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16. Abstract

Transportation planning for the 1,230-mile (1,980-km) Texas-Mexico border requires special approaches that take into account not only the complexities of a binational environment, but also the impacts of the North American Free Trade Agreement (NAFTA). Of special interest to transportation planners are the capacity utilization of binational entry systems, and the identification of border sectors where new international bridges are either needed or likely to be constructed. Current literature on capacity of traffic facilities does not include methods for analyzing binational environments' attributes, while current literature on revenue and demand analysis is restricted to site-specific revenue forecasts. New methods of capacity and demand analyses were developed in this project to address these transportation planning concerns.

Specifically, this report documents the application of these analytical methods to the Texas-Mexico border Segment 1, which begins at the Gulf of Mexico and ends immediately west of Colombia Bridge in Laredo. This report is supplemented by Research Report 1976-5, which documents the analogous results for Segment 2 (Laredo to El Paso). For each sector, the current capacity utilization of each binational entry system component was assessed using a methodology that takes into account all possible impediments in transborder traffic circulation. The capacity analysis is complemented by estimates of potential demand and revenues of new toll bridges in each sector. Recommendations concerning the potential feasibility of new toll bridges were developed using a financial analysis model that simulates the effect of managerial decisions on the predicted gross revenues and estimated costs. Together, the capacity and feasibility analyses provide a comprehensive picture of border transportation needs, including identification of those sectors where new toll bridges are financially attractive.

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OVERVIEW OF THE TEXAS-MEXICO BORDER: CAPACITY, DEMAND, AND REVENUE ANALYSES OF BORDER SEGMENT 1 (GULF TO LAREDO)

by

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Research Report 1976-4

Research Project 7-1976
Texas-Mexico Toll Bridge Study

conducted for the

Texas Department of Transportation
and the
Texas Turnpike Authority

by the

CENTER FOR TRANSPORTATION RESEARCH
Bureau of Engineering Research
THE UNIVERSITY OF TEXAS AT AUSTIN

April 1994

IMPLEMENTATION STATEMENT

This report provides recommendations for transportation planning along Texas-Mexico border Segment 1, which begins at the Gulf of Mexico and ends immediately west of the Colombia Bridge in Laredo. The findings of this report are based on the analysis of current capacity utilization, complemented by estimates of the demand for and feasibility of additional international bridges. The results can prove useful in evaluating the following aspects of border transportation planning:

(1) Current capacity utilization of each component of each binational entry system along this border segment;

(2) Current and potential sources of congestion for transborder traffic, with suggestions for short- and long-term corrective measures;

(3) Potential demand for a new toll bridge at each Segment 1 sector;

(4) Potential feasibility of a new toll bridge at each Segment 1 sector;

(5) General guide to coordinated binational and multi-agency transportation planning; and

(6) Recommendations for future border transportation studies.

The findings serve as guidelines for transportation planning and are relevant both to the objectives of this project and to future studies of border transportation needs. However, the socioeconomic profile of the Texas-Mexico border region is dynamic, and NAFTA ratification is likely to increase this pace even further, possibly reducing the duration of the effectiveness of the findings, recommendations and conclusions reported in this transportation needs study. Therefore, assumptions related to NAFTA, the Texas-Mexico border economy, and traffic demand need to be carefully evaluated when implementing the results reported in this study.

Prepared in cooperation with the Texas Department of Transportation and the Texas Turnpike Authority.

DISCLAIMERS

B. Frank McCullough, P.E. (Texas No. 19914)
Research Supervisor

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SUMMARY

Transportation planning for the 1,230-mile (1,980-km) Texas-Mexico border requires special approaches that take into account not only the complexities of a binational environment, but also the impacts of the North American Free Trade Agreement (NAFTA). Of special interest to transportation planners are the capacity utilization of binational entry systems, and the identification of border sectors where new international bridges are either needed or likely to be constructed. Current literature on capacity of traffic facilities does not include methods for analyzing binational environments' attributes, while current literature on revenue and demand analysis is restricted to site-specific revenue forecasts. New methods of capacity and demand analyses were developed in this project to address these transportation planning concerns.

Specifically, this report documents the application of these analytical methods to the Texas-Mexico border Segment 1, which begins at the Gulf of Mexico and ends immediately west of Colombia Bridge in Laredo. This report is supplemented by Research Report 1976-5, which documents the analogous results for Segment 2 (Laredo to El Paso). For each sector, the current capacity utilization of each binational entry system component was assessed using a methodology that takes into account all possible impediments in transborder traffic circulation. The capacity analysis is complemented by estimates of potential demand and revenues of new toll bridges in each sector. Recommendations concerning the potential feasibility of new toll bridges were developed using a financial analysis model that simulates the effect of managerial decisions on the predicted gross revenues and estimated costs. Together, the capacity and feasibility analyses provide a comprehensive picture of border transportation needs, including identification of those sectors where new toll bridges are financially attractive.

CHAPTER 1. INTRODUCTION

BACKGROUND

This study comprehensively investigates the Texas-Mexico border area from a binational perspective. It is defined as a planning-level needs study, and its main objective is to assist TxDOT and TTA in achieving a better understanding of the transportation demand and infrastructure needs of the Texas-Mexico border. This goal is addressed by pursuing three main objectives, which translate into four main types of deliverables.

1. A comprehensive overview of the border transportation infrastructure;
2. An automated data base of Mexican and U.S. transportation-related information;
3. An assessment of NAFTA impacts on maquiladora activity and on U.S.-Mexico trade; and
4. Capacity, demand, and revenue analyses of the binational entry systems.

The first deliverable is a comprehensive overview of the transportation infrastructure on both sides of the Texas-Mexico border; the second deliverable is a supporting data base containing Mexican as well as U.S. data that define the binational border area. A primary goal of the overview and the data base, termed TRANSBORDER in this study, is to provide information for coordinated transportation planning along the Texas-Mexico border. The TRANSBORDER data base can be utilized by other agencies for their planning purposes, thus avoiding redundant data collection efforts. These deliverables are described in the first two reports of this series. Research Report 1976-1 provides the overview of the border, while Report 1976-2 documents the development of the TRANSBORDER data base.

The third type of deliverable is an assessment of NAFTA impacts on the maquiladora industry and on U.S.-Mexico trade; the fourth deliverable is the identification of transborder traffic flow patterns, which includes a significant amount of origin and destination information collected at border bridges. These deliverables are documented in Research Report 1976-3.

A bridge over the Rio Grande is more than an urban bridge. It links two different countries, serves two different economies, addresses two different travel behaviors and, in the case of toll facilities, obtains the toll revenue in two different currencies. The border crossing procedures, and not bridge structure geometry, are in many cases the main constraint to free flow. Accordingly, they must be considered when estimating the binational entry system capacity as well as when modeling bridge alternatives. This study developed approaches to assess the current capacity of binational entry systems, and the potential demand and revenues of new toll sites along the Texas-Mexico border. Together, these products can serve as guidelines for assessing transborder infrastructure needs. The capacity, demand, and revenue analyses are discussed in the fourth and fifth reports of this series. All study findings, conclusions, and recommendations are discussed in the last report of this series (Report 1976-6F).

The difficulties encountered in this study reflect the challenges of binational planning in a dynamic, NAFTA-driven region. To be sure, the tremendous expansion of U.S.-Mexico border trade had been underway even before NAFTA. Yet the treaty's recent passage has obviously represented a remarkable boon to the area's economy. At the same time, the rapid changes in the area's socioeconomic landscape ensure that the findings and conclusions of this study will be somewhat ephemeral. Taking this into account, this study developed a "sector analysis" approach, one capable of analyzing the demand for and feasibility of a new binational entry system from a regional perspective (thus avoiding the site-specific focus that would prove inappropriate at the regional analysis level of infrastructure planning). Each sector was analyzed under three different scenarios for NAFTA impacts, which cover the main possible directions of socioeconomic and traffic demand development in the post-NAFTA future. It is recommended that recent evaluations of actual post-NAFTA development be taken into account when implementing the study's findings.

Study Organization

This study is divided into two segments. Segment 1 begins at the Gulf of Mexico and ends west of Laredo, Colombia Bridge inclusive. Segment 2 begins immediately west of the Colombia Bridge and ends at the New Mexico border west of El Paso. The two study segments are shown in Figure 1.1. The study objectives, methodology, and research approach were the same for both segments. The division into two segments reflects Texas trade corridors and facilitates the presentation of study results (as well as their future use).

The capacity and demand analysis is documented in two separate reports: Report 1976-4 for Segment 1, and Report 1976-5 for Segment 2. The methodology used to analyze the capacity of binational entry systems was developed by CTR, and is exactly the same for both segments. The demand analysis provides an indication of the potential feasibility of a new binational entry system in the sectors. The demand analysis includes four steps:

(1) estimate of future traffic for the entire sector;

(2) estimate of traffic demand for and additional (hypothetical) facility;

(3) estimate of potential revenues; and

(4) estimate of potential revenues of the new facility.

The current capacity utilization assessment, coupled with the revenue analysis described above, provides guidelines to assess the need for and feasibility of new binational entry systems along the entire border. The capacity analysis can represent our diagnosis of the traffic circulation problem, while the demand and revenue analyses can help evaluate the feasibility of a new toll bridge in the sector. CTR developed a methodology to assess the four estimates that make up the revenue analysis. This methodology was used to analyze all Segment 1 sectors.

The sensitivity of traffic diversion analysis with respect to specific bridge location depends upon several factors, one of which is the level of disaggregation of the analysis.

Traditional methods for revenue analysis are appropriate to project-specific analyses, and provide results that cannot be extrapolated to other sites. This traditional approach would limit the scope of the study and have little value to transportation planning. Conversely, the sector analysis concept used here is an aggregated approach for revenue and demand analyses that widens the scope of the study results, providing guidelines for new binational entry systems along the Texas-Mexico border.

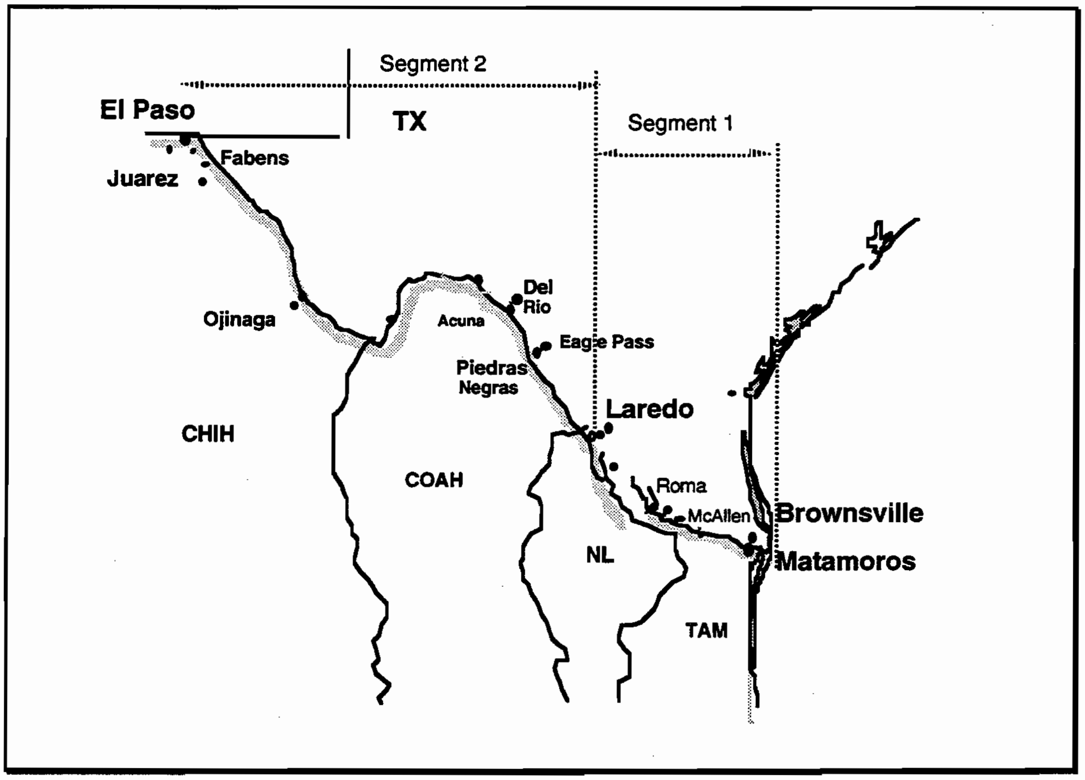

Figure 1.1. Geographical division of border into two segments for study purposes

The Sector Analysis Concept

The sector analysis concept was developed as an analysis methodology to estimate traffic demand and revenue for use in regional transportation planning, avoiding site-specific results that cannot be extrapolated and used in a regional context. It was designed to work in conjunction with traditional trip assignment methods used in traffic demand estimates. Sectors are defined based on major traffic diversion areas, which in turn depend on the socioeconomic indicators of the areas covered by major origin and destination zones. The area of economic activity that can generate and/or attract traffic was termed "economic activity center."

Because border bridges serve traffic demand, they are naturally located within economic activity centers. Indeed, a site far from any economic activity center would attract very little traffic. As this hypothetical site approaches the boundaries of an economic activity center, the traffic demand increases until it reaches either the peak traffic volume the binational entry system can process, or the maximum demand it can divert from nearby facilities. Within the economic activity center, each specific site has its own individual capability to attract traffic (within a certain range) and can be represented by an "average" potential demand anywhere within a certain subset of the economic activity center, which is termed *sector*. Sector is thus defined as the sphere of influence of an economic activity center where the potential demand of any transportation artery will fall within a certain interval whose extremes have no elasticity with respect to specific site location. Average demand by sector indicates the overall potential demand, while the interval limits give an idea of the maximum and minimum potential demand at a generic new site within any specific sector.

The sector analysis concept was developed to provide answers to questions pertaining to regional transportation planning, rather than to individual proposed sites. It works effectively in conjunction with trip assignment models, since otherwise it would be technically unsound to predict traffic demand at a specific site without taking into account all other facilities within a certain area that generate traffic willing to use the new site. Because of the uncertainties inherent to models using data from random samples, the sensitivity of the trip assignment model output with respect to specific site location is limited to a certain area. In this study, this area of sensitivity is termed *sector*. These sectors are always within economic activity centers — that is, areas that have approximately the same range of socioeconomic development and traffic generating capability.

Report 1976-3 identified nine economic activity centers and boundaries of eighteen sectors along the Texas/Mexico border. Table 1.1 summarizes the economic activity centers and Table 1.2 summarizes the preliminary sectors that fall within Texas-Mexico border Segment 1.

Table 1.1. Texas-Mexico border economic activity centers

Economic Activity Center	U.S.	Mexico
1	Brownsville-Harlingen	Matamoros, Tamaulipas
2	Eastern Valley	Rio Bravo, Tamaulipas
3	Central Valley	Reynosa, Tamaulipas
4	Western Valley	Ciudads Guerrero, Mier, Camargo, Alemán, and Ordaz (Tamaulipas)
5	Laredo	Nuevo Laredo, Tamaulipas

Table 1.2. Texas-Mexico border sectors — Segment 1

Sector Number	Sector Name	Existing Binational Entry Systems	Proposed Binational Entry Systems
1	Gulf of Mexico	None	None
2	Brownsville/Matamoros	Gateway B&M	Port of Brownsville Los Tomates Flor de Mayo
3	Los Indios	Los Indios	None
4	Eastern Valley	Progreso	Donna/Rio Bravo
5	Central Valley	Hidalgo/Reynosa Los Ebanos Ferry	Pharr/Reynosa Anzalduas Mission Los Ebanos
6	Western Valley	Rio Grande City/Camargo Roma/Miguel Aleman	None
7	Lake Falcon	Lake Falcon Dam	None
8	Laredo/Nuevo Laredo	Laredo Bridge #1 Laredo Bridge #2 Colombia	Laredo Bridge #3

REPORT OBJECTIVES

The analyses discussed in this report provide a quantitative assessment of existing binational entry systems in terms of their ability to accommodate transborder traffic along Segment 1 of the Texas/Mexico border. In addition, they provide a preliminary assessment of potential demand for and revenues of new binational entry systems in the border sectors that are located within economic activity centers.

For each sector, the report contains an evaluation of the capacity utilization of each binational entry system component, identifying the main causes of current and potential congestion. This analysis is complemented by an assessment of potential demand and revenue at a hypothetical binational entry system in the sector. The objective of the demand and revenue analyses is to identify sectors of the border that are candidates for new toll bridges. Accordingly, the revenue analyses performed by CTR include a preliminary cost analysis to provide an indication of the project feasibility, assisting transportation policy makers in answering the fundamental question of where additional infrastructure already is or will be needed along Segment 1 of the Texas/Mexico border.

REPORT ORGANIZATION

This report is comprised of ten chapters and one appendix. Chapter 1, the introduction, discusses the background, report objectives, and report organization. In addition, it briefly summarizes the sector analysis concept fully described in Report 1976-3 and briefly touched on here to facilitate comprehension of this report.

Chapter 2 describes the methodology developed by CTR to assess the binational entry systems' current capacity. It also discusses the results of some preliminary assessments needed to further develop the capacity analysis of each sector.

Chapter 3 discusses the methodologies developed by CTR to assess the potential revenue and the pre-feasibility of a new binational entry system. This methodology includes a cash flow projection based on some hypotheses, perhaps the major one being that the bridge owner will sell revenue bonds to obtain the initial funds, and will use the toll revenues exclusively to repay the debt as well as to operate and maintain the facility.

Chapters 4 through 9 document the capacity, demand, and revenue analyses for each Segment 1 sector that is located within an economic activity center. Finally, Chapter 10 summarizes the conclusions, findings, and recommendations of this report, while Appendix A offers a bilingual glossary of border-related terminology.

CHAPTER 2. CAPACITY ANALYSIS METHODOLOGY

The bridges, dams, and ferries crossing the Texas-Mexico border form an interrelated system of transportation, the main objective of which is to move people and commodities from one country into the other. This system, which includes the inspection facilities as well as the links with the rest of the infrastructure of both countries, cannot be properly studied in a disaggregated manner. Moreover, the traditional capacity analysis methodology (Ref 19) cannot account for the complexities inherent in binational entry systems. For this reason, this chapter describes a CTR capacity analysis methodology capable of weighing all factors that influence the traffic processing output of a binational bridge entry system.

BACKGROUND AND OBJECTIVES

Inspection procedures at binational bridge entry systems have the potential to cause congestion, requiring as they do the compulsory stopping of traffic. While simple measures that consider the influence of inspection procedures on traffic circulation can sometimes improve the operation of existing bridges (and prevent the same problems at new ones), inspection procedures will always have a major influence on binational entry system capacity and efficiency. In some cases, the design of inspection facilities may cause unnecessary delays (for example, when the primary truck inspection booth is located too near the bridge exit). Since trucks are longer than autos and, hence, take more space, they occupy the entire right lane of the bridge, causing traffic backup at the toll booths that in turn causes congestion on the connecting infrastructure. The commercial lot primary inspection booths should be located further away from the bridge to provide room as a "waiting area" for trucks. While the design of the Colombia Bridge in Laredo takes this problem into consideration, older bridges located near or in downtown areas do not have additional space available for relocating the primary inspection booths.

Regardless of the inspection facility design, the potential for congestion grows as the staffing capability decreases. This is schematically shown by the dashed line in Figure 2.1, where we see that the level of service improves with the addition of new traffic lanes until it reaches the asymptote that corresponds to free flow. However, the traffic flow across an international bridge can never be unimpeded; that is, it will always be stopped for a number of inspection procedures. The staffing capabilities of U.S. and Mexican inspection agencies are limited, and the solid line in Figure 2.1 shows the real situation created by the addition of more bridges to the border area. As long as the federal agencies can fully staff the new facility, the overall traffic flow will improve and the real situation (solid line) will be the same as the hypothetical (dashed line). As the staffing capability approaches its peak, however, the traffic circulation will show little improvement. When the number of binational entry systems exceeds the staffing capabilities, federal agencies will resort to relocating staff from one entry system into another, thus creating two inspection bottlenecks instead of one. As the staff is spread thinner, the addition of new facilities will decrease rather than increase the overall level of traffic service. This situation is shown by the descending part of the solid line in Figure 2.1 (segment bc).

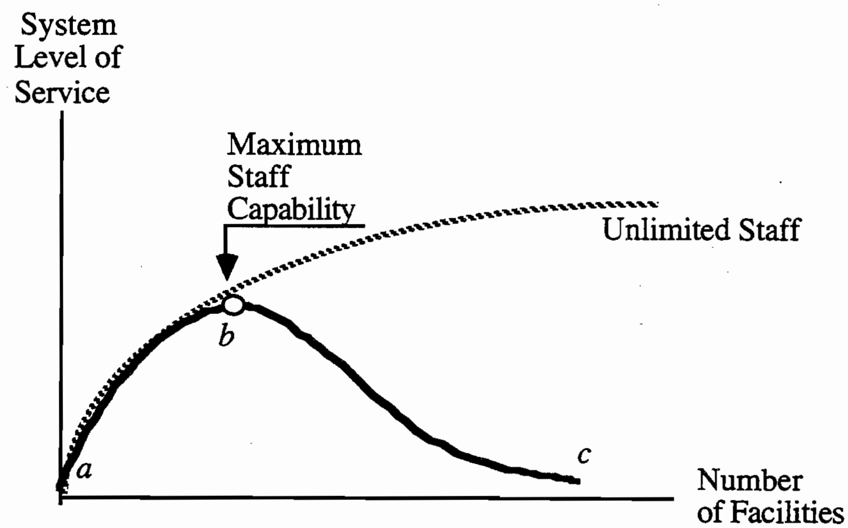

Figure 2.1. Staffing capabilities and level of service at the border

According to several staff members from U.S. agencies (e.g., General Services Administration and U.S. Customs), staffing is a major problem at the Texas-Mexico border area, a concern shared by some of their Mexican counterparts. In addition, customs inspections are expected to become more complex as NAFTA lifts old trade barriers. For example, under pre-NAFTA regulations, there was no need to verify the origin of product components for taxation — something which NAFTA now requires and which has been routine at the Canadian border since the earlier U.S.-Canada free-trade agreement took effect. As the traffic between the U.S. and Mexico grows, the staffing problem will become more critical. The capacity analysis methodology outlined later in this chapter can be seen as a step towards providing better border transportation planning.

Capacity assessments are basically comparisons between the existing traffic and the facility processing capability. Since the existing traffic fluctuates within any given time interval, the first step towards evaluating capacity is defining the numbers that will represent the traffic using the facility.

TRAFFIC ANALYSIS

A capacity analysis result is usually expressed in a volume-to-capacity ratio (v/c), which represents the percentage of the total capacity being utilized by the current traffic demand. This demand fluctuates hourly, weekly, monthly, and seasonally, and these variations must be captured by the number chosen to identify the "volume" in the v/c ratio. These volumes are usually represented by the annual average daily traffic (AADT, also abbreviated as ADT), and the hourly volume is usually summarized in terms of the k-factor, which is the ratio between the hourly volume of interest and the AADT. AADT and k-factor values were estimated for each binational entry system to use later in the capacity analysis.

Annual Average Daily Traffic (AADT) Estimates

We collected from bridge owners, U.S. Customs, and Caminos y Puentes Federales (CAPUFE) the traffic volumes at each binational entry system in the north and southbound directions. While the ideal AADT is the actual average of continuous counts taken during the entire year, in most cases only samples of the year were available. Guidelines were used (Ref 5) to estimate the weekly and seasonal fluctuations based on limited data. The AADT estimates used in this analysis are based on 24-hour traffic counts of private vehicles and commercial trucks collected for weekdays only (i.e., Monday through Friday). Table 2.1 presents the results of the auto and truck AADT estimates for Segment 1 binational entry systems. Because of the limited availability of daily traffic volumes, values in parenthesis were estimated based on data for the opposite direction.

AADT estimates were made to be consistent with the binational entry systems' operational characteristics, since their only function in the analysis is to represent the volume in the v/c ratio. Therefore, characteristics of the primary inspection lanes were taken into account when selecting the vehicle categories to include in the commercial and non-commercial AADT. Northbound truck data at the Laredo sector do not include the "tractors only" category, while the southbound truck data include "tractors only" as empty trucks. The northbound commercial truck category includes empty and loaded trucks in all binational entry systems but Hidalgo-Reynosa, where northbound empty trucks and "tractors only" have a separate lane for primary inspection.

Hourly Volume Estimates

Traffic fluctuates hourly, with some hours showing more congestion than others. Some level of congestion must always be tolerated to ensure full utilization of the facility. Statistical analysis of hourly traffic volumes can provide a probability distribution of volumes over the typical day, which in turn can be used to identify different probabilities of congestion levels during the day.

Although such a comprehensive analysis is beyond the scope of this study, some assessment of the capacity utilization at peak hours is important to give an idea of the worst level of congestion in a typical day. This involves converting the average daily traffic to a peak hour volume using peak hour k-factors calculated based on samples of hourly volumes collected at some, but not all, binational entry systems. A peak-hour k-factor is the fraction of the daily volume represented by the peak hour. It is calculated by dividing the 1-hour counts (at the peak hour) by the total daily count. Twelve-hour average k-factors were also calculated to be used as a comparison with the worst congestion of the day. Table 2.2 summarizes the results of these k-factor calculations.

TABLE 2.1. 1992 AADT estimates (Monday- Friday)

Binational Entry System	Non-Commercial		Commercial	
	Northbound	Southbound	Northbound	Southbound
Gateway	6,700	10,700	600	650
B&M	6,200	4,800	190	130
Los Indios	700	500	250	40
Progreso	2,500	2,200	120	35
Hidalgo	15,800	13,500	550	570
Rio Grande	1,100	(1,100)*	30	(30)*
Roma	2,100	(2,100)*	35	(35)*
Laredo 2	11,600	9,200	1,500	1,400
Laredo 1	6,500	7,300	n.a	1,200
Colombia	100	75	80	65

*Estimate based on data for opposite direction.

Table 2.2. 1992 peak hour k-factors

Binational Entry System	K-Factor	
	Peak-Hour	12-Hour Average
Gateway (SB, Autos & Trucks Combined)	8.3%	6.1%
Progreso (SB, Autos & Trucks Combined)	9.4%	7.3%
Hidalgo (SB, Autos & Trucks Combined)	9.9%	6.6%
Laredo 1 (NB Autos)	7.7%	5.8%
Laredo 2 (NB Autos)	8.9%	6.7%

Because they are based on limited hourly data collected, the k-factor estimates shown in Table 2.2 can only be regarded as a "snapshot" of a situation that varies continuously. However, the auto peak hour factors consistently stay within the 7.5-to-10 percent interval, while the 12-hour average factors stay in the 5.5-to-7.5 percent interval. Therefore, a single peak-hour and a single average-hour k-factor were estimated for all the binational entry systems (for each vehicle type, when applicable).

For autos, the peak hour k-factor was assumed as 9 percent and the 12-hour average k-factor was assumed as 7 percent, to remain in a conservative range of the observed interval. For trucks, the situation required more thought. Field interviews with U.S. Customs officials indicated that northbound freight carriers are released in batches from the Mexican export lot during the day, and this increases the peak hour volume. In addition, truck hourly data collected at Bridge of the Americas and Ysleta Bridge in El Paso indicated that the peak hour k-factor for trucks ranges from 13 to 18 percent. The capacity analysis discussed in this report utilizes a k-factor of 15 percent in both directions for trucks. Table 2.3 presents the peak hour volumes estimated for Segment 1 binational entry systems. The peak hour volumes were obtained by correcting the AADT estimates depicted in Table 2.1 with the k-factors discussed above.

The traffic volume estimates discussed in this section were used in the capacity analysis methodology discussed in the next sections to assess the capacity utilization of the binational entry systems along the Texas-Mexico border. This assessment was done using the methodology discussed below.

Table 2.3. 1992 peak hour volume estimates

Binational Entry System	**Autos**		**Trucks**	
	Northbound	Southbound	Northbound	Southbound
Colombia	9	7	12	10
Laredo #1	585	657	0	180
Laredo #2	1,044	828	225	210
Roma	189	(189)	5	(5)
Rio Grande City	99	(99)	5	(5)
Hidalgo	1,422	1,215	83	86
Progreso	225	198	18	5
Los Indios	63	45	38	6
B&M	558	432	29	20
Gateway	603	963	90	98

BINATIONAL ENTRY SYSTEM CAPACITY ANALYSIS METHODOLOGY

The traditional concept of capacity is based on traffic volumes, and it is appropriate to situations where a free flow is theoretically possible (Refs 15, 19). However, as discussed before, the concept of free flow is not applicable to binational entry systems, because vehicles must always stop for border inspection routines. This project developed a capacity analysis approach that takes this fact into consideration, and assesses a binational entry system capacity utilization in a disaggregated and sequential manner.

Background

In general, the capacity of a lane or roadway is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a uniform section of the facility during a given time period under prevailing roadway, traffic, and control conditions (Ref 18). Roadway conditions consist of geometric parameters, such as design speed, lane width and lateral clearance. Traffic conditions refer basically to the vehicle type(s) in the traffic stream, since vehicle operations on a roadway vary significantly between an automobile and a heavy truck. Control conditions refer to the mechanisms used on a facility where traffic flow is interrupted, such as a signalized or stop control intersection.

Capacity analysis results are given in terms of traffic processing output and, since traffic volumes continually change, the capacity needs to be analyzed in terms of some representative volume. Three concepts are used for this purpose: the average daily traffic, the average hourly volume, and the k-factor.

Another concept used in the capacity analysis is the level of service, a measure of the quality of traffic flow as it is affected by a number of factors, such as average vehicle speed, travel time, traffic interruptions, freedom of maneuver, and others. Levels of service range from "A" to "E", "A" corresponding to free flow, and "E" corresponding to congestion. Table 2.4 illustrates the levels of service and the corresponding average daily traffic (ADT) ranges for a four-lane undivided urban street, which can represent some binational entry systems' access/egress component (Ref 19).

Table 2.4. Levels of service and ADT ranges

Type of flow	Good	Tolerable	At or over capacity
Level of Service	A-B	C-D	E
ADT	<12,600	12,601-14,900	14,901-18,000

The methodology for evaluating capacity of binational entry systems uses these basic concepts. Geometric conditions and vehicle types at a binational entry system affect the capacity, and so do control conditions, such as toll booths and customs inspections, in addition to traffic control mechanisms on the approaches to and exits from the binational entry system. Accordingly, capacity at each of these components was studied separately, and the overall binational entry system capacity is determined by the smallest value of all components.

Components of a Binational Bridge Entry System

A binational bridge entry system can be disaggregated into four major facility types, in terms of traffic circulation: access/egress, toll collection, bridge structure, and customs inspections. The access/egress facilities are the connecting infrastructure, which vary from major highways to narrow streets in a historical downtown area. While the former usually has little potential for congestion, it will be shown later in this report the latter sometimes determines the binational entry system capacity. The bridge span capacity was analyzed using the traditional methodology (Ref 18). It is important to realize that traffic flow across an international bridge can never be unimpeded, as it will always be stopped for a number of inspection procedures. Accordingly, the capacity analysis is based on processing times observed along the Texas-Mexico border, as discussed in the next section.

The first step in the development of the capacity analysis methodology consisted of identifying fourteen separate processes (not including secondary inspection) that transborder commercial and non-commercial vehicles can be subject to within the four types of facilities listed above. These processes were termed "components' of a binational bridge entry system, and they are:

(1) Southbound Access,

(2) Southbound Toll (trucks),

(3) Southbound Toll (autos),

(4) Southbound Bridge structure,

(5) Southbound (Mexican) Primary Inspection (trucks),

(6) Southbound (Mexican) Primary Inspection (autos),

(7) Southbound Egress,

(8) Northbound Access,

(9) Northbound Toll (trucks),

(10) Northbound Toll (autos),

(11) Northbound Bridge structure,

(12) Northbound (Mexican) Primary Inspection (trucks),

(13) Northbound (Mexican) Primary Inspection (autos), and

(14) Northbound Egress.

Figure 2.2 depicts a scheme of these fourteen components of a binational bridge entry system. Each of the fourteen processes displayed in Figure 2.2 was analyzed for all major binational entry systems along the Texas-Mexico border, and a clear understanding of the scheme shown in Figure 2.2 is helpful to clarify the analysis results discussed in this report.

All binational bridge entry system components are complex, and a detailed capacity analysis of each one of them would require a myriad of data that are only partially available, since their level of detail by far supersedes the scope and timing of this study. Nevertheless, a clear picture of a binational entry system capacity was achieved based on the methodology developed in this project, which takes into account all major sources of delays that affect traffic flow.

Processing Rates of a Toll or Inspection Lane

The processing rate of a binational entry system toll or inspection lane is equivalent to the vehicle delay due to the toll or inspection process. This vehicle delay can be divided into four time elements: (1) Deceleration time when approaching the queue behind the booth; (2) time to move towards the booth once queued; (3) time stopped at the booth; and (4) acceleration time to clear the booth for the next vehicle.

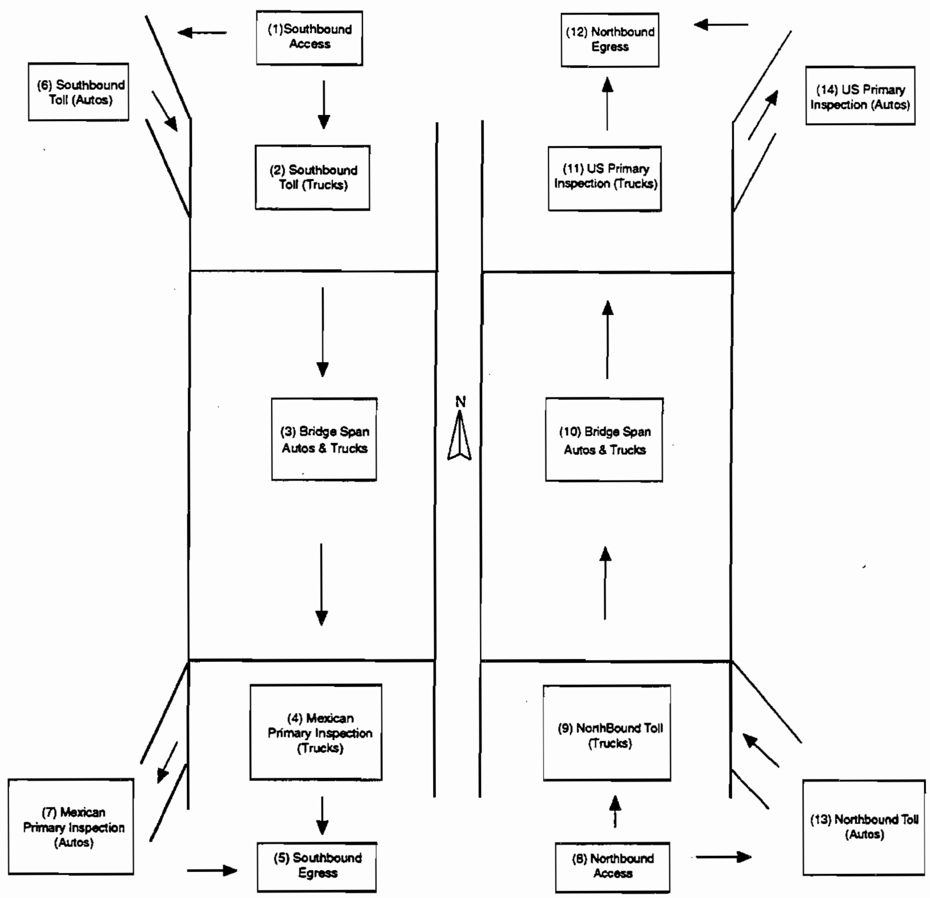

Figure 2.2. Components of a binational bridge entry system

Under ideal conditions, the vehicle coming immediately behind the one stopped at the booth would not be queued; instead, it would arrive at the booth exactly as the vehicle in front clears it, thus avoiding the delay from waiting in a queue (item 2 of the list above). In other words, the headway between vehicles would be equal to the stop delay of the toll or inspection facility. However, this idealized situation is impossible to observe in the field. The headways of arriving vehicles are generally less than the processing time of the toll or inspection booth because the vehicles usually arrive in platoons or batches. Thus, even when the average hourly arrival rate is less than the average hourly capacity, some queuing is usually observed. It must also be noted that some of these delay times overlap, because while one vehicle is still accelerating to leave the booth, the one immediately behind is already accelerating towards the booth.

In order to estimate the four delay elements discussed above, the number of vehicles that pass by the booths over a period of time while a queue exists behind the booths was counted, and divided by the number of booths. Then, the total time elapsed during the counting was divided by the number of vehicles per booth. This final time provides an estimate of the average processing rate of each booth in seconds or minutes per vehicle. This method takes into consideration all four vehicle delay elements, namely, the delay to approach the queue just behind the booth, the waiting time in the queue, the time stopped at the booth, and the time to clear the booth for the next vehicle. In addition, this method isolates to the fullest extent possible the delays due exclusively to the component under scrutiny. Individual analysis of each component is important, since field observations indicate that the propagation of delays from one component into the next may amount to a total crossing time of over an hour in the most congested sites.

Processing rate data were collected on four binational entry systems along the border: Laredo 1, Laredo 2, Hidalgo, and Eagle Pass. Data were collected at the toll booth and at inspection facilities on both sides of the border, for autos and trucks, in north and southbound directions. The available data are summarized in Table 2.4, in terms of observed average delays. These results were used to represent the toll and customs facility processing rates for the entire border.

Capacity of the Toll Collection Component

The capacity of the toll collection component is a function of the number of toll lanes, processing time per vehicle, and lane utilization by vehicle type. Field data for autos indicate that the average processing time per vehicle is approximately 14 seconds, or 257 vehicles per hour per toll booth lane (vphpl) on the U.S. side, and 12 seconds, or 300 vphpl, on the Mexican side. For trucks, data indicate an average toll processing rate of 21 seconds per truck in the U.S., and the same rate was assumed for the northbound toll in Mexico.

The data collected for southbound autos at several different sites revealed a significant difference in processing time between a facility charging toll that is a multiple of a whole dollar ($1.00), as opposed to a toll that is a fraction of a dollar and requires change more often ($1.25 or $1.50). The data collected at the Hidalgo bridge ($1.00) resulted in an average processing rate of 8 sec/veh, while the data collected at Eagle Pass ($1.50) and Laredo ($1.25) resulted in an average of 14 sec/veh processing rate, as shown in Table 2.2. This difference implies that the use of whole dollar tolls or pre-paid coupons can significantly improve the processing rate of toll facilities. The 14 seconds per vehicle processing rate was used as a conservative estimate for all border toll facilities, to take into account possible increases in toll fares.

Capacity of the Inspection Component

Customs in both countries include primary and secondary inspection of incoming private and commercial vehicles, as well as inspection of outgoing private and commercial vehicles at some ports of entry. The capacity analysis presented in this chapter will only address the primary inspection process of incoming vehicles to both countries, since the secondary inspection facility does not interfere with traffic circulation when a convenient geometric design is used (Ref 8).

Primary inspection lanes are assumed to be fully staffed for both countries. In reality, not all lanes are staffed, and this assumption implies that the analysis results estimate the maximum potential capacity available in the binational entry system.

Table 2.4. Processing rates data (time per vehicle)

Binational Entry System	Vehicle Type	Southbound		Northbound	
		Toll	Inspection	Toll	Inspection
Laredo 1	Autos				37 sec
	Trucks	27.4 sec			
Laredo 2	Autos	10.3 sec			
	Trucks	23.6 sec			
Hidalgo - Reynosa	Autos	8.3 sec	3.6 sec	6.2 sec	20 sec
	Trucks	20 sec	1min 35 sec		2 min 10 sec
Eagle Pass-Piedras Negras	Autos	15 sec		12.5 sec	

Based on field data and on field interviews with U.S. customs officials, the analysis assumes a processing rate of 33 sec/veh (109 vphpl) for autos, and of 2 minutes per trucks, for the U.S. primary inspection. As for the Mexican primary inspection processing rates, the analysis assumes the values of 8 seconds per auto, and 2 minutes per truck. Field data collected for Mexican truck primary inspection yielded an average processing rate at the booth of 1 minute and 13 seconds when a pre-clearance procedure was being applied. It was concluded that the pre-clearance activity shortened the process rate, but since this is not a border-wide policy of Mexican customs, the capacity analysis uses a conservative value of two minutes per truck.

At a v/c ratio less than 100 percent, the departure rate (capacity) is greater than the arrival rate (traffic volume) and no queuing should occur, if the vehicles arrived fairly uniformly at the booth. However, field observations indicate that in reality, vehicles do not arrive at a uniform rate. Instead, they usually arrive in platoons, which basically replicate the platoon pattern of the nearest intersection. Thus, some queuing (and delay) does occur even with a v/c ratio less than 100 percent.

Capacity of the Bridge Component

The capacity of the bridge component is a function of the number of lanes, lane utilization, grade, lane width, and percent of trucks in the vehicle mix. An ideal saturation flow rate of 1,800 vehicles per hour per lane (vphpl) is used for a typical 4-lane cross-section, while 1,400 vphpl is used for a 2-lane cross-section. The ideal saturation flow rate is adjusted by the following factors:

(1) Percentage of trucks in vehicle mix,

(2) Exclusive truck lanes or non-exclusive truck lanes due to congestion, and

(3) Narrow lanes.

An exclusive truck lane is estimated to have a capacity of 450 vphpl, obtained by dividing an ideal saturation flow rate of 1,800 vphpl by the passenger car equivalent for heavy trucks on rolling terrain ($E_T = 4$), a rather conservative assumption, since most bridges are arched. The ideal saturation flow rates and adjustment factors utilized were taken from the Highway Capacity Manual (Ref 19).

Capacity of the Access / Egress Component

The approaches to and exits from binational entry systems vary from a city street to a major arterial or a freeway, with intersection control mechanisms that vary from non-existent to a multi-phase signalized intersection. The parameters required to estimate capacity vary significantly by facility and intersection control type, and a rigorous assessment of the access/egress component is beyond the scope of this study, due to the type of detailed analysis and amount of data required (e.g., intersection turning movement counts, signal timing data). In addition, a significant portion of a border city may need to be analyzed, due to the possibility that the approaches and intersections located immediately upstream from a binational entry system may not be the critical links leading to or from a binational entry system. This type of analysis is more akin to a detailed traffic circulation study than to a transportation needs study. However, to completely disregard the immediate access/egress of a binational entry system would result in an incomplete capacity utilization analysis, because the access to or the egress from the toll or inspection facilities may either be congested, or have a potential to develop congestion in the future, especially if all other components (toll booth, bridge span, and inspections) are operating efficiently. Therefore, a capacity utilization analysis was conducted for the approaches with limited data, and this required some assumptions. The approach to estimate the capacity of the access/egress component is based on guidelines for controlled intersections documented in the Highway Capacity Manual (Refs 15, 18).

A signalized intersection is most often assumed to be the constraining factor in the amount of capacity available for a connection to and from the bridge. The analysis of a signalized intersection as described in a Nuevo Leon study (Ref 18) involves estimating stopped delay per vehicle in order to assign a level-of-service for a particular approach or movement of the intersection. The level-of-service may range from "A" (very low delay, less than 5 seconds per vehicle) to "F" (very high delay, greater than 60 seconds per vehicle). The v/c ratio is related to this stopped delay but not in a simple one-to-one fashion. It is possible, for example, to have delays in the level "F" range, while the v/c ratio of the signalized intersection is below 100 percent. The reverse is also possible. A v/c ratio of 100 percent does not automatically imply delays in the level "F" range. The signal's cycle length and signal progression of multiple signals play a significant role in determining vehicle delay than the v/c ratio. A v/c ratio less than 100 percent does not imply zero vehicle delay, zero queuing or free-flow conditions. Rather, it means that the traffic volume of the particular movement being analyzed can be processed through the intersection without having to wait for more than one red light.

Analogous interpretation is valid for unsignalized intersections. A v/c ratio greater than

100 percent implies queuing and extreme delays, while a low v/c ratio implies only the inevitable delay due to the existence of a stop sign, or due to slowing down at an uncontrolled intersection.

SUMMARY AND CONCLUSIONS

The capacity analysis approach developed in this study provides estimates of the volume-to-capacity ratio (v/c) of each binational entry system component depicted in Figure 2.2. The capacity analysis is based on the following assumptions:

(1) All existing lanes are staffed for toll collection and primary inspection.

(2) AADT estimates shown in Table 2.1 represent the annual average daily traffic for 1992.

(3) The peak hour volumes are 9 percent of the auto AADT (k_a=0.09), and 15 percent of the truck AADT (k_t=0.15) for the entire border.

(4) The average processing rates collected for the toll booths, northbound inspections, and southbound inspections are representative of all binational entry systems along the Texas-Mexico border.

(5) The analysis of the access and egress components on both sides of the border is based on limited data, and on additional assumptions concerning signal timing and turning movements at intersections, made on a case-by-case basis.

(6) Signal timing phases are estimated for signalized intersections, and green time proportions are estimated based upon the critical flow rates for each assumed phase. Whenever appropriate, minor cross streets were assumed to be actuated, and a minimum green time was allocated to the minor street movements. Elsewhere, green times were estimated based upon equal degrees of saturation per assumed phase.

The capacity utilization analysis was undertaken for all binational entry systems along the border, except for those with very little traffic, such as the dam crossings, the ferries and the La Linda binational entry system. Field data collected at several binational entry systems were used to estimate processing rates of toll booth and customs inspection facilities, as well as to verify the results of the analysis.

The capacity utilization analysis does not yield future demand or revenue predictions; rather, it gives an assessment of the total available capacities (i.e., all lanes open) of the binational entry systems along Segment 1. In other words, it gives an indication of where in the border additional infrastructure may be needed. This result is complemented by the analyses of future demand in the sector, and potential revenue of additional binational entry systems. The next chapter discusses the methodologies developed in this project to perform the demand and revenue analyses.

CHAPTER 3. APPROACHES FOR DEMAND AND REVENUE ANALYSES

INTRODUCTION AND OBJECTIVE

The tradition of serving the international traffic demand with the provision of toll bridges along the border has created a pervasive impression that additional binational entry systems are always the best solution for improving transborder traffic circulation. While in Mexico the international toll bridges are federally owned, in the U.S. they are locally owned, and there is fierce competition for these revenues. These impressions and considerations which are irrelevant to coordinated transportation planning have affected and may continue to affect the decision to build a new toll bridge (Ref 8).

The U.S. presidential permit application calls for a justification for the additional bridge, which can be accomplished based on the fact that traffic circulation is actually poor on many binational entry systems along the border. However, poor traffic circulation is rarely a result of insufficient lane capacity. Rather, it is caused by delays in the access network or at inspection facilities. In the latter case, conditions may actually worsen if the inspection agencies cannot provide adequate staff for the new bridge (Ref 8).

FEASIBILITY ANALYSIS METHODOLOGY

A detailed feasibility analysis can only be made on a project-by-project basis, and in the presence of a considerable amount of data on the particular project. On the other hand, an estimate of potential feasibility of a new binational entry system is a useful indicator for transportation planning, and CTR developed a simplified feasibility analysis methodology to address this issue. The feasibility analysis includes the following four steps:

(1) Traffic analysis, which provides an estimate of future traffic for the entire sector;

(2) Demand analysis, which provides an estimate of traffic demand for the new (hypothetical) binational entry system;

(3) Estimate of potential gross revenues; and

(4) Financial analysis, which provides an estimate of potential net revenues of the new facility, an indication of its feasibility.

A new binational bridge entry system can be financed through a variety of schemes, and revenue bonds have been used to partly or totally obtain the funds. It will be assumed throughout this report that funds for implementing any new binational bridge come from the sales of revenue bonds. A brief background on some financial analysis concepts, including the characteristics of revenue bonds, is beneficial to clarify the feasibility analysis methodology discussed in this section.

Present Value of Money

The concept of present value is very important for long-term financial analysis of the type required to analyze the potential feasibility of a new binational entry system. This concept is based on the idea that it is better to receive money now than to receive it later, because in the meantime it could be accruing interest. The present value is always less than the corresponding future amount, and its exact value depends on the amount, the time frame, the market interest rates, and the risk of the investment (Refs 9, 13). A long-term financial analysis that does not take into account this concept, and instead works with nominal values, might be wrong by a factor of more than 2, for discount rates as low as 4 percent a year.

