

**Texas Department of Transportation
Texas Turnpike Authority**

Analysis of Evacuation Benefits of TTC-35

October 23, 2006

TRANS-TEXAS CORRIDOR TTC-35

Analysis of Evacuation Benefits of TTC-35

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1 Overview

The purpose of the analysis was to determine the potential effect of a TTC-35 facility on evacuation times of five major metropolitan areas within the IH-35 corridor. The time necessary to evacuate an area is directly related to the number of vehicles exiting that area and the available capacity of the roadways serving that area.

In this analysis, evacuation time was calculated assuming the total number of vehicles within the metropolitan area (one per household) divided by the capacity (number of lanes x lane capacity per hour) of all the major roadways serving an entry and exit point of the metropolitan area.

This analysis was performed for each metropolitan area with and without a fully built out TTC-35 facility available. The results of this analysis show the potential that a TTC-35 facility would have on expediting evacuation times for each metropolitan area. San Antonio and Austin could experience as much as a 46 percent reduction in their evacuation times. Waco and Laredo could experience as much as 66 to 75 percent reduction in their evacuation times while the Dallas - Fort Worth area could experience a 17 percent reduction in evacuation time.

2 Introduction

Evacuation routes in Texas (Appendix 1) were traditionally established from the Texas Gulf Coast to more secure inland locations for protection against natural disasters such as hurricanes. However, with consideration of man-made disasters, the traditional definition of evacuation routes can be expanded to include these types of catastrophes and the further inclusion of other possible evacuation routes.

This technical report presents the findings of the evacuation scenario analysis conducted for the Trans-Texas Corridor-35 (TTC-35) project. The purpose of the analysis was to estimate the relative benefit that a TTC-35 facility would provide for evacuation of major metropolitan areas within the TTC-35 corridor should a man-made or natural disaster occur.

3 Modeling Assumptions and Methodology

For this report, benefit is defined as a reduction in evacuation time for the five major metropolitan areas within the TTC-35 study area. Evacuation time is defined as the time in hours required to evacuate a metropolitan area once the driving public reached a major roadway as defined in Table 2.

Basic assumptions developed for this report include:

- All evacuations would take place by personal vehicles operating on major roadways.
- The five major metropolitan areas in the TTC-35 study area are:
 - a. Laredo metro area consisting of Webb County
 - b. San Antonio metro area consisting of Bexar County
 - c. Austin metro area consisting of Hays, Travis, and Williamson Counties
 - d. Waco metro area consisting of McLennan County
 - e. Dallas-Fort Worth metro area consisting of Collin, Dallas, Denton, and Tarrant Counties.
- Total roadway capacity is the sum of the individual major roadway capacities available for evacuation within each respective metropolitan area.
- The number of vehicles needed to evacuate a metropolitan area would be equal to the number of households within each metropolitan area as shown in Table 1.
- Major roadways available for evacuation were identified as all Interstate, all U.S. Highways, and most State Highways exiting the boundary of each major metropolitan area. These roadways were selected based on the likelihood that they would provide the most efficient opportunity for evacuee's to exit their respective metropolitan area. The remaining roadway network's capacity was assumed to be insignificant and was not included in this analysis. The major roadways identified and used for the evacuation scenarios in each major metropolitan area are listed in Table 2.
- Roadway capacities were estimated based upon each roadway's number of lanes and optimum individual operational characteristics.
- The evacuation of each metro area was considered independently from the evacuation of other metropolitan areas.

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Table 1: Total Number of Households

Metropolitan Area	2005 Households
Laredo	59,747
San Antonio	519,298
Austin	508,912
Waco	80,546
Dallas-Fort Worth	1,817,489

Source: U.S. Census Bureau 2005 Estimates

Table 2: Identified Major Roadways used as Evacuation Routes

Metro Area	TTC-35	Interstates	U.S. Highways	State Highways
Laredo	TTC-35 (N)	IH-35 (N)	U.S.59 (E) U.S.83 (N&S)	SH 44 (E) SH 359 (E)
San Antonio	TTC-35 (N&S)	IH-10 (E&W) IH-35 (N&S) IH-37 (S)	U.S.87 (E) U.S.90 (W) U.S.181 (S) U.S.281 (N&S)	SH 16 (N&S)
Austin	TTC-35 (N&S)	IH-35 (N&S)	U.S.79 (E) U.S.183 (N&S) U.S.290 (E&W)	SH 21 (E) SH 29 (W) SH 71 (E&W) SH 80 (S) SH 95 (N&S) SH 123 (S) SH 195 (N)
Waco	TTC-35 (N&S)	IH-35 (N&S)	U.S.77 (S) U.S.84 (E&W)	SH 6 (E&W) SH 31 (N) SH 164 (E) SH 317 (S)

