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16. Abstract <p>In assessing the infrastructure needs of the 1,230-mile (1,980-km) Texas-Mexico border, state transportation planners must take into account not only the special characteristics of a binational environment, but also the impacts of the North American Free Trade Agreement (NAFTA). This study has been undertaken to assist the Texas Department of Transportation and the Texas Turnpike Authority — the joint sponsors of this project — achieve a better understanding of the border area's transportation demand and infrastructure needs. Assisting in this effort were the Institute for Manufacturing, Materials and Management (IM3) at The University of Texas at El Paso, and the LBJ School of Public Affairs at The University of Texas at Austin.</p> <p>In this study, the project staff pursued three main objectives. The first objective, the subject of Report 1976-1, was to provide a comprehensive overview of the infrastructure on both sides of the Texas-Mexico border. From this overview the study team developed a U.S.-Mexico data base, termed TRANSBORDER, that could prove useful in coordinated transportation planning along the Texas-Mexico border. The data base is described in Report 1976-2.</p> <p>The second objective was to provide macroeconomic and traffic pattern analyses under different post-NAFTA scenarios. These traffic pattern analyses, based on border-wide origin and destination information collected at the bridges, provide a current overview of transborder traffic flows. This information is presented in Report 1976-3.</p> <p>The final objective was to provide estimates of the potential demand for and revenue from additional bridges along the Texas-Mexico border, with such estimates complemented by an assessment of current capacity utilization of the available infrastructure. These results are documented in Reports 1976-4 and 1976-5. According to the findings, even conservative NAFTA trade growth estimates indicate that new bond-financed binational bridge systems pass the prefeasibility requirements in the Central Valley, Laredo, and El Paso sectors. Additional results are summarized in this report.</p> <p>Together, the capacity and potential feasibility analyses provide guidelines for future transportation planning along the border by indicating where and why there is congestion, and whether a new binational entry system is economically justifiable.</p>					
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**TEXAS-MEXICO TOLL BRIDGE STUDY:
SUMMARY REPORT**

by

B. Frank McCullough
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Angela Jannini Weissmann

Research Report 1976-6F

*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
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April 1994

IMPLEMENTATION STATEMENT

This report, the final in a series of six, summarizes the findings of the Texas-Mexico Toll Bridge Study. The observations provided can serve as guidelines for present transportation planning and for future studies of border transportation needs. However, it should be understood that the ever-shifting dynamics of the Texas-Mexico border region (especially in the wake of NAFTA) effectively limit the study's recommendations and conclusions. Thus, assumptions related to NAFTA, the Texas-Mexico border economy, and traffic demand must be carefully evaluated when considering any implementation of the results reported in this study.

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

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Robert Harrison
Co-Principal Investigators

DISCLAIMERS

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of either the Texas Department of Transportation or the Texas Turnpike Authority. This report does not constitute a standard, specification, or regulation.

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Research Supervisor

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SUMMARY

In assessing the infrastructure needs of the 1,230-mile (1,980-km) Texas-Mexico border, state transportation planners must take into account not only the special characteristics of a binational environment, but also the impacts of the North American Free Trade Agreement (NAFTA). This study has been undertaken to assist the Texas Department of Transportation and the Texas Turnpike Authority — the joint sponsors of this project — achieve a better understanding of the border area's transportation demand and infrastructure needs. Assisting in this effort were the Institute for Manufacturing, Materials and Management (IM3) at The University of Texas at El Paso, and the LBJ School of Public Affairs at The University of Texas at Austin.

In this study, the project staff pursued three main objectives. The first objective, the subject of Report 1976-1, was to provide a comprehensive overview of the infrastructure on both sides of the Texas-Mexico border. From this overview the study team developed a U.S.-Mexico data base, termed TRANSBORDER, that could prove useful in coordinated transportation planning along the Texas-Mexico border. The data base is described in Report 1976-2.

The second objective was to provide macroeconomic and traffic pattern analyses under different post-NAFTA scenarios. These traffic pattern analyses, based on border-wide origin and destination information collected at the bridges, provide a current overview of transborder traffic flows. This information is presented in Report 1976-3.