Characteristics of Revenue Bonds

A revenue bond is an instrument used by corporations and government agencies to obtain funds needed for long-term purposes, such as the construction of a new facility. A revenue bond allows time for the increased earnings from the new facility to be used in retiring the debt. A bondholder is a creditor of the corporation, unlike a stockholder, who is an owner (Ref 13). Generally, the obligations of the corporation with the bondholder are restricted to paying the face value at the end of the maturity period, and the interest at the rate at the periods printed on the bond, which functions as a legal contract

When the interest rate of a revenue bond is greater than the market rate, it can be sold at face value. However, since revenue bonds are issued primarily when the corporation is interested in delaying the retiring of the debt, they are usually sold at a discounted price, and they pay a smaller annual or semi-annual interest. Maturity periods vary, and some bonds are serial, i.e., they provide for varying maturity rates to lessen the problem of accumulating cash for payment.

A common maturity time is twenty years, and usually the investor does not keep the bond that long. There is an active secondary market of revenue bonds, where buying prices fluctuate according to the performance of the corporation issuing the bond, and to general stock market indicators. This secondary market does not affect the financial analysis methodology, because the bridge owners will need to pay the same interest and repay the same face value at the end of the maturity period, regardless of how many times the bond has been resold in the secondary market.

The bondholders' profit is the difference between the discounted price and the face value plus the interest accrued during the liability period, paid at a nominal rate printed on the bond. The effective interest rate paid by the corporation includes the annualized discount in the bond face value, and it is calculated as shown in Equation 3.1 (Ref 13).

$$EIR = \frac{FV + [FV * NIR * MP] - DP}{DP * MP} \tag{3.1}$$

where:

EIR = effective interest rate,

FV	=	face value of the bond,
DP	=	discounted price of the bond,
MP	=	maturity period, and
NIR	=	nominal interest rate.

The bond discount and the interest consist of additional costs of the new binational entry system that have to be covered by toll revenues. The effective interest rate of the bond is actually reflecting the combination of the interest accrued at the nominal rate, plus the difference between the face value and the discounted value. It is a practical way to allocate a bond expense on a cash flow analysis.

One way to evaluate bonds for rating is the "coverage ratio", which is the ratio between the present value of the monthly revenue and the annualized bond liability, which includes the annualized face value and the yearly interest. A coverage ratio of at least 1.5 is desirable, although bonds have been issued at lower coverage ratios. The better the bond rating, the safer the investment, so the interest rates can be relatively low. Conversely, poor ratings indicate a risky investment that must pay higher interest.

Cost Components

The feasibility of an investment can only be properly assessed when gross revenues are compared to costs. Accurate cost estimates can only be made on a case-by-case basis, but an approximate cost appraisal is needed to evaluate potential feasibility. This section discusses estimates of the main components of the costs of implementing and operating a binational entry system, which are:

(1) Bridge structure,
(2) Approaches,
(3) Inspection facilities,
(4) Toll facilities,
(5) Fencing and security gates,
(6) Off site utilities, and
(7) Landscaping.

The binational entry system proponents have to pay for the design and construction, including engineering, surveying, right-of-way, legal fees, and insurance. In addition, they have to pay for the bond issuance fees and interest in the case of a bond-financed facility. In order to facilitate the evaluation, costs were divided into three categories: implementation, maintenance, and bond repayment.

Implementation Costs

An average value was estimated for the amount and type of facilities that provide adequate service, based on recent presidential permit applications and other literature. This study assumes that the cost of the U.S. inspection facilities is always the responsibility of the General

Services Administration (GSA) (Refs 6, 8, 17). It also assumes that the main approach road will be TxDOT's responsibility, and that the bridge owner's responsibility is restricted to linking the bridge to the new access road, if necessary. The average costs are listed in Table 3.1.

Table 3.1. Average costs of inspection and toll facilities

Item	Cost
Services [1]	$2,000,000
Approaches (4-lane)	$200,000
Toll area facilities	$425,000
Fencing and security gates	$105,000
Off site utilities	$600,000
Landscaping	$150,000
Total	$5,280,000

[1]Engineering fees, legal fees, bond issuance fees. (Refs 14, 17, 22)

The average cost figure for bridges utilized by TxDOT in its planning analyses is about $\$500/m^2$ ($45 per square foot). This figure closely matches the cost predictions for the Anzalduas Bridge, a sophisticated binational entry system that is being proposed in the Hidalgo sector (Ref 14). This estimate is thus somewhat conservative, and it will be used as the typical cost of an international bridge. The bridge width was assumed as 63 ft (19m), which corresponds to a four-lane bridge with one pedestrian lane on each side. The bridge length was assumed as equal to the average length of all bridges in each sector, both proposed and existent. It was also assumed that 40 percent of this length is Mexican and will not be paid by U.S. owners with revenue bonds. These bridge costs were then added to the costs in Table 3.1, and the total U.S. costs for implementing a new binational bridge entry system in each Segment 1 sector are summarized in Table 3.2.

Operation and Maintenance Costs

Costs of operation and maintenance (O&M) are usually paid with toll revenues, and need to be considered in the feasibility analysis. A detailed prediction of true O&M costs depends on local conditions, and can only be made on a case-by-case basis, and in the presence of detailed data. A typical O&M cost value cannot be estimated based on the current costs of existing binational entry systems because, the older the facility, the more maintenance it requires. Since O&M cost histories are not available, a range of values was obtained from literature on proposed binational bridge entry systems, assuming an increasing maintenance need. These ranges are shown in Table 3.3. The feasibility analysis uses the mid-point of these intervals as O&M costs.

Other Considerations

Two other sources of costs and revenues have to be considered in the analysis, namely the income tax, and accrued interest on the toll surplus. If there is a surplus between toll revenues and bridge expenditures, the management should invest this money in some conservative way, such as a blue chip portfolio, to gain interest on the surplus and improve the cash flow. This surplus is taxable, and so is the profit on any other investment. It will be assumed in this analysis that a net interest rate of 4 percent a year on the net revenue represents the accrued interest minus any taxes that may apply. This is implicitly assuming that a 4 percent yearly rate represents the average net rate in the next twenty years.

Table 3.2. Average implementation cost of new binational bridge entry systems

Sector	Existing Binational Entry Systems	Proposed Binational Entry Systems	Average Cost to U.S. Owner
2. Brownsville/ Matamoros	1.Gateway 2. B&M	Port of Brownsville Los Tomates Flor de Mayo	$8,800,000
4. Eastern Valley /Rio Bravo	4. Progreso	Donna/Rio Bravo	$8,200,000
5. Central Valley/ Reynosa	5. Hidalgo/Reynosa 6. Los Ebanos Ferry	Pharr/Reynosa Anzalduas Mission Los Ebanos	$8,800,000
6. Western Valley	7. Rio Grande City/ Camargo 8. Roma/ Miguel Alemán	None	$8,300,000
8. Laredo/Nuevo Laredo	10. Laredo Bridge #1 11. Laredo Bridge #2 12. Colombia	Laredo Bridge #3	$8,700,000

Table 3.3. Estimated operation and maintenance costs history (1994 dollars)

Year of Operation	Cost (1,000 dollars)	Year of Operation	Cost (1,000 dollars)
1st	349-465	11th	439-665
2nd	357-482	12rd	450-690
3rd	365-500	13th	460-715
4th	374-518	14th	471-740
5th	382-536	15th	482-767
6th	390-557	16th	493-796
7th	400-576	17th	505-824
8th	410-598	18th	516-854
9th	419-620	19th	528-886
10th	429-642	20th	541-918

Summary of Assumptions

In addition to the assumptions discussed above, which were necessary to arrive at estimates for the binational entry system costs, revenue sources, and management strategies, the following assumptions were used in the feasibility analysis:

(1) Depreciation costs are included in operations and maintenance (O&M) costs;

(2) The O&M costs represent the present values of these costs over the entire analysis period;

(3) The revenues from the hypothetical binational entry system are used to pay only for expenses related to the new facility;

(4) Funding for implementing the project will come from revenue bond sales;

(5) Revenue bonds are sold at 8 percent effective interest rate, with a 20-year maturity period;

(6) Throughout the analysis period, the existing toll structure in the sector will remain in effect for all facilities, keeping up with inflation so that its present value at any time is exactly the same as the base year value;

(7) The majority of pedestrian traffic in every sector will always prefer the old bridges;

(8) All hypothetical bridges were considered as open and operating in 1995;

(9) Only one additional facility will be constructed in each sector during the entire analysis period;

(10) New binational entry systems are effectively designed, efficiently operated, fully staffed, and clearly identified in all access routes, in order to promote their maximum utilization;

(11) Motor fuel will remain in adequate supply and future price increases will not substantially exceed the overall rate of inflation; and

(12) There will be no national, regional or local emergency that will abnormally restrict the use of motor vehicles in either country.

Departure from any of these assumptions may substantially change the conclusions about the feasibility of a new binational entry system in the sector. In addition, departures from the assumptions and results discussed in the previous sections may also cause changes in the conclusions.

DEMAND FORECAST METHODOLOGY

The demand forecast methodology for a new binational entry system in a Texas-Mexico border sector is twofold. First, it is necessary to project the sector traffic into the entire maturity period of the bonds (assumed 20 years in this study). Next, an appropriate part of this projected traffic needs to be assigned to the new binational entry system, based on origin and destination information and traffic diversion considerations. CTR developed a simplified methodology to assess the potential auto and truck diversion to a new binational bridge in the future, and traffic forecasts scenarios that take into account the possible impacts of NAFTA on the border traffic demand.

Traffic Forecast Methodology

Traffic is a function of land use and other socioeconomic indicators, such as population, vehicle ownership ratio, employment, auto occupancy rate, and percentage of loaded trucks. These relationships are not simple, and attempts to correlate existing traffic to these variables using regression were not successful, as they could not explain much more than 60 to 70 percent of the relationship, and gave poor residual plots. The latter is a measure of lack-of-fit, which is especially important in forecasting, where the model must be extrapolated well beyond the range of calibration. All this indicates that traditional traffic forecasts based on extrapolations of past history may not be reliable. More useful traffic estimates can be obtained based on hypothetical scenarios of possible NAFTA impacts on traffic (Refs 11, 12).

NAFTA can be expected to generate three general types of economic impact — that is, high impact, moderate impact, or low impact. Proponents of the high impact scenario state that the pre-NAFTA situation is characterized by excess regulations and protectionism that hinder economic development, the first by overwhelming the free enterprise to a point of discouraging investment in new businesses and the latter by hampering competition, which is seen as the main propeller of economic progress. According to the high impact scenario, NAFTA would, by gradually lifting all trade barriers, encourage new business and foster competition. As a result, the border economy would grow.

The moderate impact scenario starts out with almost the same arguments as the high impact scenario, but it suggests that the General Agreement on Trade and Tariffs (GATT) lifted the main barriers that were hindering economic growth, and that impacts of further deregulation would be minimal. A slight dampening of current upwards trends would be observed until the economic situation reaches a new equilibrium.

The low impact scenario referred to here has little to do with the arguments of NAFTA opponents on both sides of the border. It is pessimistic with respect to the NAFTA effects on the economies of border cities and counties. This scenario states that NAFTA would motivate a considerable part of the maquiladora activity to move south away from the border. It also states that once American products can enter Mexico without taxation, there will be no need for Mexican nationals to shop in the U.S., causing much of the border retail activity to suffer. In the low impact scenario, only long-haul traffic would increase.

Although it is widely recognized that protectionism and excess regulations usually hinder economic progress, the effects of removal of these hindering forces on a particular region are not known at this point. Any recommendations for transportation planning policies based on the choice of a theory might become obsolete in the near future. This inconvenience can be circumvented by broadening the study scope to take into account the possible effects of the high, low, and moderate impact scenarios, leading to the three traffic forecass depicted in Table 3.4.

The scenarios shown in Table 3.4 were used in all traffic forecasts discussed later in this report. Local conditions, previous studies, and historical growth rates were also taken into account for each sector, on a case by case basis. In addition, there are two other factors that may affect the border transportation infrastructure. One is ISTEA in the U.S., and the other is the Mexican program to obtain funds for seaports and for rail, started by President Salinas' administration. The more optimistic the economic growth scenarios, the less transborder commercial traffic should continue to depend primarily on trucks. This study assumes that other modes would be indicated to address increasing trade, and that ISTEA, coupled with the Mexican programs, would gradually transfer potential truck demand to other modes.

Table 3.4. Traffic forecasts scenarios

Scenario	Effect on Auto Traffic	Effect on Truck Traffic
High impact	Growth rate will initially show high increase, then less increase, to reflect equilibrium after an initial NAFTA boom.	Growth rate will initially increase, then become steady to reflect increasing competition from other modes.
Moderate impact	Growth rate will show moderate increase.	Growth rate will initially increase, then become steady to reflect competition from other modes.
Low impact	Growth rate will decrease.	Growth rate will initially follow the historical trend, then become steady to reflect competition from other modes.

Traffic Assignment Methodology

Throughout much of the border, transborder auto traffic is primarily local, consisting mostly of business, shopping and school related trips. A detailed traffic diversion analysis requires availability of origin and destination data disaggregated by small border city zones, together with land use forecasts for each of these small zones of the border cities. This is well beyond the scope of a transportation needs study. In addition, accurate predictions of future land use and traffic patterns at the border region are complicated to do at this point, due to the difficulties in predicting any post-NAFTA situation.

For trucks, the situation is even more complex. Pre-NAFTA truck regulations prohibit foreign commercial traffic beyond the commercial zones of both countries — a narrow strip about 48.3 miles (30 km) wide on both sides of the border. This regulation requires commercial traffic to stop at a minimum of one commercial zone, which in turn causes most truck origins and destinations to be local. Moreover, actual cargo origins and destinations cannot be captured by a traditional survey at the bridge. NAFTA will gradually lift these regulations. By December 1995, trucks will be allowed to travel within border states, and in January 1999, they will be allowed anywhere within NAFTA territory. Therefore, a trip assignment model developed with current truck information would be obsolete in less than three years, and the most useful origin and destination data at this point are qualitative, based on interviews with trucking companies and U.S. Customs' offices.

The objectives of this study can be met with a sector analysis of the border, and sectors are defined based on major traffic diversion areas currently spanned by the sector demand. The traffic assignment methodology developed by CTR is based on a spreadsheet model that takes into consideration current origin and destination data, as well as land use data when available. The model is calibrated on a case-by-case basis, to reflect boundary conditions prevalent in each sector. Model assumptions thus vary with sectors, except the following, which are present in the basic spreadsheet used in all sectors:

(1) Currently identified O&D patterns for autos will not change during the analysis period;

(2) Traffic generation potential of the new facility is negligible;

(3) The route reconnaissance data can represent the average network characteristics over the entire analysis period (Refs 8, 20);

(4) The new binational entry system is fully staffed, efficiently operated, and each one of its components will operate at full capacity during the entire analysis period, and

(5) The binational entry system being analyzed will be the only additional one in the sector during the entire analysis period.

The second assumption is conservative in terms of demand and revenue estimates, while the fourth and fifth are not. However, they are widely used in the literature, because introduction of a second binational entry system and/or all possible under utilization of facilities would complicate the analysis and require a myriad of additional assumptions that would introduce too much error in the results.

SUMMARY AND CONCLUSIONS

This chapter discussed the methodologies developed by CTR to estimate the demand and revenues for additional binational entry systems along the Texas-Mexico border. These methodologies were applied to every Segment 1 sector that is located within an economic activity center, and the results, coupled with an assessment of the current capacity, can provide valuable guidelines to the border infrastructure needs.

Predictions of a post-NAFTA situation are very difficult at this point, because NAFTA is a unique experience, and there are no parameters to draw comparisons. NAFTA effects on the economies of the border area are not known, and there are three scenarios in the literature: the high impact, the moderate impact, and the low impact. The demand forecast for each sector was done under these three scenarios, to cover all possibilities. It is impossible at this point to predict the actual NAFTA impacts on each border sector, and it is conceivable that different locations will be differently affected. The combined results of the capacity, demand and revenue analyses discussed in the next chapters indicate sectors where additional infrastructure is needed, and why it is needed, as well as whether or not an additional toll bridge is feasible in each sector.

The analyses documented in this report are preliminary in nature, and they rely on several assumptions regarding issues such as trip generation, travel behavior, route choice, post-NAFTA commercial traffic, and future origin and destination patterns. Departures from any assumption may have a material impact on the study results. Nevertheless, demand and revenue analyses results, coupled with the current capacity assessment, can provide valuable guidelines about border infrastructure needs. These guidelines are appropriate for a preliminary transportation needs study, and cannot substitute for project-level analyses of traffic demand, or for a detailed revenue forecast for bond issuance.

CHAPTER 4. ANALYSIS OF THE BROWNSVILLE-MATAMOROS SECTOR

BACKGROUND

The Brownsville-Matamoros Sector begins at Palmito Hill Road, about 6.2 miles (10 km) east of Brownsville urban area. It ends at Flor de Mayo Road, near the intersection of US281 and FM802 at Villa Nueva, Cameron County. This sector comprises the cities of Brownsville in Cameron County, and Matamoros in the state of Tamaulipas, but it also serves international traffic generated at other cities such as Port Isabel, South Padre Island, San Juan, and El Refúgio (Tamaulipas). It includes two vehicular binational entry systems: Gateway and B&M, both located within the urban areas of Brownsville and Matamoros.

Existing Binational Entry Systems

The Gateway Bridge, a toll facility located adjacent to the Brownsville Central Business District, is open 24 hours a day. The U.S. side of the bridge is owned by Cameron County, while the Government of Mexico owns the other side, which is managed by Caminos y Puentes Federales (CAPUFE). Gateway consists of two two-lane concrete bridges, one for each traffic direction. On the U.S. side, there are four primary inspection booths (expandable to six) and seventeen secondary inspection booths for private vehicles. For trucks, there are four primary inspection booths, and an import lot with seventy secondary inspection booths and a four-lane entrance. The southbound toll facility has three toll booths, with no designated truck booth. Future toll plaza expansion would be difficult since the surrounding land is fully developed.

On the Mexican side, "Puente Matamoros," or "Puente Nuevo," or "Puerta México" has three primary inspection lanes for private vehicles, and a fourth lane for empty trucks. The secondary inspection area includes space for about 10 to 15 vehicles. Loaded trucks make a right turn to the "ruta fiscal" (fiscal route) that leads to the customs area, a 60-vehicle commercial lot.

Current southbound access to Gateway consists of E. 14th Street and E. Elizabeth Street. Northbound bridge traffic from Gateway exits on International Boulevard, which connects to Expressway 83/77. In Matamoros, Gateway access and egress are Avenue Alvaro Obregon, a four-lane divided street in fair condition. Avenue Alvaro Obregon is a commercial street located a few miles away from Matamoros Central Business District. There is no convenient access from Gateway to the Airport, or to highways MEX 2 and MEX 101/180.

B&M is a railroad bridge modified to handle vehicular traffic by means of two narrow lanes. B&M is located approximately 0.93 miles (1.5km) west of Gateway, and it is privately owned and operated by the Brownsville and Matamoros Bridge Company, a subsidiary of Union Pacific Railroad Company (UPR) and Ferrocarriles Nacionales de México (FNM). Revenues from the bridge are divided equally between the two bridge owners. B&M was open in 1910 and reconstructed in 1941, and it is the only binational rail entry system in the Brownsville sector.

The U.S. inspection facilities of B&M were expanded and remodeled in 1992. For private vehicles, there are four primary inspection booths (expandable to six), and twelve secondary inspection booths (expandable to eighteen). For trucks, there is one primary inspection booth, and 15 secondary inspection docks. The southbound toll facility has two toll booths, and there is no room for expansion.

On the Mexican side, "Puente B y M" or "Puente Viejo", has one primary inspection lane, and a space for 4 to 5 vehicles for secondary inspection. Trucks utilize the same commercial lot used by Gateway Bridge, which is located between the two bridges. The three northbound toll booths are located on the U.S. side, in line with the southbound toll facilities. "Puente B y M" connects to E. Carranza and Alvaro Obregon in the Central Business District of Matamoros. There are plans to expand the bridge, which would cost $4 million and take two years for completion, but the Mexican government has not expressed interest in this expansion.

Proposed Binational Entry Systems

The proposed Port of Brownsville Binational Entry System consists of two bridges, one single-track rail, and one four-lane vehicular, located approximately 3.1 miles (5km) south of the Brownsville Ship Channel near Los Suaces Ranch. There is a proposal to implement this binational entry system in two phases, the first being the commercial-only vehicular bridge, which would improve traffic circulation on the existing binational entry systems by diverting the trucks from the downtown areas. It has been proposed to design the bridge and its access roads for a 170,000-lb (77,180-kg) vehicle, which accommodates the Mexican legal load.

The vehicular binational bridge entry system will be connected to the Port of Brownsville via a four-lane divided Port-owned road also designed for a high load. Access from the Port will be from South Port Road, which links to the wharf, the grain elevators, and the petroleum storage tanks. South Port Road connects SH48 and FM 511, both of which connect to US 77/83. From Mexico, the roadway will be extended to Carretera a la Playa, a highway to Matamoros that has two to four lanes, depending on the section.

The Presidential Permit was submitted in 1991, and the environmental problems in the area pertain to the presence of endangered species. The Port authority expects that 50 to 80 percent of Brownsville downtown truck traffic will divert to the new bridge. On the Mexican side, the project's main obstacles are lack of a sponsor, circumvented by Port of Brownsville's offer to fund the entire project, and the belief that this binational entry would compete with the Mexican seaport of Altamira, 99 miles (160km) south of the proposed site.

Los Tomates Bridge has been proposed by the U.S. for several years and has recently received attention in Mexico. The tentative site is approximately 5 miles (8km) east of Gateway Bridge in Brownsville. If built at the proposed site, the controlled access Highway US 77/83 will be extended to the international bridge. The project has already been funded and authorized by Congress, and its construction could start by late 1995. However, SCT and SEDESOL are waiting for the development of the projected traffic for Los Indios to start concession for and construction of Los Tomates.

The third proposal in this sector is Flor de Mayo Bridge, included in the 20 year transportation plan for Brownsville. Some preliminary design work is being done, but current efforts are directed primarily towards Los Tomates.

REVENUE AND DEMAND ANALYSES

The demand and revenue analyses of the Brownsville Sector were performed using the methodology and assumptions discussed in Chapter 3. Additional assumptions regarding multimodalism, travel behavior and other details, were necessary to arrive at the results discussed in this section.

Traffic Analysis

Northbound traffic histories for this sector are available from U.S. Customs for Gateway and B&M Bridges, and from CAPUFE for Gateway only. Figures 4.1 and 4.2 show the northbound auto and truck traffic histories for each binational entry system, and aggregated for the entire sector.

The northbound data indicate that the General Agreement of Tariffs and Trade (GATT), implemented in 1987, had an impact in both auto and truck traffic. Before GATT, annual auto traffic in this sector oscillated between 4.6 million and 4.2 million, while declining at an average yearly rate of 1.94 percent. During 1988 and 1989, the average growth rate was 8.4 percent, putting the traffic at the 4.8 to 5 million level, an average 10 percent increase in magnitude. Truck traffic was fairly stagnant before GATT, oscillating between 130,000 and 150,000, at an average growth rate of 0.1 percent. After 1989, the average rate jumped to 13 percent, and 1992 truck traffic was about 200,000, a 40 percent increase over the average pre-GATT magnitudes.

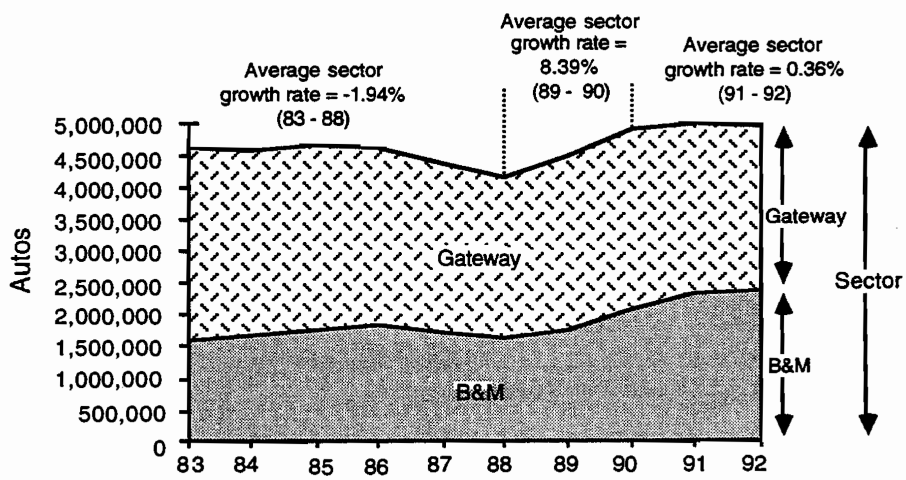

Figure 4.1. Northbound auto traffic — Brownsville Sector (Source: U.S. Customs)

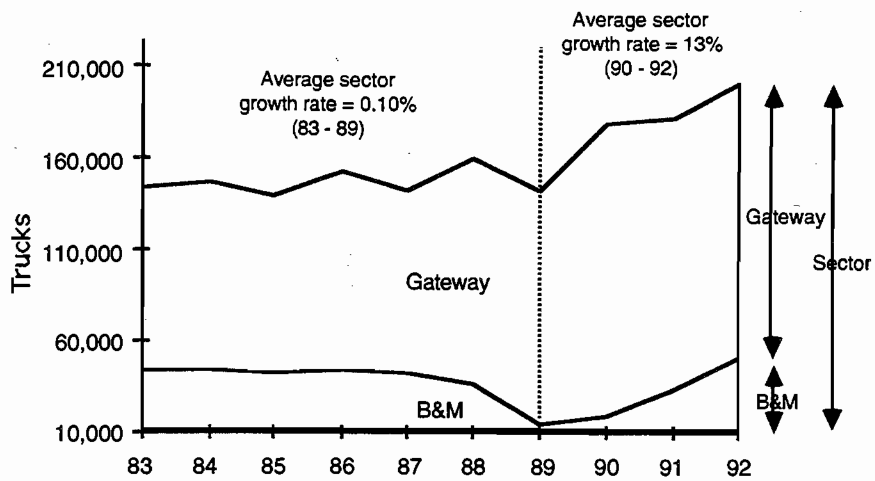

Figure 4.2. Northbound truck traffic — Brownsville Sector (Source: U.S. Customs)

Southbound traffic history is available only for Gateway from the bridge management, and Figures 4.3 and 4.4 show respectively the auto and truck traffic histories. Auto traffic has been steadily declining at Gateway since 1981, with the exception of 1988, when traffic increased. Before GATT, the decline rate averaged 2.2 percent, while after GATT (1987) the decline rate seems to have decreased a little (1.92 percent); however, the difference between the -2.2 percent average rate in seven years and the -1.92 percent rate in four years is not significant enough to warrant the conclusion that traffic growth rates have changed.

Truck traffic at Gateway shows an impressive GATT effect. Before GATT, truck traffic growth was irregular and the volumes oscillated between 45,000 and 65,000, at an average growth rate of 2 percent. During the two years after GATT implementation, truck traffic had an average growth rate of almost 39 percent, increasing volumes to the 95,000 level. After 1989, however, truck traffic has been declining at an average yearly rate of 8 percent.

Directional split at Gateway Bridge is considerably different for autos and trucks, and both are shown in figure 4.5. The auto directional split averaged 45 percent for northbound and 55 percent for southbound, with minor variations throughout the analysis period. For trucks, the directional predominance is reversed, with more trucks going north than south. During the three years after GATT implementation, southbound truck traffic averaged 44 percent of total, while it averaged 34 percent during the rest of the available history.

This study focuses on analyzing the revenue-generating traffic, which is southbound for the U.S. case, and southbound traffic histories are available only for Gateway. Total southbound traffic in the sector was estimated based on the assumption that the directional traffic distribution observed at Gateway also holds for B&M. Minor adjustments were then made on the extrapolated southbound traffic history to eliminate discrepancies between north and southbound growth patterns. The resultant sector traffic history in the southbound direction is shown in Figure 4.6.

As discussed in Chapter 3, the traffic predictions assume three scenarios for NAFTA impact: high impact, moderate impact, and low impact. Under the high impact scenario, the current auto growth rate will be assumed to continue between 1993 and 1996. By 1997, a significant number of barriers will be lifted by NAFTA, and this will cause the auto traffic to grow at a faster rate. Between 1997 and 2001, the growth rate will increase at an average of 9 percent, and then stabilize at an average of 2 percent a year, reflecting the gradual removal of trade barriers and its positive impact on the border economy.

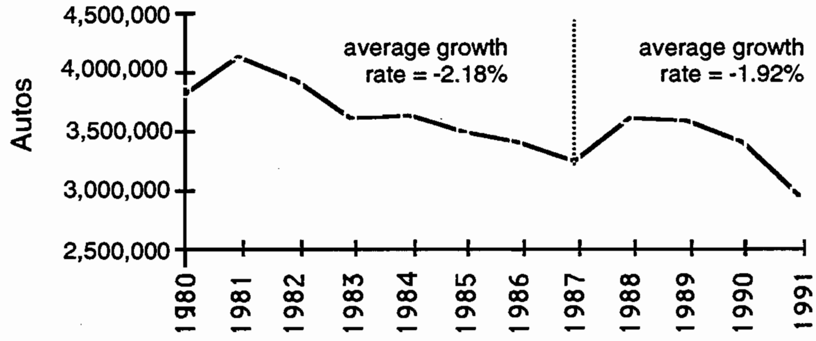

Figure 4.3. Southbound auto traffic — Gateway Bridge

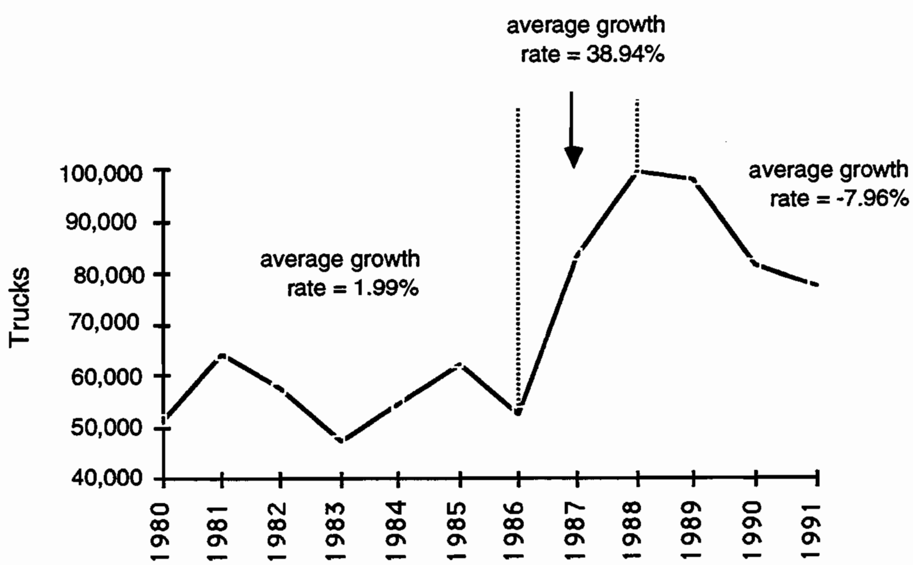

Figure 4.4. Southbound truck traffic — Gateway Bridge

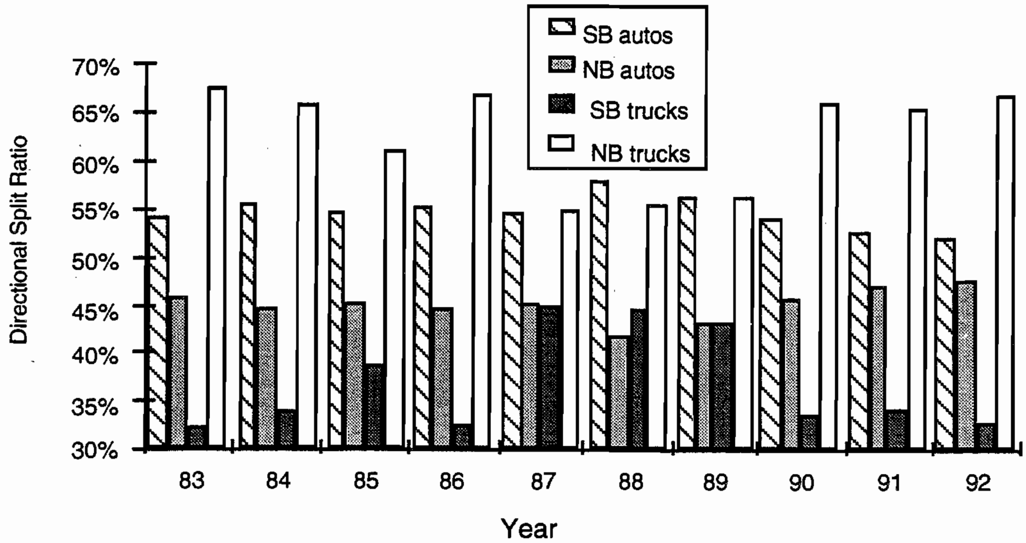

Figure 4.5. Directional traffic split at Gateway Bridge

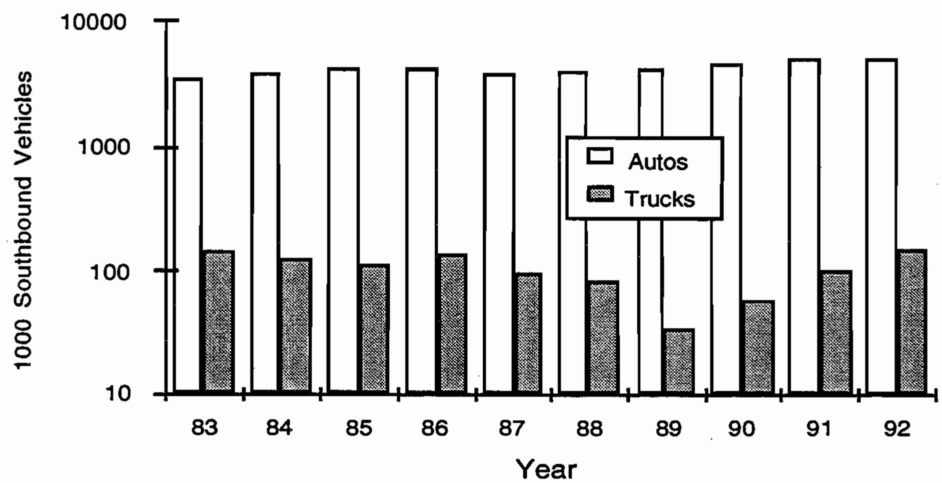

Figure 4.6. Assumed southbound traffic history for the Brownsville Sector

In the moderate impact scenario, current auto growth rates are assumed to reflect a trend towards stabilization on a level compatible with normal economic growth. NAFTA is assumed to have little impact on auto growth rates; however, since these rates have been very small over the past two years (while the other economic indicators in the sector have been growing), they were not used directly as the basis for estimating future demand. Rather, NAFTA would cause an average growth rate of 1.5 percent during the analysis period.

In the low impact scenario, the negative NAFTA impact will be felt gradually, with a moderate impact scenario for the first four years, and a gradual growth rate decrease after the NAFTA changes start taking place. This gradual decrease will be represented by an annual average decline of 0.08 percent, replicating the observed pre-GATT declines. An attempt was made to calibrate a model that estimates auto traffic as a function of some socioeconomic forecasts found in the Long Range Transportation Planning Basic Study Elements Update (Ref 3), but the resulting model had a very poor predictive power, due to the somewhat erratic past growth rates, coupled with the statistical significance of GATT in the past, and of assumed NAFTA impacts in the future, which supersede other measurable effects.

Truck traffic seems to be still developing into a post-GATT level, which should stabilize shortly. For all three post-NAFTA scenarios, this development will be assumed to continue throughout 1994. Between 1995 and 1997, truck traffic is assumed to stabilize near pre-GATT growth. After 1997, gradual changes will take place due to a combination of NAFTA impacts and, in some cases, assumed multimodal competition.

For the high impact scenario, NAFTA impacts were assumed to replicate GATT effects, with a 13 percent growth rate between 1998 and 2001, and 5 percent thereafter. The latter growth rate results from the assumption that post-NAFTA commodity flow will increasingly utilize rail and sea, due to successful efforts of both countries to foster multimodalism, coupled with the pressing need for more efficient transborder transportation. In this particular sector, however, the presence of the nearby port may encourage growth of port-related truck traffic, which, according to the origin and destination survey, amounts to 30 percent of total truck traffic.

For the moderate impact scenario, positive NAFTA impacts would be felt between 1998 and 2001, due primarily to the fact that this sector includes an important seaport. After that, truck demand would stabilize at an average of 3 percent the yearly growth rate. The post-NAFTA growth rates are 1.5 percent through the end of the analysis period for the low impact scenario. The pre-GATT rates averaged 0.1 percent, but it was assumed that the proximity of the port would encourage truck traffic growth even under a low impact NAFTA scenario, which is pessimistic in terms of the border area, but not necessarily in terms of trade between the U.S. and Mexico. The estimated future auto and truck traffic for the Brownsville Sector is shown in Table 4.1.

Under the high impact post-NAFTA scenario, total auto demand in this sector will be over 11.8 million by the year 2014. This demand drops to 8.1 million under the moderate impact scenario, and to 4.5 million under the low impact scenario. Truck demand under the high impact scenario reaches almost 400,000 by the year 2014, dropping to 256,000 under the moderate impact scenario, and to 165,000 under the low impact scenario. Before 1998, truck demand is the same under all scenarios, since the assumptions about NAFTA impacts imply that differences among scenarios will be felt mainly in the last three quarters of the analysis period.

A conservative assumption underlying truck traffic estimates is the increasing competition of other modes, a supposition based on the fact that trucks are not the best solution for an ever-increasing commodity flow. Under the more optimistic assumption of predominance of truck traffic over other modes, the Financial Feasibility Analysis of the New Port Crossing (Ref 16) predicts that truck traffic demand in the sector would be around 550,000 by the year 2014. This prediction could be closer to reality if the assumption of intermodalism does not materialize, or if it takes place later than assumed here. The sector traffic estimates were used in a simplified trip assignment model to obtain the potential traffic diversion to a new hypothetical binational entry system in this sector.

Table 4.1. Estimated southbound annual traffic for the Brownsville Sector (1000 vehicles)

Year	High Impact Scenario		Moderate Impact Scenario		Low Impact Scenario	
	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	5807	128	5807	128	5324	128
1995	6016	128	6016	128	5281	128
1996	6232	128	6232	128	5239	128
1997	6731	128	6325	128	5197	128
1998	7269	145	6420	138	5155	130
1999	7851	164	6517	149	5114	132
2000	8479	185	6614	161	5073	134
2001	9157	209	6714	174	5033	136
2002	9340	220	6814	179	4992	138
2003	9527	231	6917	185	4953	140
2004	9717	243	7020	190	4913	142
2005	9912	255	7126	196	4874	144
2006	10110	267	7232	202	4835	146
2007	10312	281	7341	208	4796	149
2008	10519	295	7451	214	4758	151
2009	10729	310	7563	220	4719	153
2010	10943	325	7676	227	4682	155
2011	11162	341	7791	234	4644	158
2012	11386	358	7908	241	4607	160
2013	11613	376	8027	248	4570	162
2014	11846	395	8147	256	4534	165

Potential Demand Estimates

Origin and destination surveys undertaken by CTR at the Gateway and B&M Bridges corroborated local observations from bridge owners and Customs officials on both sides of the border, who believe that 85 to 95 percent of the transborder traffic in this sector is local, i.e., Brownsville to Matamoros and vice-versa. According to the same officials, 60 to 70 percent of the truck traffic in this sector is maquiladora-related. At Gateway, the data indicated that 85 percent of the auto trips have origins in Brownsville and destinations in Matamoros, with no other origin or destination mentioned by more than 5 percent of the respondents. Matamoros accounts for over 96 percent of all auto destinations, while Brownsville accounts for 87 percent of all auto origins, indicating that most trips with origins in Brownsville as well as most externally originated trips have Matamoros as their destination.

Brownsville accounts for 94 percent of all truck origins, and Matamoros is the destination of 72 percent of trucks. Mexico City and Monterrey are destinations for respectively 9 percent and

7 percent of all trucks using Gateway. It is important to realize that this survey captured pre-NAFTA truck traffic, which is restricted by the prohibition of foreign trucks beyond the commercial zones. Accordingly, trucks going into any external destination in Mexico must have either an origin within the U.S. commercial zone, or a destination within the Mexican commercial zone, explaining the predominance of local origins and destinations for truck traffic.

The origin and destination survey also found that 30 percent of trucks were either loading or unloading at the Port of Brownsville, which indicates that the proximity of this Port is an important factor in truck traffic generation. Pre-NAFTA truck traffic regulations are reflected in this survey, and over 72 percent of cargo origins and destinations were warehouses where trucks exchanged trailers to comply with the foreign truck traffic prohibition.

The B&M binational entry system was closed to trucks during the survey dates, but auto patterns are similar to those observed at Gateway. Matamoros accounts for 95 percent of all destinations, while Brownsville accounts for 94 percent of all origins. The Brownsville-Matamoros pair accounts for 90 percent of all trips.

The origin and destination information was loaded into a simplified trip assignment model that includes a generic external origin, a generic external destination towards the Monterrey route, the port and the cities of Brownsville and Matamoros. In addition to the assumptions discussed in Chapter 3, the following assumptions were used:

(1) Throughout the analysis period, 30 percent of the truck traffic is coming from the Port of Brownsville.

(2) Future land use in Brownsville and Matamoros will follow the current pattern.

(3) Inspection facilities of the hypothetical bridge are designed in a way that minimizes traffic disruption.

(4) In this sector, 85 percent of truck traffic will prefer to bypass the downtown areas of Brownsville and Matamoros.

(5) Traffic generation in newly developed areas was taken into account mainly in terms of route preference of assumed percentages of future traffic.

(6) Southbound truck trips that originate outside Brownsville must stop at Matamoros under current regulations (until 1997).

(7) Elimination of truck traffic restrictions will cause elimination of all warehouses by the year 2000.

(8) Truckers will always prefer the bridge that is more convenient to the warehouse to which they are going (assumption used between 1994 and 2000), or to their future origins or destinations.

Departures from the assumptions discussed above, as well as departures from the assumptions used to estimate future southbound traffic in the sector, may cause actual demand to be considerably different than the estimates shown in Table 4.2.

Table 4.2. Demand estimates for a hypothetical bridge in the Brownsville Sector (thousands of vehicles)

	High Impact Scenario		Moderate Impact Scenario		Low Impact Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	290	38	290	38	266	38
1995	301	38	301	38	264	38
1996	312	38	312	38	262	38
1997	337	39	316	39	260	39
1998	727	73	642	69	516	65
1999	785	82	652	75	511	66
2000	848	111	661	97	507	80
2001	916	126	671	104	503	82
2002	1401	187	1022	152	749	117
2003	1429	196	1037	157	743	119
2004	1458	206	1053	162	737	121
2005	1487	216	1069	166	731	123
2006	1517	227	1085	171	725	124
2007	1547	239	1101	177	719	126
2008	1578	251	1118	182	714	128
2009	1609	263	1134	187	708	130
2010	1642	276	1151	193	702	132
2011	1674	290	1169	199	697	134
2012	1708	305	1186	205	691	136
2013	1742	320	1204	211	686	138
2014	1777	336	1222	217	680	140

The results indicate that, by the year 2014, auto demand for a hypothetical binational entry system in this sector would be 1.8 million for the high impact scenario. This figure lowers to 1.2 million and 680,000, respectively, for the moderate impact and low impact scenarios. The assumption that currently observed local auto origins and destinations will prevail throughout the analysis period, coupled with the implicit assumption that local trips would prefer the old bridges had an important impact on these estimates. On the other hand, this new binational entry system would be the preferred truck route, capturing 336,000 under the high impact scenario, 217,000 under the moderate impact, and 140,000 under the low impact scenario.

Potential Revenue Estimates

The demand estimates discussed above were utilized to analyze the potential feasibility of a bond-financed binational entry system, using the financial model developed in this study (Chapter 3). The southbound toll prices at the hypothetical binational entry system were assumed to be the same as the current prices charged by Cameron County at Gateway and Los Indios, which are $1.00 for autos, and a sliding fare for trucks, depending on the number of axles. Data on truck distribution by the number of axles were obtained during the origin and destination survey conducted in this sector (Ref 21), and they show a predominance of 5-axle trucks, as well as a high percentage of large trucks. Truck toll prices and axle distribution are depicted in Table 4.3. According to the data shown in Table 4.3, the average truck toll is $9.25. This weighted average is based on survey data comprising only 185 trucks, and it may change seasonally, weekly, and/or daily. The toll shown in Table 4.3 and the demand estimates shown in Table 4.2 were loaded into the financial model, and the net revenues are shown in Table 4.4.

Table 4.3. Truck toll fares and axle distributions at the Brownsville Sector

Number of Axles	% of Trucks	Toll (1993 dollars)
2	12	4.00
3	9	6.00
4	5	8.00
5	52.5	10.00
≥ 6	21.5	12.00

Table 4.4. Revenue estimates for a hypothetical bridge in the Brownsville Sector

	Net Revenues In Thousands Of 1993 Dollars		
Year	High Impact Scenario	Moderate Impact Scenario	Low Impact Scenario
1995	-1259	-1221	-1221
1996	-1251	-1200	-1200
1997	-1236	-1177	-1156
1998	-705	-533	-412
1999	-690	-460	-251
2000	-548	-230	103
2001	-534	-138	320
2002	70	692	1419
2003	84	756	1542
2004	98	820	1669
2005	111	884	1800
2006	122	949	1935
2007	133	1014	2074
2008	143	1080	2219
2009	151	1146	2368
2010	159	1212	2523
2011	166	1280	2684
2012	172	1347	2850
2013	177	1416	3023
2014	180	1485	3203
Total	-4457	9123	25,496

Under the most high impact scenario, the analysis indicates that net revenues from a hypothetical binational entry system in this Sector would be about $3.2 million (U.S.) by the year 2014. This figure drops to $1.4 million under the moderate impact scenario, and to $180,000 under the low impact post-NAFTA scenario. The results indicate that the revenues would be too low to warrant feasibility even under the most optimistic scenario, which would not warrant a good bond coverage ratio.

Conclusions

Under the high impact scenario, the financial analysis results show a total profit of over $25 million (U.S.)by the end of the analysis period, while the low impact shows a loss of almost $4.5 million. However, the net revenues shown on Table 4.4 are overestimated, because their magnitude is not enough to warrant a good bond rating. A poor bond rating means higher interest rates, implying in turn that several expenses assumed in the development of the financial analysis model are underestimated, and net revenues cannot reach the levels depicted in Table 4.4.

The Financial Feasibility Analysis of the New Port Crossing (Ref 16) assumed that truck toll fares would be $12.00, $24.00, and $30.00, respectively, for four, five, and six or more axles. This analysis also presumes that the operation and maintenance expenses are lower than those assumed in this study. Under these assumptions, the Port of Brownsville (Ref 16) obtained a bond coverage ratio high enough to warrant a good rating and lower liabilities for its optimistic traffic growth scenarios. The more pessimistic scenarios analyzed in the Financial Feasibility Analysis of the New Port Crossing (Ref 16) do not warrant feasibility of a bond-financed binational entry system in this sector, and the low impact predictions of the Port of Brownsville are similar to the high impact predictions of this study, mainly because Brownsville assumes predominance of trucks over other modes, while this study assumes the opposite.

CAPACITY ANALYSIS OF THE BROWNSVILLE SECTOR

The analysis of the current capacity utilization at the Brownsville Sector follows the methodology described in Chapter 2, and it focuses on the identification of binational entry system components that are either experiencing, or have a potential to develop congestion. The analysis encompasses the two binational entry systems in this sector: Gateway and B&M.

Gateway Binational Entry System

Gateway is the busiest binational entry system in this sector, carrying about 70 percent of the sector traffic. It is located in downtown Brownsville and Matamoros, and its U.S. access/egress components are shown in Figure 4.7. The immediate access and egress for Gateway consists of International Boulevard and Washington Street in the north/south direction, intercepted by East 14th Street, and Elizabeth Street in the east/west direction of downtown Brownsville.

Two streets provide direct access to Gateway and are assumed to constrain its southbound access: the eastbound approach on Elizabeth Street and the southbound approach on East 14th Street. This intersection is assumed to be controlled by a two-phase, 100-second cycle length signal, which yields a critical volume-to-capacity (v/c) ratio of 81 percent for the entire intersection, based upon the allocation of green times that give equal degrees of saturation.