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Metro Area	TTC-35	Interstates	U.S. Highways	State Highways
Dallas-Fort Worth	TTC-35 (S)	IH-20 (E&W) IH-30 (E) IH-35 (N) IH-35E (S) IH-35W (S) IH-45 (S)	U.S. 67 (S) U.S. 75 (N) U.S. 80 (E) U.S. 81 (N) U.S. 175 (S) U.S. 287 (S) U.S. 377 (N&S) U.S. 380 (E&W)	SH 5 (N) SH 66 (E) SH 114 (E) SH 121 (N) SH 199 (W) SH 205 (S) SH 289 (N) SH 342 (S) SH 360 (S)

Notes:

Letters in parentheses indicate assumed direction of travel.

Based on the data presented in Appendix 2, the following three evacuation scenarios were developed:

- 1) Normal highway operations meaning two-way traffic on existing roadways without TTC-35.
- 2) Normal highway operations of existing roadways with a normal operating TTC-35 facility.
- 3) Normal highway operations of existing roadways with a contraflow (meaning the use of all lanes evacuating in one direction) TTC-35.

4 Results of the Modeling

The evacuation time (hours) as outlined in Table 3 below is based upon the number of vehicles and the available roadway capacity from each major metropolitan area under each of the three evacuation scenarios and is not route specific.

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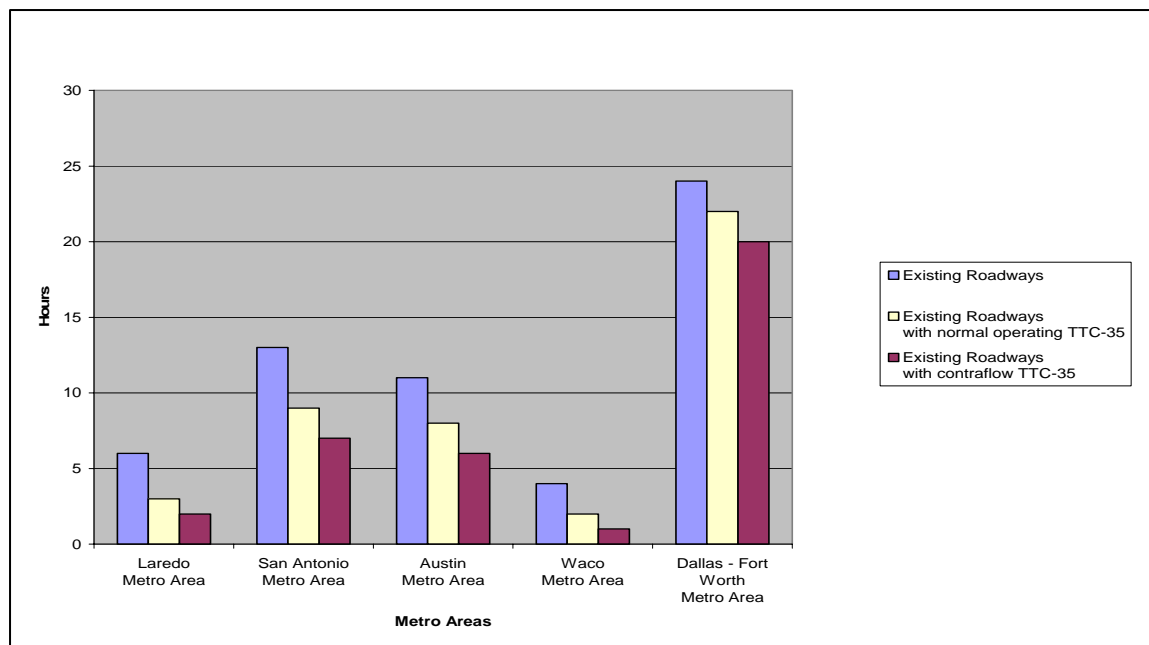
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Table 3: Evacuation Time from Major Metropolitan Areas

Metro Area	Existing Evacuation Routes (hours)	Existing Evacuation Routes With Normal Operating TTC-35 (hours)	Existing Evacuation Routes With TTC-35 Contraflow (hours)
Laredo	6	3	2
San Antonio	13	9	7
Austin	11	8	6
Waco	4	2	1
Dallas – Fort Worth	24	22	20

Figure 1 below graphically depicts the time savings in hours for each of the three modeled scenarios.

