,204,200	$1,114,126,500	$1,682,154,100	$558,204,200	$1,114,126,500	$1,682,154,100
2061	$580,974,900	$1,162,247,000	$1,754,378,700	$580,974,900	$1,162,247,000	$1,754,378,700	$580,974,900	$1,162,247,000	$1,754,378,700
2062	$604,595,100	$1,212,351,800	$1,829,674,900	$604,595,100	$1,212,351,800	$1,829,674,900	$604,595,100	$1,212,351,800	$1,829,674,900
2063	$628,965,900	$1,264,616,300	$1,909,229,100	$628,965,900	$1,264,616,300	$1,909,229,100	$628,965,900	$1,264,616,300	$1,909,229,100
2064	$654,584,800	$1,319,531,400	$1,992,126,700	$654,584,800	$1,319,531,400	$1,992,126,700	$654,584,800	$1,319,531,400	$1,992,126,700
2065	$680,864,900	$1,376,804,800	$2,082,381,700	$680,864,900	$1,376,804,800	$2,082,381,700	$680,864,900	$1,376,804,800	$2,082,381,700
2066	$708,420,300	$1,437,013,300	$2,177,797,100	$708,420,300	$1,437,013,300	$2,177,797,100	$708,420,300	$1,437,013,300	$2,177,797,100

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

WilburSmith
ASSOCIATES