Northbound egress from Gateway consists of stop controlled driveways for auto traffic leaving U.S. primary inspection and entering the intersection of Elizabeth Street and International Boulevard. These stop controlled driveways are estimated to be operating at a v/c ratio of 35 percent, based on an hourly volume of 600 vph and a critical gap of 4 seconds. The next intersection of the northbound egress (International Boulevard and Adams Street) is signalized. Assuming that this signal is two-phase with a 60-second cycle, and allocating green times based on equal degrees of saturation, the intersection of International Boulevard and Adams Street is estimated to be at 61 percent capacity. This means that this signalized intersection is a greater constraint to the northbound egress from Gateway than the stop controlled driveways leaving U.S. Customs.

Figure 4.8 shows the access/egress components of Gateway in Matamoros. Assuming that the intersection of Alvaro Obregon Avenue and Tamaulipas Avenue converge into two northbound lanes to provide northbound access to Gateway without any intersection control mechanisms, the two-lane approach is estimated to be at a v/c ratio of 30 percent.

Southbound egress from Gateway is estimated to be limited by the westbound approach of the intersection of Alvaro Obregon Avenue and Calle Seis. This intersection is stop controlled for southbound B&M bridge traffic only and the westbound approach is estimated to be at a v/c ratio of 45 percent.

Figure 4.9 summarizes the results of the capacity analysis of the binational entry system components at Gateway. The analysis indicates that the southbound toll for autos and trucks is the most congested component, operating considerably over capacity even with all lanes staffed (v/c=140 percent). The second worst component is the southbound access to Gateway in downtown Brownsville, estimated to be operating near capacity, with a v/c value of 81 percent. The southbound truck primary inspection in Mexico is located away from the bridge, and was not analyzed because it does not affect traffic circulation around this binational entry system.

In the northbound direction, the Mexican toll booth and the U.S. primary inspection for autos are the most congested components, with v/c ratios respectively of 101 percent and 111 percent even with all lanes staffed. In addition, field observations indicate that northbound trucks often queue behind the U.S. primary inspection. This observation was taken into consideration for the analysis of the bridge span, which assumes a de facto truck lane operating at 20 percent capacity. If this binational entry system provided a waiting area for trucks, the U.S. truck inspection would not impair the traffic circulation, since it operates below capacity (v/c ratio of 75 percent), with all lanes open and a two minute processing time per truck.

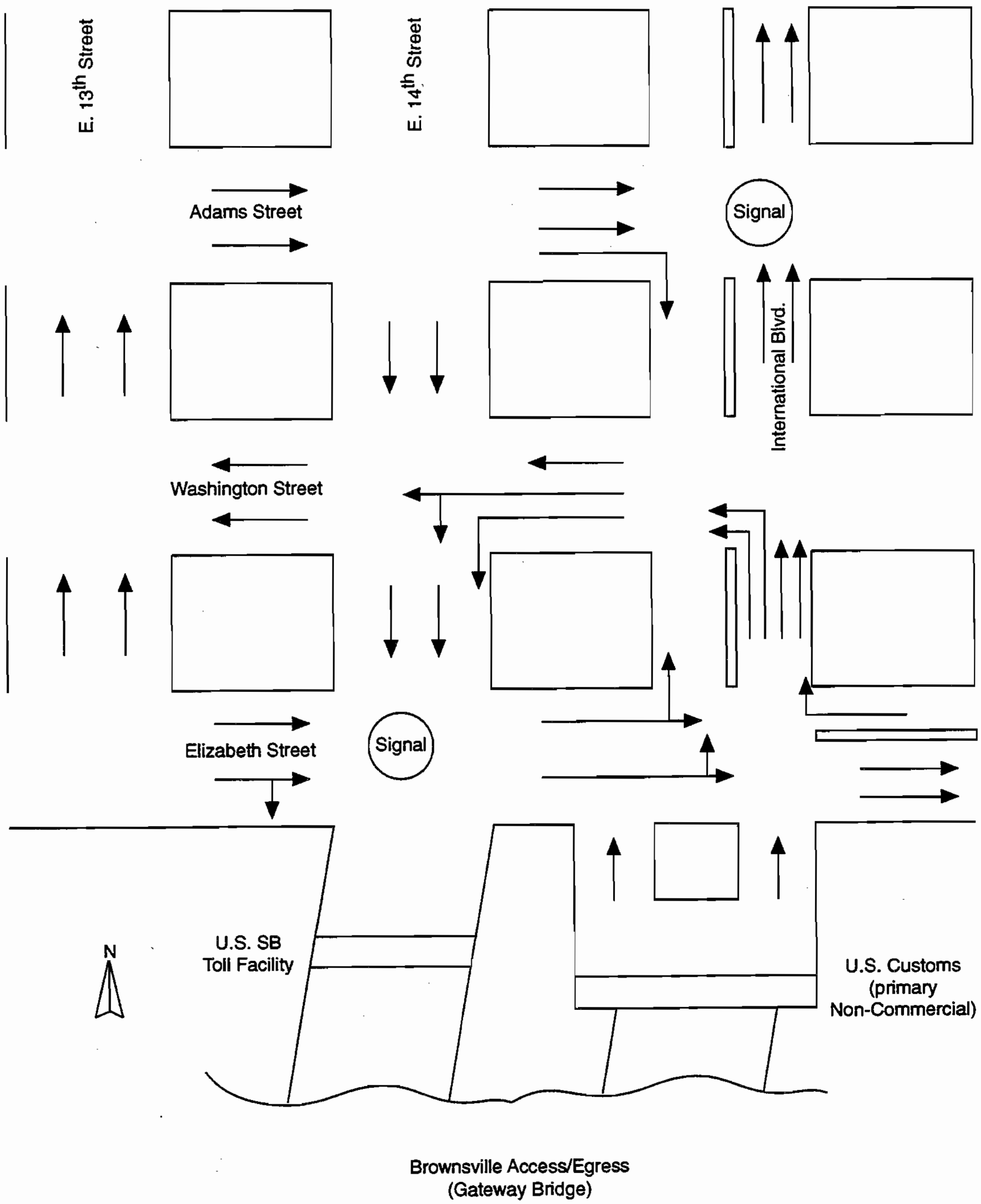

Figure 4.7. Gateway access/egress component in Brownsville

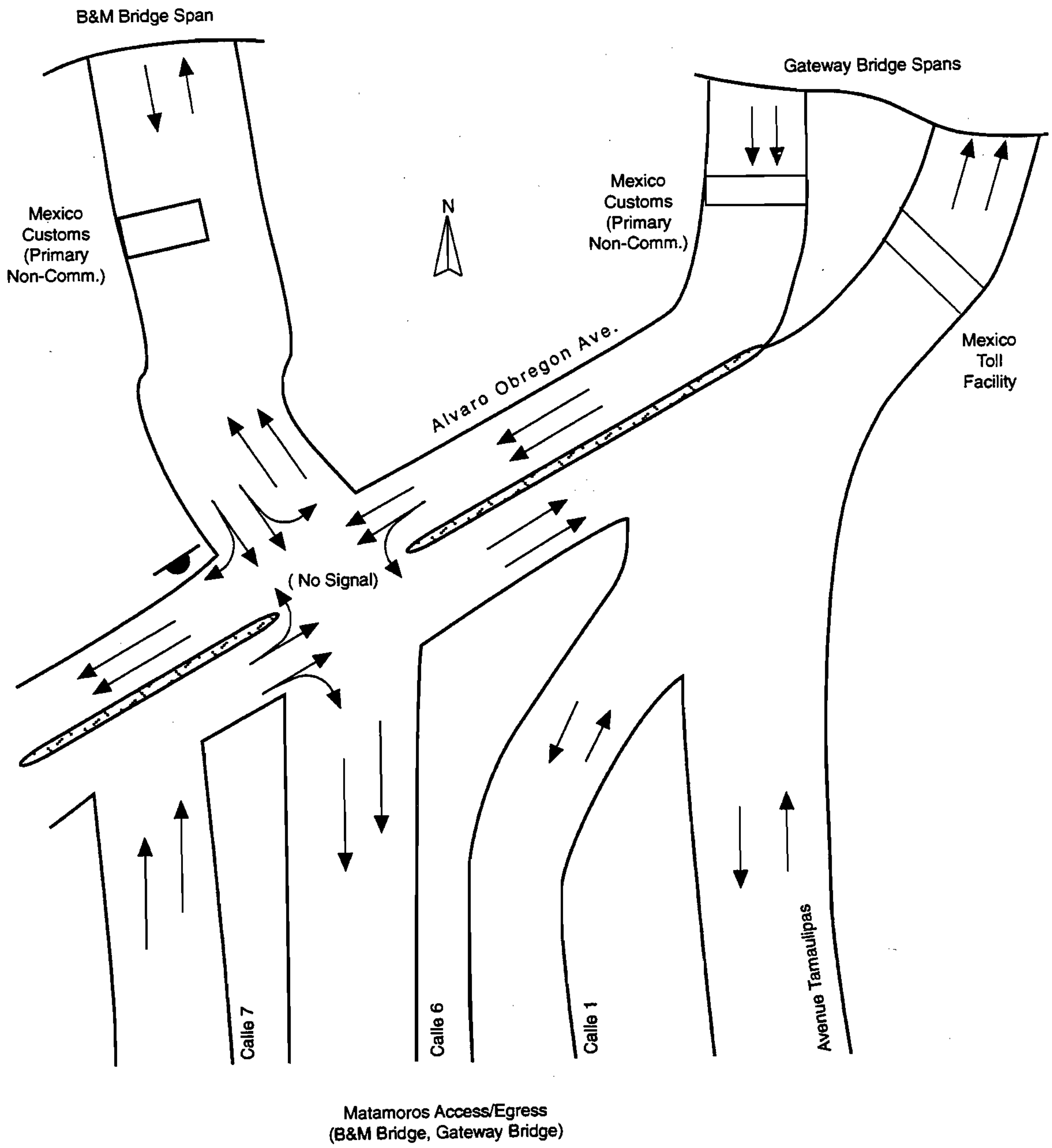

Figure 4.8. Gateway access/egress component in Matamoros

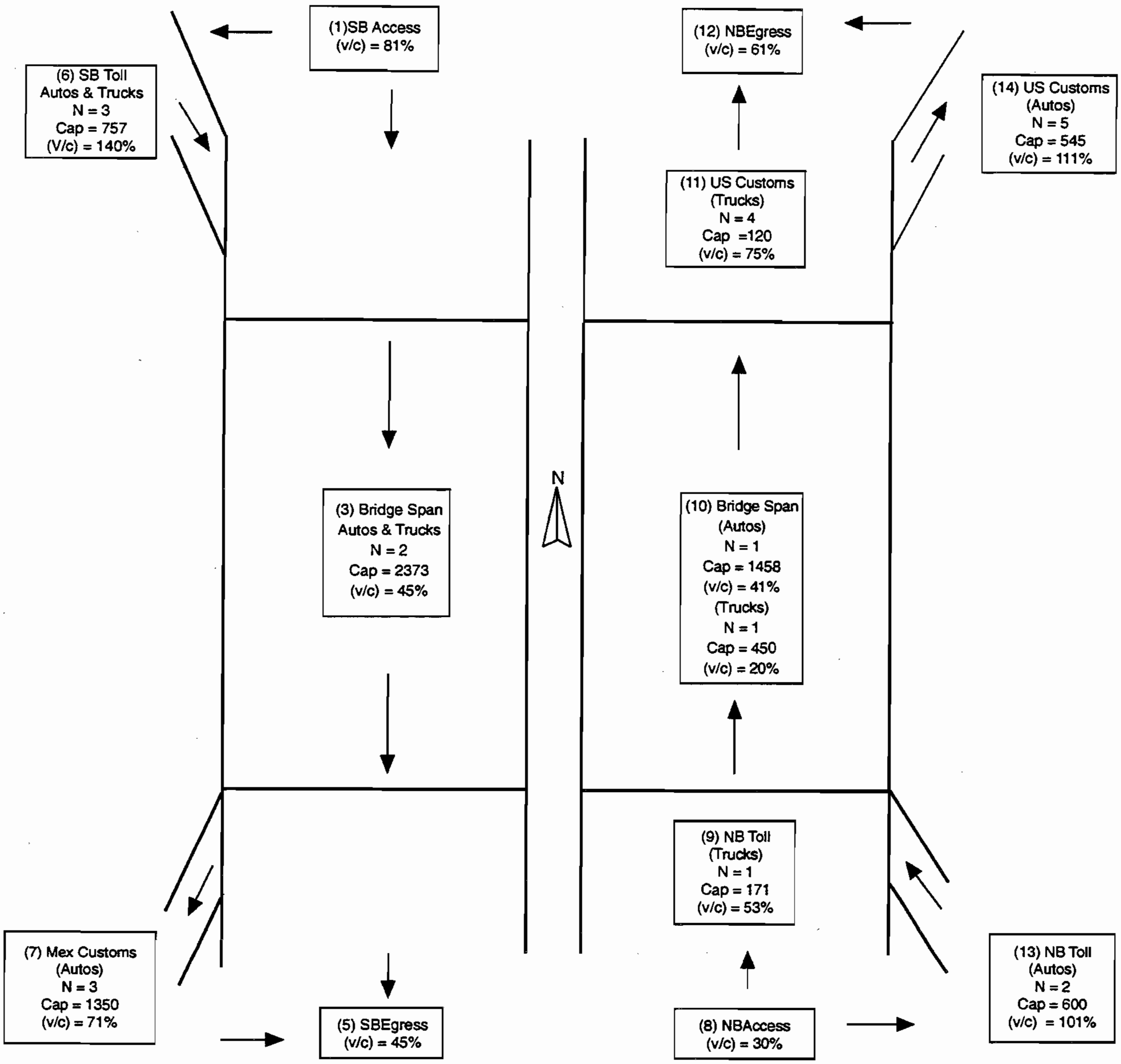

Figure 4.9. Gateway capacity utilization

B&M Binational Entry System

In Brownsville, the B&M direct access/egress is supplied by Mexico Street, which intersects Sam Pearl Boulevard and Palm Boulevard, as shown in Figure 4.10. Sam Pearl intersection with Mexico Street is stop sign controlled for all approaches, and Palm Blvd. is signalized. Assuming that the Sam Pearl Blvd./Mexico St. intersection has a 70/30 directional split, and constrains the access/egress of B&M in the U.S, the analysis yields a volume-to-capacity ratio of 48 percent for the intersection as a whole.

In Matamoros, the B&M direct access/egress is supplied by Alvaro Obregon, Calle Seis, and Calle Siete, as depicted in Figure 4.9. The intersection of Alvaro Obregon Avenue and Calle Seis is assumed to constrain the access and egress at B&M, and is idealized as stop controlled for the southbound approach (B&M egress traffic), the eastbound left turn (assumed to provide the only northbound access to the B&M Bridge), and the westbound left turn. Traffic data are not available for Matamoros, and a conservative analysis was made based upon the assumption that local and international traffic utilizing the access/egress main intersections have approximately the same volume.

The northbound access to B&M in Matamoros is constrained by the eastbound left turn at the intersection of Alvaro Obregon Avenue and Calle Seis. The eastbound left turn at Calle Seis and Alvaro Obregon Avenue is assumed to constrain the northbound access to B&M. Assuming that this intersection is stop controlled, with 982 vph conflicting volume, and a 5.5 seconds critical gap, the estimated v/c ratio for the northbound access to B&M is 134 percent.

The southbound approach to the Calle Seis/Alvaro Obregon intersection is assumed to constrain the B&M southbound egress. Idealized as a stop controlled intersection, with 1,838 vph conflicting volume, and 6.5 seconds critical gap, this intersection has no capacity available for the southbound through movement, due to the large volumes at the eastbound left movement. The southbound right turn movement at the Calle Seis/Alvaro Obregon intersection is estimated to operate at 130 percent capacity if all B&M southbound traffic utilizes the one lane assumed available to turn right (conflicting volume, 923 vph; critical gap, 5.5 seconds). Field observations indicate that congestion in Matamoros is not that bad. In fact, it was observed that most congestion occurs when B&M opens for truck traffic. B&M is narrow, and one-way truck traffic occupies both lanes when crossing the bridge, requiring northbound traffic to be help up while southbound trucks cross. The conflict among field observations and analysis results indicate that local Matamoros traffic was overestimated.

Figure 4.11 summarizes the results of the capacity utilization of the binational entry system facilities at B&M. Since the analysis of Mexican access/egress seems too conservative, the results are actually indicating that the most congested components are the U.S. toll and the Mexican primary inspection for autos, which are both are operating near capacity, with v/c ratios respectively of 89 and 96 percent.

Summary of Sector Results

The capacity utilization analysis separately examined each component of each binational entry system, in order to identify the actual sources of traffic congestion. The capacity utilization of each component of the two binational entry systems in the Brownsville sector are summarized on Table 4.5.

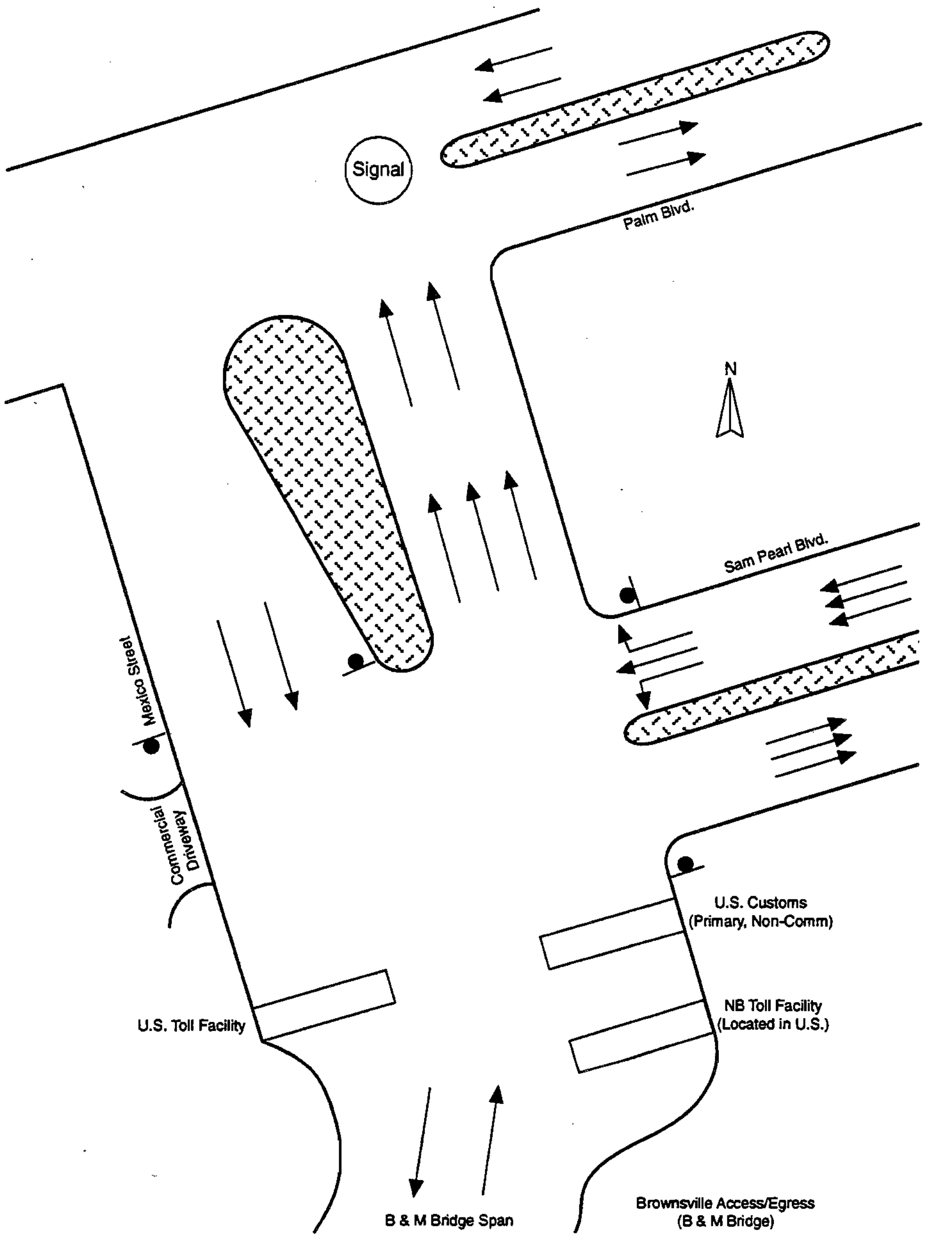

Figure 4.10. B&M access/egress component in Brownsville

The results indicate that, theoretically, additional bridge lanes are not needed to alleviate traffic congestion in this sector at this point, since in the worst case (narrow B&M) they operate at 48 percent capacity. The access/egress components of Gateway in Matamoros and northbound egress in Brownsville are below capacity, but southbound access is near capacity with a v/c ratio of 81 percent. However, v/c ratios of 60 percent or more often indicate unstable conditions, and queues at the congested toll plazas and inspection facilities on both sides of the border, can contribute to further impair the traffic circulation. Gateway has better access/egress layout and by itself would not be congested; however, traffic backups at an intersection often cause congestion in the subsequent one, and the overall effect is congestion near both international bridges. The situation in Matamoros may be even worse than indicated by the analysis, since traffic volumes were not collected for city streets in downtown Matamoros, and some intersections were analyzed assuming that only international traffic is present, when in reality additional local traffic is also present.

Table 4.6 shows a comparison between the total available capacity and the capacity utilization at the entire Brownsville Sector. This summary is based on approximations necessary to aggregate the capacity utilization estimates for the entire sector.

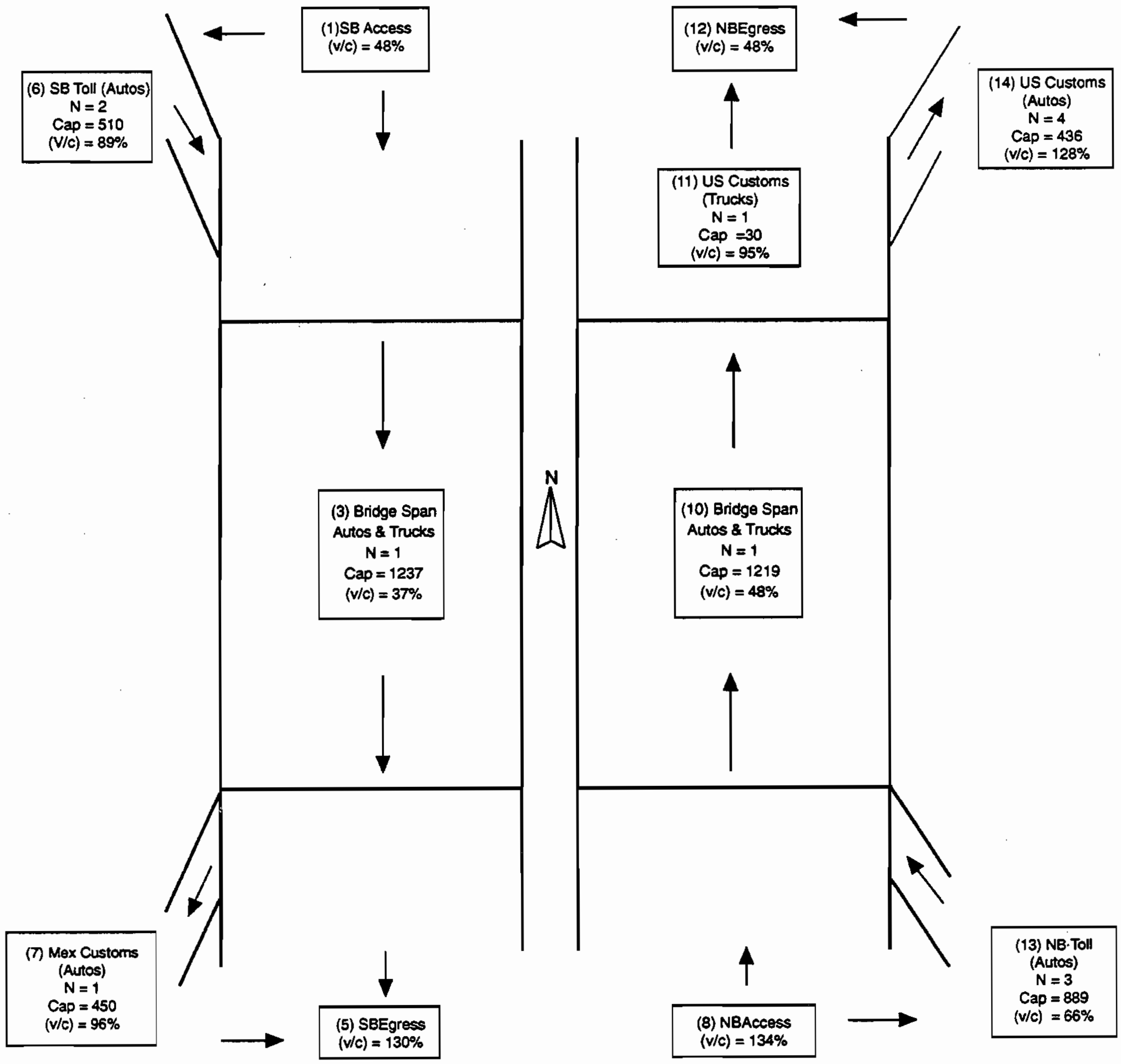

Figure 4.11. Capacity utilization at B&M

Table 4.5. Summary of capacity utilization of Brownsville's binational entry systems

	Component		
	Access	**Gateway**	**B&M**
South-bound	Toll (autos)	81%	48%
	Toll (trucks)	140%	89%
	Bridge Span (Autos & Trucks)		
	Mexican Primary Inspection (autos)	45%	37%
	Mexican Primary Inspection (trucks)	71%	96%
	Egress	N/A	-
	Access	45%	130% (*)
North-bound	Toll (autos)	30%	134% (*)
	Toll (trucks)	101%	66%
	Bridge Span (autos)	53%	
	Bridge Span (trucks)	41%	48%
	U.S. Primary Inspection (autos)	20%	
	U.S. Primary Inspection (trucks)	111%	128%
	Egress	75%	95%
		61%	48%

(*) not confirmed by field observations; based on very conservative assumptions.

Table 4.6. Capacity utilization at Brownsville Sector

Binational Entry System Component	Southbound Direction		Northbound Direction	
	Total Available Capacity	Total Capacity Utilization	Total Available Capacity	Total Capacity Utilization
Toll (auto)	1267	76%	1489	65%
Bridge span (auto)	3610 (*)	27% (*)	3130 (*)	32% (*)
Primary inspection (auto)	2700	36%	981	99%
Primary inspection (truck)	N/D	N/D	150	65%

Based on k-factors of 9 percent for autos and 15 percent for trucks.
(*) Approximate
N/D No aggregated data applicable

The available capacity of northbound auto primary inspection is almost fully utilized (99 percent), and congestion at this component usually implies a chain-reaction effect: primary inspection queues block traffic at the bridge, impair toll booth operation, and cause traffic congestion on the bridge access and egress. The latter are operating at levels that are affected by traffic flow instabilities, and the situation can get much worse due to queues at congested toll plazas and primary inspection lanes. Evidently, this situation requires additional facilities, but it is important that future infrastructure address the actual sources of congestion to prevent repetition of the same problems in the near future.

CONCLUSIONS AND RECOMMENDATIONS

The Brownsville-Matamoros Sector and the Central Valley Sector share the same approximate amount of transborder traffic in border Segment 1 (25 percent). Brownsville is an important sector; it serves international commodity flow using the Port of Brownsville, tourist flow to South Padre Island, and a significant amount of local traffic between the two sister cities. Its two binational entry systems are congested in components that cannot be expanded, and there is a clear need for additional infrastructure.

Capacity Utilization

The capacity analysis indicates that U.S. primary inspection and toll collection components are the main bottlenecks in this sector. The access/egress components in Matamoros are also suffering congestion, due to a combination of traffic back-ups at northbound inspections, coupled with an already low capacity of the network that feeds the two binational entry systems.

Theoretically, traffic circulation in this sector could be considerably improved by expanding and fully staffing the toll plazas and the primary inspection facilities, and by improving the access and egress components on both sides of the border. However, the required land for expansion of all these components does not seem available in the downtown areas of Brownsville and Matamoros, and another binational entry system may be the only available solution; its feasibility is discussed in the next section.

Feasibility of a New Binational Entry System

Under the assumptions made for estimating potential demand and revenues, the financial analysis does not suggest feasibility of a bond-financed binational entry system in this sector even under the most optimistic post-NAFTA scenario. On the other hand, truck revenues estimated by the Port of Brownsville (Ref 16) would warrant feasibility of a truck-only bridge, under its most optimistic scenarios, but not for its low impact scenarios. Toll prices assumed by Brownsville were used in the financial model, but this additional model run indicated that these prices are still insufficient to warrant a good bond coverage ratio under the high impact post-NAFTA scenario. The discrepancy is primarily due to the following assumptions: predominance of truck cargo (Ref 16) instead of multi- and intermodalism (this study), the more expensive truck tolls indicated in the Brownsville study, and lower operational expenses than those assumed in this study.

It is also important to realize that traffic forecasts are always based on past traffic history, and a number of assumptions are necessary to take into consideration a post-NAFTA situation, which has no parallel and is thus very difficult to extrapolate. Past traffic history is utilized in all forecasts to some extent, but it may have no influence on future traffic, which could be considerably greater than the estimates based on historical data.

Recommendations

Traffic circulation around the Gateway and B&M binational entry systems is poor during the peak hours, and even during other high hours in case of Gateway. In Matamoros, the situation is worse than in Brownsville, due to a combination of poorer approaches and more traffic back-ups at the northbound inspection components. Likewise all other border sectors, additional bridge lanes are not needed to alleviate congestion, which is primarily due to queues at toll and inspection facilities coupled with low capacity access/egress components of Gateway. However, the downtown location of the existing binational entry systems encumber future expansion (specially of the access/egress components). An additional binational entry system may be the only solution to this problem, as long as the inspection agencies are able to adequately staff the border stations on both the U.S. and Mexican sides.

Auto demand is primarily local, and trip purposes indicate that autos would prefer to continue using the downtown bridges, specially if another binational entry system is built and relieves the current congestion. The demand for a new binational entry system in this sector is likely to be primarily commercial, and additional truck data are indispensable to accurately analyze the feasibility of such facility. Current data reflect the pre-NAFTA ban of truck traffic beyond commercial zones, and actual origins and destinations of truck cargo are needed to re-analyze this sector. If the assumption of multimodalism does not materialize, and instead truck traffic predominates in this sector, the feasibility analysis results indicate that a new revenue forecast study based on the assumption of truck predominance is likely to yield good bond ratings. Availability of real cargo origins and destinations would also help investigating the potential market for especial toll facilities designed to serve the Mexican legal loads.

According to the maquiladora analysis developed in this study (Ref 21), the east coast of Mexico is one of two areas expected to have the greatest maquiladora growth. This will create additional demand at the coastal commercial hub, which can partly be served by trucks. This study does not recommend that commodity flow be planned based on truck prevalence. Pre-cleared rail cargo should prevail throughout the border, since it simultaneously solves two problems: congestion due to a large number of trucks, and staff shortages for Customs inspections. Ideally, the Port cargo flow should be primarily handled by rail, and truck traffic should be limited to the situations in which the combination of short distances and light loads make rail infeasible. Feasibility of a rail bridge with truck lanes that would divert all truck traffic out of the congested downtown areas of Brownsville and Matamoros seems the best plan for the future transborder traffic flow in this sector.

CHAPTER 5. ANALYSIS OF THE LOS INDIOS / LUCIO BLANCO SECTOR

BACKGROUND

The Los Indios Sector begins at Flor de Mayo Road near the intersection of US281 and FM802 at Villa Nueva, Cameron County. It ends at the intersection of US281 and the FM491 extension near Relampago, in Hidalgo County. This sector has one binational entry system, the Los Indios Bridge.

Existing Binational Entry Systems

The Los Indios or the Free Trade Bridge is a toll facility located in a rural area, approximately 18 miles (29 km) west of the Brownsville/Matamoros and 10 miles (16 km) east of Harlingen/San Benito. Matamoros is about 16 miles (26km) to the east, and Reynosa is about 30 miles (48km) to the west. Los Indios was open in November 1992, and it operates daily from 6AM to 10PM. On the U.S. side, it is owned by Cameron County (50 percent), the City of Harlingen (25 percent), and the City of San Benito (25 percent). On the Mexican side the bridge is under concession by CAPUFE.

Los Indios has the most modern U.S. border station of the Lower Valley. Its bridge has four lanes, two in each traffic direction. The U.S. Customs facility has four primary inspection booths for private vehicles (expandable to twelve), as well as 12 secondary inspection booths, expandable to 36. The truck import lot has 50 docks for secondary inspection, and includes a hazardous cargo area, as well as a large area for bureaucratic procedures associated with import operations. The southbound toll facility has two toll booths for all traffic, and there is sufficient room for future expansion. There are facilities for pedestrians, but the demand is very limited at this binational bridge entry system, due to its non-urban location.

The southbound Mexican inspection facilities of "Puente Libre Comércio" or "Puente Lucio Blanco" include three primary inspection lanes and a secondary inspection area for 8 to 10 privately owned vehicles. The commercial lot includes three primary inspection lanes, and a dock with capacity for approximately 50 to 60 trucks. The Mexican northbound toll facility has two lanes for privately owned vehicles, and another two for trucks.

Inadequate connecting infrastructure appears to be hindering growth of bridge traffic. However, efforts are under way to improve bridge connections with U.S. and Mexican highways. On the U.S. side, a new spur from the bridge connects to US281. Loop 590 is under development, and it will provide a direct route from the bridge to US77/83, to the Port of Harlingen, to the Valley International Airport, and to Harlingen's Industrial Parks. On the Mexican side, a new spur about 1.9 miles (3 km) long connects the bridge with MEX02.

Los Indios is the only binational entry system in Brownsville port of entry that handles vehicles heading to other countries beyond Mexico, and traveling through Mexico ("transmigrant" vehicles). About 50 to 60 transmigrants cross the bridge every day.

TRAFFIC ANALYSIS

This sector encompasses primarily rural areas on both sides of the border, and as such it does not have significant local demand. It is primarily a preferred route for commercial and private vehicles that bypass the urban areas of Brownsville and Matamoros. The existence of a new binational entry system usually encourages development of the surrounding areas and generates traffic, but it is too early to observe such developments in this sector.

Traffic data for Los Indios are available in north and southbound directions, respectively from U.S. Customs and the bridge management. Since Los Indios was open in the end of 1992, it does not have a traffic history that can be used to predict future traffic. Table 5.1 shows the available traffic data, disaggregated by month and by vehicle type.

Table 5.1. Traffic data at Los Indios

	Northbound			Southbound		
Date	Autos	Trucks	Growth Rate	Autos	Trucks	Growth Rate
Nov. 1992	19,031	176		15,190	274	
Dec. 1992	24,647	162	29 percent	20,395	1,830	44 percent
Jan. 1993	23,079	197	-6 percent	17,726	886	-16 percent
Feb. 1993	20,908	279	-9 percent	17,063	1,093	-2 percent
March 1993	23,293	276	11 percent	n/a	n/a	n/a

n/a: not available when data were collected.
Growth rate refers to all vehicles (trucks plus autos).

The high growth rate observed in December and the subsequent declines registered in January and February probably reflect the winter holidays peak. The March growth rate is positive, but additional data are required to perform an analysis and draw conclusions as to whether it represents an isolated fluctuation, or if it is the beginning of an upwards trend. Revenue and demand analyses for a new binational entry system were not done, because it is evident that a second facility in this sector will be neither feasible nor needed as long as the traffic demand for Los Indios is still developing.

CAPACITY ANALYSIS

The Los Indios binational entry system is still serving a very small percentage of the expected traffic, and it is operating considerably below capacity at this point. Nevertheless, a capacity analysis is beneficial to indicate which components have potential to develop congestion in the future. The capacity analysis was based on the methodology and assumptions discussed in Chapter 2, as well as on additional assumptions discussed in this section.

Access/Egress Component

Figure 5.1 shows the access/egress facilities of the Los Indios Bridge, in the U.S. and in Mexico. Access/egress is supplied by US281 in the U.S., and by MEX02 in Mexico. On the U.S. side, southbound access and northbound egress are constrained by the eastbound approach and the westbound left turn at the signalized US281/US509 intersection. Assuming an actuated signal with a three-phase sequence and a 30 second cycle length, where the minor movements are given a minimum green time (5 seconds), the following v/c ratios are estimated:

(1) Southbound access: 19 percent, and

(2) Northbound egress: 12 percent.

Given the access/egress facilities layout, this component is operating at the highest of these two levels (19 percent).

In Mexico, southbound egress from and northbound access to the bridge are provided by a T-intersection between the bridge access/egress lanes and highway MEX02. This intersection is assumed to be stop-controlled in the southbound direction only. Two-way traffic data collected at a section of MEX02 near Los Indios (Ref. 20) was used to estimate turning movements at this unsignalized T-intersection, in conjunction with the following additional assumptions:

(1) Southbound left turn : Conflicting volume = 308 vph, critical gap=8.0 seconds,

(2) Southbound right turn: Conflicting volume = 129 vph, critical gap = 6.5 seconds, and

(3) Eastbound left turn: Conflicting volume = 179 vph, critical gap =5.5 seconds.

Based on these data and assumptions, both the southbound egress and the northbound access are estimated to operate at a v/c ratio of 6 percent.

Capacity Analysis Results

Figure 5.2 summarizes the results of the capacity analysis of the Los Indios binational entry system. The results indicate excess capacity available for all components, in both the southbound and northbound directions. The highest v/c value is 21 percent for U.S. truck inspection, followed by 19 percent at the U.S. access/egress. The lowest v/c ratio is 2 percent for the bridge span component, followed by 3 percent at Mexican auto inspection.

Current traffic at Los Indios is below 20 percent of the planned demand, and two of its components are already utilizing about 20 percent of their capacity. This indicates a potential for future congestion at these components, which are U.S. Customs and U.S. access/egress. The bridge itself does not appear to have any potential for future congestion, a situation observed in all other sectors along the Texas-Mexico border. Toll booths will take longer to reach capacity than U.S. inspection, but should be closely monitored as an additional source of congestion.

CONCLUSIONS AND RECOMMENDATIONS

The Los Indios sector may be described as incipient in terms of traffic demand and local socioeconomic development, and this incipience is one of the forces that are hindering traffic development in the binational entry system. A new bond-financed binational entry system in this sector is not a recommended investment in the foreseeable future.

As the traffic at Los Indios evolves to a higher level of demand, congestion can be expected first at the U.S. Customs, and also at the U.S. access/egress. The toll booths will operate at high levels of capacity utilization, and the combination of queues at the toll booths, the access/egress components, and the U.S. inspection will create an overall congestion of this binational entry system similar to that observed in older binational entry systems with high demands. Expansion of the inspection and toll facilities, and a geometric upgrade to increase the U.S. access/egress capacity may become necessary in five to ten years, earlier if NAFTA impacts are more intense than expected.

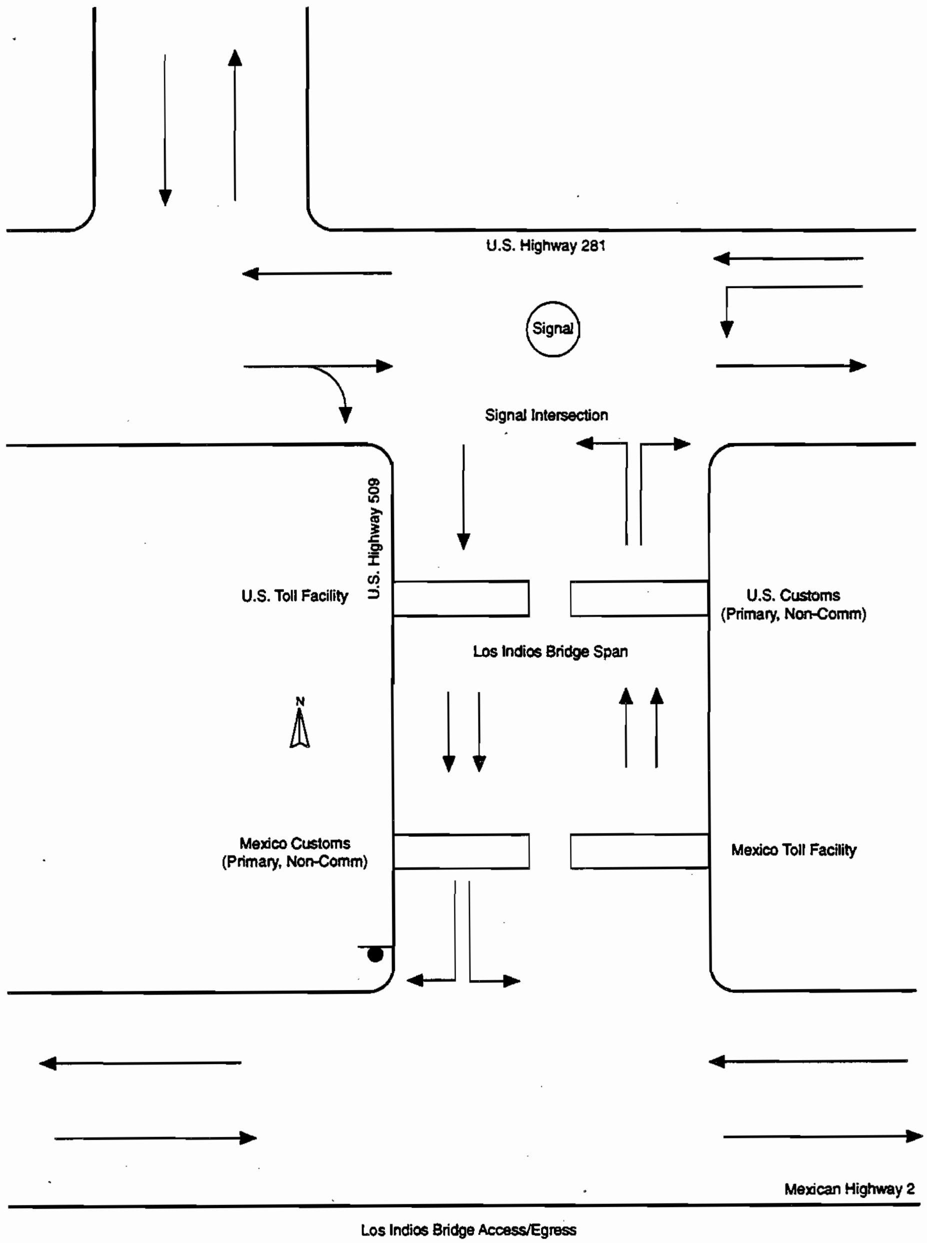

Figure 5.1. Access/egress component at Los Indios

Los Indios is close to the Port of Brownsville, and it has some of the super-crossing characteristics already in place, such as a modern border station. If upgraded to a super-crossing, Los Indios should divert commercial traffic out of the downtown areas of Brownsville and Matamoros, and optimize overall traffic circulation in both Los Indios and Brownsville sectors. Close monitoring of post-NAFTA traffic patterns that will develop in the Brownsville and Los Indios Sectors, together with development of potential demand estimates, are strongly recommended as a basis for the decision to upgrade Los Indios to a super-crossing facility.

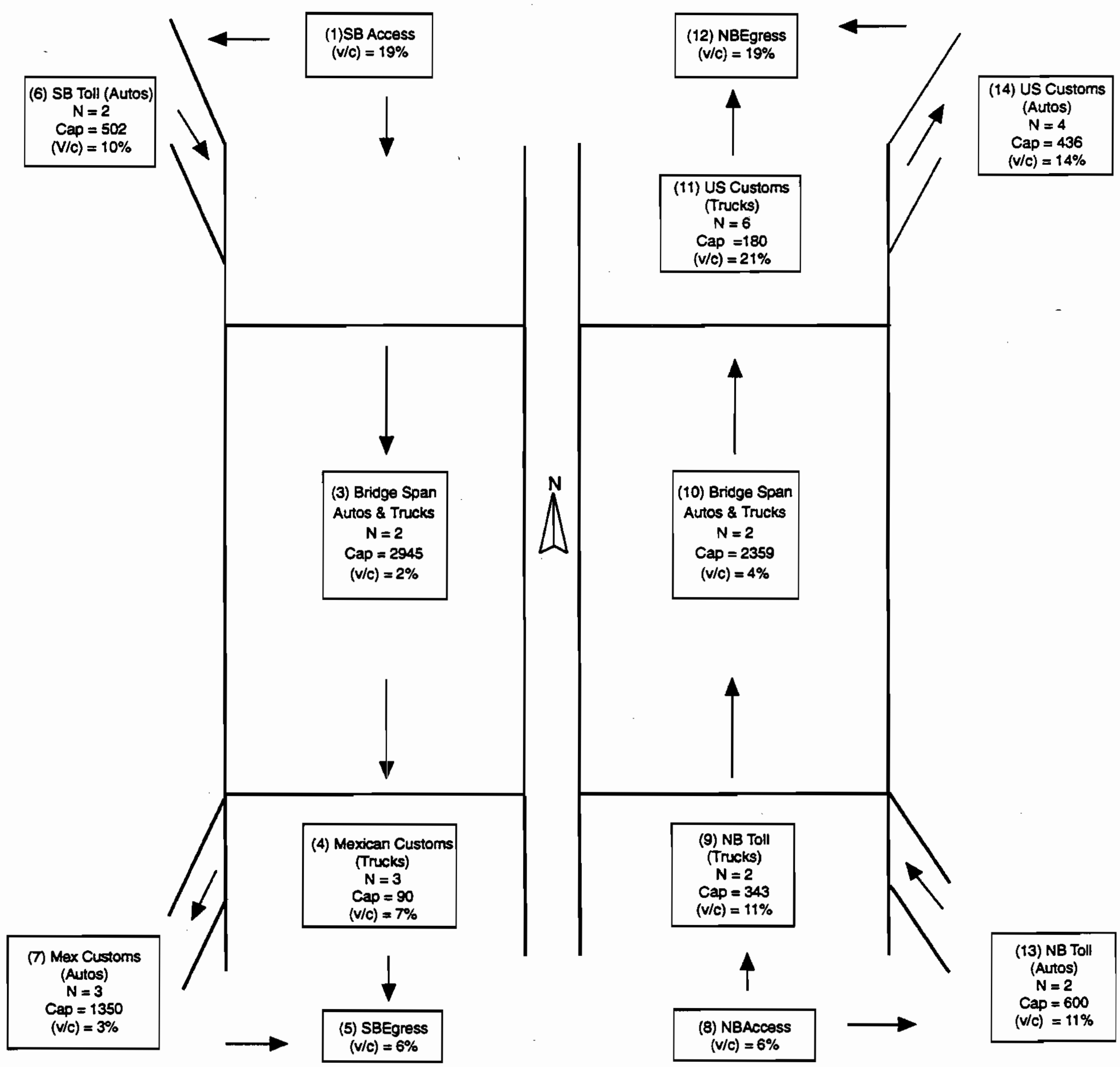

Figure 5.2. Capacity utilization at Los Indios

CHAPTER 6. ANALYSIS OF THE EASTERN VALLEY SECTOR

BACKGROUND

The Eastern Valley Sector begins at the intersection between US281 and the FM491 extension near Relampago, and ends at the intersection between US281 and the FM1423 extension (Valley View Road) near Donna. On the U.S. side the sector is entirely within Hidalgo County, and the main urban concentration consists of the towns of Mercedes, Weslaco, and Donna. In Mexico, the main city is Rio Bravo, in Tamaulipas. The sector has one binational entry system, the Progreso or B&P Bridge.

Existing Binational Entry System

The Progreso or B&P Bridge is a privately owned, two-lane toll facility connecting the towns of Progreso and Progreso Lakes on the U.S. side with Nuevo Progreso on the Mexican side. The Progreso International Bridge was built in 1953, and expanded in 1983 to accommodate northbound trucks and enable cars to get a better vantage point of the open customs booths, which was the main source of congestion. Renovation and improvement of the U.S. border station was completed at the end of 1989.

On the U.S. side, B&P is directly connected by FM1015 to US281, and it is located in a rather rural area south of Progreso. On the Mexican side, the bridge leads directly into MEX02, and from there into the busy city streets of downtown Nuevo Progreso, which are in bad condition. Nuevo Progreso is a popular tourist attraction frequently visited by Winter-Texans.

On the U.S. side, Progreso has four primary inspection booths for private vehicles (expandable to six), and sixteen secondary inspection booths with no room for expansion. For trucks, there are two primary inspection booths, which are not being utilized, since currently 100 percent of all trucks are referred to secondary inspection (a 14-dock area). The U.S. southbound toll facility includes two toll booths for general traffic.