The final objective was to provide estimates of the potential demand for and revenue from additional bridge capacity along the Texas-Mexico border, with such estimates complemented by an assessment of current capacity utilization of the available infrastructure. These results are documented in Reports 1976-4 and 1976-5. According to the study findings, even conservative estimates of NAFTA trade growth indicate that new bond-financed binational bridge systems pass the prefeasibility requirements in the Central Valley, Laredo, and El Paso sectors. Additional results are summarized in this report.

Together, the capacity and feasibility analyses provide guidelines for future transportation planning along the border by indicating where and why there is congestion, and whether a new binational entry system is economically justifiable.

EXECUTIVE SUMMARY

INTRODUCTION

The tremendous increase in U.S.-Mexico trade — spurred by earlier Mexican trade initiatives and, more recently, by the North American Free Trade Agreement (NAFTA) — has prompted new concerns regarding the Texas-Mexico border transportation infrastructure. Given that much of this burgeoning trade will be routed by surface through Texas, there are fears that, without adequate infrastructure in place, the economic blessings promised by NAFTA may never be fully realized. Thus, this research project, sponsored jointly by the Texas Department of Transportation and the Texas Turnpike Authority, undertook to assess the Texas-Mexico border area in terms of the need and potential demand for additional infrastructure over the Rio Grande.

The resulting investigation had many facets. Among other efforts, the study team analyzed and catalogued the present border transportation infrastructure, developed a binational data base of traffic and socioeconomic data, assessed the capacity and utilization of existing infrastructure, and, finally, evaluated (for both short- and long-term planning purposes) the potential need for and financial viability of additional facilities along the Texas-Mexico border.

By comparing current capacity utilization with traffic demand along the entire Texas-Mexico border, this project developed guidelines to determine whether new bridge systems (termed *binational entry systems*) could be supported within specific economic sectors of the border. The multidisciplinary team included Center for Transportation Research staff, faculty from the Lyndon B. Johnson School of Public Affairs of The University of Texas at Austin, staff at The University of Texas at El Paso, and private consultants from Wilbur-Smith Associates.

STUDY REPORTS

Border infrastructure investment should enhance transportation efficiency and, at the same time, attract or retain the lucrative revenues associated with international border crossing mechanisms. However, such investment decisions require precise traffic pattern data, capacity utilization assessments, and a method for evaluating the potential demand for (and financial viability of) additional toll bridges along the Texas-Mexico border.

In providing the sponsors with this necessary data, this study produced six reports. The first report (1976-1) provides a comprehensive overview of the infrastructure on both sides of the Texas-Mexico border. The second report (1976-2) contains a supporting data base of both Mexican and U.S. data. A primary goal of this data base, termed TRANSBORDER in this study, is to provide information for coordinated transportation planning along the Texas-Mexico border.

The next report, 1976-3, analyzes the macroeconomic impacts of NAFTA on both countries, assesses NAFTA impacts on the maquiladora industry, and identifies transborder traffic flow patterns based on border-wide origin and destination surveys. Research Reports 1976-4 (Gulf to Laredo) and 1976-5 (Eagle Pass to El Paso) present two types of assessments: capacity utilization of the current infrastructure, and the potential demand for and revenue from additional toll bridges along the border. This final report (1976-6F) summarizes study findings.

STUDY ORGANIZATION

To reflect present Texas trade corridors, and to facilitate the presentation of study results, the project staff divided the study area into the two segments depicted in Figure 1. Segment 1 begins at the Gulf of Mexico and extends to a point just west of Laredo (Colombia Bridge inclusive). Segment 2 begins immediately west of the Colombia Bridge and extends to the New Mexico border (west of El Paso). The study objectives, methodology, and research approach were the same for both segments.

Also facilitating this study was an aggregated research approach in which individual sites were grouped into specific sectors within the two segments. In this approach, referred to here as a “sector analysis” approach, we looked at an overall region — or sector — rather than at site-specific facilities. As we have formulated it, a sector is the sphere of influence of an economic activity center within which a transportation artery will have approximately the same demand characteristics, whereas the boundaries of the range of potential traffic demand at a specific facility will have no elasticity with respect to site location. We believe such an approach overcomes the obstacles inherent in predicting the potential demand at specific proposed sites along the border, and thus allows planners to address the Texas-Mexico border area from a binational transportation planning perspective. It works effectively in conjunction with trip assignment models, since traffic demand cannot be accurately predicted at a specific site without taking into account all other sites within the influence (i.e., same traffic diversion) area.