Figure 1: Evacuation Time from Major Metropolitan Areas



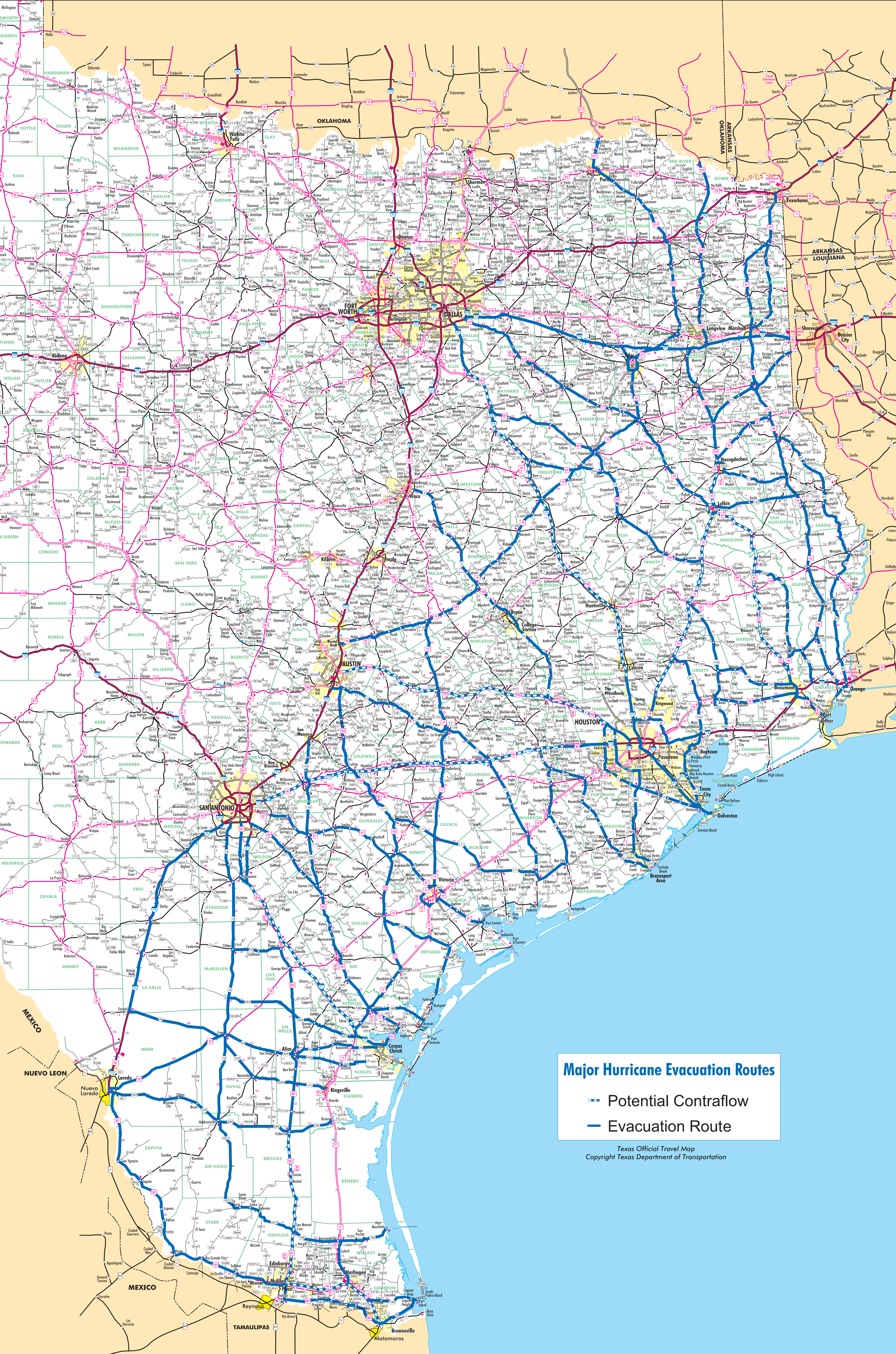
5 Conclusions

The evacuation time results are presented within the narrow context of the assumptions, methodology and scenarios outlined in this report. Under the scenarios and assumptions developed, the hypothetical operation of TTC-35 provided a benefit in terms of reduced evacuation times for the five major metropolitan areas. A TTC-35 facility would likely provide the greatest benefit in those areas where there are fewer existing candidate evacuation routes.