On the Mexican side, "Puente Las Flores" has two primary inspection booths for privately owned vehicles, one of which is closed, and the secondary inspection area is very small. Concerning northbound toll collection, there is one turnstile for pedestrians, As for traffic there are two booths, however only and two vehicular booths, one of which is open only when traffic queues.

Proposed Binational Entry System

The City of Donna proposed a four-lane bridge approximately 13.8 miles (23km) east of Hidalgo and 7.1 miles (11km) west of Progreso, which links FM 493 on the US side with MEX 2 on the Mexican side. The latter connects directly with Rio Bravo, Tamaulipas. Rio Bravo is a predominantly agricultural city with a population of approximately 100,000.

The Department of State issued a Presidential Permit on August 22, 1979, but the Mexican government had no plans for a bridge at this location (Ref 6). Recently, the city of Donna has been actively pursuing the bridge, and recently signed a contract with Christie Bridge Corporation to construct the bridge, using the 1979 Presidential permit.

REVENUE AND DEMAND ANALYSES

The demand and revenue analyses of the Eastern Valley Sector were performed using the methodology and assumptions discussed in Chapter 3. Additional assumptions discussed in this section also apply, and both analyses assume that the hypothetical binational entry system is the only additional facility built in this sector during the entire analysis period.

Traffic Analysis

Traffic history for this sector is available from two sources: bridge management (southbound) and U.S. Customs (northbound). Northbound auto and truck traffic histories are shown respectively in Figures 6.1 and 6.2.

Before 1985, northbound auto traffic was declining at an average rate of 8.6 percent. Between 1985 and 1989, traffic grew at an average rate of 6.7 percent. After that, it seems to have stabilized at no growth, since the average rate is -0.02 percent (a very small decline). Northbound truck traffic, on the other hand, has been steadily growing since 1984, at an average rate of 42 percent, with a fairly uniform trend.

Southbound auto and truck traffic histories are shown respectively in Figures 6.3 and 6.4, and they replicate the pattern observed in the northbound direction. Southbound auto traffic had been declining from 1981 to 1985, at an average rate of 6.2 percent. Between 1985 and 1989, it grew at an average rate of 8.1 percent. After that, it seems to have stabilized at an average growth rate of 1.1 percent. On the other hand, southbound truck traffic has been steadily growing since 1982, at an average rate of 19.6 percent, but with a less uniform trend than that observed in the northbound direction. Unlike most other sectors, traffic at the Eastern Valley sector seems unaffected by Mexico joining the General Agreement of Tariffs and Trade (GATT).

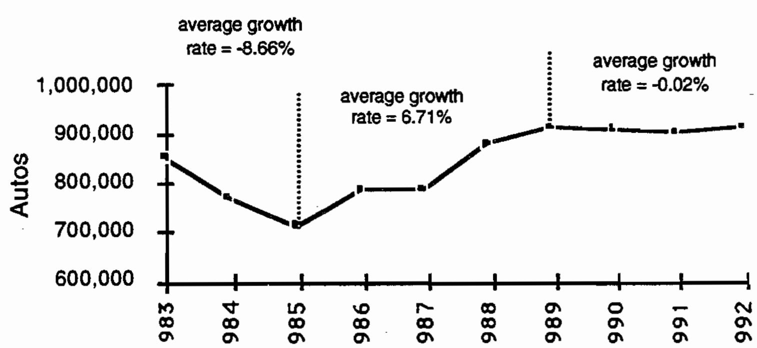

Figure 6.1. Northbound auto traffic history — Eastern Valley Sector (Source: U.S. Customs)

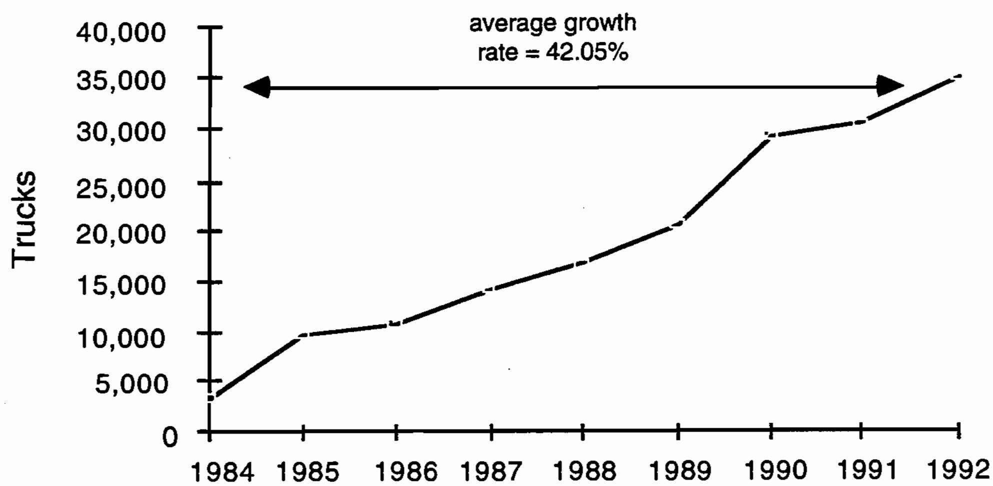

Figure 6.2. Northbound truck traffic history — Eastern Valley Sector (Source: U.S. Customs)

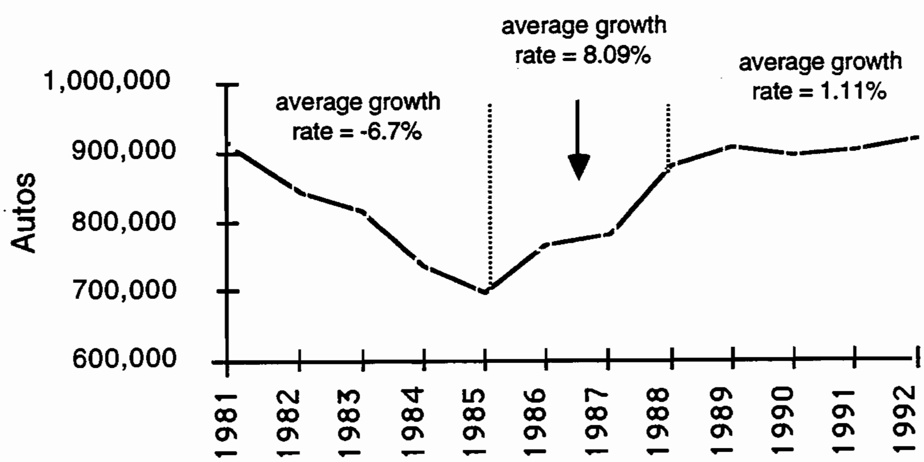

Figure 6.3. Southbound auto traffic history — Eastern Valley Sector

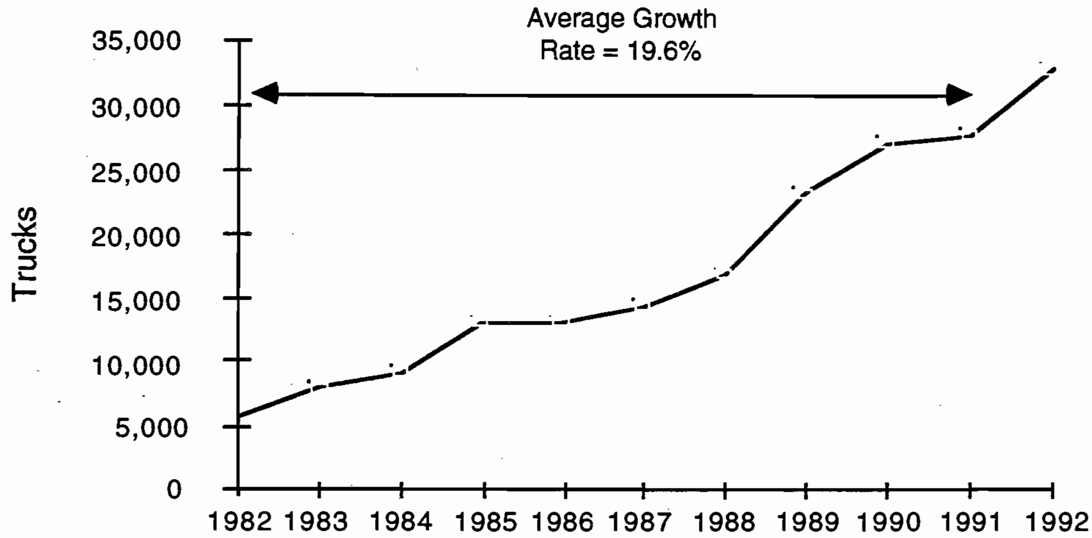

Figure 6.4. Southbound truck traffic history — Eastern Valley Sector

As discussed in Chapter 3, traffic predictions assume three scenarios for NAFTA impacts: high impact, moderate impact, and low impact. In other sectors, GATT impacts were used as a basis to estimate potential NAFTA impacts, but GATT impacts were not observed in this sector. For autos, the current growth rate trend of 1 percent will be assumed to continue between 1994 and 1997, for all scenarios. By 1997, a significant number of barriers will be lifted by NAFTA, and in the high impact scenario this will cause the auto traffic to grow at a faster rate. Between 1998 and 2003, the growth rate will increase at an average of 9 percent, and then stabilize at an average of 2.5 percent a year, reflecting the gradual removal of trade barriers and its positive impact on the border economy, followed by a stabilization at a moderate growth level. In the moderate impact scenario, NAFTA is assumed to have some impact on the current trend in auto growth rates, and a 1.5 percent growth will be assumed between 1998 and the end of the analysis period (2014).

In the low impact scenario for autos, the negative NAFTA impact will be felt gradually, with current growth rates (1 percent) between 1994 and 1997, and a gradual growth rate decrease after the NAFTA changes start taking place, represented by an annual average growth rate of 0.5 percent from 1998 to 2005, and 0.3 percent thereafter.

Truck traffic has been growing steadily regardless of GATT, and this may be partially due to the current traffic congestion at nearby Hidalgo-Reynosa binational entry system in the Central Valley Sector. According to bridge managers and customs officials, southbound truck traffic is mostly from the granaries located near the bridge, with a daily traffic volume between 20 to 150 trucks. Maquiladora traffic is low, though a significant amount of produce (fresh fruits, cantaloupe, onions) pass through Progreso. The produce trucks are estimated by Customs officials to be nearly a 50/50 split between local and long-haul traffic. This empirical observation is corroborated by the origin and destination survey, which captured 63 percent of destinations in Rio Bravo and Nuevo Progreso, 52 percent origins in Progreso, and 10 percent origins in Brownsville.

In the high impact scenario, local commerce will be assumed to grow at a higher rate than currently observed, while long-haul traffic will be assumed to be gradually diverted to other modes. In the moderate impact scenario, local traffic is assumed to grow at the current rates, while long-haul is also assumed to be diverted to other modes. The low impact scenario also splits the truck traffic into local and long-haul. Growth rates of local truck traffic are assumed to steadily decrease after 1997, when NAFTA deregulation start taking place. The long-haul traffic demand is less affected by the three NAFTA scenarios, which are restricted to the border region. The estimated future auto and truck traffic for the Eastern Valley Sector is shown in Table 6.1.

Table 6.1. Estimated southbound annual traffic for the Eastern Valley Sector (1000 vehicles)

	Low Impact Scenario		Moderate Impact Scenario		High Impact Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	941	28	941	28	941	28
1995	951	33	951	33	951	33
1996	960	40	960	40	960	40
1997	970	47	970	47	970	47
1998	975	54	984	56	1,057	58
1999	980	62	999	67	1,152	70
2000	984	72	1,014	80	1,256	86
2001	989	83	1,029	95	1,369	105
2002	994	95	1,045	113	1,492	128
2003	999	50	1,060	134	1,627	156
2004	1,004	52	1,076	160	1,667	190
2005	1,009	55	1,093	190	1,709	232
2006	1,012	57	1,109	226	1,752	283
2007	1,015	60	1,126	269	1,795	345
2008	1,018	63	1,142	320	1,840	421
2009	1,022	66	1,160	381	1,886	514
2010	1,025	70	1,177	453	1,933	627
2011	1,028	73	1,195	539	1,982	764
2012	1,031	77	1,213	642	2,031	933
2013	1,034	81	1,231	764	2,082	1,138
2014	1,037	85	1,249	909	2,134	1,388

Under the high impact post-NAFTA scenario, total auto demand in this sector will be over 2.1 million by the year 2014. This demand drops to 1.25 million under the moderate impact scenario, and to slightly over one million under the low impact scenario. Truck demand under the high impact scenario reaches almost 1.4 million by the year 2014, dropping to 909,000 under the moderate impact scenario and to 85,000 under the low impact scenario. Before the year 1998, truck demand is the same under all scenarios, because it is assumed that impacts of NAFTA deregulation of truck traffic will be felt mostly in the later part of the analysis period.

In this sector, current truck traffic is split at approximately 60/40 percent between local and long haul, and this distribution was assumed to hold during the entire analysis period, due to the predominance of produce trucks, and the fact that economic activity in this sector is predominantly agricultural. It was also assumed that the long-haul truck traffic would gradually be substituted by other modes, a supposition based on the fact that trucks are not the best solution for an ever-increasing long-haul commodity flow. The future traffic estimates were all based on extrapolations of past growth rates and traffic levels, with variations to accommodate different post-NAFTA scenarios. Due to the historical difference between auto and truck growth, the latter become an increasingly greater percentage of traffic demand in the sector.

Potential Demand Estimates

The demand estimates discussed in this section are valid for a new binational entry system located in the eastern part of this sector, selected because a western location in this sector would compete with Los Indios, which is underutilized, while the eastern location would compete with Hidalgo-Reynosa, which is congested. All assumptions discussed in Chapter 3 are applicable to demand estimates results, as well as the following additional assumptions:

(1) Auto traffic prefers the binational entry system that is most convenient to their origins, due to a preference for U.S. highways over Mexican ones.

(2) Traffic destined to Nuevo Progreso will use the Progreso Bridge.

(3) All trucks will be assumed to be traveling between the actual cargo origins and destinations by the year 2000.

(4) After 2000, most long-haul truck trips will gradually give way to other modes, and the sector will serve primarily local traffic.

Table 6.2 depicts the demand estimates for a new binational entry system in this sector. These results are based on the assumptions discussed above, and the methodology and assumptions discussed in Chapter 3. Departures from any assumption used in the analysis may cause a material effect on the results.

The results indicate that the potential auto demand for a new binational entry system in this sector is increasingly less important than truck demand, even considering the assumption that most long-haul trips will be substituted by other modes. By the year 2014, auto demand is 311,000, and truck demand is 41,000 under the low impact scenario. This demand increases to 375,000 and 436,000 under the moderate impact, and to 640,000 (autos) and 666,000 (trucks) for the high impact scenario.

Table 6.2. Demand estimates for a hypothetical binational entry system in the Eastern Valley Sector (1000 vehicles)

	High Impact Scenario		Moderate Impact Scenario		Low Impact Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	188	18	188	18	188	18
1995	190	22	190	22	190	22
1996	192	26	192	26	192	26
1997	194	31	194	31	194	31
1998	244	32	246	34	264	35
1999	245	37	250	40	288	42
2000	246	43	254	48	314	52
2001	247	47	257	54	342	60
2002	298	54	314	64	448	73
2003	300	29	318	76	488	89
2004	301	30	323	91	500	108
2005	303	31	328	108	513	132
2006	304	27	333	108	526	136
2007	305	29	338	129	539	166
2008	305	30	343	154	552	202
2009	307	32	348	183	566	247
2010	308	34	353	217	580	301
2011	308	35	359	259	595	367
2012	309	37	364	308	609	448
2013	310	39	369	367	625	546
2014	311	41	375	436	640	666

Potential Revenue Estimates

The demand estimates discussed above were used in the financial model discussed in Chapter 3 to estimate the potential feasibility of a bond-financed binational entry system in this sector. The southbound toll prices at the hypothetical facility were assumed to be the same as the current prices charged by the Progreso Bridge, which are $1.00 for autos, and a sliding fare for trucks, depending on the number of axles. Data on truck distribution by number of axles were obtained during the origin and destination survey conducted at the Hidalgo Bridge (Ref 21), and they show a predominance of trucks. Toll prices and axle distribution are depicted in Table 6.3.

Table 6.3. Truck toll fares and axle distributions at the Progreso Bridge

Number of Axles	% of Trucks	Toll (1993 dollars)
2	22.7	4.00
3	9.1	6.00
4	0	8.00
5	27.3	10.00
6	40.9	12.00
7	0	14.00
8	0	16.00

According to the data shown in Table 6.3, the average truck toll is $9.09. This weighted average is based on survey data collected on 23 trucks, and it may change seasonally, weekly, and/or daily. Nevertheless, the financial analysis model assumes that this axle distribution holds for the entire analysis period (up to 2014). It is important to realize that small changes in this distribution may cause significant effects on the average toll price, which in turn substantially affects the revenue estimates. The toll prices were multiplied by the demand estimates shown in Table 6.2, and the gross revenues were used in the financial analysis methodology discussed in Chapter 3. The resultant net revenue estimates are shown in Table 6.4.

Under the most optimistic scenario, the analysis indicates that net revenues from a hypothetical binational entry system located on the east side of the Eastern Valley Sector would yield about $9.4 million in accumulated net revenues, and $5.1 million by the year 2014. This figure drops to losses under the moderate impact and low impact scenarios.

Conclusions

Under the high impact scenario, the financial analysis shows a total profit of over $9.4 million (U.S.) by the end of the analysis period. However, the net revenues shown on Table 6.4 are overestimated every time their magnitude is not enough to warrant a good bond rating. A poor bond rating means higher interest rates, which in turn imply that several expenses assumed in the development of the financial analysis model are underestimated, and net revenues would actually be lower than the estimates depicted in Table 6.4.

The assumptions that have more impact on the demand and revenue estimates are the extrapolation of historical truck growth rates (low for autos, high for trucks) coupled with the assumption that long-haul truck traffic will be substituted by other modes. In addition, over half of trucks in this sector carry local produce, and this pattern was assumed to continue throughout the analysis period. Urbanization and industrialization on either side of the border have a potential to invalidate these analysis results.

Table 6.4. Revenue estimates for hypothetical binational entry system in the Eastern Valley Sector

	Net Revenues In Thousands of 1993 Dollars		
Year	Low Impact Scenario	Moderate Impact Scenario	High Impact Scenario
1995	-1401	-1401	-1401
1996	-1348	-1348	-1348
1997	-1287	-1287	-1287
1998	-1212	-1198	-1168
1999	-1157	-1123	-1067
2000	-1093	-1040	-943
2001	-1047	-972	-830
2002	-926	-813	-593
2003	-1164	-693	-397
2004	-1151	-546	-200
2005	-1133	-379	39
2006	-1171	-374	85
2007	-1159	-176	378
2008	-1148	57	733
2009	-1138	334	1164
2010	-1126	660	1685
2011	-1118	1048	2315
2012	-1108	1513	3088
2013	-1099	2062	4025
2014	-1091	2714	5164
Total	-23076	-2962	9443

CAPACITY ANALYSIS

The analysis of the current capacity utilization of the Eastern Valley Sector follows the methodology described in Chapter 2, and it focuses on the identification of binational entry system components that are either experiencing, or have a potential to develop congestion.

Access/Egress Components

Figure 6.5 shows the access/egress components of the Progreso Binational Entry System in the U.S. and in Mexico. The signalized intersection at US281 and US1015 is assumed to be main the access/egress constraint on the U.S. side. At this intersection, southbound access is constrained by the eastbound traffic and the westbound left turn. Northbound egress is constrained by the northbound approach at the same intersection. Assuming an actuated signal where the minor movements are given a minimum green time (5 seconds), and assuming for this signal a three phase sequence and a 30-second cycle length, the following v/c ratios are estimated:

(1) Southbound access: 36 percent, and

(2) Northbound egress: 42 percent.

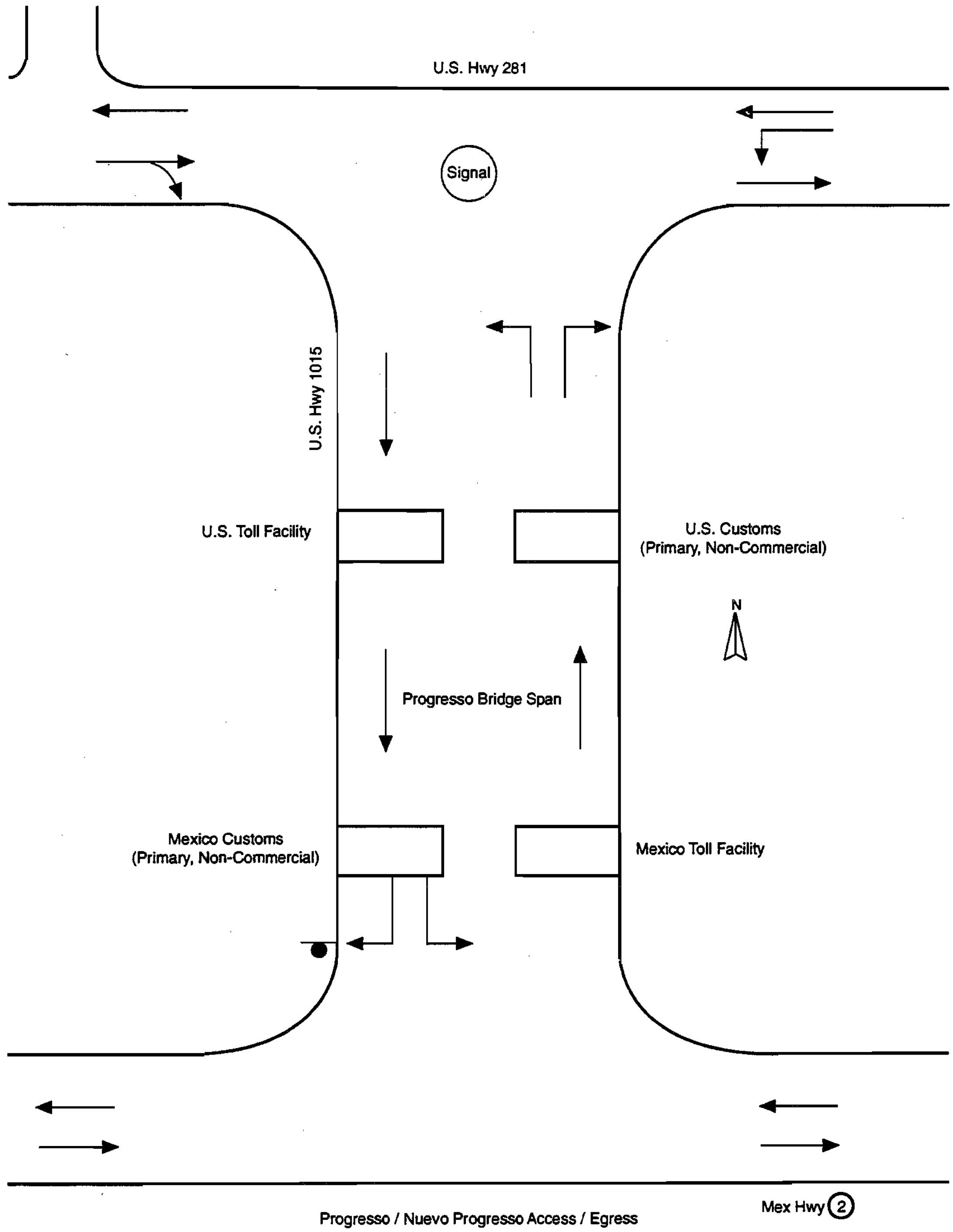

Figure 6.5. Progreso access/egress component

In Mexico, southbound egress and northbound access are constrained by the T-intersection of MEX02 and the bridge access/egress, which is assumed to be stop controlled for southbound traffic only. Traffic data collected at MEX02 (Ref 20), in conjunction with bridge traffic data, were used to estimate turning movements. An analysis of this unsignalized T-intersection was then conducted, based on the estimated turning movements, and on the following additional assumptions:

(1) Southbound left turn : Conflicting volume = 612 vph; critical gap = 8.0 seconds;

(2) Southbound right turn: Conflicting volume = 246 vph; critical gap = 6.5 seconds; and

(3) Eastbound left turn: Conflicting volume = 366 vph; critical gap =5.5 seconds.

These results and assumptions yield a v/c ratios of 41 percent for the southbound egress, and 17 percent for the northbound access in Nuevo Progreso.

Progreso Capacity Utilization

Figure 6.6 summarizes the results of the capacity analysis of the Progreso binational entry system. The analysis suggests that all binational entry system components operate below capacity, since the highest v/c value is 75 percent for the Mexican toll collection facility. The U.S. inspections are operating at approximately half of their total theoretical capacity, and, similarly to all other binational entry systems along the Texas-Mexico border, the bridge span component has the lowest capacity utilization, namely 16 percent in the southbound direction, and 21 percent in the northbound. Field observations of this site confirm that traffic circulation is acceptable in this binational entry system.

CONCLUSIONS AND RECOMMENDATIONS

The Eastern Valley sector comprises several U.S. towns, such as Donna, Mercedes, and Weslaco, but the main urban concentrations in the sector are Rio Bravo and Nuevo Progreso, which is significantly larger than Progreso. The sector serves approximately 5 percent of Segment 1 traffic demand, and the capacity analysis indicated that there is no congestion in this binational entry system. The revenue and demand analyses suggest that a binational entry system is not feasible in this sector. Together, the capacity and feasibility analyses indicate that a new binational entry system in this sector is neither needed nor financially feasible at this point.

Based on more optimistic assumptions regarding truck traffic demand and post-NAFTA scenarios, Charles Rivers Associates (Ref 4) estimated that, in 2000, the total auto trip attraction for Rio Bravo alone is over 1 million autos, and over 32,000 trucks, while this study estimates a total sector demand of 52,000 trucks and about 350,000 autos. The difference between the concepts of sector demand and Rio Bravo trip attraction definitely cannot explain the threefold disparity in auto trips. Rather, this disparity illustrates the considerable impact that assumptions regarding socioeconomic development, route choice criteria, NAFTA scenarios, and modal split have on demand estimates. This indicate a clear need for constant monitoring and updating of transportation planning guidelines at the Texas-Mexico border.

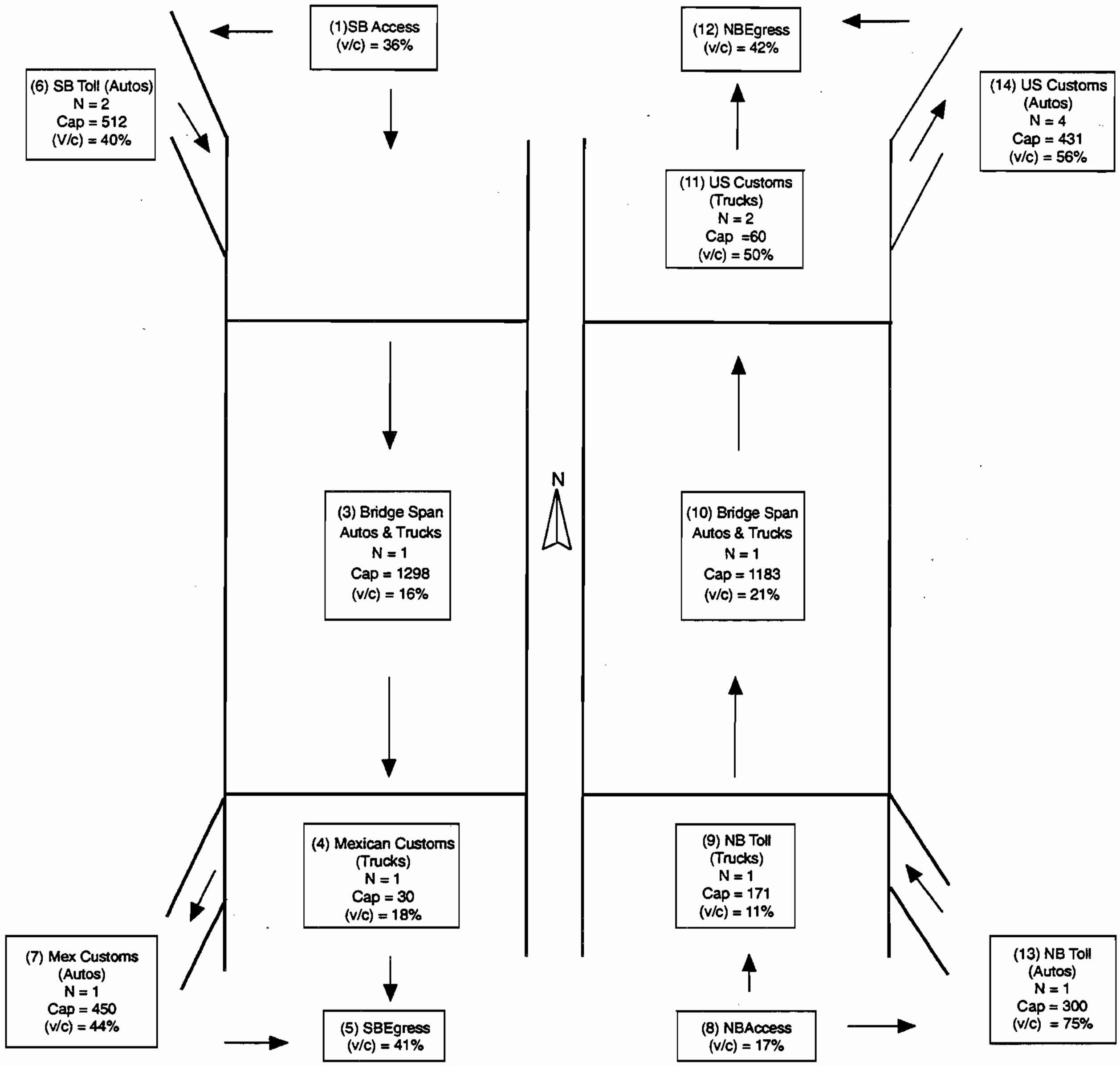

Figure 6.6. Progreso capacity utilization

CHAPTER 7. ANALYSIS OF THE CENTRAL VALLEY SECTOR

BACKGROUND

The Central Valley Sector extends from FM1423 east of Donna, through the FM886 extension in western Los Ebanos. It is entirely located in Hidalgo County (Texas), and Tamaulipas, Mexico. In Texas, the sector comprises the border cities of Alamo, San Juan, Pharr, Edinburg, McAllen, Mission, Palmview, Palmhurst, and Alton. In Mexico, it comprises the city of Reynosa and several small towns.

The Central Valley Sector has two binational entry systems: the Hidalgo Bridge, and the Los Ebanos Ferry. The Hidalgo Bridge carries over 98 percent of all the sector traffic, while Los Ebanos is a ferry-boat service used mainly by tourists.

Existing Binational Entry Systems

The Hidalgo-Reynosa binational entry system consists of two separate four-lane bridges, which replaced an old suspension bridge authorized in 1926 and demolished in 1971. The City of McAllen owns and operates the Hidalgo Bridge, and the City of Hidalgo shares in the surplus revenues, which were about $5 million in 1992. The first of the two bridges was completed in 1966, and an additional four-lane structure was completed in 1988. The new bridge carries northbound traffic, while the old bridge serves the southbound direction. Hidalgo Reynosa links downtown Reynosa to a roadway that leads to the urbanized area of McAllen-Edinburg in the U.S. The closest U.S. highways to the bridge are Spur115, US281/Spur241, and US83. On the Mexican side, the main links to this bridge are MEX02, MEX97, and MEX40.

On the U.S. side, Hidalgo binational entry system has eleven primary inspection booth for private vehicles, one for empty trucks, and 45 secondary inspection booths. For loaded trucks, there are two primary inspection booths, and an import lot with 33 truck docks. The U.S. southbound toll facility includes four toll booths, with no room for expansion.

On the Mexican side of "Puente Reynosa," there are six customs inspection booths for privately owned vehicles and one lane for buses and empty trucks. Two booths are designated for commercial traffic at the entrance of the import lot. There are four toll booths for non-commercial vehicles (one of which is usually closed), and a separate toll booth for commercial traffic.

Proposed Binational Entry Systems

This sector has three proposals for new binational entry systems, and one of them, the Pharr International Bridge, is projected to be opened to traffic in 1996. The Pharr Bridge will link US281 in Pharr to an industrial area on the east side of Reynosa, and it will connect to MEX02, near Reynosa's airport. This bridge will be located approximately 4.8 miles (8km) east of the existing Hidalgo-Reynosa International Bridge. Two vehicular traffic lanes in each direction and one pedestrian sidewalk are planned for this 3-miles (4k-m) long, 57-foot (17-m) wide, bridge. In addition to the bridge itself, the project includes the construction of approach roads on both the

U.S. and Mexican sides of the border. The City of Pharr is located about 9 miles (14.5km) to the north of the intersection between US281 and the Rio Grande. During the Eleventh Binational Conference on Bridges and Border Crossings in Ciudad Victoria, Tamaulipas, (November 13-14, 1991), the "Secretaría de Desarrollo Urbano y Ecología" (SEDUE) placed a high priority on Pharr Bridge. SEDUE believes that this binational entry system would improve traffic circulation and concentration of pollutants at the nearby Hidalgo bridge, by diverting the commercial traffic.

The proposed U.S. inspection facility will include cargo containment area, import dock, export dock, administration building, kennel, inspection area, impoundment area, and a safety area for vehicles carrying hazardous materials that are leaking, require inspection, or are about to be impounded.

Bridge ownership will be shared by the City of Pharr and the Mexican Government. The total cost of the new binational entry system and some of the connecting infrastructure is estimated at $20.7 million. Southbound toll revenues will be used to repay the U.S. debt, which includes the U.S. inspection facilities.

Another proposed binational entry system in this sector is Anzalduas, located about 3.1 miles (5k m) west of the Hidalgo-Reynosa Bridge. The Anzalduas proposal was initially submitted by a joint agreement between the cities of McAllen, Mission and Hidalgo, but the recently incorporated city of Granjeno (population approximately 500) wants to be part of the agreement and share revenues, and the situation is being argued in court. As a result, the cities of Hidalgo, Mission and McAllen are considering a location west of Chimney Park, at the Sharyland subdivision, about 2 miles (3.2km) south of US83. However, this proposal is not currently supported by GSA or Mexico; neither part wants to commit to another binational entry system so close to the new Pharr bridge, especially one that includes an eight-lane vehicular bridge, as well as a rail bridge.

The City of Mission had been actively pursuing the Mission Bridge, whose Presidential Permit was approved on December, 20, 1978. This binational entry system would consist of a rail and a four-lane vehicular bridge. However, all plans are currently on hold and will be dropped if the Anzalduas proposal is approved, especially because the local proponents of the Mission Bridge combined efforts with the cities of McAllen and Hidalgo, which are now supporting Anzalduas. There is no support for this bridge in Mexico, due to the need for a new road to link with MEX02.

A four-lane bridge is proposed by the Reyna estate to replace the existing ferry at a site west of the Los Ebanos ferry, but an official presidential permit has not been submitted yet. Issues that remain unresolved at the present time include historical concerns related to the existing ferry, a suitable border station site outside the Rio Grande flood plain, preservation of endangered species in the area, and possible impacts to the local community. The U.S. Government does not appear to be positive about this project at this point, but Mexico has expressed some interest in it.

DEMAND AND REVENUE ANALYSES

The demand and revenue analyses of the Central Valley Sector were done using the methodology and assumptions discussed in Chapter 3. The results represent the average potential demand and revenue from a hypothetical bridge on the western side of this sector. A western location was selected based on the fact that the Pharr Bridge is already under construction in the eastern part of the sector. The analyses assume that both the Hidalgo and the currently under construction Pharr Bridge are conveniently connected to the rest of the infrastructure, as well as fully staffed and efficiently operated. The results discussed in this section represent a situation in which the Pharr and the hypothetical new bridge are both operative.

Traffic Analysis

North and southbound traffic histories are available for this sector, respectively from U.S. Customs, CAPUFE, and the Hidalgo bridge management. Traffic history at Los Ebanos is available for only three years in the northbound direction (from U.S. Customs), but Los Ebanos traffic hardly affects the analysis, since the Hidalgo bridge serves 99.2 percent of the auto traffic and all the truck traffic in this sector. Figures 7.1 and 7.2 show the southbound traffic histories, respectively for autos and trucks, and Figures 7.3 and 7.4 show the northbound traffic histories, respectively, for autos and trucks.

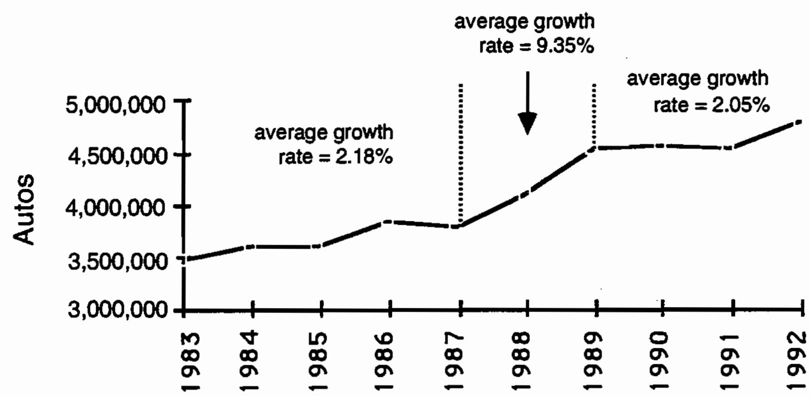

Figure 7.1. Southbound auto traffic history at the Central Valley Sector (Source: Bridge owners)

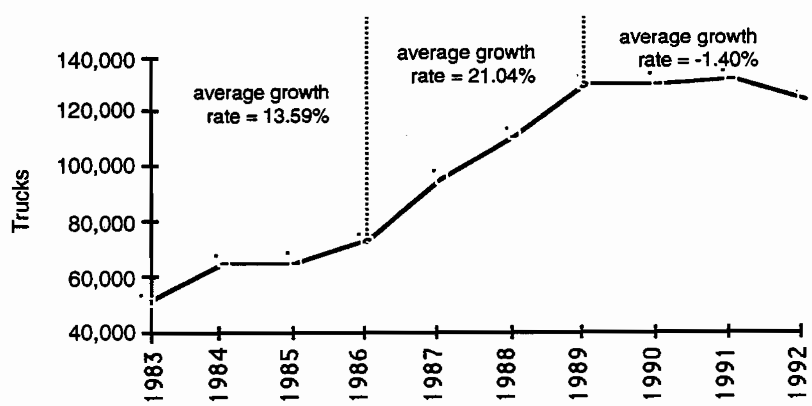

Figure 7.2. Southbound truck traffic history at the Central Valley Sector (Source: Bridge owners)

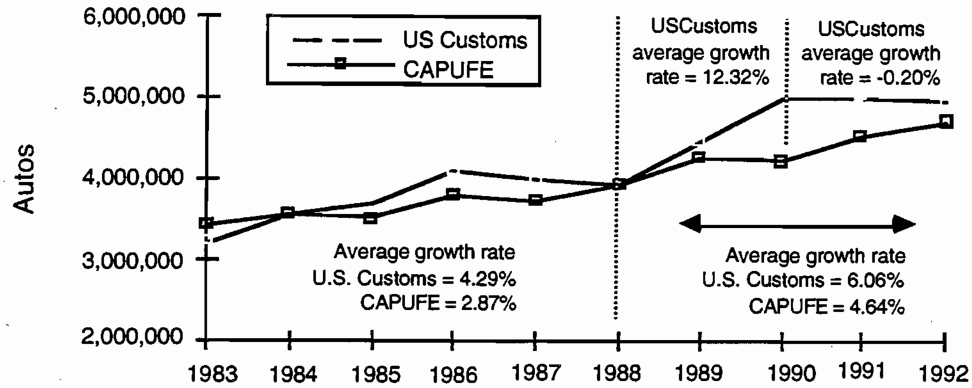

Figure 7.3. Northbound auto traffic history at the Central Valley Sector (Sources: U.S. Customs and CAPUFE)

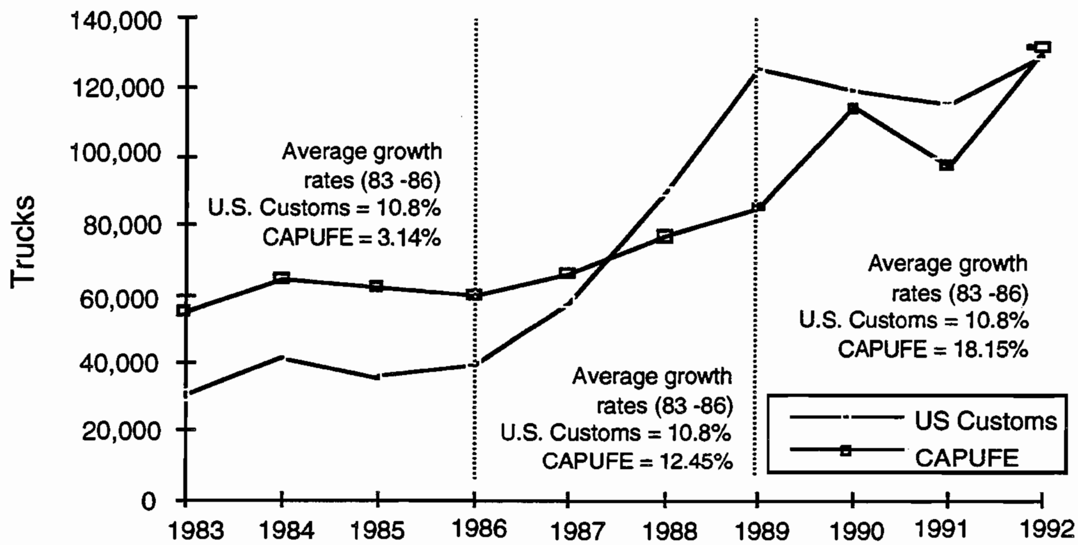

Figure 7.4. Northbound truck traffic history at the Central Valley Sector (Sources: U.S. Customs and CAPUFE)

Southbound traffic history indicates that traffic growth in the Central Valley sector for the past ten years has two distinct phases: before and after Mexico joined the General Agreement on Tariffs and Trade (GATT), in late 1986. Before GATT, the average southbound truck growth rates were 2.2 percent for autos and 13.6 percent for trucks. Between 1987 and 1992, these growth rates increased respectively to 9.4 percent for autos and 21 percent for trucks, during the years immediately after GATT. After 1989, auto growth rates returned to the average level of 2 percent, while truck growth rates began to decrease at 1.4 percent. Apparently, GATT encouraged auto and truck traffic to move to an upper level of demand. Before GATT, yearly auto traffic was between

3.5 and 4 million, while after the GATT boom it oscillated between 4.5 and 5 million. Truck traffic was between 50,000 and 70,000 before GATT, and between 110,000 and 130,000 after the GATT boom.

Northbound traffic data from the two available sources have discrepancies that are due to differences in data collection procedures. U.S. Customs data are recorded by fiscal year, while CAPUFE data are recorded by calendar year. The fiscal year starts in October, and implies a three-month lag with respect to the calendar year. In addition, U.S. Customs and CAPUFE use different criteria to disaggregate vehicles into commercial and non-commercial (autos). Nevertheless, auto data from both sources consistently show the impacts of GATT, with significant differences in pre- and post-GATT average growth rates. On the average, post-GATT rates increased from 2.9 percent to 4.6 percent according to CAPUFE, and from 4.3 percent to 6.1 percent according to U.S. Customs.

Northbound truck traffic exhibits a more erratic growth pattern. Before GATT, average growth rates for trucks were 10.8 percent and 3.1 percent, respectively according to U.S. Customs and CAPUFE. During the three years after GATT, truck growth rates averaged 47 percent, and stabilized at an average of 1.25 percent thereafter, according to U.S. Customs. CAPUFE shows a steady increase between 1986 and 1989, and an erratic pattern thereafter. Nevertheless, both sources consistently verify GATT impacts on traffic growth in this sector.

As discussed in Chapter 3, traffic predictions assume three scenarios for NAFTA impacts: high impact, moderate impact, and low impact. In the high impact scenario, NAFTA impacts on traffic will roughly replicate GATT's magnitudes, but the timing of the impact will differ. For autos, the current growth rate trend will be assumed to continue between 1993 and 1996. By 1997, a significant number of barriers will be lifted by NAFTA, and in this scenario this will cause auto traffic to grow at a faster rate. Between 1997 and 2003, the growth rate will increase at an average of 9 percent, and then stabilize at an average of 2.5 percent a year, reflecting the gradual removal of trade barriers and its positive impact on the border economy, followed by a stabilization trend.

Under the moderate impact scenario, the current trend in auto growth rates will be extrapolated throughout the analysis period (2014). In the low impact scenario, negative NAFTA impacts will be felt gradually, with a moderate impact scenario for the first four years, and a gradual decrease in the growth rates after NAFTA changes start taking effect. This gradual decrease is represented by an annual average growth rate of 1 percent from 1997 to 2005, and 0.8 percent thereafter, replicating the observed pre-GATT growth scenario.

Southbound truck traffic decreased in 1992, while in the northbound direction it increased at an average of 1.25 percent a year for the past three years. This can be interpreted either as a tendency to stabilize at an upper, post-GATT level, or as a result of over-capacity conditions, which imply the existence of some latent truck demand. This study used the conservative assumption, and the small growth scenario was assumed to continue until 1997 (0.5 percent), when gradual changes would take place due to a combination of NAFTA impacts and, in some cases, rail and sea competition.

For the low impact scenario, the post-NAFTA growth rates are 1.5 percent through the end of the analysis period. For the high impact scenario, NAFTA impacts were assumed to replicate GATT effects, with a 20 percent growth rate between 1998 and 2001, and 5 percent thereafter. For the moderate impact scenario, some positive NAFTA impacts would be felt between 1998 and 2001, at 10 percent average growth rate from 1998 to 2001.

After that, truck traffic would stabilize at an average of 3 percent yearly growth rate. The smaller growth rates after 2002 are based on the assumption that post-NAFTA commodity flow will be gradually done primarily by rail and sea, due to successful efforts of both countries to foster multimodalism, coupled with the pressing need for more efficient transborder transportation. The estimated auto and truck traffic for the Central Valley Sector is shown in Table 7.1.

Under the high impact post-NAFTA scenario, total auto demand in this sector will be over 11.5 million by the year 2014. This demand drops to 7.4 million under the moderate impact scenario, and to 6.2 million under the low impact scenario. Truck demand under the high impact scenario reaches almost half a million by the year 2014, dropping to 273,000 under the moderate impact scenario and to 164,000 under the low impact scenario. Before the year 1998, truck demand is the same under all scenarios, because it is assumed that impacts of NAFTA deregulation of truck traffic will be felt mostly in the later part of the analysis period.

A conservative assumption underlying truck traffic estimates is the increasing competition of other modes, a supposition based on the fact that trucks are not the best solution for an ever-increasing commodity flow. Under the more optimistic assumption of predominance of truck traffic over other modes, coupled with the high impact assumption that truck traffic origins for the Central Valley Sector are from the Gulf to Laredo, Charles Rivers Associates (Ref 4) predicts that truck traffic demand in the sector would be around 2.4 million by the year 2000. This prediction seems too optimistic. For the past two years, the Laredo and Brownsville sectors have been sharing about 70 percent of Segment One truck traffic, and together they had about 750,000 trucks in 1992. This would require a 15 percent yearly growth rate for both Laredo and Central Valley to match the 2.4 million trucks predicted by Ref. 4 for the Central Valley Sector alone, which has been serving 20 percent of Segment 1 truck demand.

Another study on the same sector (Ref 14) predicted 6.6 to 9.9 million autos and 353,000 to 516,000 trucks for the entire sector by the year 2008, depending on the socioeconomic scenario. The magnitudes of the auto traffic predictions approximately match those in Table 7.1, while the truck predictions are twice as high for the low impact scenario, and 40 percent higher for the high impact case. Differences in truck traffic predictions are basically due the fact that the Bridge Board (Ref 14) did not assume competition from other modes, while this study did.

The three demand estimates for the sector were used in a trip assignment model to estimate the potential traffic diversion to a new hypothetical binational entry system in this sector. This model is based on the assumption that the Pharr Bridge, which is now under construction, will be operating during the entire analysis period, and is efficiently connected to rest of the infrastructure. Before discussing the results of the trip assignment, a discussion of the potential demand for Pharr and Anzalduas is beneficial to achieve a better understanding of the sector traffic.