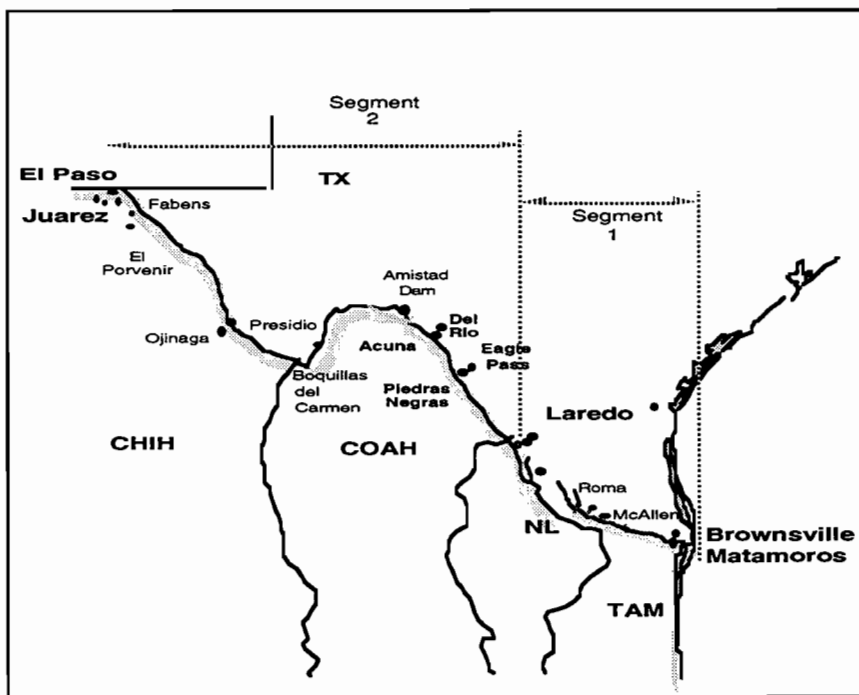


Figure 1. Geographical division of border into two segments for study purposes

Thus, the sector analysis concept addresses primarily the local traffic (about 90 percent) generated and attracted within an economic activity center. To be sure, Texas-Mexico binational entry systems also serve important trade flows that can originate from as far away as northern Canada. But because these trips currently represent a small percentage of the total trade, they do not greatly affect the accuracy of demand estimates based on sector analysis. On the other hand, they *do* represent a significant percentage of international trade, and as such they are extremely important to national interests. NAFTA, coupled with changes brought about by the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), may create new commercial trip patterns, owing to the removal of traffic, customs, and brokerage restrictions and to the growth of intermodal systems. From a transportation planning perspective, these innovations are highly desirable, insofar as they will allow more efficient transborder traffic flows.

In identifying specific sector boundaries, we used a three-step process that started with the identification of economic activity centers along the border (such centers generate most of the traffic). Next, the southbound traffic at existing binational entry systems was assessed to further verify the economic activity centers. In the final step, origin and destination data provided additional information on the transborder traffic patterns and the area of traffic diversion spanned by the current demand, which constrain the sector boundaries. Using this methodology, the border was divided into the 18 sectors depicted in Figure 2 and in Table 1.

Finally, with respect to study organization, we complemented the sector analysis approach with the super-crossing concept, one specifically developed to address future long-haul freight transportation needs in a modern and technologically efficient manner.