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APPENDIX 1: MAJOR HURRICANE EVACUATION ROUTES



Major Hurricane Evacuation Routes

- Potential Contraflow
- Evacuation Route

Texas Official Travel Map
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APPENDIX 2: OPERATIONAL CHARACTERISTICS OF MAJOR ROADWAYS

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Dallas-Fort Worth

	Capacity Per Lane Per Hour	One-way Lanes	Total Capacity Per Hour
IH35-N	1,800	2	3,600
US377-N	1,400	1	1,400
SH289-N	1,200	1	1,200
US75-N	1,800	2	3,600
SH5-N	1,200	1	1,200
SH121-N	1,200	1	1,200
US380-E	1,400	1	1,400
SH66-E	1,200	1	1,200
SH205-S	1,200	1	1,200
IH30-E	1,800	3	5,400
US80-E	1,800	2	3,600
IH20-E	1,800	3	5,400
US175-S	1,600	2	3,200
IH45-S	1,800	3	5,400
SH342-S	1,200	1	1,200
IH35E-S	1,800	2	3,600
US67-S	1,600	2	3,200
SH360-S	1,600	1	1,600
US287-S	1,800	2	3,600
IH35W-S	1,800	3	5,400
US377-S	1,600	2	3,200
IH20-W	1,800	3	5,400
SH199-W	1,600	2	3,200
US81-N	1,600	2	3,200
SH-114E	1,200	1	1,200
US380-W	1,400	1	1,400
SubTotal		46	75,200
TTC-N	1,800	5	9,000
SubTotal		5	9,000
TOTAL		51	84,200
TOTAL+ TTC35 Contraflow		56	93,200

Waco

	Capacity Per Lane Per Hour	One-way Lanes	Total Capacity Per Hour
IH35-N	1,800	3	5,400
SH31-N	1,200	1	1,200
US84-E	1,400	1	1,400
SH164-E	1,200	1	1,200
SH6-E	1,200	1	1,200

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US77-S	1,400	1	1,400
IH35-S	1,800	3	5,400
SH317-S	1,200	1	1,200
US84-W	1,400	1	1,400
SH6-W	1,400	1	1,400
SubTotal		14	21,200
TTC-N	1,800	5	9,000
TTC-S	1,800	5	9,000
SubTotal		10	18,000
TOTAL		24	39,200
TOTAL+ TTC35 Contraflow		34	57,200

Austin

	Capacity Per Lane Per Hour	One-way Lanes	Total Capacity Per Hour
US183-N	1,600	2	3,200
SH195-N	1,200	1	1,200
IH35-N	1,800	3	5,400
SH95-N	1,200	2	2,400
US79-E	1,600	2	3,200
SH95-S	1,200	2	2,400
US290-E	1,600	2	3,200
SH71-E	1,600	2	3,200
US183-S	1,600	2	3,200
SH21-E	1,200	1	1,200
SH80-S	1,200	2	2,400
SH123-S	1,200	2	2,400
IH35-S	1,800	3	5,400
US290-W	1,600	2	3,200
SH71-W	1,400	2	2,800
SH29-W	1,200	2	2,400
SubTotal		32	47,200
TTC-N	1,800	5	9,000
TTC-S	1,800	5	9,000
SubTotal		10	18,000
TOTAL		42	65,200
TOTAL+ TTC35 Contraflow		52	83,200

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San Antonio

	Capacity Per Lane Per Hour	One-way Lanes	Total Capacity Per Hour
US281-N	1,600	2	3,200
IH35-N	1,800	2	3,600
IH10-E	1,800	2	3,600
US87-E	1,600	2	3,200
US181-S	1,600	2	3,200
IH37-S	1,800	2	3,600
US281-S	1,600	2	3,200
SH16-S	1,600	2	3,200
IH35-S	1,800	2	3,600
US90-W	1,600	2	3,200
SH16-N	1,600	2	3,200
IH10-W	1,800	2	3,600
SubTotal		24	40,400
TTC-N	1,800	5	9,000
TTC-S	1,800	5	9,000
SubTotal		10	18,000
TOTAL		34	58,400
TOTAL+ TTC35 Contraflow		44	76,400

Laredo

	Capacity Per Lane Per Hour	One-way Lanes	Total Capacity Per Hour
US83-N	1,400	1	1,400
IH35-N	1,800	2	3,600
SH44-E	1,400	1	1,400
US59-E	1,400	1	1,400
SH359-E	1,200	1	1,200
US83-S	1,600	1	1,600
SubTotal		7	10,600
TTC-N	1,800	5	9,000
SubTotal		5	9,000
TOTAL		12	19,600
TOTAL+ TTC35 Contraflow		17	28,600