Table 7.1. Estimated southbound annual traffic for the Central Valley Sector (thousands of vehicles)

	Low Impact Scenario		Moderate Impact Scenario		High Impact Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	4,997	125	4,997	125	4,997	125
1995	5,097	126	5,097	126	5,097	126
1996	5,198	126	5,198	126	5,198	126
1997	5,302	127	5,302	127	5,302	127
1998	5,355	129	5,408	140	5,780	152
1999	5,409	131	5,517	154	6,300	183
2000	5,463	133	5,627	169	6,867	219
2001	5,518	135	5,739	186	7,485	263
2002	5,573	137	5,854	191	8,158	276
2003	5,629	139	5,971	197	8,893	290
2004	5,685	141	6,091	203	9,115	305
2005	5,742	143	6,213	209	9,343	320
2006	5,788	145	6,337	216	9,576	336
2007	5,834	147	6,464	222	9,816	353
2008	5,881	150	6,593	229	10,061	371
2009	5,928	152	6,725	236	10,313	389
2010	5,975	154	6,859	243	10,571	408
2011	6,023	156	6,996	250	10,835	429
2012	6,071	159	7,136	257	11,106	450
2013	6,120	161	7,279	265	11,383	473
2014	6,242	164	7,425	273	11,668	497

Potential Demand for Pharr and Anzalduas

The literature has three studies that have developed demand and revenue estimates for a new binational entry system in this sector: a U.S. feasibility study for the new Pharr Bridge (Ref 4), its Mexican counterpart (Ref 10), and the Anzalduas study (Ref 14). Table 7.2 shows a comparison among the results of these three studies, which took into account traffic data up to 1990, and as a result may have extrapolated some of the full impact of the GATT boom into their traffic predictions, since the stabilizing trends observed after 1990 were still unknown.

For the year 1995, the magnitude of U.S. auto and truck demand estimates for the Pharr Bridge are more than twofold the Mexican estimates. By the middle of the analysis period, the differences decrease to 1.6 times for autos and 1.3 times for trucks. By the end of the analysis period, the U.S. demand estimates are slightly lower for autos (98 percent), and significantly lower for trucks (about 64 percent of the Mexican estimate). The U.S. Pharr study examined southbound traffic, while the Mexican study examined northbound traffic; however, directional differences in traffic volumes cannot satisfactorily explain such differences, since, on the average, northbound volumes have been 1.01 times the southbound volumes during the available traffic history. Differences in results are due to different assumptions regarding origin and destination of the autos and trucks. The U.S. Pharr study (Ref 4) considered Segment 1 (Brownsville to Laredo) as a potential market for the new Pharr Bridge, while the Mexican study (Ref 10) assumed that most of its demand would be restricted to the Central Valley sector. The Mexican study assumption seems closer to reality, since origin and destination data collected by CTR at the Hidalgo Bridge indicated that 83 percent of the auto demand and 75 percent of the truck demand have origins and destinations within the Central Valley sector.

Table 7.2. Summary of existing demand and revenue estimates for the central valley sector

	1995			2000			2010		
Predictions	Pharr (Mex)	Pharr (U.S.)	Anzalduas	Pharr (Mex)	Pharr (U.S.)	Anzalduas	Pharr (Mex)	Pharr (U.S.)	Anzalduas*
Potential Demand (1000 autos)	922	2,100	1,496-3,072	1,154	1,947	1,668-3,690	1,807	1,779	2,118-5,420
Potential Demand (1000 trucks)	98	229	36-92	154	207	54-145	360	233	126-307
Potential Revenues (10^6 dollars)	2.3	1.1	n/a	3.2	2.4	n/a	6.1	2.4	n/a

Assumed tolls Mexican Study: $1.43 autos, $9.80 trucks (US. Study) $0.75 autos, $4.39 trucks

Sources: Pharr (U.S.). Study = Refs 4, Pharr (Mex) study = Ref 10; Anzalduas = Ref 14.
n/a = not available
* Based on continued projection. Ref 14 Analysis period ends in 2008.

On the other hand, the Mexican study did not take into account the competition from the then-proposed bridges (which included the new Los Indios Bridge in the neighboring sector), while the U.S. study included all proposed bridges in the study area (the Gulf to Laredo). This explains why the U.S. demand estimates decrease with time, while the Mexican do not. Revenue estimates of the Mexican study are higher than the U.S. estimates, due to a twofold difference in assumed toll prices. Mexican toll prices are in general more expensive than their U.S. counterparts throughout the border.

The Anzalduas study (Ref 14) used three traffic projection hypotheses, and three traffic diversion assumptions, which when combined yield nine scenarios for demand estimates. Table 7.2 shows the two extremes (low impact and high impact). The middle point of the Anzalduas study predictions (Ref 14) approximately matches the Mexican study predictions (Ref 10) for autos in the years 1995 and 2000, but is higher for the year 2010. For trucks, the Anzalduas study estimates approximately match the lowest of the two Pharr predictions. None of these studies took into account the possibility of other modes competing with trucks as transborder commerce grows; instead, truck traffic was assumed to grow in addition to rail. Therefore, their truck traffic magnitudes match the demand predicted by this study for the entire sector (Table 7.1).

Potential Demand Estimates

Origin and destination surveys conducted by CTR (Ref 21) at the Hidalgo bridge indicated that 83 percent of the auto traffic using this bridge have origins in an area approximately 386 square miles (1000km^2) comprising the cities of Hidalgo (8.5 percent), McAllen (60 percent), and Pharr (5.5 percent). The other 17 percent of origins included the nearby cities of Edinburg and Mission, and external origins as far as Canada. On the other hand, 88 percent of the destinations are into a much smaller area in Mexico comprising the city of Reynosa, while the other 12 percent of destinations vary from nearby towns to Mexico City and even other countries, such as Guatemala. According to U.S. Customs, this auto traffic pattern changes during the Holy Week, when about 50 percent of auto destinations are in the interior of Mexico.

According to the same U.S. Customs officials, truck traffic patterns have a significant seasonal variation. Between November and April, 65 percent of truck traffic is produce-related, and 35 percent is maquiladora related, while between May and October there is a reversal in this trend. The origin and destination survey was conducted in June, and as such it captured primarily the maquiladora truck traffic, which showed an origin and destination pattern similar to that of auto traffic. Seventy-five percent of truck origins are either Hidalgo (26 percent), McAllen (44 percent), or Pharr (16 percent), while Reynosa accounts for 62 percent of truck destinations. It is not certain that this origin and destination pattern is valid between November and April, when produce prevails over maquiladora trucks.

This origin and destination information was loaded into a simplified trip assignment model that included a generic external origin, a generic external destination, the cities of Hidalgo, McAllen, Pharr, Alamo, Edinburg, Mission, etc., and the urban and industrial areas of Reynosa. In addition to all assumptions discussed in Chapter 3, this model also included the following sector-related assumptions:

(1) Both the hypothetical and the Pharr binational entry systems are fully operational and conveniently accessible.

(2) Origin and destination patterns identified during the origin and destination survey and U.S. Customs interviews are expandable to the entire analysis period.

(3) Future land use in Reynosa will follow the current pattern.

(4) Inspection facilities of the hypothetical bridge are designed in a way that minimizes traffic disruption.

(5) Traffic generation in newly developed areas was taken into account basically in terms of route preference of future traffic.

Under existing regulations, foreign truck traffic is prohibited beyond both countries commercial zones, causing all trucks to stop at a truck yard or warehouse to pass either the trailer to another tractor, or to load to another truck. Most transborder truck trips are actually going from one yard or warehouse to another, and commercial route choices are constrained by locations of yards and warehouses. This situation may begin to change after these prohibitions are lifted. Nevertheless, interviews with U.S. trucking companies do not indicate a clear picture of the future situation. In some cases, the companies indicate that they would still prefer the old system for southbound traffic, while others indicate that they would change operations. In addition, the Mexican legal load higher than the Texas legal load, and Mexican companies may continue using the old drayage system instead of upgrading their fleets to comply with Texas law. The legal load issue is under discussion, and a sensible scenario at this point is one that allows for gradual change, while trucking companies adapt to the new rules, until eventually they take full advantage of deregulation. Below is a summary of assumptions used in the traffic diversion model for truck traffic, which includes the deregulation issue discussed above:

(1) No change in current bridge choice until 1998.

(2) Between 1998 and 2000, bridge choices will gradually move out of urban areas, due to better inspection facilities and better traffic circulation in the access/egress on both sides of the border.

(3) After 2001, 80 percent of trucks in this sector will use either the Pharr or the hypothetical bridge.

(4) Most warehouses to which the cargo is destined are in Reynosa. (Assumption used until 1997).

(5) Elimination of truck traffic restrictions will cause elimination of all warehouses by the year 2000.

(6) Trucks will always prefer the bridge that is more convenient to the warehouse to which they are going, or to their origins or destinations.

Simplified bridge choice algorithms were developed for autos and for trucks, based on the assumptions listed above, and the results are shown in Table 7.3. Departures from the assumptions discussed above as well as departures from the assumptions used to estimate future traffic in the sector may cause actual demand to be considerably different from the results shown in Table 7.3.

Potential Revenue Estimates

The demand estimates discussed above were used in the financial model discussed in Chapter 3 to analyze the potential feasibility of a bond-financed binational entry system. The southbound toll prices at the hypothetical facility were assumed to be the same as the current prices charged by the Hidalgo Bridge, which are $1.00 for autos, and a sliding fare for trucks that increases with the number of axles. Data on truck distribution by number of axles were obtained during the origin and destination survey conducted at the Hidalgo Bridge (Ref 21), and they show a predominance of 5-axle trucks. Truck toll prices and axle distribution are depicted in Table 7.4, and it is not known whether the seasonal variation in truck traffic observed by U.S. Customs officials has an effect on the percentages depicted on this table.

According to the data shown in Table 7.4, the average truck toll is $10.33. This weighted average is based on survey data collected on 137 trucks, and it may change seasonally, weekly, and/or daily. Nevertheless, the financial analysis model assumes that this axle distribution holds for the entire analysis period (up to 2014). The toll prices discussed above were multiplied by the demand estimates shown in Table 7.3, and the gross revenues were used in the financial analysis. The resultant net revenue estimates are shown in Table 7.5.

Table 7.3. Demand estimates for a hypothetical binational entry system in the Central Valley Sector (1000 vehicles)

	High Impact Scenario		Moderate Impact Scenario		Low Impact Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	3423	31	3423	31	3423	31
1995	3491	32	3491	32	3491	32
1996	3561	32	3561	32	3561	32
1997	3632	32	3632	32	3632	32
1998	3959	38	3704	35	3668	32
1999	4316	46	3779	39	3705	33
2000	4704	55	3854	42	3742	33
2001	5127	66	3931	47	3780	34
2002	5588	69	4010	48	3818	34
2003	6092	73	4090	49	3856	35
2004	6244	76	4172	51	3894	35
2005	6400	80	4256	52	3933	36
2006	6560	84	4341	54	3965	36
2007	6724	88	4428	56	3996	37
2008	6892	93	4516	57	4028	38
2009	7064	97	4607	59	4061	38
2010	7241	102	4698	61	4093	39
2011	7422	107	4792	63	4126	39
2012	7608	113	4888	64	4159	40
2013	7797	118	4986	66	4192	40
2014	7993	124	5086	68	4276	41

Table 7.4. Truck toll fares and axle distributions at the Hidalgo Bridge

Number of Axles	Percentage of Trucks	Toll (1993 dollars)
2	20.5%	4.00
3	6.1%	6.00
4	5.3%	8.00
5	59.8%	10.00
≥ 6	8.4%	12.00

Table 7.5. Revenue estimates for a hypothetical binational entry system in the Central Valley Sector

	Net Revenues In Thousands Of 1993 Dollars		
Year	Low Impact Scenario	Moderate Impact Scenario	High Impact Scenario
1995	2067	2067	2067
1996	2148	2148	2148
1997	2242	2242	2242
1998	2295	2363	2660
1999	2349	2488	3123
2000	2400	2614	3632
2001	2452	2746	4197
2002	2502	2847	4717
2003	2551	2950	5282
2004	2599	3055	5483
2005	2646	3159	5687
2006	2684	3266	5896
2007	2721	3371	6111
2008	2760	3480	6332
2009	2795	3589	6556
2010	2829	3697	6785
2011	2862	3807	7023
2012	2896	3918	7265
2013	2928	4033	7515
2014	3012	4148	7772

Under the most optimistic scenario, the analysis indicates that net revenues from a hypothetical binational entry system located on the west side of the Central Valley Sector would yield about $7.8 million in net revenues by the year 2014. This figure drops to $4.2 million under the moderate impact scenario, and to $3 million under the low impact post-NAFTA scenario. These predictions are based on the assumptions discussed above, and they take into account a fully operational Pharr Bridge.

Conclusions

Under the financial analysis assumptions (regarding costs, managerial decisions, and interest rates), and under the high impact post-NAFTA scenario, the net revenue estimates shown in Table 7.5 might be enough to warrant a reasonable bond rating. During the first six years of the analysis period, the annualized bond coverage ratio is under 1.5, but after that the bond rating starts to increase significantly, reaching 2.79 by the end of the analysis period, at an average of 1.9. Under the moderate impact and low impact scenarios, the 1.5 bond coverage ratio is never reached during the entire analysis period. The project never reaches a theoretical break-even point under the low impact NAFTA scenario, while it theoretically reaches break-even under the moderate impact scenario. However, the good bond ratings assumed in the financial analysis would not be obtained under the moderate impact and low impact scenarios, which means that the liabilities would be higher than those assumed, resulting in lower net revenues.

CAPACITY ANALYSIS

The analysis of the current capacity utilization of the Central Valley Sector uses the methodology and assumptions described in Chapter 2, and it focuses on the identification of current and potential congestion. The analysis encompasses all binational entry system component in both direction, i.e., access/egress, toll collection, bridge span, and border inspections.

Access/Egress Component

The U.S. access/egress component of the Hidalgo binational entry system is shown in Figure 7.5. Both bridges of this binational entry system are at US115, and the egress has a U.S. Customs area, a turnaround lane, and a parking lot. The signalized intersection at Bridge Boulevard and US115 is assumed to constrain the southbound access and northbound egress at the Hidalgo bridge. Two approaches at this intersection provide direct access to Reynosa for southbound traffic, namely the westbound approach on Bridge Boulevard and the southbound approach on US115. The northbound egress from U.S. inspections also utilizes this intersection, as shown in Figure 7.5.

In order to achieve a low degree of saturation, Bridge Boulevard and US115 intersection was assumed to be controlled by a pre-timed signal with a 120 seconds cycle and a three phase sequence. Green times were allocated based upon equal degrees of saturation in each signal phase. Given these assumptions, the southbound access to the bridge and the northbound egress from U.S. customs are estimated to operate at a v/c ratio of 72 percent.

The Mexican access and egress components are shown on Figure 7.6. Southbound egress from the bridge is provided by two unsignalized intersections between a two-lane, two-way avenue (Aldama) and the one-lane, one-way streets that feed into the two bridges of the Hidalgo binational entry system. Given that traffic volumes in downtown Reynosa were not available, the following assumptions were made for the analysis of the Reynosa access/egress component:

(1) Eastbound and westbound approach volumes are 764 vph (vehicles per hour).

(2) The critical movement is the southbound right turn from the bridge, with a volume of 850 vph (70 percent of southbound bridge auto traffic).

(3) Conflicting volume is one-half of the westbound approach volume (382 vph) on the two-way Aldama Avenue.

(4) The critical gap is 4.5 seconds.

(5) The capacity is 900 vph.

For northbound access to the bridge in Reynosa, the following assumptions are made:

(1) Westbound approach volume on the two-way Aldama Avenue includes 60 percent of northbound bridge traffic.

(2) Eastbound approach volume on the two-way Aldama Avenue includes 30 percent of northbound bridge traffic (eastbound left turn).

(3) Conflicting volume on the eastbound left turn is 1,567 vph.

(4) The critical gap on the eastbound left turn is of 4.0 seconds

(5) The capacity of the eastbound left turn is 400 vph.

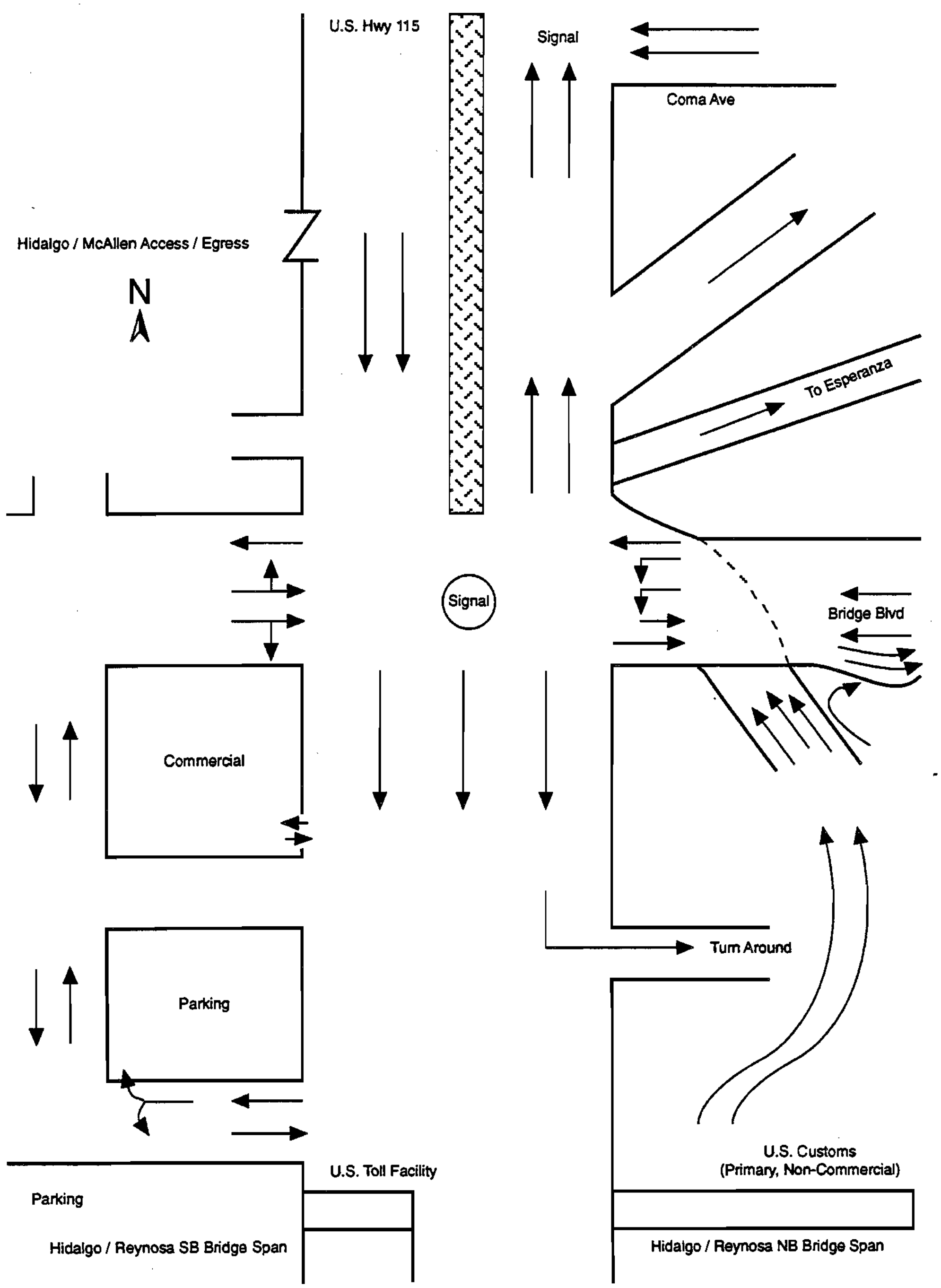

Figure 7.5. U.S. access/egress at Hidalgo Binational Entry System

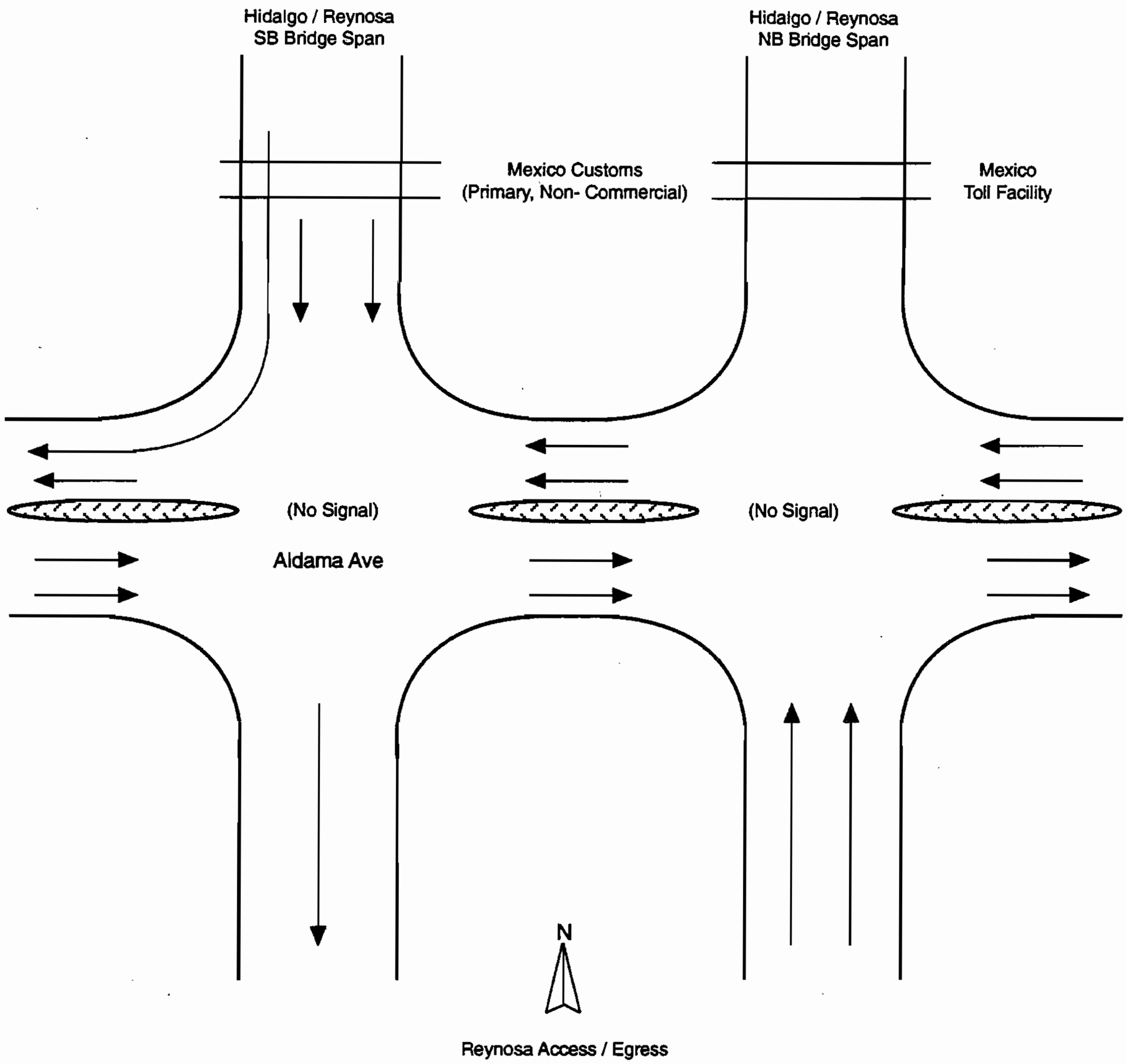

Figure 7.6. Mexican access/egress at Hidalgo Binational Entry System

Based on the above assumptions, the analysis yields a 94 percent capacity utilization for the southbound egress from the Reynosa bridge, and 71 percent to 107 percent for northbound access to the bridge. Field observations indicate that these intersections are actually congested, but this congestion could also be the result of northbound traffic queues extending from U.S. primary inspection facilities or Mexican northbound toll collection facilities.

Capacity Utilization of Hidalgo

The other components of the binational entry system were analyzed based on the methodology and assumptions discussed in Chapter 2, and Figure 7.7 summarizes the results. Assuming that one of the southbound toll lanes is used exclusively by trucks, the U.S. toll facility for autos is operating over capacity, with a v/c ratio of 158 percent. Field observations verify the lane utilization and the significant queues that form behind the toll facility during peak periods, even with all toll lanes open. The Mexican primary inspection for trucks is also congested, at 143 percent capacity. Trucks typically queue at the right hand side of the southbound bridge access, waiting for the Mexican Customs facility. As truck traffic on the bridge starts to move through the Mexican Customs, a Hidalgo police officer releases a batch of trucks to move south. This causes considerable traffic disruptions on the southbound bridge access, which is already operating with a v/c value of 72 percent. In addition, the southbound egress in downtown Reynosa is near capacity, with a v/c value of 94 percent, which indicates unstable flows and congestion.

In the northbound direction, three of the binational entry system components are operating over capacity even with all lanes open: the Mexican toll collection for autos (v/c=119 percent), and the U.S. primary inspection for autos (v/c=119 percent) and trucks (v/c=138 percent). In addition, the northbound access/egress is estimated to be operating either near or over capacity (v/c between 71 and 107 percent), given the assumptions concerning downtown Reynosa traffic volumes.

Conclusions

The capacity analysis methodology discussed in Chapter 2 assumes a conservative toll lane capacity based on toll prices that require change, such as a $1.25 or $1.50, increasing the processing time and decreasing the theoretical capacity. As of December, 1993, the southbound auto toll at Reynosa was changed to $1.00; the current capacity of the toll collection facility is actually larger than indicated on Figure 7.7. A processing time of 8 sec/veh would be more representative of a whole-dollar toll price, increasing the toll capacity for autos from 771 vph to 1,350 vph, and decreasing the v/c ratio to 90 percent, which is still high enough to explain the long queues observed in the field. Additionally, the Mexican primary inspection for trucks is causing a queue extending from Mexican Customs to Hidalgo and across the bridge, which hinders vehicles from exiting the U.S. toll facility, and adds to the traffic circulation problem. This truck queue extending across the entire bridge span was observed during field trips, and the analysis of the bridge span capacity took this defacto truck lane into account.

Even considering that one bridge lane is used exclusively by truck traffic, the bridge span itself is operating below capacity. Traffic congestion on the Hidalgo binational entry system is due to a combination of congested inspection and toll components, and access/egress components operating near capacity. Traffic back-ups in downtown Reynosa may queue traffic onto the bridge span, where truck queues due to congestion at Mexican Customs are already hindering traffic both at the bridge and at the toll booth exit; the latter is also congested by itself, and causing queues on an access/egress component that would already operate near capacity without this successive congestion effect. An analogous situation is found in the northbound direction, with the U.S. inspection for autos and trucks causing queues that hinder traffic circulation around this binational entry system.

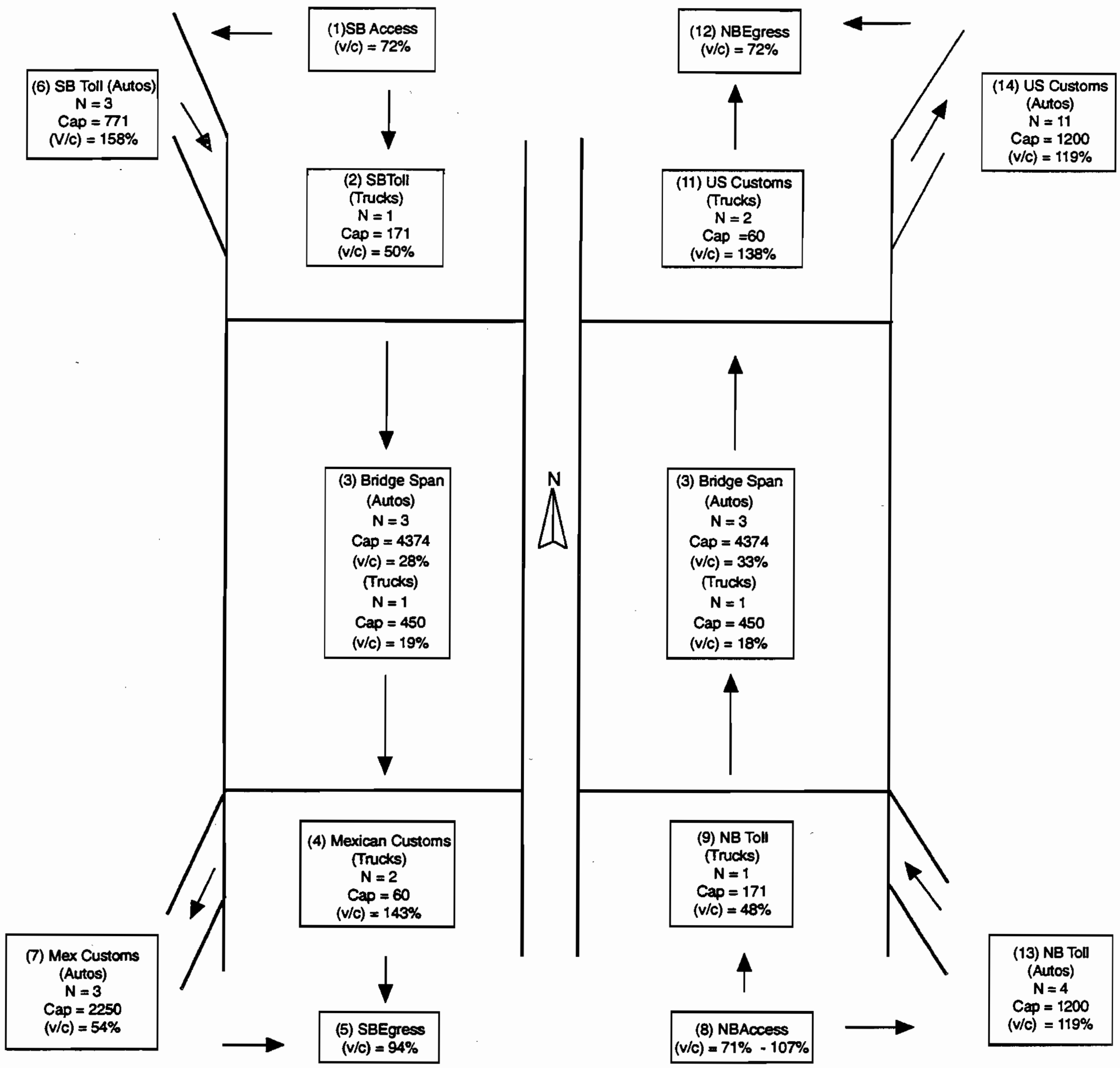

Figure 7.7. Capacity utilization of the Hidalgo Binational Entry System

CONCLUSIONS AND RECOMMENDATIONS

The Central Valley Sector is the third busiest sector in border Segment 1 (Brownsville to Laredo), serving over 25 percent of the total transborder traffic in this segment. The imminent competition of the new Pharr Bridge and the more widespread origins of southbound traffic create additional hurdles for estimating potential demand and revenue for another binational entry system in this sector. Nevertheless, revenue and demand estimates were obtained, and they indicate some possibility for a feasible binational entry system in this sector, while the capacity analysis indicates a very poor traffic circulation at Hidalgo.

Capacity Utilization

The current demand of the Central Valley Sector is entirely served by the Hidalgo Binational Entry System, which is operating either over or near capacity at almost every component except the bridge lanes. Clearly, this need for additional infrastructure could theoretically be met by expanding the toll plaza, the inspection areas, and the access/egress components. However, such expansion is not possible due to the lack of available land at Hidalgo and especially at Reynosa.

Table 7.6 shows some approximate v/c ratios for the toll and inspection components of Hidalgo and Pharr combined, assuming that the new Pharr Bridge would duplicate the current sector capacities. The bridge lane component is not shown in Table 7.6 because it is not congested by itself. In Table 7.6 all capacity utilization values over 80 percent are highlighted.

Table 7.6. Estimate of sector capacity utilization by years 2000, 2010 and 2014

		Capacity Utilization (percent)								
Direction		**Low Impact**			**Moderate Impact**			**High Impact**		
	Component	**2000**	**2010**	**2014**	**2000**	**2010**	**2014**	**2000**	**2010**	**2014**
South bound	Toll (autos)	**89**	**97**	**101**	**91**	**111**	**120**	**111**	**171**	**189**
	Toll (trucks)	16	19	20	21	30	33	27	50	61
	Inspection (autos)	30	33	35	31	38	41	38	59	65
	Inspection (trucks)	46	53	57	59	**84**	**95**	76	**142**	**173**
North bound	Toll (autos)	57	62	65	59	71	77	72	**110**	**122**
	Toll (trucks)	16	19	20	21	30	33	27	50	61
	Inspection (autos)	57	62	65	59	71	77	72	**110**	**122**
	Inspection (trucks)	46	53	57	59	**84**	**95**	76	**142**	**173**

*Approximate ratios for Hidalgo and Pharr combined
*Pessimistic post-NAFTA scenario

Under the low impact post-NAFTA scenario, the southbound toll collection components would already be near capacity by the year 2000, while the other components would still have some capacity available. By the year 2010, southbound auto toll collection would be very congested, with traffic back-ups at the toll plaza causing serious traffic circulation problems on the U.S. access component. Truck inspection would also be nearing capacity on both sides, which means truck queues impairing traffic circulation on the other binational entry system components. This situation gets worse in 2014, when the volumes at the most congested components would be almost twice their capacity. Additional infrastructure seems clearly indicated in the future, but it is imperative that it be adequately planned to tackle the main sources of congestion, which are primary inspection and toll collection rather than bridge lanes.

Feasibility of a New Binational Entry System

Under the high impact post-NAFTA scenario, the net revenue estimates might be favorable, since the low bond coverage ratios observed during the first six years of the analysis period are compensated with high ratios later in the analysis period, at an average of 1.9. Under the moderate impact and low impact scenarios, the good bond ratings assumed for the financial analysis model would not be obtained; this means higher interest rates, higher liabilities, and net revenues lower than predicted.

The demand and revenue analyses are based on a conservative assumption of successful competition of other modes with trucks, which would have moderate growth rates even under the most optimistic NAFTA scenario. Although multimodalism is desirable from a transportation planning perspective, it cannot be taken for granted at this point for every Texas-Mexico border sector. If this assumption does not materialize, the analysis results will be very conservative, and may underestimate the potential revenues of a feasible project.

Recommendations

The capacity and feasibility analyses suggest a pressing need for coordinated planning in this sector, based on correct diagnosis of the causes of poor traffic circulation. Theoretically, additional bridge lanes are not necessary, and the new Pharr Bridge will significantly increase the capacity of a component that would not need expansion if its full utilization were not hindered by congestion in other binational entry system components. On the other hand, the Pharr binational entry system would have to be able to quadruplicate the current sector capacity in terms of auto toll collection (southbound), and truck primary inspection (both sides), as well as to triplicate the current capacity of northbound auto toll and primary inspection, in order to meet the high impact demand for the next 20 years.

All analyses discussed in this document are generally based on conservative assumptions, such as low truck growth rates due to a successful intermodal program. If these assumption do not materialize, congestion of the toll and inspection components would occur much earlier. One of the few non-conservative assumptions of the capacity and feasibility analyses is that all toll and inspection lanes are fully staffed and operate with as little delay as possible. This assumption is necessary to estimate the theoretical available capacity of the inspection components. In reality, however, the inspection agencies are already struggling to staff the existing facilities, indicating a pressing need for additional funds for this service. This staffing problem also indicates that additional bridges may cause even more congestion if the inspection facilities have to share the available staff with more binational entry systems.

The findings of these analyses are based on several assumptions, and the results are not clear-cut. The estimated revenues are just enough to suggest feasibility under the most optimistic scenario. The sector capacity analysis also suggests that the Pharr binational entry system may provide enough capacity to serve traffic demand in the near future, depending on the design of its border stations and toll plazas. It would be beneficial to redo the capacity analysis after this design is established, and the demand and revenue analyses after Pharr traffic has developed.

During the next five years, a close monitoring is recommended for this sector, to evaluate the effects on traffic circulation of the new binational entry system currently under construction in Pharr, as well as the occurrence (or not) of the assumptions in which the results of this study are based. Seasonally replicated origin and destination surveys should also be part of this monitoring, since U.S. Customs officials have been observing significant seasonal fluctuations in truck and auto demand, which could not be taken into account in this study due to lack of seasonal data.

CHAPTER 8. ANALYSIS OF THE WESTERN VALLEY SECTOR

BACKGROUND

The Western Valley sector begins at the FM886 extension in western Los Ebanos, and ends at the western city limits of Roma. In Texas, this sector includes the cities of Rio Grande and Roma, in Starr County. In Mexico, it includes the cities of Camargo and Miguel Alemán, in Tamaulipas. This sector serves approximately 7 percent of Segment 1 traffic, and it has two binational entry systems: Roma/Miguel Alemán, and Rio Grande City/Cd. Camargo.

Existing Binational Entry Systems

Rio Grande City-Cd. Camargo is a two-lane toll bridge privately owned by Starr-Camargo Bridge Company on the U.S. The Mexican Government owns the bridge on the Mexican side, and its Mexican administrative offices are located at the other bridge (Roma). It was built in 1969, and it is open daily from 7AM to midnight.

On the U.S. side, Rio Grande City-Cd. Camargo is located on the outskirts of Rio Grande City, and it links to US83. This binational entry system has only one northbound primary inspection booth (expandable to three). It also has four secondary inspection booths for private vehicles (expandable to six), and six secondary inspection docks for trucks. The southbound toll plaza has two toll booths.

On the Mexican side, "Puente Internacional de Camargo" is located about 6 miles (10km) from Cd. Camargo, Tamaulipas and it links with MEX02 through a 4 mile (7km) road. It has one primary inspection and one secondary inspection lane, and one toll booth, for both trucks and autos.

Roma/Miguel Alemán is a toll facility located in the downtown areas of Roma in the U.S., and Cd. Miguel Alemán in Mexico. It is owned by Starr County on the U.S. side, and by SCT (Secretaria de Comunicaciones y Transportes) on the Mexican side. This two-lane bridge was built in 1979, replacing an old suspension bridge opened in 1927, and closed in 1979, when the new bridge was built adjacent to the old facility. The old suspension bridge is listed on the National Register of Historic Places, and recently was declared one of Texas' ten most endangered historic properties by the Texas Preservation Trust Fund.

On the U.S. side, the Roma binational entry system has four primary inspection booths, and fourteen secondary inspection booths for privately owned vehicles, with no room for expansion. Trucks move directly to the secondary inspection area, an 18-dock import lot. The southbound toll facility has two toll booths for general traffic, and there is no apparent room for expansion.

On the Mexican side, "Puente Internacional Miguel Alemán" is located about 1.2 miles (2km) north of MEX02, accessible through the central business district of Cd. Miguel Alemán. Mexican Customs has a total of five primary inspection lanes, three for passenger vehicles with nothing to declare, one for passenger vehicles with declarations, and one for trucks. There are 15-

20 spaces allotted for secondary inspection of vehicles, two of them for trucks. There is one toll booth for vehicles and one for pedestrians.

TRAFFIC AND FEASIBILITY ANALYSIS

A consistent southbound traffic history is not available for both binational entry systems in this sector. For Rio Grande, the history goes back to 1983, while for Roma only the years of 1989, 1990, 1991, and 1992 are available. Figure 8.1 shows auto traffic history for Rio Grande, while Figure 8.2 shows the four-year auto traffic history available for the entire sector in the southbound direction.

Auto growth rates at Rio Grande Bridge averaged 4.4 percent up to 1987. During 1988 and 1989, the average rate increased to 6.1 percent, and after 1990 there is no defined pattern, and the average rate is -0.6 percent. Total auto traffic in this sector (Fig 6.2) increased almost 50 percent from 1989 to 1990, and then declined at an average rate of nearly 2 percent. The General Agreement on Trades and Tariffs (GATT) does not appear to have influenced auto traffic in this sector.

Figure 8.3 depicts truck traffic history for Rio Grande Bridge. Truck growth rates at Rio Grande Bridge appear to have a cyclic pattern consisting of an upward trend followed by a sharp decrease, with a positive moving average. However, each cycle seems to be take half the available history, and the data are not enough to obtain an accurate moving average model. In addition, the 1987-1989 period may be atypical, if it reflects influence of GATT. Truck traffic grew 88.7 percent between 1987 and 1989, at an average yearly rate of 33 percent. The growth rate observed between the first and last year of the available history is 110 percent for this Bridge.

Figure 8.4 shows the four-year truck traffic history available for the entire sector in the southbound direction. The growth pattern observed at Rio Grande does not hold for Roma. While truck traffic at Rio Grande Bridge was growing in 1990, 1991 and 1992, Roma it was at decreasing. This seems to be due to the lack of cargo related facilities such as warehouses and cold storage. Furthermore, Roma streets were not designed for truck, and conditions are said to be even worse on the Mexican side. The 4-year truck traffic history for the entire sector displays a very smooth growth, at an average yearly rate of 3.7 percent.

Ten-year northbound traffic series are available from U.S. Customs for both bridges in this sector. Figures 8.5 and 8.6, respectively, show the northbound auto and truck traffic histories. As shown in Figure 8.5, auto traffic growth was very erratic before 1988, but stabilized at an average yearly rate of -0.5 percent (decline). Truck traffic has two peaks, one in 1983 and another in 1989, which were observed at the Roma bridge. Other than that, it remained around 20,000 a year throughout the available period. GATT does not appear to have influenced the northbound traffic in this sector.

A complete northbound traffic history is available from CAPUFE for this sector, starting at 1967 for Roma, and at the first year of operation for Rio Grande City. Figures 8.7 and 8.8, respectively, depict the auto and truck history for each bridge and the entire sector. Auto traffic histories show the development of the demand in this sector, starting with low volumes, and steadily growing into a rather stable level. The early eighties have the highest auto traffic growth and, likewise the other data sources, there is no effect of GATT. Truck traffic histories develop more erratically, with three peak years: 1981, 1985, and 1989. The cyclical pattern is also present in data from other sources, and it may correspond to agricultural production peaks, due to the nature of the commodities using this sector.

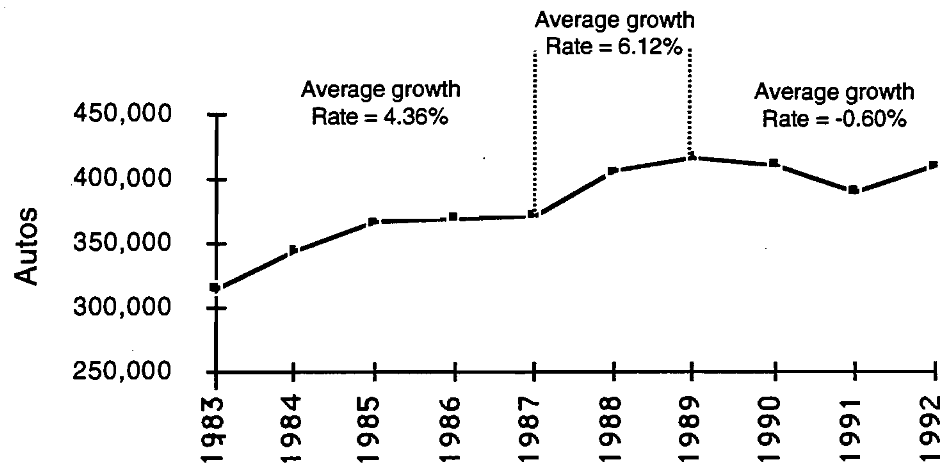

Figure 8.1. Southbound auto traffic history — Rio Grande Bridge (Source: Bridge management.)

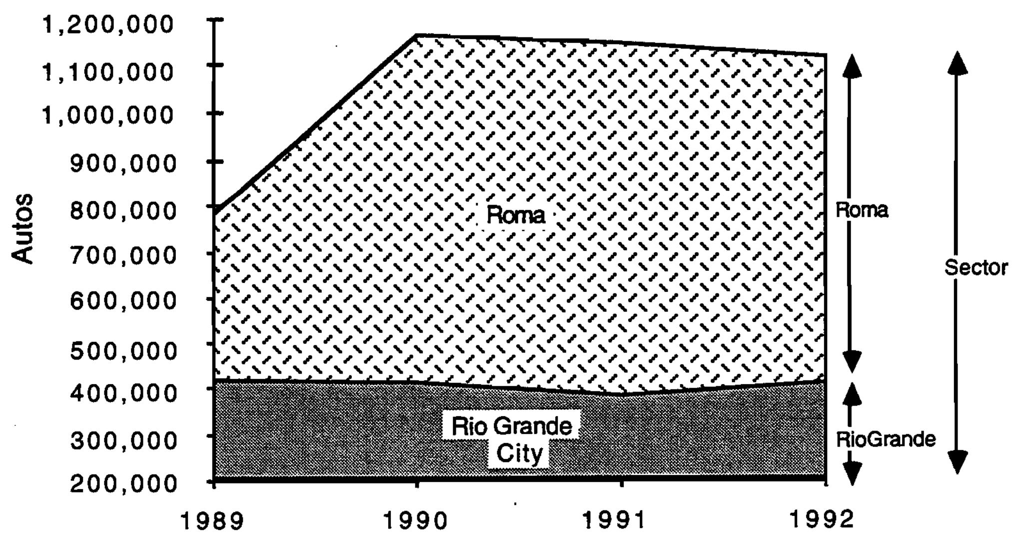

Figure 8.2. Southbound auto traffic history — Western Valley Sector

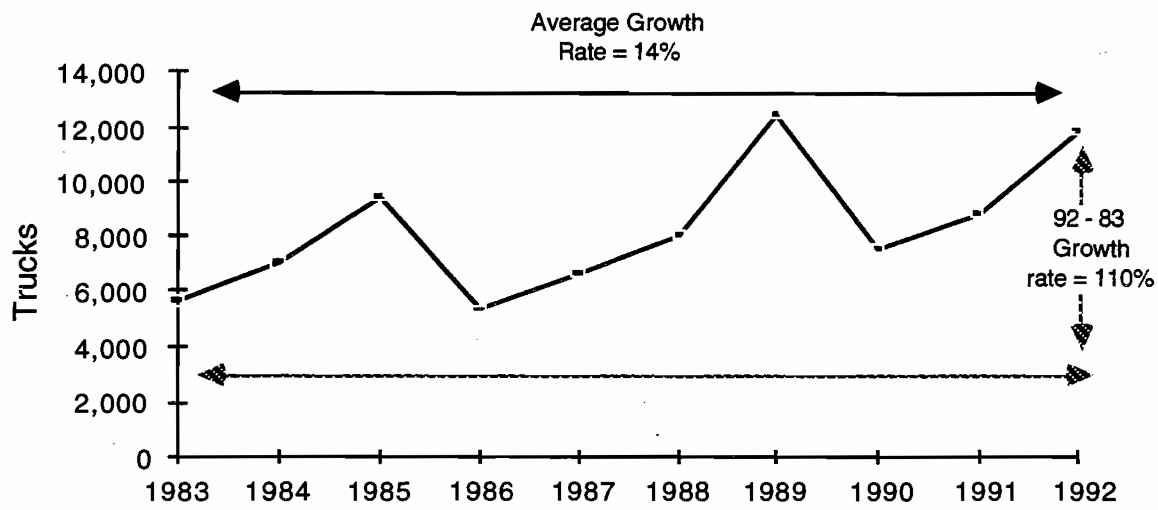

Figure 8.3. Southbound truck traffic history — Rio Grande Bridge (Source: Bridge management)

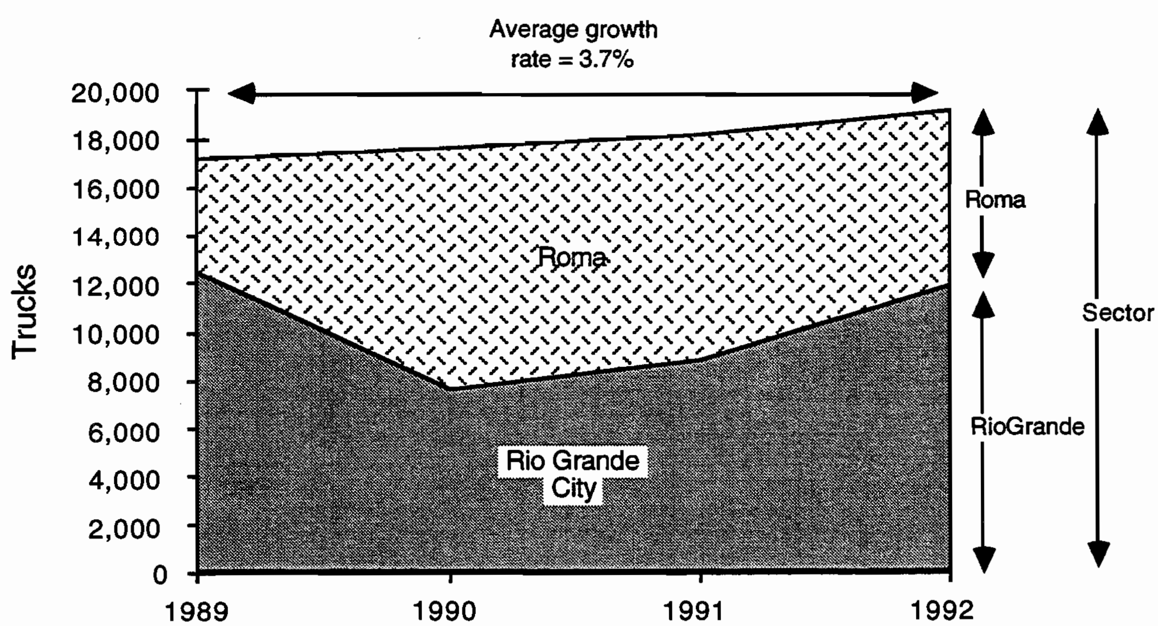

Figure 8.4. Southbound truck traffic history — Western Valley Sector (Source: Bridge management)

Origin and destination are available only from the Pharr Bridge Feasibility Study (Ref 4), but the survey results for the Western Valley sector are aggregated for the entire Starr County, and do not give information about bridge choice within the sector. Bridge managers and Customs officials have observed that auto traffic at Rio Grande Bridge is mostly local, going from Rio Grande City to either Cd. Camargo or other small communities located near this bridge. From February through May, truck traffic is at its peak, due mainly to fresh produce imported from Mexico. Other commodities passing through Rio Grande Bridge are cement and bricks. An average of 50 percent empty trucks are observed at Rio Grande Bridge. At Roma, Customs officials observed that northbound traffic origins are evenly split between Mexican border cities within the sector and Monterrey. City leaders are advocating for a direct route from Monterrey to Corpus Christi, which seems to be the main destination of the northbound traffic from Monterrey. The referred officials attribute the truck traffic decline registered during the past few years to the poor traffic circulation around Roma binational entry system.