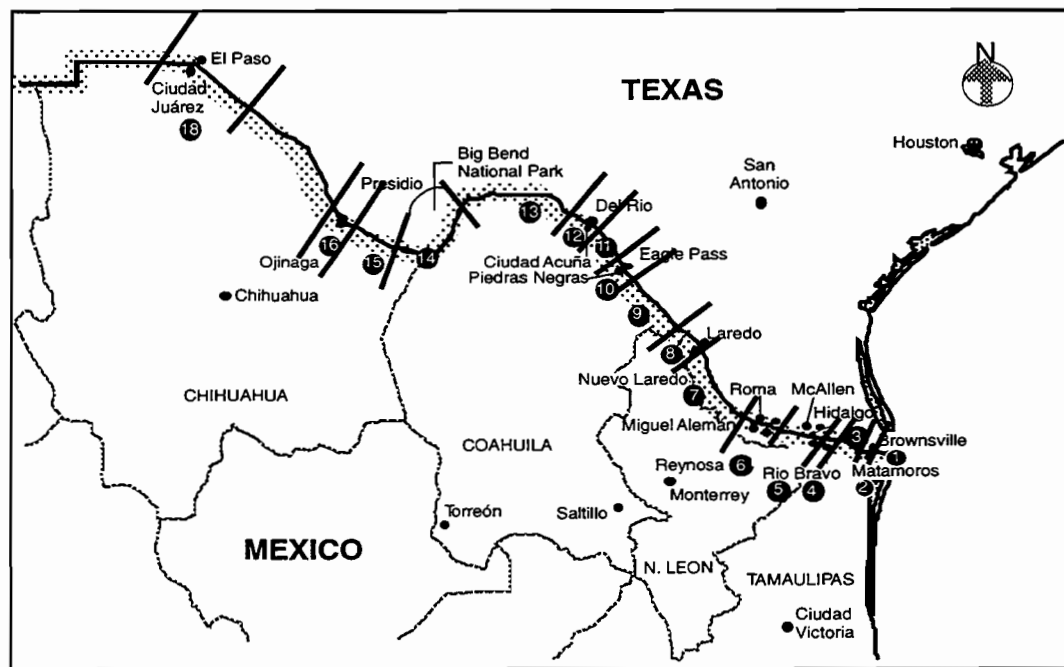


Figure 2. Texas-Mexico border sectors

As to terminology, we used the “binational entry system” expression developed by TxDOT’s International Relations Office to describe the system comprising the boundary between two countries, the border stations and inspection facilities on both sides, and the facility required to cross the border (a bridge in the case of the Texas-Mexico border). A binational bridge entry system over the Rio Grande has three major components: (1) access/egress, (2) bridge span, and (3) border stations.

In the case of toll facilities, a fourth component — the toll plaza — is also present. This project’s capacity analysis focused on each of these components, while the potential demand and revenues were estimated using the sector analysis approach.

Table 1. Texas-Mexico border sectors

Sector	Sector Name	Eastern Boundary	Western Boundary	Existing Binational Entry Systems	Proposed Binational Entry Systems
1	Gulf of Mexico	Gulf of Mexico	Palmito Hill Road	None	None
2	Brownsville/Mata - moros	Palmito Hill Road	Flor de Mayo Road	1. Gateway 2. B&M	1. Port of Brownsville 2. Los Tomates 3. Flor de Mayo
3	Los Indios	Flor de Mayo Road	Extension of FM 491	Los Indios	None
4	Eastern Valley/Rio Bravo	Extension of FM 491	Extension of FM 1423	Progreso	Donna/Rio Bravo
5	Central Valley/Reynosa	Extension of FM 1423	Extension of FM 886	1. Hidalgo/Reynosa 2. Los Ebanos Ferry	1. Pharr/Reynosa 2. Anzalduas 3. Mission 4. Los Ebanos
6	Western Valley	Extension of FM 886	Western city limits of Roma	1. Rio Grande City/Camargo 2. Roma/Miguel Alemán	None
7	Lake Falcon	Western city limits of Roma	Eastern city limits of Laredo	Lake Falcon Dam	None
8	Laredo/Nuevo Laredo	Eastern city limits of Laredo	Colombia Bridge	1. Laredo Bridge #1 2. Laredo Bridge #2 3. Colombia	Laredo Bridge #3
9	Guerrero	Colombia Bridge	Eastern city limits of Eagle Pass/Piedras Negras	None	None
10	Eagle Pass/Piedras Negras	Eastern city limits of Eagle Pass	Western city limits of Eagle Pass	Eagle Pass/Piedras Negras #1	Eagle Pass/Piedras Negras #2a and #2b
11	Quemado	Western city limits of Eagle Pass	Eastern city limits of Eagle Pass	None	None
12	Del Rio/Ciudad Acuña	Eastern city limits of Del Rio	Western city limits of Del Rio	Del Rio/Ciudad Acuña	None
13	La Linda	Western city limits of Del Rio	East boundary of Big Bend National Park	La Linda Bridge	None
14	Big Bend National Park	Big Bend National Park east boundary	Big Bend National Park west boundary	1. Boquillas Ferry 2. Santa Elena Ferry	None
15	Terlingua	Big Bend National Park west boundary	Eastern boundary of Presidio	None	None
16	Presidio/Ojinaga	Eastern city limits of Presidio	Western city limits of Presidio	Presidio/Ojinaga	None
17	Ft. Hancock/El Porvenir	Western city limits of Presidio	Fabens Bridge	Ft. Hancock/El Porvenir	None
18	El Paso/Ciudad Juárez	Fabens Bridge	Texas/Chihuahua/New Mexico tri-state border	1. Fabens 2. Ysleta 3. BOTA 4. GNB 5. PDN	1. Fabens Replacement 2. Socorro 3. BOTA Replacement

PRIMARY FINDINGS

The primary observations and findings of this study relate to: (1) issues associated with new binational entry systems; (2) transborder socioeconomic data; (3) socioeconomic impacts of NAFTA; (4) traffic patterns; and (5) the capacity and demand analyses of the border sectors.

Issues Associated with New Binational Entry Systems

Certainly, constructing a bridge across the Rio Grande is a more complex project than constructing a bridge across a river that is otherwise not an international boundary. A binational entry system links two different countries, serves two different economies, addresses two different travel behaviors and, in the case of toll facilities, obtains revenue in two different currencies. Moreover, it is often the border crossing *procedures*, rather than bridge *capacity*, that are the main constraints to unimpeded flow. Accordingly, these procedures must be considered when estimating the bridge traffic processing output, as well as when modeling the trip assignment to bridges. The following summarizes some of the issues to be considered by the numerous agencies and interests involved in establishing a new binational entry system on the Texas-Mexico border.

Economics: First, there are economic considerations. A binational entry system functions as an economic entity in that the structure represents a source of considerable toll revenue. In assessing the need for a new international bridge from this economic perspective, planners often focus on the proposed structure's ability to meet financial obligations. It is this economic perspective that has historically dominated the provision of binational entry systems (e.g., it is the primary incentive in Mexico, where toll revenues are controlled by the federal government); however, the increase in traffic, NAFTA, and the advent of new technologies now call for a broader transportation planning perspective.

Traffic flow: Next, there are considerations of traffic circulation within individual cities on both sides of the border — an issue that recognizes that this desirable source of revenue (the international traffic) may also be a source of city congestion. While it is an issue primarily for the individual municipalities, such internal traffic circulation is significantly affected by the distribution of international traffic.

Environmental factors: Recent environmental legislation, which includes the 1990 Clean Air Act, requires that cities and regions exceeding the National Ambient Air Quality (e.g., El Paso) develop congestion management plans and transportation control measures that alleviate air pollution. Potential reduction of vehicular emissions near the border could be used as partial justification for a new binational entry system.

Conversely, environmental concerns could also *hamper* efforts to promote a new bridge. For example, if a proposed structure threatened to elevate upstream water levels, objections by the International Boundary Water Commission (IBWC) could, at certain locations, inhibit construction by driving up costs. Wildlife issues might also undermine financial feasibility of a project, owing to the high costs of bypassing a known wildlife habitat.

Inspection: Finally, the operation of a binational entry system involves conducting various inspections. Given that inspection agencies have limited budgets and staffing, each

additional border station represents a burden that these agencies may not be capable of assuming. From the perspective of these agencies, the fewer border stations the better.

Effective binational transportation planning requires a multidimensional perspective that considers all issues described above. It is an approach that is still evolving, though the sector analysis and super-crossing concepts developed in this project represent steps toward such broad-based planning. Ultimately, successful binational planning depends on the ability of all parties involved to subordinate individual interests to the greater overall benefit of the entire border area.

Transborder Socioeconomic Data

Transportation planning requires socioeconomic data (e.g., population, vehicle ownership, and employment) as well as traffic volume, highway condition, and commodity flow data. The task of collecting, reducing, and storing such data — difficult and time-consuming under any circumstances — is made even more difficult in a binational environment. At a minimum, bilingualism *and* familiarity with another country's official agencies and data collection procedures are essential for obtaining necessary information.

Following its inventory of all Texas-Mexico binational entry systems, CTR developed a data base, termed the TRANSBORDER data base, that contains: (1) socioeconomic data; (2) traffic histories of each binational entry system; (3) traffic histories of main network links; (4) maquiladora indicators; (5) infrastructure data; and (6) origin/destination information. The data contained in the TRANSBORDER data base should prove useful in other border research projects.