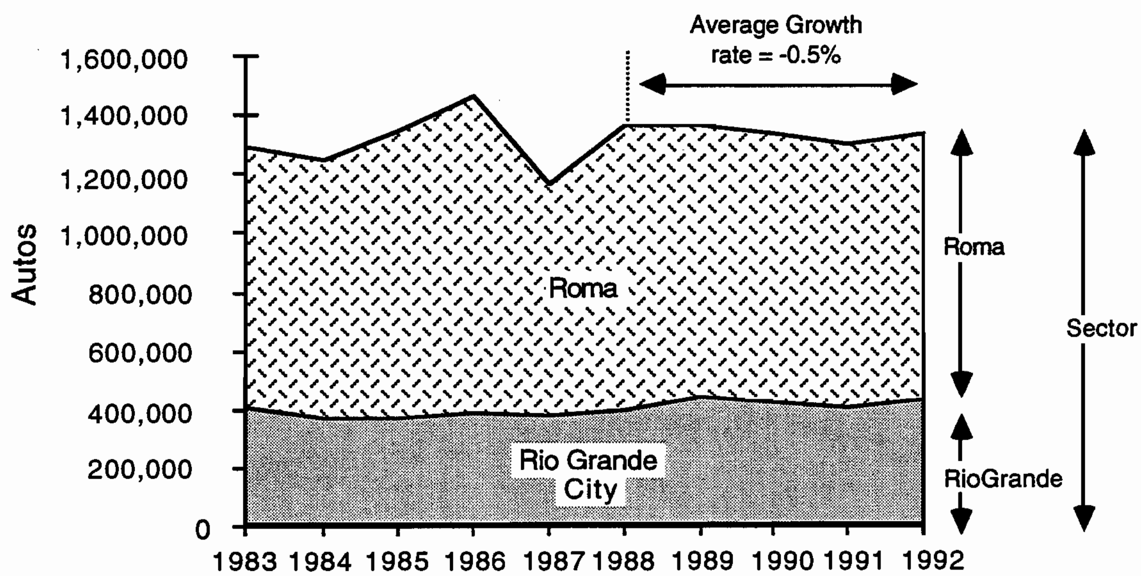

Figure 8.5. Northbound auto traffic history — Western Valley Sector (Source: U.S. Customs)

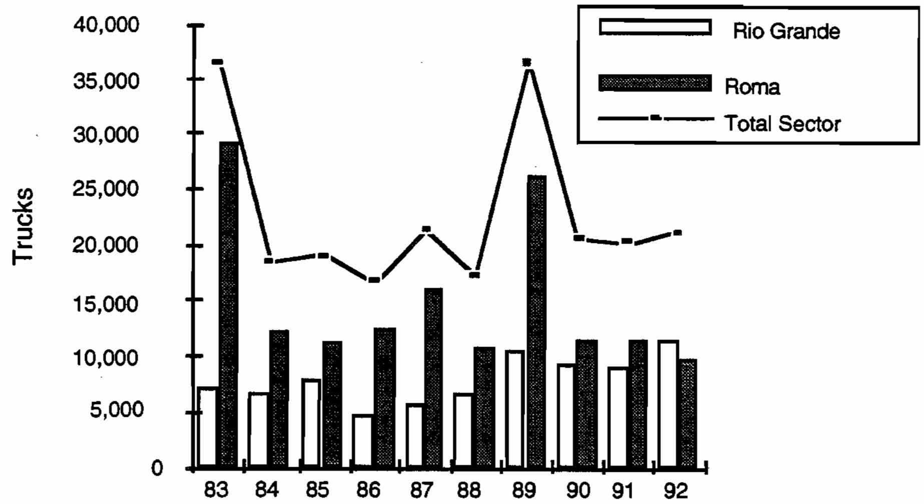

Figure 8.6. Northbound truck traffic history — Western Valley Sector (Source: U.S. Customs)

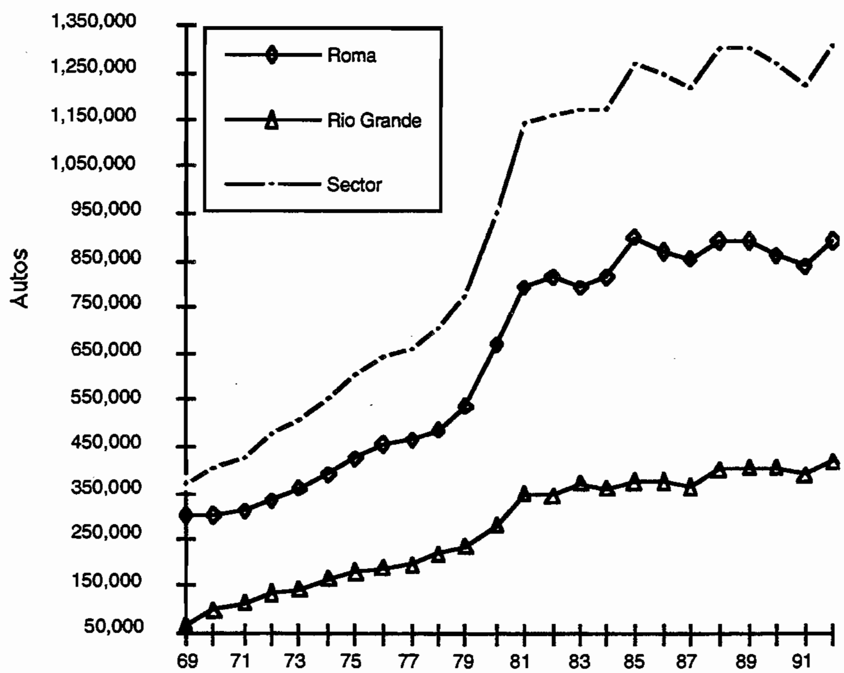

Figure 8.7. Northbound auto traffic history — Western Valley Sector (Source: CAPUFE)

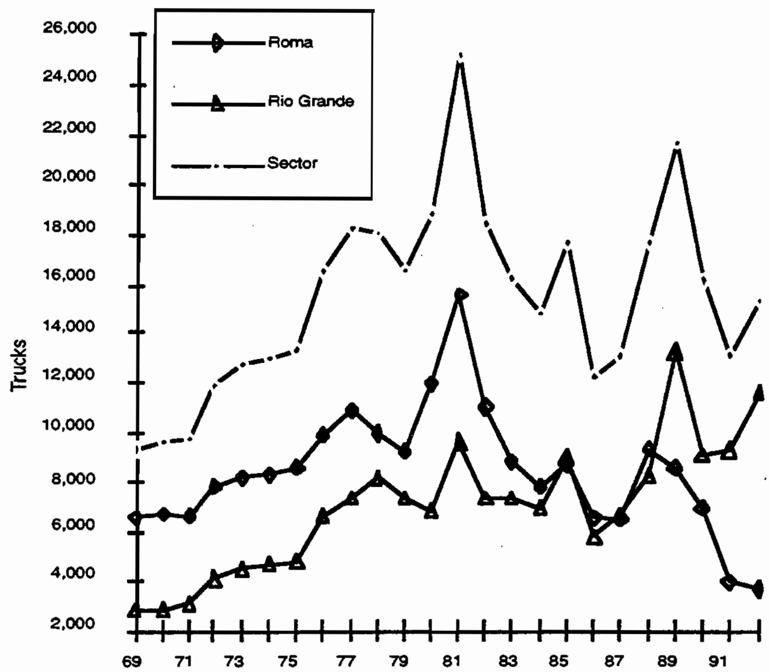

Figure 8.8. Northbound truck traffic history — Western Valley Sector (Source: CAPUFE)

As discussed in Chapter 3, traffic predictions assume three scenarios for NAFTA impacts: high impact, moderate impact, and low impact. In other sectors, GATT impacts were used as a paradigm for estimating potential NAFTA impacts, but GATT impacts on traffic volumes were not observed in this sector. Accurate statistical models that predict future traffic as a function of socioeconomic indicators could not be obtained for this sector, and the approach used to investigate traffic growth is similar to a sensitivity analysis. The low impact scenario assumes that the decline trends observed in the past four years will continue throughout the analysis period. The moderate impact and high impact scenario examine the consequences of two possibilities: 2 percent and 5 percent average yearly growth rates, both for autos and trucks. Under these assumptions, the estimated future auto and truck traffic for the Western Valley Sector would be as shown in Table 8.1.

Under the 5 percent growth scenario, which in this case would represent an optimistic post-NAFTA scenario, total auto demand in this sector would be over 3.7 million by the year 2014. This demand drops to 2 million under the 2 percent growth scenario (moderate impact), and to 877,000 under the low impact scenario, which maintains the currently observed decline trend. Truck demand under the high impact scenario reaches 61,000 by the year 2014, dropping to 33,000 under the moderate impact scenario and to 20,000 under the low impact scenario.

Potential Feasibility

The level of traffic existent in this sector is not enough to warrant feasibility of a new bond-financed binational entry system. Under the high impact assumption that this hypothetical binational entry system would attract 90 percent of the truck traffic and 30 percent of the auto traffic in the sector, an average yearly growth rate of 18 percent would be needed throughout the analysis period, to warrant feasibility of new binational entry system that charges at $1.00 per auto and (on the average) $10.00 per truck.

Table 8.1. Estimated southbound annual traffic for the Western Valley Sector (1000 vehicles)

	Decline Scenario		2% Growth Scenario		5% Growth Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	1314	22	1368	22	1408	23
1995	1288	22	1395	23	1478	24
1996	1262	22	1423	23	1552	25
1997	1237	22	1452	24	1630	27
1998	1212	21	1481	24	1711	28
1999	1188	21	1510	25	1797	29
2000	1164	21	1540	25	1887	31
2001	1141	21	1571	26	1981	33
2002	1118	21	1603	26	2080	34
2003	1096	21	1635	27	2184	36
2004	1074	21	1667	27	2294	38
2005	1052	21	1701	28	2408	40
2006	1031	21	1735	28	2529	41
2007	1011	21	1769	29	2655	44
2008	990	20	1805	30	2788	46
2009	971	20	1841	30	2927	48
2010	951	20	1878	31	3074	50
2011	932	20	1915	31	3227	53
2012	914	20	1954	32	3389	56
2013	895	20	1993	33	3558	58
2014	877	20	2033	33	3736	61

CAPACITY ANALYSIS

The analysis of the current capacity utilization of the Western Valley Sector follows the methodology and assumptions described in Chapter 2, and it focuses on the identification of binational entry system components that are either already experiencing congestion, or have a potential to develop it. The analysis encompasses the two binational entry systems in this sector: Rio Grande/Cd. Camargo and Roma.

Rio Grande City /Cd. Camargo Binational Entry System

The Rio Grande City binational entry system carries approximately 40 percent of the auto traffic, and about 67 percent of the truck traffic of the Western Valley sector. This binational entry system is located on the outskirts of Rio Grande City, and its access/egress components are depicted in Figure 8.9.

In the U.S., access/egress is provided by US755, and its signalized T-intersection with US83 is assumed to constrain the traffic circulation. This signal was assumed to be actuated, with a 5-second green time allocated to minor movements, and a 30-second cycle length with a three phase sequence. Utilizing TxDOT's traffic counts taken near this intersection (Ref 20), as well as bridge traffic data to calculate flow rates for each movement, the following v/c ratios are obtained:

(1) Southbound access: 18 percent for the westbound left turn, and 41 percent for the through and right turn movements; and
(2) Northbound egress: 36 percent.

Figure 8.10 summarizes the results of the capacity analysis of the Rio Grande City binational entry system. In addition to the assumptions discussed in Chapter 2, the analysis also assumes that the two U.S. primary inspection lanes operate in tandem (according to interviews with U.S. Customs officials). The results indicate that the component with the highest capacity utilization is the U.S. northbound primary inspection for autos, operating at 48 percent capacity, followed by the U.S. access/egress, which is at 41 percent capacity. Likewise the rest of the Texas-Mexico border, the bridge itself is the most under-utilized component, operating at 8 percent capacity.

Roma / Miguel Alemán Binational Entry System

The Roma binational entry system carries approximately 60 percent of the sector auto traffic, and about 33 percent of the truck traffic using the Western Valley sector. This binational entry system is located downtown Roma and Cd. Miguel Alemán, and its U.S. access/egress component is depicted in Figure 8.11. Traffic data are not available for the Mexican access/egress component. Direct access to Roma is provided by Bravo Avenue in downtown Roma. Northbound egress usually requires a westbound left turn movement followed by an eastbound right turn into Bravo Avenue. These movements are stop-controlled, and the signalized intersection between Bravo Avenue and US83 is assumed to constrain the traffic circulation at the access/egress component.

TxDOT's traffic counts on US83 (Ref 20) as well as bridge traffic data were used to estimate flow rates at the main access/egress movements. A three-phase sequence, 20-second cycle length signal was assumed to control the US83/Bravo Avenue intersection, with green time splits that warrant equal degrees of saturation. Based on these assumptions, Roma access/egress component has a volume to capacity ratio (v/c) of 66 percent.

Figure 8.12 summarizes the results of the capacity analysis of all components of Roma binational entry system. The Mexican inspection lane used exclusively for autos with declarations was not considered in the analysis, because it hardly interferes with traffic circulation. The analysis indicates that all processes in both directions have excess capacity available; the components with the highest capacity utilization are the Mexican northbound toll for autos (v/c=65 percent), and the U.S. access and egress (v/c=66 percent).

CONCLUSIONS AND RECOMMENDATIONS

This sector serves about 7 percent of Segment 1 traffic, and it has two binational entry systems: Roma and Rio Grande City. The capacity analysis indicates that all components of these two entry systems are operating below capacity. Congestion can be expected mainly at the U.S. primary inspection, the toll collection and access/egress way before the bridges become congested.

A new, bond-financed binational bridge entry system in this sector seems to be neither financially viable, nor needed at this point. Expeditious inspection procedures, improvement of the toll plazas, and access/egress components upgrades are recommended in the near future.

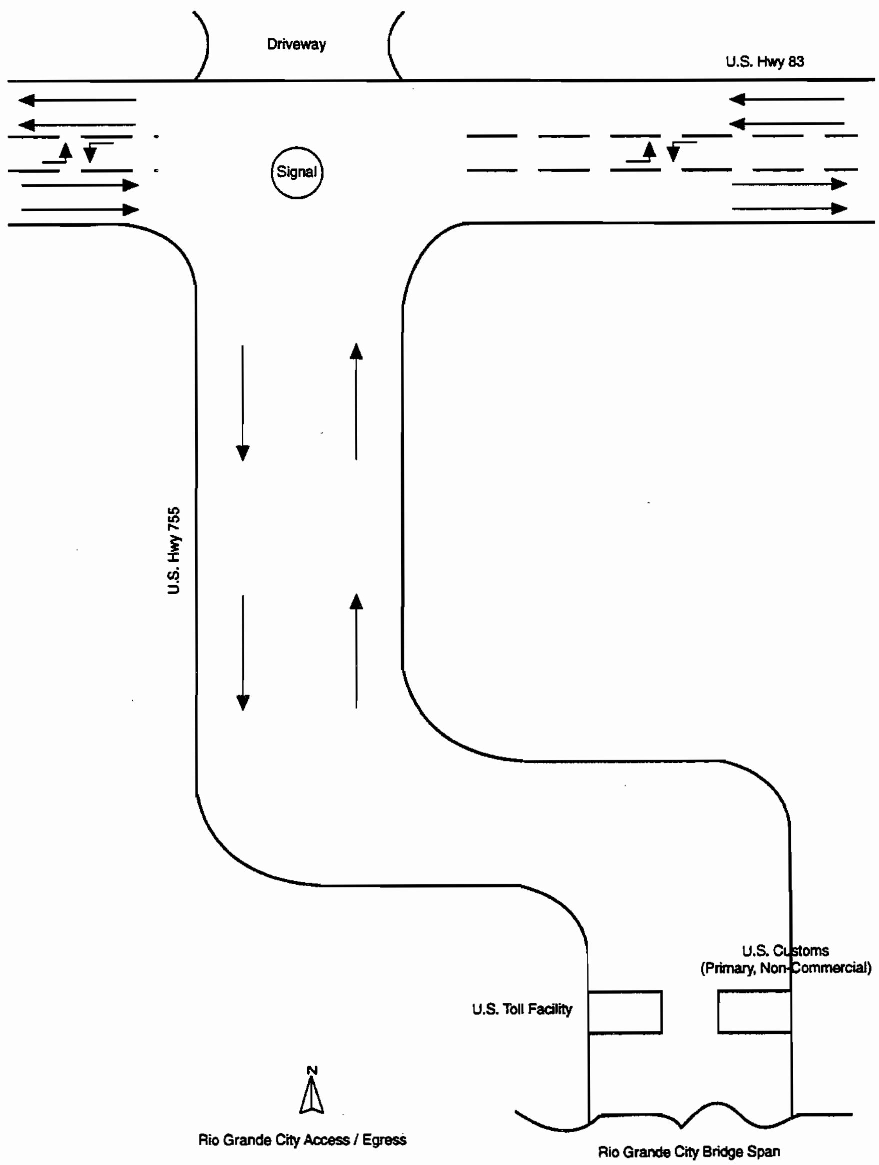

Figure 8.9. Rio Grande/Camargo access/egress components

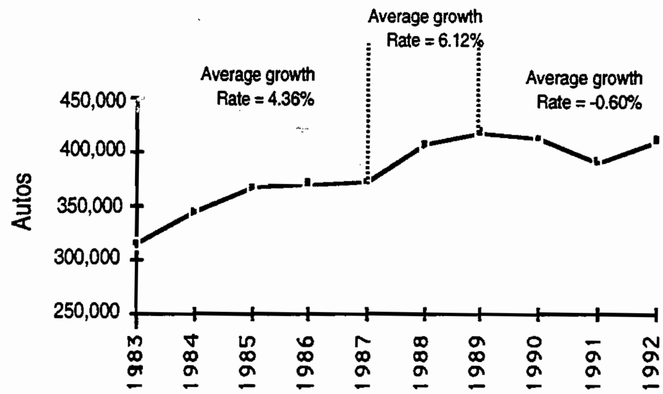

Figure 8.10. Rio Grande/Camargo capacity utilization

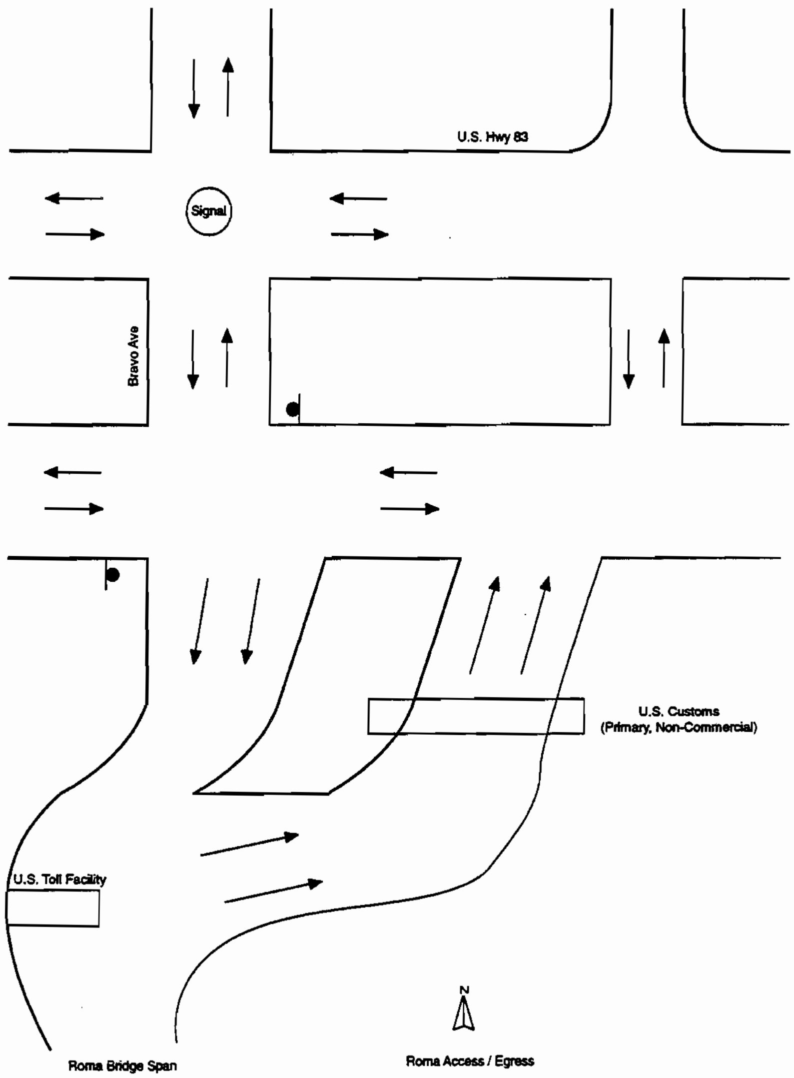

Figure 8.11. Roma access/egress component

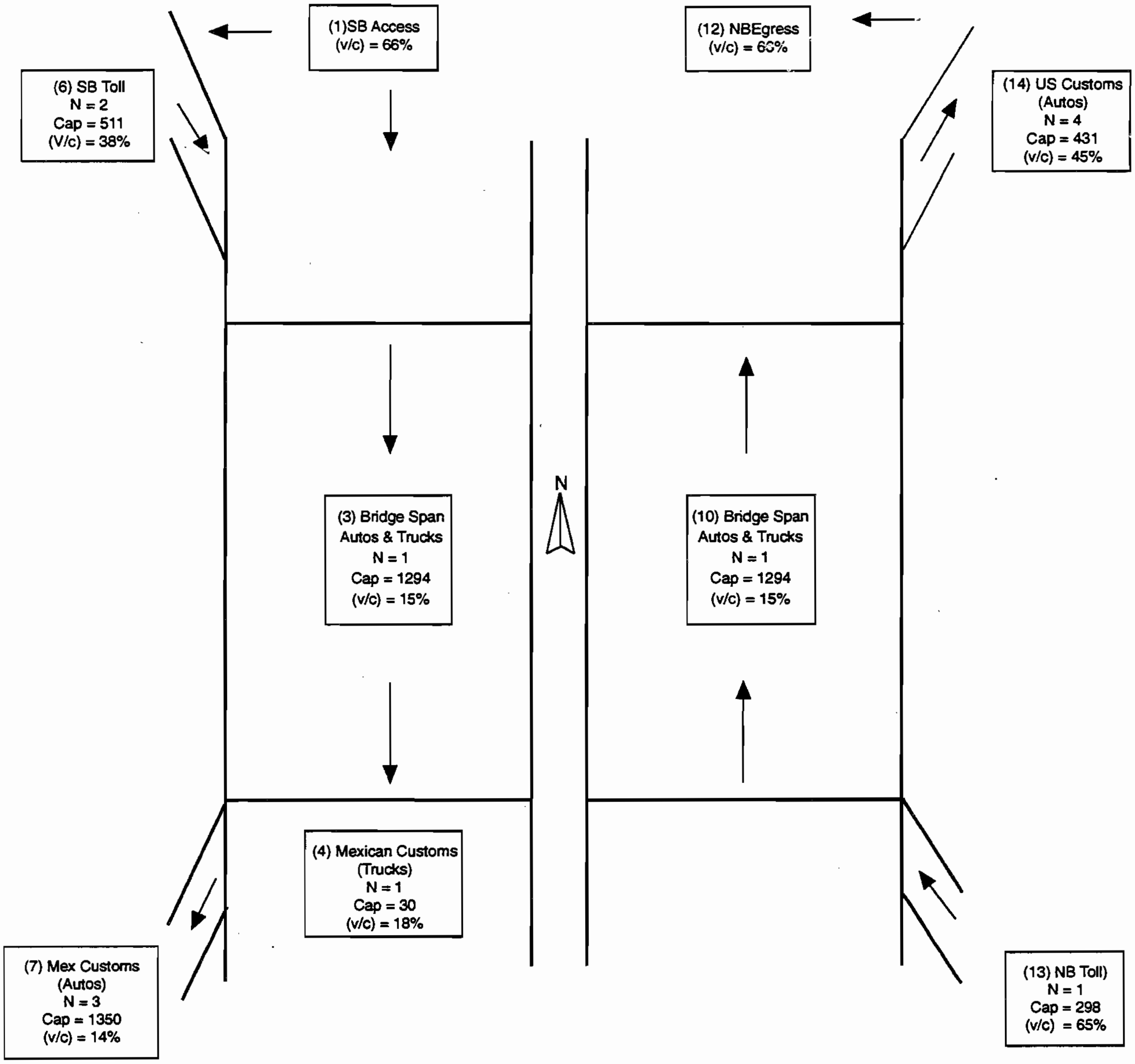

Figure 8.12. Roma capacity utilization

CHAPTER 9. ANALYSIS OF THE LAREDO SECTOR

BACKGROUND

The Laredo Sector begins at the eastern city limits of Laredo, in Webb County, and ends immediately west of the Colombia Bridge, which is a rural area on both sides of the border. On the U.S. side, the entire sector is located in Webb County, while in Mexico it encompasses the city of Nuevo Laredo, Tamaulipas, and the town of Colombia, Nuevo León. Tamaulipas makes up approximately two-thirds of the sector length, while Nuevo León makes up the other third.

The sector includes three vehicular bridges and one rail bridge. Two of the vehicular bridges (Laredo 1 and Laredo 2) link the downtown areas of Laredo, Texas, and Nuevo Laredo, Tamaulipas. They are both open 24 hours a day. The third bridge, eight-lane Colombia Bridge, is located about 20 miles (32km) northwest of the downtown areas of both Laredos, and it links Dolores (Laredo extraterritorial limits), Texas to Colombia, Nuevo León. It is open from 7:00 a.m. to 11:00 p.m., daily.

The City of Laredo owns all three bridges, in partnership with Mexico, and the Southbound gross revenues from the three bridges were over $12.5 million in 1992, which is a 20 percent increase over the 1991 revenue. The 1993 revenues were estimated to reach $15 million, and actual values were not yet available when this document was being written.

Laredo 1

Laredo Bridge 1, the Old Bridge, or Convent Street Bridge was officially named "Gateway to the Americas" in January 1994. It is a four-lane toll facility that provides a direct link between Convent Street in downtown Laredo and Guerrero Avenue in downtown Nuevo Laredo. The original bridge was destroyed by a flood in 1954, rebuilt in 1956, and re-inaugurated in 1957.

On the U.S. side, Laredo 1 has 4 primary and 22 secondary inspection booths for privately owned vehicles, with no room for expansion of these components. Customs operations at this binational bridge entry system currently include private vehicles, pedestrians, buses, empty trucks and tractors. Loaded trucks must use either Laredo 2 or Colombia. The southbound toll facility includes three toll booths, with no designated truck booth.

On the Mexican side, "Puente Laredo 1" or "Puente Viejo" has four southbound primary inspection booths for autos, three of which equipped with the random choice system, and a fourth booth for voluntary declaration. It also has 20 parking spaces for secondary auto inspection. Trucks must turn to the right, where the bridge egress leads to three booths for random selection. Selected trucks proceed to the same import lot of Laredo 2, open from 7:00 a.m. to 8:00 p.m.

Laredo 2

Laredo 2, or Juarez-Lincoln Bridge, was opened in 1976. It is a six-lane, two-way bridge, with the rightmost lane in each direction dedicated to trucks. During periods of heavy southbound traffic, four lanes are designated for southbound traffic and two lanes for northbound traffic.

Pedestrians are not allowed to use this binational entry system, since the Mexican government does not have the appropriate facilities. All northbound loaded trucks must go through Laredo 2, while both downtown bridges (Laredo 1 and 2) serve empty and loaded southbound trucks.

On the U.S. side, Laredo 2 is directly linked to Interstate Highway 35. There are 12 primary inspection and 54 secondary inspection booths for privately owned vehicles, with no room for expansion. There are five primary inspection booths for trucks. The import lot has recently been upgraded to handle 180 to 200 trucks. The southbound toll facility includes six toll booths, with one truck-only lane.

On the Mexican side, "Puente Laredo 2," or "Puente Juarez-Lincoln" has four primary inspection booths for autos, three of which are for random selection, and the fourth (rightmost lane) for voluntary declaration. There are 15 parking spaces for secondary inspection. Trucks turn right at the end of the bridge, and are processed through four primary inspection booths and a 50-truck import lot with an additional parking area for 110 trucks.

Colombia

The Colombia or Solidarity Bridge is a new eight-lane toll bridge that was completed in July 1991. It links Dolores, in Webb County, to Colombia, Nuevo León, and it is the only direct link between the U.S. and the State of Nuevo León. It was initiated by the state of Nuevo León in 1987, and the city of Laredo shares the bridge ownership with the Mexican government .

Construction of the U.S. inspection facility has been carried out over phases, and it is not completely finished. Phases I and II are complete, and include four northbound primary inspection lanes for trucks, two northbound primary inspection lanes for non-commercial vehicles, and 50 docks of a 100-truck dock in the import lot. Phase II, finished in Spring 1993, included eight northbound primary inspection lanes for trucks, four northbound primary inspection lanes for non-commercial vehicles, and another 50-truck docks. Phase 3, which is not expected to be finished in the near future, consists of a second import dock with an additional 100-truck docks. The existing four primary inspection booths for private vehicles could be expanded to twelve, and the existing six secondary inspection booths are expandable to 36 booths. There are currently eight primary inspection lanes for trucks, expandable to twenty. The import lot currently consists of 100 truck docks. The southbound toll facility consists of six toll booths, with no designated truck booth.

On the Mexican side, "Puente Solidaridad" or "Puente Colombia" has six southbound primary inspection booths for autos and a 150-vehicle secondary inspection area. There are five primary inspection booths and a 140-truck import lot for trucks or commercial vehicles. In the northbound direction, there are six vehicular toll booths managed and operated by CAPUFE. The export lot consists of six primary inspection booths and has the capacity for 60 trucks. The customs facilities are designed to handle up to 4,000 trailers a day in both directions.

The Colombia Bridge is accessible through FM1472 (Mines Road), which is currently being expanded into four lanes from the bridge entrance to Laredo. On the Mexican side, two-lane highway MEX02 is the connecting infrastructure with Nuevo Laredo, and it needs repair.

Adequate design, high-tech inspection equipment, and impressive size of all facilities warrant high capacity to all components of this binational entry system. Nevertheless, it not being fully utilized. There are several reasons for the under-utilization of Colombia bridge, such as inadequate road infrastructure on both sides of the border, scarcity of Mexican Customs Brokers licensed to operate in both Tamaulipas and Nuevo León, and the additional time involved to reach the facility.

In a recent survey conducted for the state of Nuevo León, respondents were asked if they would use a new toll road directly to Colombia Bridge (Ref 18). The poll was conducted on the two main highways between Monterrey and Nuevo Laredo and on the Monterrey-Colombia road. Sixty percent of respondents using the Monterrey-Nuevo Laredo highway responded positively, and 90 percent of respondents at the Colombia Road responded positively. Pursuant to this result, the Nuevo León Transportation Department requested that the Secretaría de Comunicaciones y Transportes (SCT) grant the state a concession to construct a connecting toll road to the Laredo-Colombia Solidarity Bridge. An environmental assessment of three possible alignments is to begin in mid-March and be concluded in May 1994. A right-of-way study of the same three alignments is expected to be completed by September 1994. When all studies are completed, they will be submitted to the SCT with a formal request for the concession. If awarded to Nuevo León, the state would accept bids from the private sector to award the concession for construction, operation and maintenance. The term of the concession would be a minimum of 20 years. Four Mexican construction companies have expressed interest in the concession.

Construction could begin before year's end. The two-lane toll road would be constructed of concrete with a configuration similar to US59. The first two lanes would be constructed on a 333 foot (100 m) wide right-of-way, to accommodate construction of two additional lanes as traffic demand requires.

The alignment that Nuevo León prefers is from Colombia to La Tinaja, a distance of 102 miles (165km). The estimated construction cost for that alignment is $78 million. The other two alignments are Colombia-La Gloria and Colombia-Vallecillos, which intersects the Monterrey-Nuevo Laredo toll road approximately midway between La Tinaja and La Gloria. Exhibit 9.1 shows a sketch of these three alignments.

Proposed Binational Entry Systems

A third bridge has been proposed by the City of Laredo about 5 miles (8k m) west of downtown Gateway to the Americas Bridge and approximately 3 miles (5k m) from IH-35, connecting with Loop 20 inside the city limits. The Texas government recently asked for and apparently obtained federal support for this bridge, which is called Laredo 3 in the presidential permit application (Ref 2). The activities towards implementing this binational bridge entry system are increasing, and the environmental assessment is currently under evaluation. However, at the July 1992 Bilateral meeting in Nogales, Arizona, the State Department indicated that the need for this entry system had been questioned by U.S. Inspection Agencies, due to the low traffic volumes that are currently processed at Colombia Bridge. On the other hand, the city of Laredo and the Tamaulipas government feel that this bridge would reduce congestion in Laredo and Nuevo Laredo. Colombia Bridge is seen as adequate for long-haul traffic, as opposed to Laredo 3, which is intended primarily to serve local traffic.

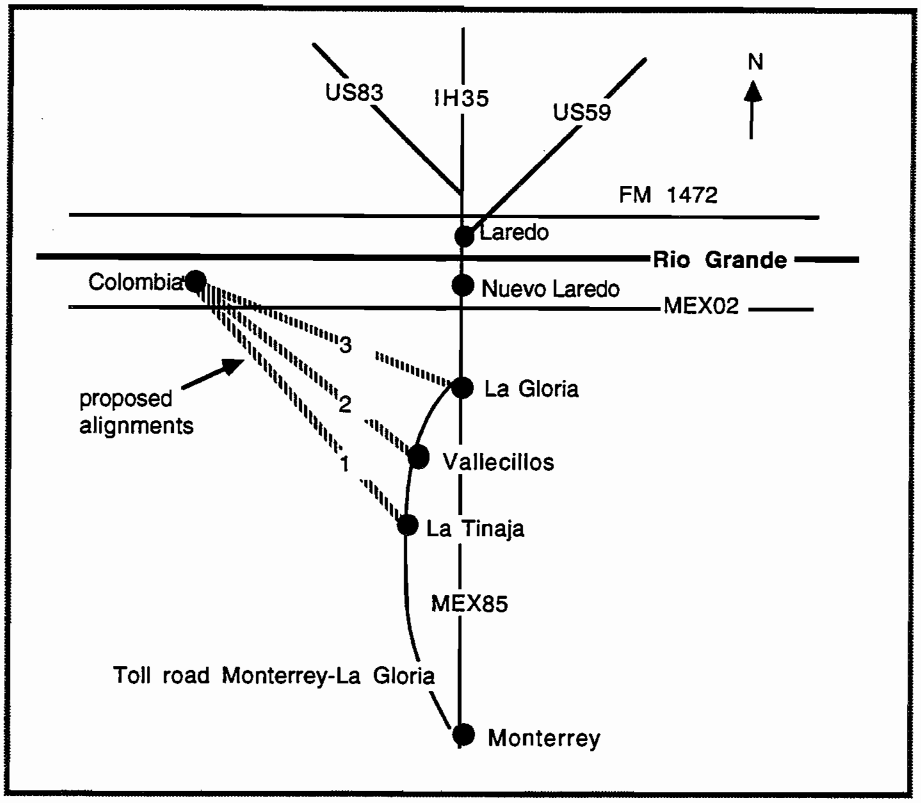

Exhibit 9.1. Proposed alignments of the new access road to Colombia

There is also a proposal by Union Pacific Railroad and the Ferrocarriles Nacionales de México (FNM) to relocate rail lines in both Laredo and Nuevo Laredo to a new rail bridge. The location currently considered is northwest Laredo, connecting the existing rail line near Mines Road to the proposed Laredo 3 Bridge. Similarly, in Nuevo Laredo the rail line would go west and connect to the main FNM line west of the city.

REVENUE AND DEMAND ANALYSES

The demand and revenue analyses of the Laredo Sector are based on the methodology discussed in Chapter 3. The analyses are based on limited information about origin and destination and land use in the area, and all assumptions discussed in Chapter 3 apply to these analyses. The results are valid for a hypothetical bridge anywhere in the sector, and they represent the average demand and revenue from hypothetical bridges on the east and west sides of the sector, located either at or near the existing and proposed loops around both Laredos. The results discussed in this section represent a situation in which the Colombia and the hypothetical new bridge are efficiently connected to the rest of the infrastructure on both sides of the border.

Traffic Analysis

Northbound traffic histories are available from U.S. Customs and CAPUFE, while southbound data are available from the Laredo Bridge System. CAPUFE traffic history is comprehensive for Gateway to the Americas Bridge, but encompasses only two years for Laredo 2, while U.S. Customs data are consistently available from 1984 to 1993 for both bridges. Customs data are recorded by fiscal year (which starts in September of the previous calendar year), and this introduces a three-month lag in the data with respect to southbound information. Figures 9.1 and 9.2, respectively, depict the northbound auto and truck traffic, and Figures 9.3 and 9.4, respectively, depict the southbound auto and truck traffic.

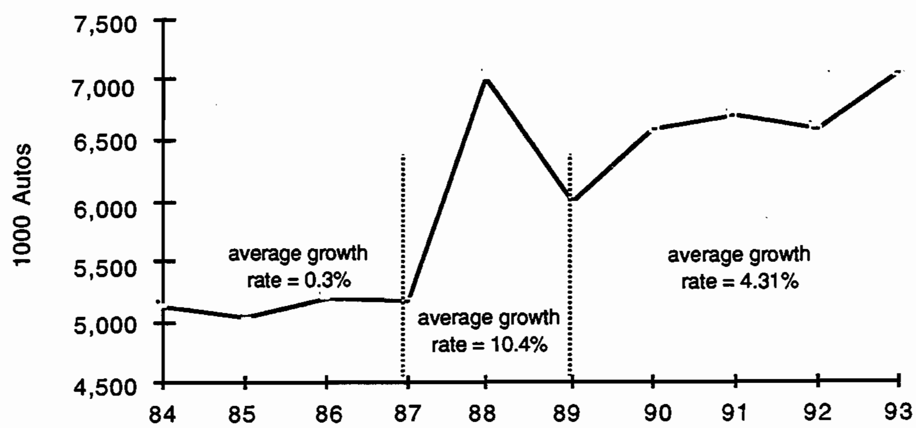

Figure 9.1. Northbound auto traffic — Laredo Sector (Source: U.S. Customs)

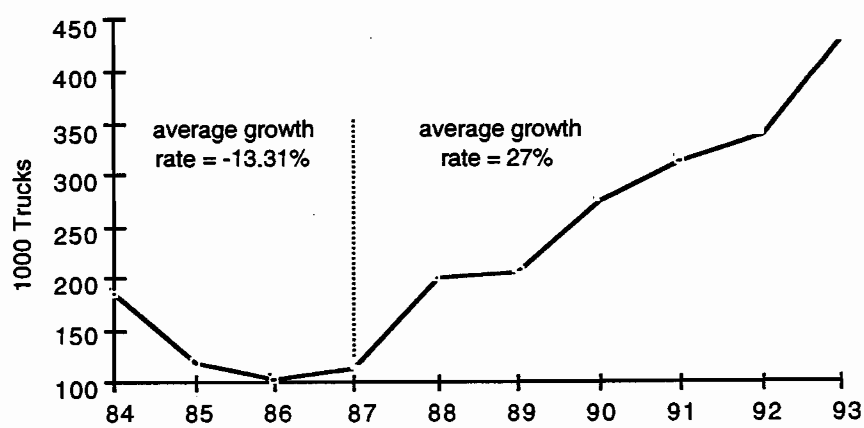

Figure 9.2. Northbound truck traffic — Laredo Sector (Source: U.S. Customs)

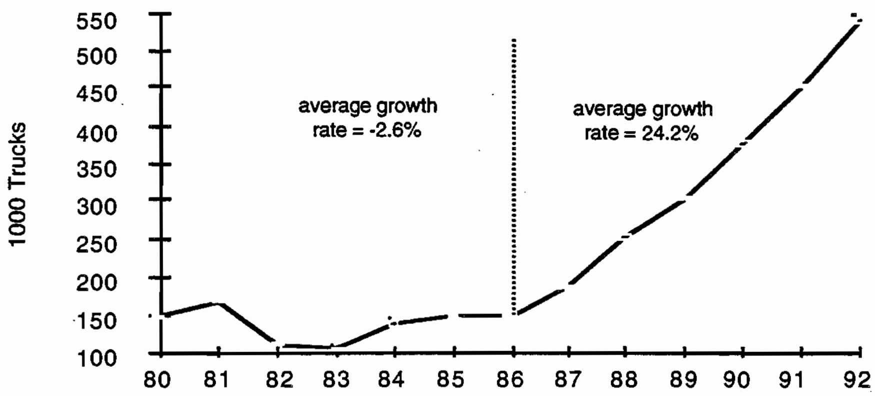

Figure 9.3. Southbound auto traffic — Laredo Sector (Source: Laredo Bridge System)

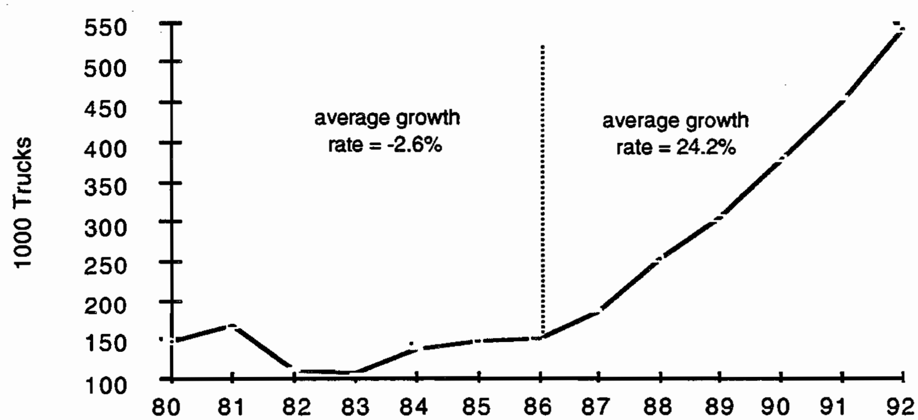

Figure 9.4. Southbound truck traffic — Laredo Sector (Source: Laredo Bridge System)

The data indicate that traffic growth in the Laredo sector for the past ten years has two distinct phases: before and after Mexico joined the General Agreement on Tariffs and Trade (GATT), in late 1986. Before GATT, the average southbound growth rates were 1.17 percent for autos and 2.6 percent for trucks. Between 1987 and 1992, these growth rates increased respectively to 3.6 percent and 24.2 percent. Apparently, GATT encouraged auto growth rates to increase about 2.6 times and truck growth rates to increase ninefold. The latter was observed in conjunction with a 67.3 percent increase in railroad cars during the same period, which reflects the growing U.S.-Mexico trade, and the fact that more than one-third of this trade is transported through Laredo (Ref 1). The growth rates decrease somewhat after 1988, and the years 1986 and 1987 can be regarded as representing a boom from GATT prospect and which implementation put the traffic demand at higher levels. Figure 9.5 depicts a comparison between the southbound auto and truck growth rates from 1981 to 1992. The GATT effect is more impressive for trucks, which changed from a very erratic growth rate pattern to a consistent pattern of high growth.

As discussed in Chapter 3, the traffic predictions assume three scenarios for NAFTA impact: high impact, moderate impact, and low impact. The high impact scenario assumes that NAFTA and GATT would have analogous effects on traffic growth. For autos, the current growth rate trend will be assumed to continue between 1993 and 1996. By 1997, a significant number of barriers will be lifted by NAFTA, and in the high impact scenario this will cause auto traffic to grow at a faster rate. Between 1997 and 2003, the growth rate will first increase, and then stabilize at an average of 8 percent a year, reflecting the gradual removal of trade barriers and its positive impact on the Laredo economy. From 2004 and after, average auto traffic growth will be assumed 1.7 percent a year, reflecting moderate growth under the stabilized situation expected to occur after most NAFTA adjustments take place.

The moderate impact scenario assumes no special impacts from NAFTA. Current auto growth rates are assumed to reflect a trend towards stabilization on a level compatible with normal economic growth. The current trend in auto growth rates will be assumed to continue throughout 2014.

In the low impact scenario, NAFTA negative impact will be felt gradually, with a moderate impact scenario for the first four years, and gradual decrease in growth rates after the NAFTA changes start taking place. This gradual decrease will be represented by an annual average growth rate of 1 percent from 1997 to 2005, and 0.8 percent thereafter. The latter replicates the observed pre-GATT growth rates.

In all three scenarios, the basic assumption for truck traffic is that commercial traffic between the two countries will gradually be transferred to sea and rail, with truck traffic growth stabilizing at a certain rate after 2001. In all cases, the current growth rate of approximately 20 percent was assumed to continue until 1997, when a gradual decrease would take place due to rail and sea competition. This gradual decrease was simulated with a 5 percent growth rate between 1998 and 2000 for all scenarios. After 2001, the rate is 3 percent for the high impact scenario, 2.5 percent for the moderate impact, and 1.5 percent for the low impact scenario. The estimated future traffic for the Laredo Sector is shown in Table 9.1.

Under the high impact post-NAFTA scenario, total auto demand in this sector will be over 14.5 million by the year 2014. This demand drops to 9.5 million under the moderate impact scenario, and to 8.3 million under the low impact scenario. Truck demand under the high impact scenario reaches over 2.3 million by the year 2014, drops to 2.2 million under the moderate impact scenario and 1.95 million under the low impact scenario. Before the year 2000, truck demand is the same under all scenarios, since the assumptions about the impacts of NAFTA deregulation of truck traffic imply that differences among scenarios will be felt mostly in the later part of the analysis period.

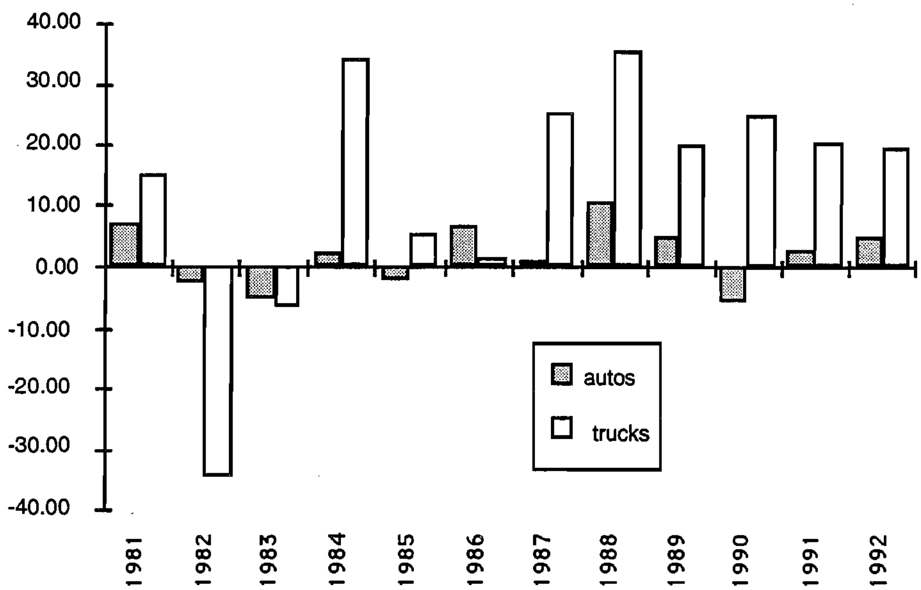

Figure 9.5. Auto and truck growth rates in the Laredo Sector

Table 9.1. Estimated future annual traffic for the Laredo Sector (1000 vehicles)

	Low Impact Scenario		Moderate Impact Scenario		High Impact Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	6802	781	6802	781	6802	781
1995	6917	937	6917	937	6917	937
1996	7035	1125	7035	1125	7035	1125
1997	7154	1350	7154	1350	7598	1350
1998	7226	1417	7276	1417	8205	1417
1999	7298	1488	7400	1488	8862	1488
2000	7371	1563	7525	1563	9571	1563
2001	7445	1610	7653	1610	10336	1610
2002	7519	1634	7783	1650	11163	1658
2003	7594	1658	7916	1691	12056	1708
2004	7670	1683	8050	1733	12261	1759
2005	7747	1708	8187	1777	12470	1812
2006	7809	1734	8326	1821	12682	1866
2007	7872	1760	8468	1867	12897	1922
2008	7935	1786	8612	1913	13117	1980
2009	7998	1813	8758	1961	13340	2039
2010	8062	1840	8907	2010	13566	2100
2011	8126	1868	9059	2060	13797	2163
2012	8191	1896	9213	2112	14031	2228
2013	8257	1924	9369	2165	14270	2295
2014	8323	1953	9529	2219	14513	2364

A conservative assumption underlying truck traffic estimates is the increasing competition of other modes, a supposition inspired by the fact that trucks are not the best solution for an ever-increasing commodity flow. Based on the more optimistic assumption of predominance of truck traffic over other modes, the Laredo Development Foundation (Ref 11) predicts that truck traffic demand in the sector will be between 2.6 and 3.7 million by the year 2000, depending on the intensity of the NAFTA impacts, while under the conservative assumption of multimodalism, truck traffic would be about 1.6 million by the same year. If this study's assumption of multimodalism does not materialize, truck traffic predictions from Ref 11 will be closer to reality than the estimates documented in Table 9.1. These traffic estimates were used in a simplified trip assignment model to estimate the potential traffic diversion to a new hypothetical binational entry system in the sector.

Potential Demand Estimates

Predictions of bridge choice within the Laredo Sector require specific data which are not currently available, and some assumptions were made on origin and destination of local and long-haul trips, factors influencing route choice, travel behaviors, and future land use on both sides of the border. In addition, all existing and hypothetical binational entry systems were assumed to be conveniently accessible from both sides of the border.

Origin and destination data are limited to three sources: a feasibility study for the Pharr Bridge (Ref 4), a Laredo Development Foundation truck shipment study (Ref 11), and a feasibility study for a toll road from Monterrey to Colombia (Ref 18). None of these studies have detailed data that permit specific conclusions about route choices within Laredo, and none was particularly interested in determining detailed origins and destinations of auto traffic. Based on a small auto sample, Ref 4 found that less than 40 percent of the traffic using the Laredo Bridges is local (origin in Laredo and destination in Nuevo Laredo). Recent origin and destination surveys conducted at other border cities consistently found at least 80 percent of local traffic (Ref 21), and descriptive information from different sources indicate that a considerable amount of auto trips are local, while others indicate that Laredo is a preferred route for long-haul trips. Since the percentages of local and long-haul auto trips are not clear, two hypotheses were considered:

(1) Hypothesis 1 (<u>high</u> percentage of <u>long-haul</u> trips)

Laredo to Nuevo Laredo	=	38%
External U.S. to Nuevo Laredo	=	4%
External U.S. to External Mexico	=	42%
Laredo to External Mexico	=	16%

(2) Hypothesis 2 (<u>high</u> percentage of <u>local</u> trips)

Laredo to Nuevo Laredo	=	75%
External U.S. to Nuevo Laredo	=	7%
External U.S. to External Mexico	=	11%
Laredo to External Mexico	=	7%

Lack of land use predictions, socioeconomic forecasts, and detailed origin and destination, coupled with the idiosyncrasies of the Laredo sector, require that a certain number of assumptions be made before estimating the demand for a new binational entry system. The following assumptions were used in the demand estimates (in addition to those discussed in Chapter 3):

(1) Both the hypothetical and the Colombia binational entry systems are fully and conveniently accessible.

(2) Laredo land use in the future will be as predicted by the Laredo City Council.

(3) Future land use in Nuevo Laredo will follow the current pattern.

(4) Any new binational entry system in the Laredo sector will be built outside the downtown areas of both Laredos.

(5) Traffic generation in newly developed areas was taken into account only in terms of route preference of future traffic.

Auto traffic depends on land use, travel behavior, trip purpose, availability of mass transit options, and a number of socioeconomic indicators such as population, employment, and vehicle ownership rates. There are no forecasts of any of these data in the level of detail required to produce accurate estimates of trip production and assignment, and the following additional assumptions are embedded in the bridge choice model for autos:

(1) Sixty percent of traffic going to destinations in the interior of Mexico will bypass Laredo, while the other 40 percent will stop temporarily at Laredo.

(2) Trips going into the interior of Mexico and not coming from IH 35, Laredo, or US 59 are equally split between West and East origins.

(3) Ninety percent of the trips with origins in Laredo and destinations in the interior of Mexico will prefer Laredo 1 and Laredo 2 bridges to a bridge located in the Laredo outskirts.

(4) Autos will always prefer bridges that are more convenient to their origins and/or destinations.

Under existing regulations, foreign truck traffic is prohibited beyond both countries' commercial zones, causing all trucks to stop at a truck yard or warehouse to pass either the trailer to another tractor, or the load to another truck. Most transborder truck trips are actually going from one yard or warehouse to another, and commercial route choices are constrained by locations of yards and warehouses. Since the latter are usually within the city limits of both sister cities, southbound trucks currently prefer the Laredo area bridges over Colombia. This situation may begin to change after the prohibitions are lifted. Nevertheless, interviews with U.S. trucking companies do not indicate a clear picture of the future situation. In some cases, the companies indicate a preference for the old system for southbound traffic, due to the conditions of Mexican roads and language barriers. Other companies have indicated that they are looking forward to the deregulation to operate more efficiently. Most Mexican companies intend on taking advantage of the new regulations, but the Mexican legal load higher than the Texas legal load. In addition, Texas minimum insurance requirements are stricter than those prevalent in Mexico, and it may be more convenient to Mexican companies to continue using the old drayage system instead of upgrading their fleets to comply with Texas law. These legal issues are under discussion, and a sensible scenario at this point is one that allows for gradual change while trucking companies adapt to the new rules, until eventually they all take full advantage of the deregulation. Below is a summary of assumptions used in the traffic diversion model for truck traffic, which includes the deregulation issue discussed above.

(1) No change in current bridge choice until 1998.

(2) Between 1998 and 2000, bridge choices will gradually move out of downtown Laredo, due to better inspection facilities and better traffic circulation in the access/egress on both sides of the border.

(3) After 2001, only 5 percent of trucks in this sector will use Laredo 1 (Gateway to the Americas) and Laredo 2.

(4) The truck shipment origins and destinations determined by the Laredo Development Foundation in 1989 will be the same throughout 2014, and so will the origins and destinations assumed from these data.

(5) Origins of truck cargo are assumed to be as follows: 70 percent from San Antonio on IH 35, 15 percent from Houston on US 59, and the remaining 15 percent local.

(6) Destinations of truck cargo are assumed as follows: 20 percent in the city limits of Nuevo Laredo, 80 percent elsewhere in Mexico.

(7) All warehouses to which the cargo is destined are in Nuevo Laredo (assumption used until 1997).

(8) The elimination of truck traffic restrictions will cause the elimination of 80 percent of empty trucks and of all warehouses by year 2000.

(9) Eighty percent of traffic from IH 35 currently stops at warehouses in the downtown Laredo area, 17.5 percent stops on Mines Road, and 2.5 percent stops at the Union Pacific Facility.

(10) Ninety percent of US 59 traffic goes to downtown Laredo and 10 percent goes to Mines Road.

(11) Trucks will always prefer the bridge that is more convenient to the warehouse to which they are going (assumption used between 1994 and 2000).

Bridge choice models were developed for both autos and trucks, based on the assumptions listed above, and the results are shown in Tables 9.2 and 9.3, respectively, for hypothesis 1 (predominance of long-haul auto trips), and hypothesis 2 (predominance of local auto trips). Departures from the assumptions discussed above, as well as departures from the assumptions used to estimate future traffic in the sector, may cause actual demand to be considerably different than the results shown in Tables 9.2 and 9.3.

Table 9.2. Demand Estimates for a new binational entry system in the Laredo Sector (thousands of vehicles). Hypothesis 1 (high percentage of long-haul auto trips)

	High Impact Scenario		Moderate Impact Scenario		Low Impact Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	2040	266	2040	266	2040	266
1995	2075	319	2075	319	2075	319
1996	2110	382	2110	382	2110	382
1997	2279	459	2146	459	2146	459
1998	2872	496	2547	496	2529	496
1999	3102	595	2590	595	2554	595
2000	3350	703	2634	703	2580	703
2001	3618	805	2679	805	2606	805
2002	3907	995	2724	990	2632	980
2003	4220	1025	2771	1015	2658	995
2004	4291	1055	2818	1040	2685	1010
2005	4364	1087	2866	1066	2711	1025
2006	4439	1120	2914	1093	2733	1040
2007	4514	1153	2964	1120	2755	1056
2008	4591	1188	3014	1148	2777	1072
2009	4669	1223	3065	1177	2799	1088
2010	4748	1260	3118	1206	2822	1104
2011	4829	1298	3171	1236	2844	1121
2012	4911	1337	3224	1267	2867	1138
2013	4994	1377	3279	1299	2890	1155
2014	5079	1418	3335	1331	2913	1172

The results indicate that, on the average, the differences between auto origin and destination assumptions have more impact on the estimated demand than the scenarios for NAFTA effects. Under an optimistic NAFTA scenario, in the year 2014 potential auto demand for this hypothetical binational entry system is 5 million if more auto trips are long-haul, and 3.6 million if more auto trips are local. A moderate impact NAFTA scenario lowers the demand levels to 3.3 and 2.4 million, while a low impact NAFTA scenario leads to 2.9 and 2.1 million, again respectively for hypothesis 1 (predominance of long haul auto trips) and hypothesis 2 (predominance of local auto trips). The differences between NAFTA scenarios averaged 24.9 percent for high impact to moderate impact, and 5.2 percent from moderate impact to low impact, while the average differences between the two origin and destination hypotheses is 35.8 percent. Figure 9.6 compares the differences between the two origin and destination hypotheses, and a pair of NAFTA scenarios. This figure illustrates that the differences in auto origins and destinations have greater impacts on demand than assumed NAFTA scenarios.

Table 9.3. Demand Estimates for a new binational entry system in the Laredo Sector (thousands of vehicles). Hypothesis 2 (high percentage of local auto trips)

	High Impact Scenario		Moderate Impact Scenario		Low Impact Scenario	
Year	Autos	Trucks	Autos	Trucks	Autos	Trucks
1994	680	266	680	266	680	266
1995	692	319	692	319	692	319
1996	703	382	703	382	703	382
1997	760	459	715	459	715	459
1998	2051	496	1819	496	1806	496
1999	2215	595	1850	595	1825	595
2000	2393	703	1881	703	1843	703
2001	2584	805	1913	805	1861	805
2002	2791	995	1946	990	1880	980
2003	3014	1025	1979	1015	1899	995
2004	3065	1055	2013	1040	1918	1010
2005	3117	1087	2047	1066	1937	1025
2006	3170	1120	2082	1093	1952	1040
2007	3224	1153	2117	1120	1968	1056
2008	3279	1188	2153	1148	1984	1072
2009	3335	1223	2190	1177	2000	1088
2010	3392	1260	2227	1206	2015	1104
2011	3449	1298	2265	1236	2032	1121
2012	3508	1337	2303	1267	2048	1138
2013	3567	1377	2342	1299	2064	1155
2014	3628	1418	2382	1331	2081	1172

The differences in auto demand estimates under hypotheses 1 and 2 are basically due to the assumptions that autos prefer bridges that are most convenient to their origins and/or destinations, and that the new bridge will be located outside the main commercial and residential areas. The latter assumptions is conservative, since future land development near the new bridge would make it convenient to more potential users.

Truck traffic is affected primarily by the locations of drayage companies, which were assumed to gradually become obsolete under NAFTA deregulations. Hypotheses 1 and 2 apply to auto traffic and do not affect truck traffic. In the year 2014, potential truck demand for this binational entry system is 1.4 million under the most optimistic post-NAFTA scenario. Under the moderate impact and low impact scenarios, it drops respectively to 1.3 and 1.17 million. These results are based on the conservative assumption of increasing competition with other modes, and they would considerably underestimate the potential truck traffic if it continues to prevail over other modes.

Potential Revenue Estimates

The Laredo Bridge System charges $1.25 for autos and local buses, $8.00 for empty trucks, $4.00 for loaded 2-axle trucks, $6.00 for loaded 3-axle trucks, and $12.00 for loaded trucks with four axles or more. Data on truck classification by axle could not be obtained from the

Laredo bridge system but, field trips to the area indicate a predominance of large trucks. It seems safe to assume, for loaded trucks, 5 percent are two-axle, 10 percent are three-axle, and the remaining 85 percent are four axles or more. This distribution results in an average toll price of $11.00 for loaded trucks.

The average percentage of empty trucks was around 35 percent between 1980 and 1992, with a decreasing trend in the past two years. It was assumed that the percentage of empty trucks will decrease after all traffic restrictions are lifted, which will take place in two main phases. Three years after NAFTA signing, commercial traffic will be allowed into the border states.

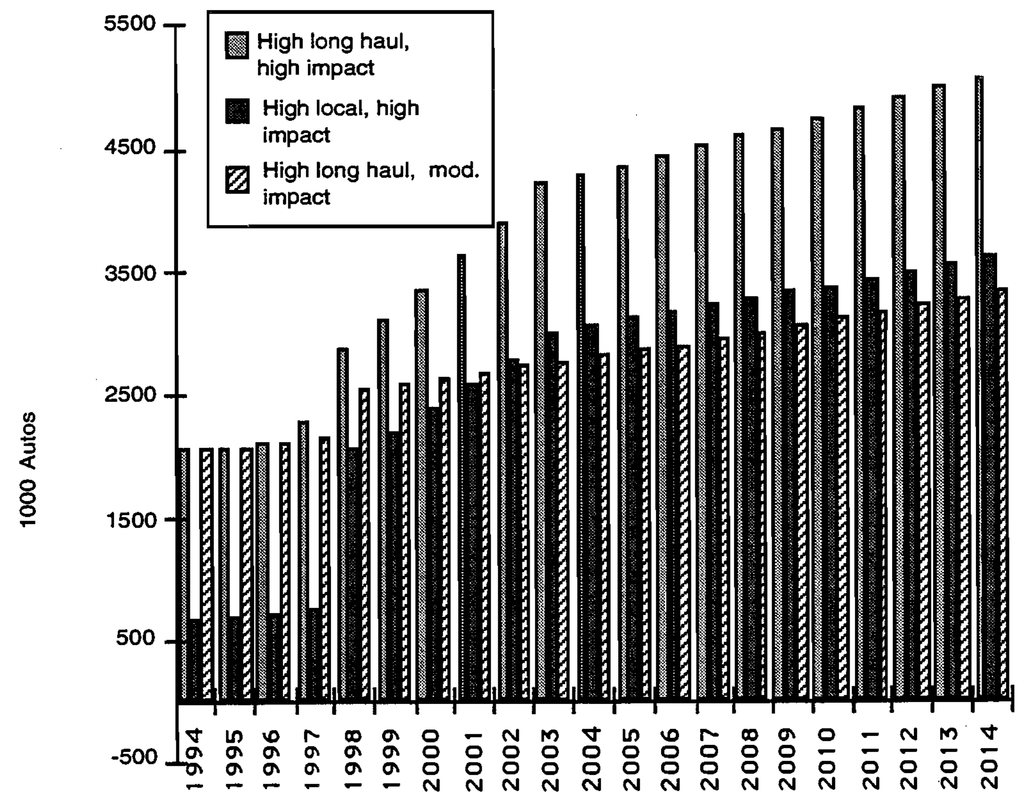

Figure 9.6. Differences in estimated auto demand

Six years after ratification, it will be permitted anywhere within NAFTA territory. Further provisions regard foreign investment in transportation provision. It was assumed that the percentage of empty trucks will drop to 17.5 percent in 1997, and to 10 percent after 1999. Table 9.4 presents the results of the feasibility analysis estimates, based on the assumptions discussed above, as well as on the general assumptions of the feasibility analysis methodology discussed in Chapter 3.

Table 9.4. Net revenue estimates for Laredo Sector (thousands of 1993 dollars)

	High Impact Scenario		Moderate Impact Scenario		Low Impact Scenario	
Year	H1	H2	H1	H2	H1	H2
1995	4062	2264	4062	2264	4062	2264
1996	4777	2948	4777	2948	4777	2948
1997	6046	4071	5873	4013	5873	4013
1998	7226	6159	6803	5857	6780	5841
1999	8611	7459	7946	6984	7899	6951
2000	10275	9031	9345	8366	9274	8316
2001	11755	10412	10535	9540	10440	9472
2002	14244	12793	12653	11641	12425	11448
2003	14980	13413	12986	11957	12620	11633
2004	15412	13818	13326	12279	12818	11820
2005	15853	14232	13672	12607	13015	12008
2006	16305	14657	14024	12942	13207	12192
2007	16769	15092	14384	13283	13401	12378
2008	17243	15538	14751	13632	13596	12564
2009	17729	15995	15125	13987	13792	12752
2010	18227	16463	15506	14348	13988	12940
2011	18738	16944	15896	14718	14187	13130
2012	19260	17436	16293	15095	14386	13321
2013	19797	17942	16698	15480	14588	13514
2014	20346	18459	17111	15872	14790	13708

H1: predominance of long-haul auto trips
H2: predominance of local auto trips

Conclusions

By the end of the bond liability period (2014), yearly net revenues have a potential to reach over $20 million (1993 dollars) under the most optimistic combination of assumptions, which is predominance of long-haul auto trips and high impact NAFTA scenario. Under the same origin and destination assumption, the highest potential revenues drop to $17 million for a moderate impact NAFTA scenario, and to 14.8 million under a more pessimistic NAFTA scenario, while they drop to $18.5 million under the assumption that local auto trips prevail, and an optimistic NAFTA scenario. These changes are illustrated in Figure 9.7, which compares the net revenues for both auto trip hypothesis under an optimistic NAFTA scenario, with a moderate impact NAFTA scenario for the first auto trip hypothesis. This figure helps visualize the influences of NAFTA impacts and auto origin and destinations on potential revenues.

During the first five years of the liability period, auto origin and destination has more impacts on the revenues than NAFTA scenarios. This is due to the assumption that NAFTA impacts will start to be felt primarily after 1997, when important deregulations will take effect. After 2000, NAFTA scenarios will have more influence on revenues than auto origins and destinations. On the average, changes in auto origin and destination assumption cause revenues to drop 13 percent, while a change in NAFTA impacts assumption cause a 10 percent drop from high impact to moderate impact, and a 5 percent drop from moderate impact to low impact.

Under the most pessimistic combination of assumptions, (a low impact post-NAFTA scenario and a predominance of local auto trips that prefer the downtown bridges) the estimated net revenues reach the coverage ratio of 1.5 in third year of operation, and an average bond coverage ratio of 3.8 throughout the liability period, indicating a high potential feasibility of a new binational entry system in this sector.

CAPACITY ANALYSIS OF THE LAREDO SECTOR

This section discusses the current capacity utilization of the three binational entry systems in the Laredo sector, namely Gateway to the Americas (Laredo 1), Laredo 2, and Colombia. This analysis follows the methodology described in chapter 2, and it focuses on the identification of current and potential congestion. The analysis encompasses each binational entry system component in each direction: the access, the toll booth, the bridge, the inspection facilities, and the exit or egress.

Gateway to the Americas (Laredo 1) Binational Entry System

Access to and egress from the Gateway to the Americas Bridge are provided by Convent Street, and its signalized intersection with Zaragoza Street is assumed to constrain the southbound access and northbound egress to the bridge. In Nuevo Laredo, the immediate access and egress to this bridge consists of narrow streets one block north of a central business district (CBD) area. Figure 9.8 shows the access/egress facilities in the U.S. and Mexico for the Gateway to the Americas Bridge.

Southbound access has one lane for southbound through traffic on Convent Street and one lane for westbound traffic turning left on Zaragoza Street. The analysis assumes that all southbound bridge traffic utilizes the southbound approach on Convent Street, and that additional non-bridge traffic utilizes Zaragoza Street at a flow rate of 0.20 veh/sec. This provides a conservative estimate of the intersection's capacity utilization in terms of international traffic.

Flow rates were estimated for the north/south approaches on Convent Street utilizing bridge traffic data. A two-phase, 60-second cycle length signal was used, and green times were allocated by equal degrees of saturation yielding a volume to capacity (v/c) ratio of 72 percent for both the southbound access and northbound egress.

The intersections in the CBD area, just one block from the bridge, were assumed to constrain the access and egress capacity in Nuevo Laredo. These intersections were not analyzed because no traffic volume information is available for downtown Nuevo Laredo.

The other components' capacity utilization were analyzed based on the methodology described in Chapter 2, and Figure 9.9 summarizes the results. In the southbound direction, the U.S. toll facility is estimated to be operating over capacity conditions for both autos (v/c= 128 percent) and trucks (v/c=105 percent), based on the assumption that one of the three southbound toll lanes functions as a defacto truck lane during peak periods. Field observations corroborate this assumption, since southbound trucks exiting the export lot just upstream of the toll facility do in fact force autos to use only two of the toll lanes.

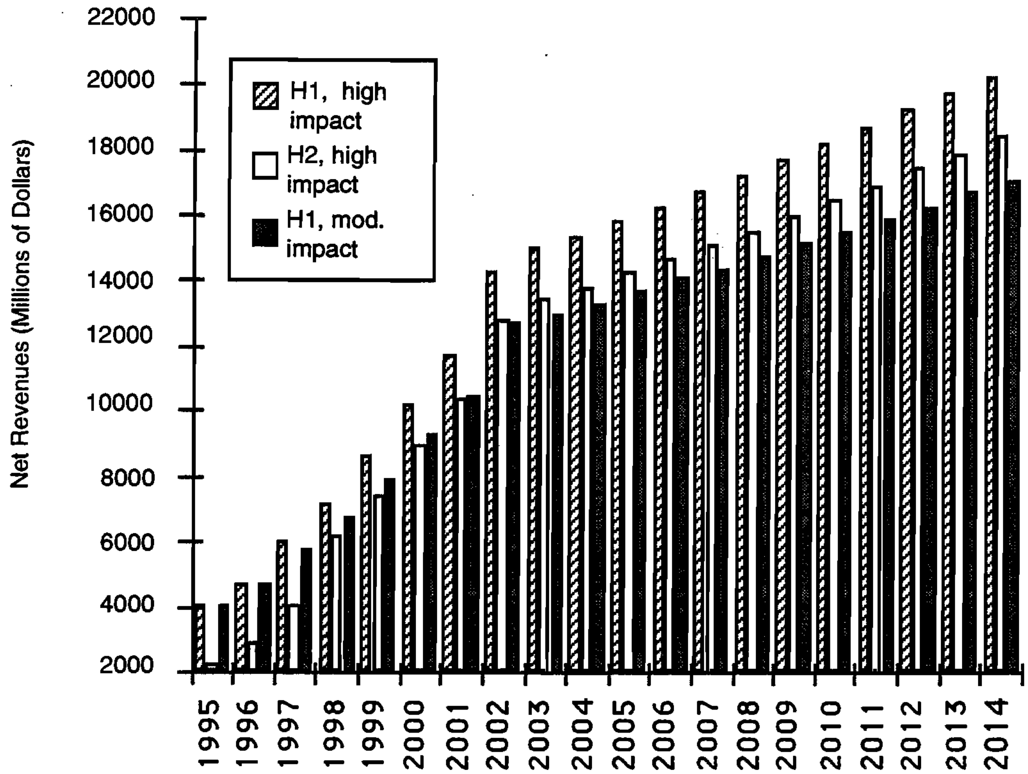

Figure 9.7. Differences in potential net revenues

H1: predominance of long-haul auto trips
H2: predominance of local auto trips

The Mexican primary inspection for trucks is estimated to be operating at 200 percent capacity utilization with all lanes open; this causes truck traffic back-ups on the bridge, which in turn causes one lane on the bridge span to function as a defacto truck lane. The bridge span component is estimated to be operating under capacity, assuming one lane on the bridge span is dedicated for truck traffic. Finally, the southbound access component and the Mexican primary inspection for autos are estimated to operate respectively at v/c values of 72 percent and 73 percent, still below capacity.

Poor traffic circulation in the southbound direction is due to congestion at the toll booths, which causes traffic back-ups on the bridge access, and the Mexican inspections, which cause traffic back-ups along the bridge. This sequence of queues causes the binational entry system components to appear congested.

In the northbound direction, the main source of congestion is the U.S. primary inspection of non-commercial traffic (all northbound commercial traffic in Laredo must cross either Laredo 2 or Colombia), estimated to operate at 179 percent capacity with all lanes staffed. The second busiest component is the Mexican northbound toll collection, which is operating under capacity with a v/c value of 69 percent. Congestion at the U.S. primary inspection causes traffic back-ups across the bridge into other binational entry system components, and relief of this source of congestion would improve northbound traffic circulation.

Laredo 2 (Juarez-Lincoln) Binational Entry System

Southbound access to and northbound egress from the Laredo 2 Bridge are provided by the IH-35 extension, called Santa Ursula Avenue in the southbound direction, and San Dario Avenue in the northbound direction, as shown in Figure 9.10. The signalized intersection at Santa Ursula/San Dario Avenues and Hidalgo Street was assumed to constrain U.S. southbound access and northbound egress for the Laredo 2 Bridge. In Nuevo Laredo, commercial traffic has an exclusive exit from the bridge, while non-commercial traffic goes to an unsignalized intersection, also shown in Figure 9.10.

No traffic data were collected at these intersections, and their capacity utilizations were analyzed based on some assumptions. In Laredo, a flow rate of 0.20 veh/sec was assumed for Hidalgo Street, while Santa Ursula and San Dario Avenues were assumed to be utilized primarily by international traffic. Assuming an actuated signal with a 30-second cycle length, and allocating green times at equal degrees of saturation, a v/c ratio of 48 percent is obtained for both the southbound access and northbound egress at the Laredo 2 bridge.

In Nuevo Laredo, the immediate access and egress for the Juarez-Lincoln bridge is not signalized, and the southbound egress was assumed to be stop-sign controlled. Traffic volumes on the cross street at this intersection were not collected in Nuevo Laredo, and were assumed to be 20 percent of southbound auto bridge traffic. In addition, the following assumptions were made for the southbound egress stop controlled traffic analysis:

(1) The critical gap (T_C) is 6.5 seconds. This critical gap is higher than needed in most cases, and thus yields a conservative capacity estimate.

(2) The actual capacity of southbound egress from the bridge is 713 vph per lane.

(3) Two lanes are available for southbound egress.

Based upon these assumptions, the analysis indicates that the capacity utilization for the southbound egress component at Laredo 2 is 58 percent.

The northbound access to the Laredo 2 bridge in Nuevo Laredo is composed of three westbound lanes on the cross street in front of the bridge for autos, and one additional lane that acts as a defacto truck lane. These lanes have no intersection control immediately in front of the bridge, and under these conditions the v/c ratio of the three auto lanes is estimated to be 24 percent. The defacto truck lane was assumed as level terrain (E_T=1.7), which yields a v/c ratio of 26 percent.

The capacity utilization of the other binational entry system components were analyzed based on the methodology and assumptions discussed in chapter 2, and on the additional assumption that one southbound lane on the bridge span acts as an exclusive truck lane. Figure 9.11 summarizes the capacity analysis results. In the southbound direction, the most congested components are the U.S. toll collection facility for trucks (v/c=123 percent), and the Mexican primary inspection of trucks (v/c=175 percent), while the U.S. southbound toll collection for autos is operating near capacity with a v/c ratio of 81 percent with all lanes open. In the northbound direction, both U.S. primary inspection and Mexican toll collection facilities for both autos and trucks are operating over capacity even with all lanes open. The bridge span is operating well below capacity; the exclusive truck lanes are at 46 percent capacity in the southbound direction and 50 percent in the northbound direction. Congestion observed at the bridge lanes is due primarily to traffic back-ups at the toll and inspection facilities, in both directions.

Colombia Binational Entry System

As discussed in the background section, the Colombia binational entry system is an impressive facility, which was planned and designed to operate efficiently. It has features such as:

(1) Dedicated truck lanes into the cargo area,
(2) Adequate truck docks,
(3) Adequate staging area for cargo trucks,
(4) Sufficient space for customs broker facilities,
(5) Dedicated break bulk area,
(6) Truck scale,
(7) Cargo containment facility,
(8) X-ray equipment to expedite cargo inspections, and
(9) Hazardous material waste disposal facility.

All components of the Colombia binational entry system have very high capacity, but Colombia is evidently operating at a small fraction of its capacity. Nevertheless, estimates of capacity utilization were made using the capacity analysis methodology discussed in Chapter 2, to give an idea of the excess capacity available in this binational entry system. The results are summarized in Figure 9.12.

The capacity analysis results indicate that the highest v/c ratio is at the Mexican primary inspection for trucks, which is operating at 7 percent of its theoretical capacity, and the second highest is at the U.S. primary inspection for trucks, operating at 5 percent. It must be pointed out, however, that Colombia has high-tech inspection technologies that expedite truck inspections, and this feature is not taken into account in the capacity analysis methodology (Chapter 2). Consequently, the 5 percent capacity utilization is a conservative estimate based on the implicit assumption that the equipment for expeditious inspections is inoperative.

Summary of Results

The capacity utilization analysis examines each binational entry system's component separately to identify the actual sources of traffic congestion. This identification is difficult with field observations, since some components with excess capacity available may appear congested due to traffic queues extending from other components that are operating over capacity. A summary of the capacity utilization of each component of the three binational entry systems in the Laredo sector is shown on Table 9.5.

Table 9.5. Summary of capacity utilization of Laredo's binational entry systems

		Binational Entry System		
	Component	Laredo 1	Laredo 2	Colombia
	Access	72%	48%	n/d
	Toll (autos)	128%	81%	1%
South-bound	Toll (trucks)	105%	123%	n/d
	Bridge Span (autos)	52%	47%	4%
	Mexican Primary Inspection (autos)	73%	46%	4%
	Mexican Primary Inspection (trucks)	200%	175%	7%
	Egress	n/d	58%	n/d
	Access	n/d	26%	n/d
	Toll (autos)	69%	116%	1%
North-bound	Toll (trucks)	n/a	131%	1%
	Bridge Span (autos)	23%	50%	4%
	U.S. Primary Inspection (autos)	179%	106%	2%
	U.S. Primary Inspection (trucks)	n/a	150%	5%
	Egress	72%	48%	n/d

n/a: not applicable
n/d: no data.

In the southbound direction, the U.S. toll collection for autos and trucks at Gateway to the Americas (Laredo 1) are estimated to operate over capacity, with v/c values of 128 percent and 105 percent, respectively. The Mexican primary inspection for trucks is also operating over capacity, with a v/c ratio of 200 percent. In the northbound direction, the U.S. primary inspection facility is estimated to operate at 179 percent capacity, and the bridge egress operates near capacity, at 72 percent.

At Laredo 2, the analysis indicates the Mexican primary inspection for trucks as the most congested component, operating over capacity at a v/c ratio of 175 percent. Still in the southbound direction, the U.S. toll collection facility is operating with a v/c of 123 percent for trucks, and at 81 percent capacity for autos. In the northbound direction, the U.S. primary inspection and Mexican toll collection operate over capacity for autos and trucks, at v/c ratios respectively of 116 percent and 131 percent in Mexico, and 106 percent and 150 percent in the U.S.

The results indicate that, theoretically, additional bridge lanes are not needed at this point to alleviate traffic congestion in this sector, since in the worst case (Laredo 2) the truck lanes operate at 50 percent capacity, while the auto lanes operate at 32 percent, suggesting that assignment of an extra truck lane might be indicated during peak hours. The access/egress components are also operating below capacity, the worst v/c ratio being 72 percent for Laredo 1 on the U.S. side. The most congested components are the toll plazas and inspection facilities on both sides of the border.

Table 9.6 shows a comparison between the total available capacity and the capacity utilization at the Laredo Sector. This summary is based on approximations necessary to aggregate capacity utilization of similar components of different binational entry systems. Total available capacity of northbound auto primary inspection was almost at full capacity at the time the analysis was made (1992 data), and traffic is continuing to grow in this sector. Full capacity utilization of the primary inspection component usually implies a domino-effect: primary inspection queues block traffic at the bridge all the way to the toll booths, which are already congested and causing traffic back-ups into the bridge access. The latter are operating below capacity, but queues from toll plazas and primary inspections can cause a significant amount of congestion on narrow streets already operating at over 50 percent capacity. The results are felt as an overall congestion of the entire binational entry system. Evidently, this situation requires correction, but it is important that future infrastructure address the actual sources of congestion to prevent repetition of the same problems.

Table 9.6. Summary of capacity utilization at Laredo Sector

Bin. Ent. Syst. Component	Southbound Direction		Northbound Direction	
	Total Available Capacity	Total Capacity Utilization	Total Available Capacity	Total Capacity Utilization
Toll (auto)	2,847	52%	2,774	59%
Toll (truck)	342 (*)	117% (*)	1,200	33%
Bridge span (auto)	8,700	17%	11,120	15%
Bridge span (truck)	900 (*)	40% (*)	900 (*)	40% (*)
Primary inspection (auto)	6,300	24%	1745	94%
Primary inspection (truck)	540	74%	390 (*)	103% (**)

Based on k-factors of 9 percent for autos and 15 percent for trucks.
(*) approximate
(**) does not take into account Colombia's equipment for expeditious inspections

Theoretically, traffic circulation in this sector could be considerably improved by expanding and fully staffing the toll plazas and the primary inspection facilities, and by making sure that the high-tech inspection equipment available at Colombia is fully utilized to expedite truck primary inspection. However, the required land for expansion of primary inspection and toll plazas does not seem available in the downtown areas of Laredo and Nuevo Laredo.

CONCLUSIONS AND RECOMMENDATIONS

The considerable traffic growth observed in this sector is partly due to the increasing economic activity in the area, and partly due to Laredo's convenient location as a corridor for U.S.-Mexico trade. During 1991, Laredo handled 38 percent of all U.S. exports into Mexico, which translate into 56 percent of the U.S. exports that are shipped through the Texas-Mexico border. These numbers show that Laredo bridges are serving an important share of the national interests of both countries, in addition to providing a link between two cities for personal and business trips. There is a clear need for additional infrastructure to continue serving these important functions; the capacity and feasibility analyses discussed in this chapter diagnose the reasons for congestion, and provide guidelines for coordinated transportation planning in this sector.

Capacity Utilization and Feasibility of a New Binational Entry System

The capacity analysis results indicated that the main constraints to traffic circulation on Laredo 1 and 2 are the inspection procedures and toll plazas, followed by the access/egress facilities. The bridges themselves are operating at a low percentage of their full capacity, but additional binational entry systems in this sector may be necessary because expansion of inspection areas and toll plazas are not possible in the downtown areas of both Laredos. This fact can be used as a favorable argument for new binational entry system proposals, and the feasibility analysis indicated that a new binational entry system in this sector is feasible even under the most pessimistic combination of assumptions, which are a low impact post-NAFTA scenario, and a high percentage of local auto trips that prefer the downtown bridges.

Recommendations

While Gateway to the Americas (Laredo 1) and Laredo 2 are heavily congested within the problematic components where traffic must stop and queue, the Colombia binational entry system operates with considerable excess capacity available; its highest v/c value is 7 percent, which is the Mexican primary inspection for trucks. Clearly, a better utilization of this binational entry system would have a positive effect on the traffic circulation in this sector, especially if trucks are encouraged to avoid the downtown areas and utilize Colombia.

The capacity of primary inspection and toll collection components is a function of two variables: layout of the facility and staffing capabilities. For example, if a new binational entry system is built in the sector, but inspection agencies have to juggle existing staff between the old and the new inspection facilities, the bottlenecks - and the resulting congestion -will continue to exist. Plans for a new binational entry system must also take into consideration the fact that traffic must always stop at toll plazas and inspection components, and the facility layout must have enough waiting area to prevent these unavoidable queues from congesting the rest of the binational entry system. Coordinated transportation planning is the only answer to this dilemma, and plans for additional infrastructure should start with an objective comparison between the required and available capacities of the most congested components. In many cases, better staffing or more efficient procedures would make more difference to traffic flow than additional bridge lanes.

Future truck traffic estimates are very high for this sector, even under the conservative assumptions used, and trucks have an enormous potential to cause congestion in urban areas. A new binational entry system at or near an urbanized area that is open to truck traffic would soon become as congested as Laredo 1 and 2.

Auto occupancy and percentage of loaded trucks are also important factors influencing traffic flows. Currently, the average auto occupancy at the Texas-Mexico Border is two people per car and the average percentage of empty trucks is 40 percent. There is a tremendous potential for improving the transborder traffic just by encouraging high occupancy vehicles, implementing mass transit options and discouraging unloaded trucks. Current toll schedules may contribute to this problem, by charging about 5 to 6 times more for loaded trucks than for empty.

The process of providing and operating infrastructure in the border area involves many agencies at all levels, from federal to local, in both countries. Each entity has its own mission and budget, and their priorities may not coincide. In addition, agencies such as U.S. Customs and INS have problems to staff a large number of bridges and are interested in a more efficient use of the existing ones. There is a pressing need for coordinated planning at the border, and the ideal situation would be a coordinated effort combining U.S. Federal agencies, Mexican Federal agencies, U.S. and Mexico border states Departments of Transportation, and border city representatives.

Multimodalism and intermodalism seem a better solution to meet an increasing demand for transborder commodity flow. The Laredo sector is a good candidate for a super-crossing, and the Colombia Bridge already has several of the super-crossing elements already in place. The advantages of diverting truck traffic to a binational entry system located outside any urban concentrations are many in this sector, and absence of congestion caused by trucks may encourage additional auto demand.

There is a strong feeling that traffic circulation at the border cannot be improved unless mass transit and multimodal options are available, high occupancy lanes are encouraged, and inspection procedures are expedited. Cd. Juárez city officials are now discussing with U.S. Customs and Immigration and Naturalization officials the possibility of implementing several suggestions, some of which are also applicable to the Laredo sector. These are:

(1) Create a pre-clearance system for frequent auto travelers with known (previously checked) backgrounds, and reserve the primary inspection for general traffic.

(2) Encourage transborder mass transit, and implement a park-and-ride system to link Laredo and Nuevo Laredo. The transborder mass transit vehicles would park on a special parking lot, and inspection procedures would be done on pedestrians, rather than on cars waiting on queues.

(3) Create and encourage high occupancy lanes in Laredo1 and 2.

The mass transit options have an enormous potential to improve traffic circulation, but its efficient implementation requires harmonization of U.S. and Mexican standards for vehicles, while simultaneously obeying Mexican laws about circulation of imported vehicles. NAFTA will remove the latter barrier, and make mass transit services more attractive to investors and service providers as soon as standards are harmonized. It is strongly recommended that mass transit options be seriously considered by city officials on both sides of the border. A feasibility study of mass transit services would provide interesting insights on profitability of a city-owned service. The City of Laredo should also consider joint-ventures to upgrade Colombia into a super-crossing designed to serve most of the long-haul commercial traffic.

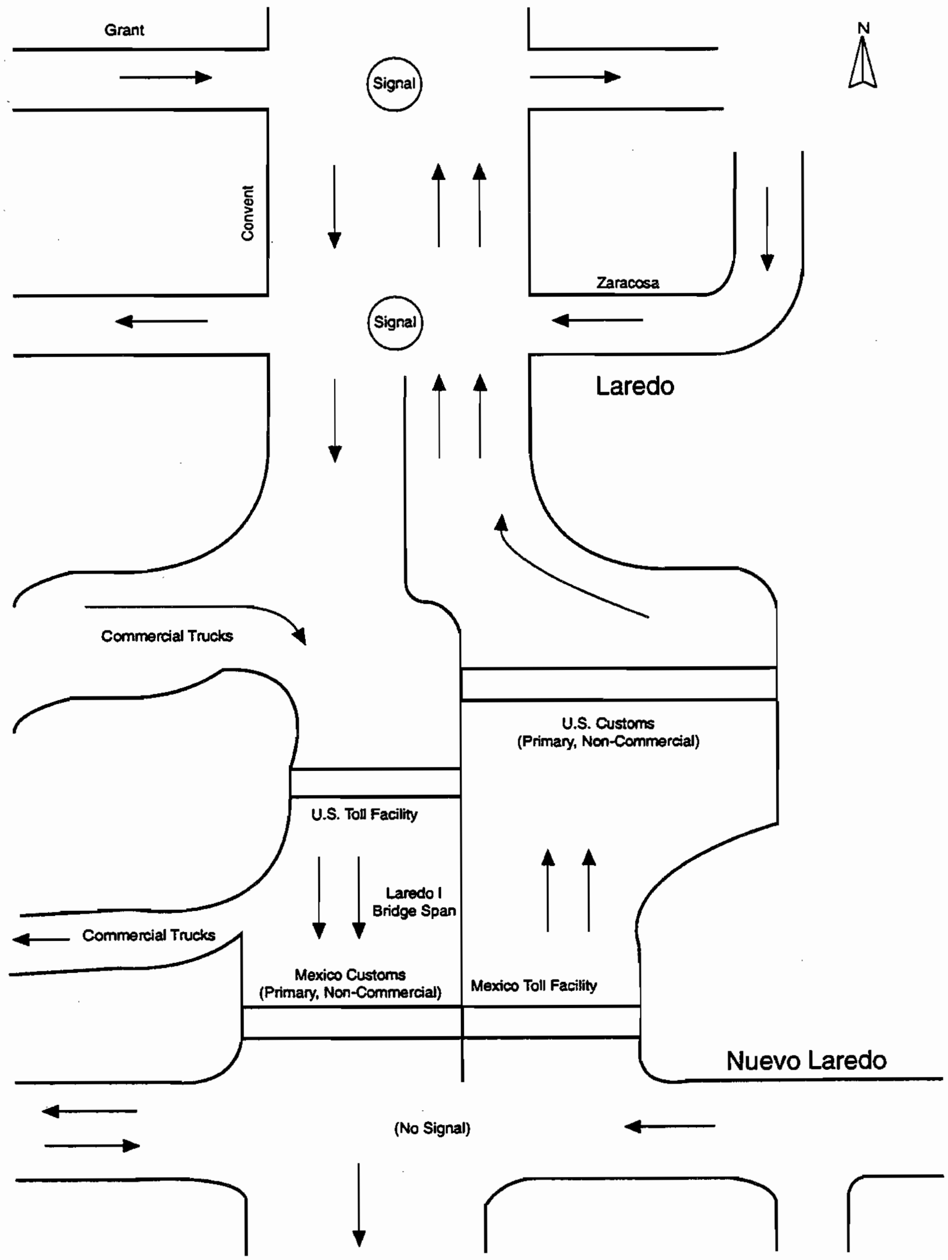

Figure 9.8. Gateway to the Americas access and egress

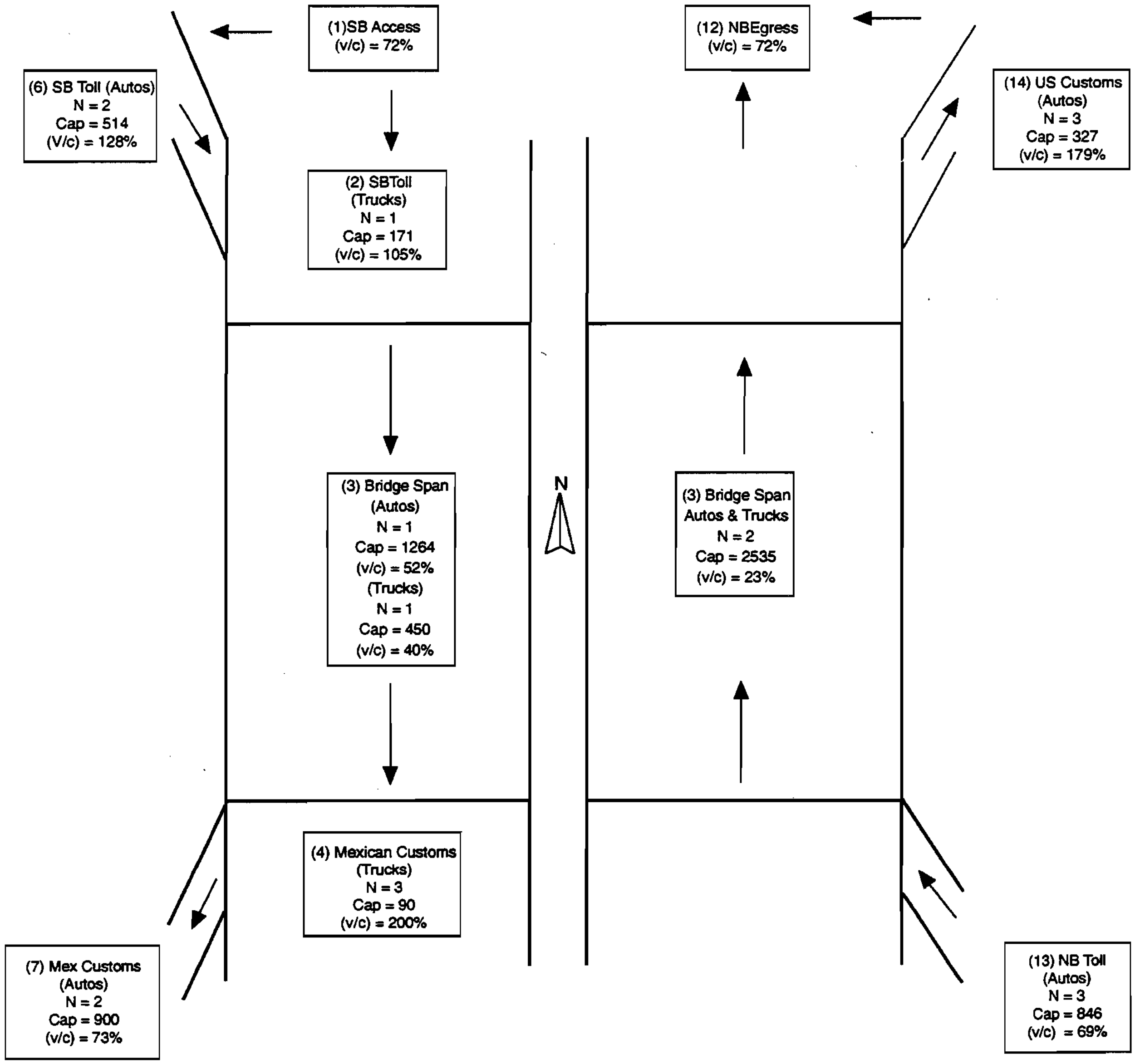

Figure 9.9. Laredo 1 capacity utilization

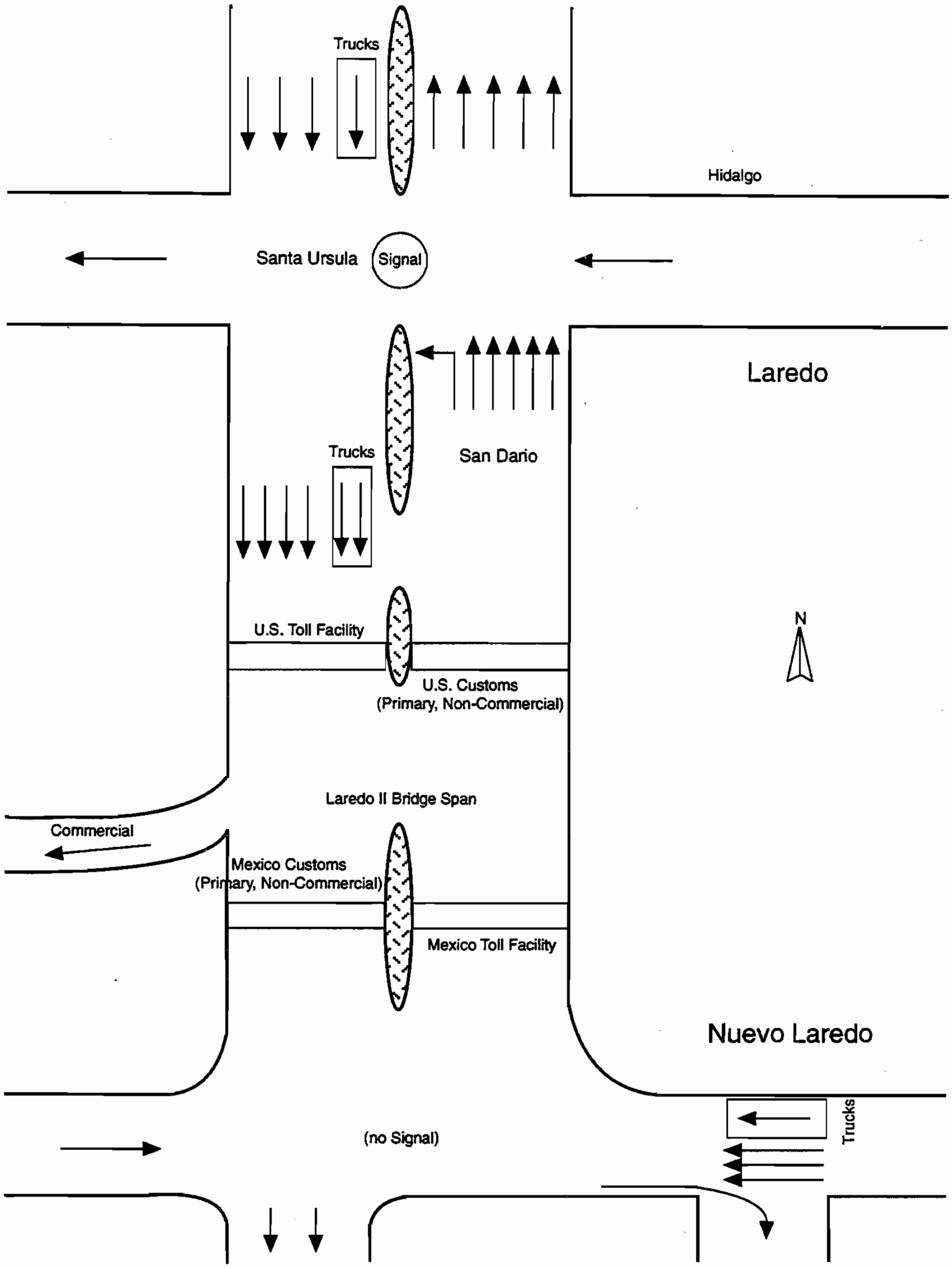

Figure 9.10. Laredo 2 access and egress

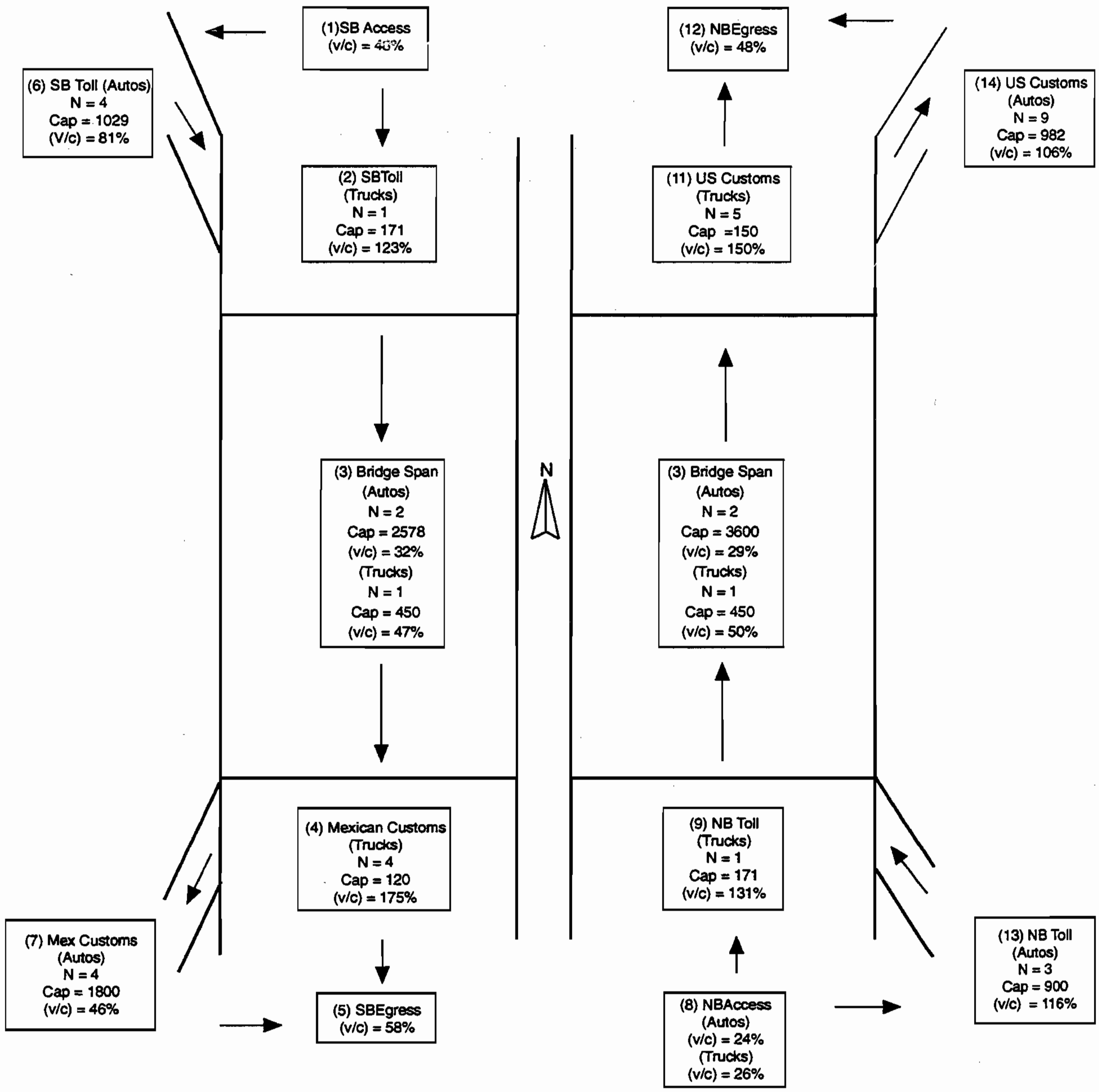

Figure 9.11. Laredo 2 capacity utilization

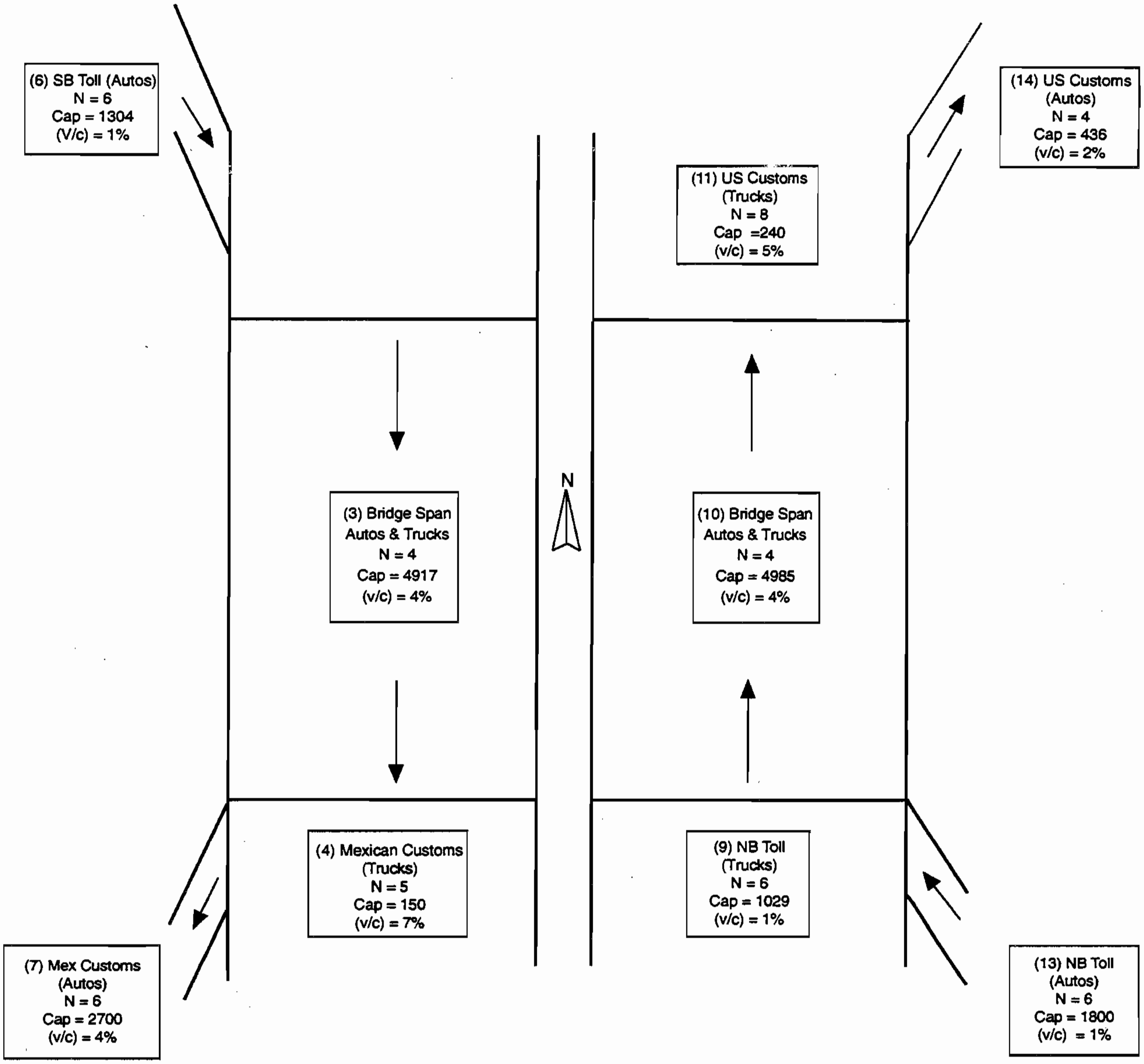

Figure 9.12. Colombia capacity utilization

CHAPTER 10. CONCLUSIONS AND RECOMMENDATIONS

The increasing traffic at the Texas-Mexico border region, coupled with the recent North American Free Trade Agreement (NAFTA), prompted the Texas Department of Transportation (TxDOT) and the Texas Turnpike Authority (TTA) to seek technical guidance on the current status of the border transportation infrastructure, as well as on the potential demand for additional infrastructure to cross the Rio Grande. A particular feature of this study was the use of an aggregated analysis approach, in which individual sites are grouped into specific sectors. Such an approach—the sector analysis concept—overcomes the obstacle inherent in predicting the potential demand at specific proposed sites along the border, and allows planners to address the Texas-Mexico border area from a binational transportation planning perspective.

This report documents the results of the sector analysis of Texas-Mexico border Segment 1 (Gulf to Laredo), which comprises two parts: evaluation of the current capacity utilization, and an analysis of the potential feasibility of additional binational entry systems in each sector. These results are used as a basis for recommendations and guidelines for effective transportation planning along the Texas-Mexico border.

CAPACITY ANALYSIS APPROACH

Proper identification of transportation infrastructure needs starts with an evaluation of the current capacity utilization of the facilities, which identifies existing and potential congestion. Traditional methods of evaluating capacity utilization were developed for facilities that do not incorporate the complexities of an international trip, and can be directly applied only to some components of a binational entry system.

The capacity analysis approach developed by CTR started with proper disaggregation of a Texas-Mexico binational entry system into fourteen major components. These components are:

(1) Southbound Access,
(2) Southbound Toll (trucks),
(3) Southbound Bridge Span,
(4) Southbound Mexican Primary Inspection (trucks),
(5) Southbound Egress,
(6) Southbound Toll (autos),
(7) Southbound Mexican Primary Inspection (autos),
(8) Northbound Access,
(9) Northbound Toll (trucks),
(10) Northbound Bridge Span,
(11) Northbound U.S. Primary Inspection (trucks),
(12) Northbound Egress,

(13) Northbound Toll (autos), and

(14) Northbound U.S. Primary Inspection (autos).

Each component was evaluated separately, and the results estimate the percent utilization of the total theoretical capacity of each component. Since these components reflect a sequential traffic processing, the overall binational entry system capacity is given by the lowest of its components' capacity. The capacity analysis results are based on the following assumptions:

(1) All existing toll and primary inspection lanes are fully staffed.

(2) AADT estimates discussed in Chapter 2 represent the actual annual average daily traffic for 1992.

(3) The peak hour volumes are 9 percent of the auto AADT (k_a=0.09), and 15 percent of the truck AADT (k_t=0.15), for the entire border (based on the analysis discussed in Chapter 2).

(4) The average processing rates collected for the toll booths, northbound inspections, and southbound inspections are representative of all binational entry systems along the Texas-Mexico border.

(5) The analysis of the access and egress components on both sides of the border is based on limited data, and all additional assumptions concerning signal timing and turning movements at intersections are either valid or conservative.

(6) Signal timing phases are estimated for signalized intersections, and green time proportions are estimated based upon the critical flow rates for each assumed phase. Whenever appropriate, minor cross streets were assumed to be actuated, and a minimum green time was allocated to the minor street movements. Elsewhere, green times were estimated based upon equal degrees of saturation per assumed phase.

The capacity analysis approach was developed to diagnose traffic circulation problems, indicating which component of the binational entry system is the weakest link in the traffic flow sequence (an eight-lane bridge cannot be fully used if it ends in a narrow downtown street, or if the inspection facility is congested). As such, the capacity analysis results indicate which sectors are in immediate need of additional infrastructure, and why. The demand and revenue analyses can assist in determining whether a new toll bridge is profitable.

APPROACHES FOR DEMAND AND REVENUE ANALYSES

In the U.S., a new binational entry system is usually proposed locally, and proponents need to repay the initial investment using toll revenues. Revenues are a direct function of the demand, but an unfeasible binational entry system is not necessarily dispensable. Conversely, a feasible binational entry system may not be the best solution to improve traffic circulation in a particular sector. Coordinated border transportation planning needs to take into account these two aspects; accordingly, the feasibility analysis provides an indication of the potential feasibility of a new binational entry system in the sectors and, when coupled with the capacity analysis, provides an overall evaluation of border transportation needs.

Discussion

The feasibility analysis of new binational entry systems in a border sector includes four sequential steps, which are:

(1) Traffic analysis, which provides an estimate of future traffic for the entire sector;

(2) Demand analysis, which provides an estimate of traffic demand for the new (hypothetical) facility;

(3) Estimate of potential gross revenues; and

(4) Financial analysis, which provides an estimate of potential net revenues of the new facility (an indication of its feasibility).

The major assumptions used when developing the four-step approach for the 20-year feasibility analysis period are:

(1) Depreciation costs are included in operations and maintenance (O&M) costs;

(2) The O&M costs discussed in Chapter 3 represent the expected values of these costs over the entire analysis period;

(3) The revenues from the hypothetical binational entry system do not need to be shared with other expenses, such as compensating for revenues diverted from other binational entry systems in the same sector;

(4) Funding for implementing the project will come from revenue bond sales;

(5) Revenue bonds are sold at an 8 percent effective interest rate, with a 20-year maturity period;

(6) Throughout the analysis period, the existing toll structure in the sector will remain in effect for all facilities, keeping up with inflation so that its present value at any time is exactly the same as the base year value;

(7) The majority of pedestrian traffic in every sector will always prefer the old bridges because of their convenient downtown location;

(8) All bridges were considered as open and operating in 1995;

(9) Only one additional facility will be constructed in the sector during the analysis period;

(10) New bridges are effectively designed, efficiently operated, fully staffed, and clearly identified along all the access routes, in order to promote maximum utilization of the new facilities;

(11) Motor fuel will remain in adequate supply and future price increases will not substantially exceed the overall rate of inflation; and

(12) There will be no national, regional or local emergency that will abnormally restrict the use of motor vehicles in either country.

In addition, each sector requires specific assumptions on a case by case basis, as discussed in the pertaining chapters. Departures from any of these assumptions may substantially change the conclusions about the feasibility of a new binational entry system in the sector. Assumption (3) is especially important. All the conclusions regarding feasibility, break-even points, and bond coverage rations assume that the revenues generated by the hypothetical facility will be used exclusively to repay the debt, meet bond obligations, and pay O&M expenses. Actual use of revenues to pay for other expenses, such O&M of other binational entry systems in the sector, would invalidate the conclusions.

Each sector requires specific assumptions on a case-by-case basis. Departures from any of these assumptions may substantially change the conclusions about the feasibility of a new binational entry system in the sector. Nevertheless, demand and revenue analyses results, coupled with the current capacity assessment, can provide valuable guidelines about the border infrastructure needs. These guidelines are preliminary in nature, and cannot substitute for project-level analyses of traffic demand, or for a detailed revenue forecast for bond issuance.

BROWNSVILLE SECTOR

The Brownsville Sector serves about 25 percent of the traffic of the Texas-Mexico border Segment 1, and it has two binational entry systems: B&M and Gateway, both located within the urban areas of Brownsville and Matamoros. There are three proposals for a new binational entry system in this sector: Port of Brownsville, Los Tomates, and Flor de Mayo.

Conclusions

The capacity analysis indicates that U.S. primary inspection and toll collection components are the main bottlenecks in this sector. Theoretically, traffic circulation could be considerably improved by expanding and fully staffing the toll plazas and the primary inspection facilities, and by improving the access and egress components on both sides of the border. However, the required right-of-way for expansion of all these components does not seem available in the downtown areas of Brownsville and Matamoros. A new binational entry system may be required to alleviate congestion, but the financial analysis does not ensure feasibility of a bond-financed binational entry system in this sector. However, the assumptions used in this study for truck traffic are very conservative and, if they do not materialize, a new binational entry system could be feasible.

Recommendations

Currently, both this study and the Port of Brownsville feasibility study (Ref 16), are somewhat inconclusive about the feasibility of a multimodal (rail and vehicular) binational entry system, given the nature and amount of assumptions needed to perform the analysis. Auto traffic is predominantly local, and the demand for a new binational entry system in this sector is likely to be primarily commercial. Additional truck data are indispensable to accurately analyze the feasibility of such facility, and actual origins and destinations of truck cargo are needed to re-analyze this sector. Given the dynamic profile of the border region, and the inconclusive results currently found in this and other study (Ref 16), it is recommended that this sector be re-analyzed when post-NAFTA outlook becomes more clear.

According to the maquiladora analysis developed in this study (Ref 21), the east coast of Mexico is one of two areas expected to have the greatest maquiladora growth. Because this growth will create additional demand at the coastal commercial hub, this study recommends that commodity flow be planned based on pre-cleared rail cargo, since it simultaneously solves two problems: congestion due to a high number of trucks, and staff shortages for customs inspections. Truck traffic should be limited to those situations in which the combination of short distances and light loads make other modes impractical. The proximity of the Port of Brownsville suggests that the latter type of truck demand might become fairly high in this sector, and a feasibility study for a high-load road to serve that demand is recommended. (Such a study would require availability of real cargo origins and destinations, which are necessary to successfully investigate the potential market for these high-load facilities.)

LOS INDIOS

The Los Indios sector encompasses mainly a rural area between Brownsville and Harlingen, and it has one binational entry system, the Los Indios (or Free Trade) Bridge, a toll facility located approximately 18 miles (29 km) west of the Brownsville/Matamoros area, and 10 miles (16 km) east of Harlingen/San Benito. The low traffic demand that characterizes the Los Indios sector suggests that a new bond-financed binational entry system in this sector would not presently represent a good investment.

As the traffic at Los Indios evolves, congestion can be expected at U.S. Customs stations, and to a lesser extent at the U.S. access/egress. The toll booths will operate at high levels of capacity utilization, and the combination of queues at the toll booths, the access/egress components, and the U.S. inspection will create an overall congestion of this binational entry system similar to that observed in other sectors. Expansion of the inspection and toll facilities, and a geometric upgrade to increase the U.S. access/egress capacity may become necessary in the near future, especially if NAFTA impacts are greater than expected. We recommend that the necessary right-of-way be secured before the surrounding area overdevelops and land costs increase.

Los Indios is close to the Port of Brownsville, and it has some of the super-crossing characteristics already in place, such as a modern border station. If upgraded to a super-crossing, Los Indios could divert some commercial traffic out of the downtown areas of Brownsville and Matamoros, and optimize overall traffic circulation in both Los Indios and Brownsville sectors. Close monitoring of post-NAFTA traffic patterns, together with development of potential demand estimates, are strongly recommended as a basis for the decision to upgrade Los Indios to a super-crossing facility.

EASTERN VALLEY SECTOR

The Eastern Valley Sector's main urban concentration consists of the towns of Mercedes, Weslaco, and Donna in the U.S., and Rio Bravo in Mexico. The sector has one binational entry system, the Progreso or B&P Bridge, a privately owned, two-lane toll facility connecting the towns of Progreso and Progreso Lakes on the U.S. side with Nuevo Progreso on the Mexican side. The sector serves approximately 5 percent of Segment 1 traffic demand, and the capacity and feasibility analyses indicate that a new binational entry system is neither needed nor financially feasible at this point.

The analyses of this study are based on somewhat conservative assumptions, and the Pharr feasibility study (Ref 4), which is based on more optimistic assumptions regarding truck traffic demand and post-NAFTA scenarios, found that total trip attraction for Rio Bravo alone is much higher than this study's demand estimates for the entire sector. This disparity illustrates the considerable impact that assumptions regarding socioeconomic development, route choice criteria, NAFTA scenarios, and modal split have on demand estimates, and indicates a clear need for constant monitoring and updating of transportation planning guidelines at the Texas-Mexico border.

CENTRAL VALLEY SECTOR

The Central Valley Sector is the third busiest sector in border Segment 1, serving over 25 percent of the total transborder traffic in this Segment. It has two binational entry systems: the Hidalgo Bridge, and the Los Ebanos Ferry. The Hidalgo Bridge carries over 98 percent of all traffic in this sector, while Los Ebanos is a ferry-boat used mainly by tourists.

The impending competition of the new Pharr Bridge, and the more widespread origins and destinations of southbound traffic create additional hurdles for estimating potential demand and revenue for another binational entry system in this sector. Nevertheless,. revenue and demand estimates were obtained, and they indicate some possibility for a feasible binational entry system in this sector, while the capacity analysis indicates poor traffic circulation around the Hidalgo Bridge.

Conclusions

The current demand of the Central Valley Sector is almost entirely served by the Hidalgo binational entry system, which is operating either over or near capacity at almost every component except the bridge lanes. Theoretically, additional bridge lanes are not necessary, and the new Pharr Bridge will significantly increase the capacity of a component that would not need expansion of its full utilization were not hindered by congestion in other binational entry system components. On the other hand, the Pharr binational entry system would have to be able to quadruple the current sector capacity in terms of auto toll collection (southbound) and truck primary inspection (both sides), as well as to triple the current capacity of northbound auto toll collection and primary inspection, in order to meet the higher demand estimate for the next 20 years.

The demand and revenue analyses indicate that a third binational entry system may be feasible under the high impact post-NAFTA scenario, but not under the low or moderate impact scenarios. However, these analyses are based on conservative assumptions that may not materialize, and they may underestimate the potential revenues of a feasible project.

Recommendations

The findings of this study are based on several assumptions, and the results are not conclusive. The estimated revenues are just enough to suggest feasibility of a third binational entry system under the high potential scenario. The sector capacity analysis also suggests that the Pharr binational entry system may provide enough capacity t serve traffic demand in the near future, depending on the design and staffing of its border stations and toll plazas. It would be beneficial to redo the capacity analysis based on the final Pharr layout, as well as to re-analyze the potential demand and revenue for a third binational entry system after Pharr traffic has developed and the post-NAFTA outlook becomes clearer.

A close monitoring is recommended for this sector to evaluate the effects on traffic circulation of the new binational entry system currently under construction in Pharr, as well as the occurrence (or not) of the assumptions in which the results of this study are based. Seasonally replicated origin and destination surveys should also be part of this monitoring, since U.S. Customs officials have been observing significant seasonal fluctuations in truck and auto demand, which could not be taken into account in this study due to lack of seasonal data.

Together, the capacity and feasibility analyses suggest a pressing need for coordinated planning in this sector based on correct diagnosis of the causes of poor traffic circulation. Future measures to improve traffic circulation must include expeditious inspections and toll collection, as well as other options for overall binational entry system efficiency (suggested later in this chapter).

WESTERN VALLEY SECTOR

The Western Valley Sector includes the cities of Rio Grande and Roma, in Starr County. In Mexico, it includes the cities of Camargo and Miguel Alemán, in Tamaulipas. This sector serves approximately 7 percent of Segment 1 traffic, and it has two binational entry systems: Roma/Miguel Alemán, and Rio Grande City/Cd. Camargo. All components of these two entry systems are operating below capacity. Congestion can be expected first at the U.S. primary inspection, and then at the toll collection and access/egress components. A new, bond-financed binational entry system in this sector seems to be neither financially viable nor needed at this point. Expeditious inspection procedures, improvement of the toll plazas, and access/egress components upgrades are recommended in the near future.

LAREDO SECTOR

On the U.S. side, the entire Laredo Sector is located in Webb County, while in Mexico it encompasses the city of Nuevo Laredo, Tamaulipas, and the town of Colombia, Nuevo León. Tamaulipas makes up approximately two-thirds of the sector length, while Nuevo León makes up the other third. The sector includes three vehicular bridges and one rail bridge. Two of the vehicular bridges (Laredo 1 and Laredo 2) link the downtown areas of Laredo, Texas, and Nuevo Laredo, Tamaulipas. The third bridge, eight-lane Colombia Bridge, is located about 20 miles (32 km) northwest of the downtown areas of both Laredos; it links Dolores (Laredo, Texas, extraterritorial limits) to Colombia, Nuevo León.

The considerable traffic growth observed in this sector is due partly to the increasing economic activity in the area, and partly to Laredo's convenient location as a corridor for U.S.-Mexico Trade. During 1991, Laredo handled 38 percent of all U.S. exports into Mexico, which translates into 56 percent of the U.S. exports that are shipped to Mexico through the Texas-Mexico border. These numbers show that Laredo bridges are serving an important share of the national interests of both countries, in addition to providing a link between two cities for personal and business trips. There is a clear need for additional infrastructure to continue serving these important functions; the capacity and feasibility analyses discussed in this report identify the reasons for congestion, and provide guidelines for coordinated transportation planning. The latter is especially needed in this sector, since it encompasses a triple border: Texas, Tamaulipas, and Nuevo León.

Conclusions

The capacity analysis indicates that the main constraints to traffic circulation on Laredo 1 and 2 are the inspection procedures and toll plazas, followed by the access/egress facilities. The bridges themselves are operating at a low percentage of their full capacity, but additional binational entry systems in this sector may be necessary because expansion of inspection areas and toll plazas are not possible in the downtown areas of both Laredos. This fact can be used as a favorable argument for new binational entry system proposals, and the feasibility analysis indicates that a new binational entry system in this sector is feasible even in the most pessimistic combination of assumptions, which are the low potential post-NAFTA scenario, and a high percentage of auto trips preferring the downtown bridges.

Recommendations

While Laredos 1 and 2 are heavily congested within the problematic components where traffic must stop and queue, the Colombia binational entry system operates with considerable excess capacity available; its highest v/c value is 7 percent (for the Mexican primary inspection for trucks). Clearly, a better utilization of this binational entry system would have a positive effect on the traffic circulation in this sector, especially if trucks are encouraged to avoid the downtown areas and utilize Colombia.

A twofold study, described below, could identify how a fourth binational entry system might improve traffic circulation in this sector. This study would:

(1) re-evaluate the sector capacity analysis under the assumptions that truck traffic would be diverted from Laredo 1 and 2 into Colombia, and that all three binational entry systems would be fully staffed; and

(2) obtain cooperation from inspection agencies on both sides of the border to estimate staffing needs to operate as assumed in item 1, and to compare such needs to actual staff availability in the sector.

If it is found that actual staff availability is less than required for efficient operation of all bridges, and that inspection agencies would redistribute staff from three binational entry systems to four, additional capacity analysis may show that a fourth binational entry system would reduce rather than augment the actual sector capacity in terms of primary inspections, which are the main source of congestion in this sector as well as almost everywhere along the border.

Auto occupancy and percentage of loaded trucks are also important factors influencing traffic flows. Currently, the average auto occupancy at the Texas-Mexico border is about 2 people per auto, and the average percentage of empty trucks is 40 percent. Current toll schedules may contribute to this problem, by charging about 5 to 6 times more for loaded trucks than for empty ones. There is a considerable potential to improve transborder traffic by encouraging high occupancy vehicles, and discouraging unloaded trucks.

Multi- and intermodalism seem a better solution to meet an increasing demand for transborder commodity flow. The Laredo sector is a good candidate for a super-crossing, and the Colombia Bridge has several of the super-crossing elements already in place. The advantages of diverting truck traffic to a binational entry system located outside any urban concentration are many. A new binational entry system that is open to truck traffic and is located at or near urbanized areas would soon become as congested as Laredo 1 and 2.

There is a strong feeling that traffic circulation at the border cannot be improved unless mass transit and multimodal options are available, high occupancy lanes are implemented, and inspection procedures are expedited. Several recommendations in that regard are discussed later in this chapter, and they are specially recommended for consideration in this sector. The City of Laredo should also consider joint ventures to upgrade Colombia to a super-crossing designed to serve most of the long-haul commercial traffic.

DISCUSSION AND GENERAL RECOMMENDATIONS FOR BORDER TRANSPORTATION

The objective of the capacity, demand, and revenue analyses is the provision of guidelines for border transportation infrastructure planning. The capacity analysis identifies the congested components of a binational entry system, and in general it indicates that toll booths and inspection facilities are the main problems in most binational entry systems, followed by inadequate access to and egress from the bridge. The bridge itself is never the problem. In busy sectors, an additional toll bridge is almost certain to be a good investment; but this does not necessarily mean that it is the best or the only solution to improve traffic circulation. New bridges may be necessary when there is no practical way to relocate or expand inspection or toll facilities, but their potential to improve traffic circulation is dependent upon efficient design, full staffing of the new inspection facilities, and adequate access/egress on both sides of the border.

Framework for Coordinated Border Transportation Planning

The provision of a bridge over the Rio Grande requires the coordination of all agencies involved. At the core of the problem is the fact that additional infrastructure has the potential to disrupt traffic circulation even more if adequate inspection staffing is not provided. This fact is not intuitive since, in any other situation, additional infrastructure yields at least a marginal improvement in traffic circulation. Interagency cooperation is not the norm, and neither the U.S. nor the Mexican presidential permit procedures encourage such cooperation during the early discussions of a new proposal (Ref 8).

The need for a new binational entry system along the Texas-Mexico border can be seen from the perspective of each party involved. These various perspectives are correlated and intertwined, but the traditional way of providing binational entry systems implicitly considers these perspectives mainly as sequential and fairly independent of one another. This situation should be replaced by a more coordinated transportation planning framework, one capable of accommodating the different perspectives summarized in Table 10.1.

Table 10.1. Perspectives in providing binational entry systems

Perspective	Objectives	Preferred Action
Local	- Maximize city revenues - Attract visitors to city - Improve traffic circulation	Build new bridges whenever they are profitable or may improve traffic circulation in the city
Environmental	- Minimize Pollution - Maximize biota preservation - Minimize changes in river channel and water level	Avoid new bridges that adversely affect the environment, and encourage them if they relieve "hot spots"
Inspection Agencies	- Minimize staff - Optimize equipment	Consolidate traffic into fewer bridges, preferably multimodal
Coordinated Transportation Planning	- Maximize level of service of traffic circulation along the entire border - Minimize infrastructure costs along the entire border	Permanent, ongoing binational planning efforts

Coordinated transportation planning is a multi-dimensional perspective, one that considers the problem to its fullest extent, striving to optimize all the different perspectives and objectives into one solution. One possible way to successfully implement binational transportation planning for the U.S.-Mexico border would be to create a committee composed of both U.S. and Mexican federal, state, and local officials to represent the various interested parties. The Committee would also include representatives of research organizations to act as technical consultants. This binational, multi-agency committee would ensure that all responsible parties have their interests represented, and that they cooperate in data collection and/or release, study financing, and harmonization of infrastructure plans and implementation. This would ensure that no public money is wasted in redundant studies and data collection efforts, and that any new proposed infrastructure serves the national interests of both countries and does not create serious burdens to any interested party. Some U.S. border cities are reluctant to agree to mass transit and multimodal options because they fear that consolidation of revenues from several autos into less mass transit vehicles would be financially unfeasible. They also hesitate over the option of rerouting trucks to bridges located on the city outskirts, even when the city also owns this bridge. One possible study sponsored by this international committee should determine if these losses would be compensated by additional revenues from mass transit options, and latent demand that would be encouraged to cross the border more often if the traffic circulation was better.

While the International Coordinating Committee Texas-Nuevo León is a pioneer attempt at binational planning, but the ideal committee should encompass all border states in both countries, possibly with subcommittees for each pair of neighboring states. In the beginning, the main mission of this binational planning committee would be to persuade all parties involved to subordinate individual interests for the greater good of the entire border.

Border Transportation Options

The need for expediting time and staff required for successful inspection procedures suggests that a better long-term solution for border transportation is the implementation of mass transit, multimodal, and intermodal options. These measures must always take into account that expeditious inspection procedures would in many cases do more to improve traffic circulation than additional binational entry systems. Inspection and city officials on both sides of the border have several ideas to expedite these procedures that should be discussed on a binational and multi-agency committee on border transportation matters. Some of their ideas closely match and/or supplement the concepts of sector analysis and super-crossing (Ref 21), and are also based on the binational transportation planning perspective. A border transportation efficiency program should focus on three perspectives:

(1) In most sectors, expeditious toll collection and inspection procedures would do more to improve traffic circulation than additional binational entry systems;

(2) Trucks are not always the most efficient way to transport cargo; and

(3) Mass transit provides economies of scale impossible to attain when individual transportation prevails.

The proposed super-crossing concept is based on this perspective. The specific design of a super-crossing would incorporate state-of-the-art inspection equipment and facilities for pre-cleared commodities, and it would simultaneously minimize delays and inspection staff. U.S. Customs and GSA were very enthusiastic about it, as it meets their goals and needs, and actually agrees with their basic idea of an ideal binational entry system.

The high cost of providing multi-modal facilities with state-of-the-art inspection facilities and equipment means that super-crossings need to be constructed at international trade corridors that generate enough commercial traffic. In Segment 1, two binational entry systems have the potential to become a super-crossing: Colombia and Los Indios. They already have many of the sure-crossing elements already in place, and additional investment would convert them into super-crossings. Demand and pre-feasibility studies could be conducted with funds from the Intermodal Surface Transportation Efficiency Act (ISTEA).

There are several simple programs that can be implemented at lower costs, which would improve transportation efficiency in several sectors. Some measures are already being proposed by border city officials (Cd. Juárez is very active in this), while other propositions were developed during this study. In all, these recommendations are:

(1) Create a pre-clearance system for frequent auto travelers with previously checked backgrounds, and reserve the primary inspection for general traffic.

(2) Encourage transborder mass transit, and implement a park-and-ride system in both sister cities. The transborder mass transit vehicles would park in a special parking lot, and inspection procedures would be done on the pedestrians, rather than on vehicles waiting in queues.

(3) Create high occupancy lanes on as many bridges as possible. (Currently, border-wide average auto occupancy is around 2.)

(4) Encourage loaded trucks and discourage unloaded ones. Currently, the loaded/unloaded split averages 60/40 percent.

(5) Charge auto tolls that do not require change. This may increase auto toll collection capacity by over 50 percent.

(6) Implement and encourage the use of pre-paid toll coupons. (Average auto and truck trip frequencies are three to four times a week.)

(7) Whenever possible, implement an automatic scanning system that eliminates the need to stop at the toll booth, which would be used mainly by sporadic travelers.

(8) Implement a pre-clearance system for truck cargo.

(9) In sectors that have out-of-town bridges, discourage or prohibit truck traffic in the downtown areas (this would alleviate not only congestion, but also pollution).

(10) Optimize inspectors during peak hours, by relocating to busier bridges some of the staff assigned to less congested ones.

The recommendations above and the implementation of super-crossings are not mutually exclusive. Indeed, they are complementary, and, ideally, each sector including a major commercial hub, such as Laredo or El Paso, should implement a super-crossing in conjunction with as many as simple measures as possible in the other binational entry systems.

Environment and Transportation Interaction

Related to the traffic circulation concerns are environmental and air quality perspectives for justifying the need for a new international bridge. United States environmental legislation such as the 1990 Clean Air Act require cities and regions that exceed the National Ambient Air Quality Standards to develop congestion management plans and transportation control measures in order to alleviate air quality problems. Potential reduction of the overall city-wide level of emissions (including emissions "hot-spots") could be used to justify the funding of a new binational bridge.

NAFTA implementation has also been raising a significant number of environmental concerns, and the World Bank assigned an $8 billion fund for environmental studies along the entire U.S.-Mexico border. A coordinated study between transportation and environmental agencies on both sides of the border could use part of these funds to evaluate air and quality along the border, and suggest transportation options that address the challenges of meeting the Clean Air Act standards. Some of these funds could also be used to implement mass transit and multimodal facilities, which are considerably less harmful to the environment than individual transportation and truck cargo movements.

CONCLUSION

The combined results of the capacity, demand, and net revenue analyses indicate that, while there is no need for additional bridge lanes anywhere along border Segment 2, traffic circulation is in fair condition only at sectors with low demand. Even in those sectors, some queues are observed, due to the fact that transborder traffic flow can never be unimpeded (it must always stop for inspections at least). The solution goes well beyond the problem of designing, building, and operating a bridge. The binational environment, the need for several inspection procedures, and the different and sometimes conflicting priorities of all agencies involved make this an extremely complex problem that cannot be efficiently solved solely from the transportation arena. There is a strong need for coordinated binational planning, and a possible solution may be the creation of an international committee with representatives of all agencies involved in border crossing procedures, supplemented by specialists from independent research organizations with no vested interest in the provision of border infrastructure.

NAFTA is expected to change both commercial and auto traffic patterns in the border. In addition, the recently approved Intermodal Surface Transportation Efficiency Act (ISTEA) may foster changes in border transportation modes, especially for commercial traffic. The results of this study are based on data collected before NAFTA, and they reflect a situation that is expected to undergo significant changes. The difficulty in predicting the impact of NAFTA was mitigated somewhat through the use of three NAFTA scenarios, and with the use of the sector analysis concept, a tool for disaggregated analysis of potential demand for new binational entry systems along the border. However, actual NAFTA impacts on border communities may turn out to be some combination of the three basic scenarios investigated in this study. In addition, sectors are defined based on major traffic diversion areas, which are also likely to change as NAFTA is implemented. This dynamic nature of the border region must be taken into account when implementing the findings of this study, especially its transportation planning guidelines.

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APPENDIX A

GLOSSARY

AADT: Annual Average Daily Traffic

AASHTO: American Association of State Highways and Transportation Officials (Associación Americana de Representantes Estatales de Carreteras y Transportes)

ABI: Automated Broker Interface (Interface Automatizada de Agentes Aduanales)

ACR: Automatic Cumulative Recorders

ADT: Average Daily Traffic

Aduana Fronteriza: Mexican Customs

AFIS: Automated Fingerprint Identification System (Sistema Automatizado de Identificación de Huellas Digitales)

AMS: Automated Manifest System (Sistema Automatizado de Manifestos)

APHIS: Animal and Plant Health Inspection Service (Servicio de Inspección Sanitaria de Animales y Plantas)

ATR: Automatic Traffic Recorders (Estaciones Automatizadas de Aforo de Vehículos)

AVC: Automatic Vehicle Classification (Estaciones Automatizadas de Clasificación de Vehículos)

Binational Entry System: A system comprised by the boundary between two countries, and the border stations and inspection facilities in both countries (Sistema Binacional de Entrada).

Binational Bridge Entry System: A binational entry system where the two countries are linked by a bridge.

Binational Dam Entry System: A binational entry system where the two countries are linked by a dam.

Border Crossing: A binational entry system where the border is only an imaginary line (Cruze Fronterizo, Cruze Internacional).

BOTA: Bridge of the Americas, El Paso, Texas (Puente Cordova, Juarez,)

BRINSAP: Bridge Inventory, Inspection and Appraisal Program (Programa de inspección e Inventario de Puentes)

CAPUFE: Caminos y Puentes Federales de Ingresos y Servicios Conexos (Federal Toll Roads, Bridges and Related Services)

Caseta: Booth

Cd.: Ciudad (city)

CES: Centralized Inspection Station (Estación Centralizada de Inspección)

CET: Contraband Enforcement Team (Agentes de Control de Contrabando)

Chih.: Chihuahua

CILA: Comisión Internacional de Límites y Aguas (International Boundary and Water Commission)

CIS: Central Index System (Sistema Central de Información)

Coah.: Coahuila

CRA: Charles Rivers Associates

CTR: Center for Transportation Research (Centro para la Investigación del Transporte)

DBMS: Data Base Management System

DEA: Drug Enforcement Agency (Agencia de Control de Drogas)

DGF: Dirección General de Fronteras (General Office of Borders)

DOT: Department of Transportation (Departamento del Transporte)

DPF: Departamento de Puertos Fronterizos (Department of Border Ports)

DPS: Department of Public Safety (Departamento de Seguridad Publica)

Economic Activity Center: Areas with the same range of socioeconomic indicators such as population, retail sales, employment by industry, and maquiladora activity (Centros de Actividad Economica).

EOIR: Executive Office for Immigration Review (Oficina Ejecutiva de Inmigración)

EPA: Environmental Protection Agency (Agencia de Protección Ambiental)

ETZ: Extra-territorial Zone (Zona Extraterritorial)

FDA: Food and Drug Administration (Departamento de Alimentos y Drogas)

FHWA: Federal Highway Administration (Dirección General de Carreteras Federales)

FIDENOR: Fideicomiso Para el Desarrollo del Norte del Estado de Nuevo León (The Development Trust of Northern Nuevo Leon)

FNM: Ferrocarriles Nacionales de Mexico (National Railroads of Mexico)

FWS: Fish and Wildlife Service (Departamento de Pesca y Vida Silvestre)

GAO: General Accounting Office (equivalente norteamericano a la Secretaría de Hacienda y Crédito Público)

Garita: Checkpoint

GATT: General Agreement on Tariffs and Trade (Acuerdo General sobre Aranceles y Comercio)

GIPSF: Grupo Intersecretarial de Puertos y Servicios Fronterizos (Inter-Departmental Group of Border Ports and Services)

GNB: Good Neighbor Bridge (Puente Reforma), El Paso, Texas

GSA: General Services Administration (Departamento de Servicios Generales)

IBWC: International Boundary and Water Commission (Comisión Internacional de Límites y Aguas)

I&C: Inspection and Control (Inspección y Control)

ICC: Interstate Commerce Commission (Comisión Interestatal de Comercio)

IM3: Institute for Manufacturing and Materials Management (Instituto de Manufactura y Administración de Materiales).

INEGI: Instituto Nacional de Geografía y Estadistica

Ing.: Ingeniero (Engineer)

INS: Immigration and Naturalization Service (Servicio de Inmigración y Naturalización)

ISTEA: Intermodal Surface Transportation Efficiency Act (Ley para el Eficiente Transporte Intermodal Terrestre)

K9: Trained dogs used at the border (Designación de los perros entrenados utilizados en la frontera)

LDF: Laredo Development Foundation (Fundación para el Desarrollo de Laredo)

Lic.: Licenciado (a college graduate in Law, Business Administration, Marketing, and other related areas)

LLTV: Low Light Level Television, a type of surveillance camera used by U.S. border patrol. (televisión de bajo nivel de luz, un tipo de camera de vigilancia utilizada por la patrulla fronteriza de Estados Unidos)

MEX: Mexican Federal Highway (designación de las carreteras federales mexicanas).

NAFTA: North American Free Trade Agreement (Tratado de Libre Comercio)

NCIC: National Criminal Information Computer (computadora nacional de informacíon criminal).

N.L.: Nuevo León

O/D: Origin and Destination (Orígen y Destino)

PHS: Public Health Service (Servicio Público de Salud)

PDN: Paso Del Norte Bridge, El Paso, Texas

PDP: Project Development Plan (Plan de Desarrollo de Proyetos)

POE: Port of Entry. A place where the entry of people and goods is allowed from one country to the other after going through inspection agencies, such as customs, immigration, etc. A port of entry could be comprised of one or more binational entry systems under the jurisdiction of one port.

POV: Privately Owned Vehicle (vehículo particular)

Port of Entry (POE): A place where the entry of people and goods is allowed from one country to the other after going through inspection agencies, such as customs, immigration, etc. A port of entry could be comprised of one or more binational entry systems under the jurisdiction of one port.

PPQ: Plant Protection and Quarantine (Protección y Quarentena de Plantas)

Presa: Dam

Puerto Fronterizo: The Mexican facilities of a binational entry system. This is not the Spanish equivalent of "port of entry."

SAAI: Sistema de Automatización Aduanero Integral (Integrated System of Customs Automation)

SARH: Secretaría de Agricultura y Recursos Hidráulicos (Department of Agriculture and Water Resources).

SCT: Secretaría de Comunicaciones y Transportes (Department of Communications and Transportation).

SDS: SAS data set

Sector: Sphere of influence of an economic activiy center where the potential demand (and revenue) of any new transportation artery falls within a certain range that has no elasticity with respect to the sector boundaries.

Sectur: Secretaría de Turismo (Department of Tourism)

SED: Shippers Export Declaration (Declaracíon de Exportación)

SEDESOL: Secretaría de Daesarrollo Social (Department of Social Development).

SG: Secretaría de Gobernación (Department of the Interior).

SH: State Highway (designacion de carreteras estatales en Texas)

SHCP: Secretaría de Hacienda y Crédito Público (Department of Treasury and Public Finance).

SP: Southern Pacific Railroad (Ferrocarril del Pacífico Sur)

SRE: Secretaría de Relaciones Exteriores (Department of Foreign Affairs).

Supercrossing: A multimodal binational entry system served by up-to-date equipment designed to efficiently handle commercial traffic, as well as to speed up the border crossing procedures for both commercial and non-commercial traffic (Cruze del futuro)

TAM.: Tamaulipas/Road in Tamaulipas

TAMP: Tamaulipas

TIB: Temporary Importation Under Bond (Importación Temporal con Depósito de Fianza)

TIP: Transportation Improvement Program (Programa de Mejoramiento del Transporte)

TLC: Tratado de Libre Comercio Norteamericano (NAFTA).

Trade Corridor: The area encompassing all possible existing and idealized commercial routes between two major commodity production and/or attraction areas.

Traffic Generating Areas: Economic Activity Center

Transborder: (1) Movement of people and / or goods across the border, as in "transborder traffic," or (2) Database developed by the Center for Transportation Research.

Transborder Activity Center: Activity Center encompassing both sides of the border

Transportation Corridor: The area encompassing existing and idealized routes between a major area of traffic production and a major area of traffic attraction.

TRC: Texas Railroad Commission (Comisión de Ferrocarriles de Texas)

TTA: Texas Turnpike Authority (Departamento de Infrestructura de Cuota de Texas)

TTI: Texas Transportation Institute (Instituto del Transporte de Texas)

TxDOT: Texas Department of Transportation (Departamento del Transporte de Texas)

UP: Union Pacific Railroad ("Union Pacific" Ferrocarril)

USCG: United States Coast Guard

USCS: United States Customs Service (Departamento de Aduanas)

USDA: United Stated Department of Agriculture (Departamento de Agricultura)

UTEP: University of Texas at El Paso

VS: Veterinary Service (Servicio Veterinario)

WIM: Weight in Motion

WSA: Wilbur Smith Associates