Socioeconomic Impacts of NAFTA

NAFTA-heightened maquiladora activity is certain to test the adequacy of the U.S.-Mexico transportation infrastructure. Accordingly, this study reviewed the growth of maquiladoras in Mexico and developed a post-NAFTA macroeconomic analysis that includes projections of Texas exports to Mexico disaggregated by area of economic activity and geographical region. The University of Texas at El Paso's IM3 Center prepared the maquiladora analysis, while The University of Texas at Austin's Lyndon B. Johnson School of Public Affairs prepared the macroeconomic analysis. The following presents important study findings relating to the socioeconomic impacts of NAFTA.

Maquiladora Industry: The maquiladora program has been successful both because of the lower cost of labor in Mexico and because of the tariff advantages of in-bond industrial inputs. This success has been such that, ironically, even with NAFTA scheduled to remove most tariffs, U.S. and European manufacturers, together with their Asian competitors, are likely to continue to establish plants in Mexico. In this way, these manufacturers can use the country's lower labor costs (as well as NAFTA provisions on tariffs) to compete favorably in the North American market. Barring future U.S. protectionist initiatives, that competition for profits and market share should accelerate. But while Mexico-based production will continue to be a viable strategy for many manufacturers, particularly those serving the price-conscious consumer market, such production will increasingly move away from the border (i.e., to interior Mexico).

It has been projected that the number of maquiladora plants and employees will double

by 1997, with such expansion stimulated in large part by the growth in Mexican domestic demand. However, such projections are likely to be wide of the mark unless Mexican infrastructure (particularly transport) is upgraded and enhanced.

Certain border cities, such as Cd. Juárez, have reached their saturation point in their ability to sustain additional maquiladora growth, while other cities can accommodate additional growth for the next three to five years (or longer). Greater opportunities for maquiladora growth can be found in the interior of Mexico, particularly in such areas as Monterrey and the eastern coast (though Baja California, Sonora, and Cd. Chihuahua could also sustain more growth).

Macroeconomic Analysis: NAFTA will benefit both Mexico and Texas economically. However, the gains will not be uniform across all regions of Texas and Mexico, nor across different areas of the border economy. According to a model developed at the LBJ School of Public Affairs, such exports as electronics, computers, industrial machinery, and transportation equipment are predicted to increase under NAFTA, with such increases expected to pressure transportation links in the Dallas-Fort Worth and Central Corridor regions. Likewise, the expected growth of oil and gas field equipment exports will burden transportation networks along the Gulf Coast.

The estimated regional impacts suggest that by far the greatest proportion of benefits will accrue to the Greater Dallas-Forth Worth Metroplex, an area projected to gain over 40 percent of the economic benefits. The Gulf Coast region, centered in Houston and, more generally, Harris County, is expected to account for over 20 percent of NAFTA's direct economic benefits. The border area as a whole comes in third, with a substantial portion of these benefits predicted to accrue to San Antonio. The Upper Rio Grande will need to rely heavily on its service sector (especially distribution and professional services) and on its economic links with Ciudad Juárez on the other side of the border to maximize the benefits brought about through NAFTA.

Transborder Traffic Flow Patterns

Transborder traffic flow patterns were determined using a combination of existing data and information obtained through origin and destination surveys conducted at selected bridges. Table 2 summarizes the major auto origins and destinations identified along the Texas-Mexico border, while Table 3 similarly summarizes truck traffic.

Automobile data indicate that most bridges serve primarily local traffic moving between sister cities on both sides of the border. Even in the absence of sister cities (as in the case of the Progreso Bridge, which is located in a U.S. rural area), the traffic still originates primarily from nearby cities and towns. The trip purposes are split at 30 percent business and 70 percent non-business for almost all bridges, with the non-business trip purposes associated mostly with shopping and recreation. It is possible, however, that the number of non-business trips is overestimated, owing to respondents' reluctance to declare the purpose of a business trip at an international border (i.e., given the risk of customs or immigration inspections).

Auto traffic is usually about 95 percent of the total traffic. Observed truck traffic is never above 10 or 11 percent, even in those areas carrying a significant percentage of the transborder truck traffic (e.g., Laredo). Thus, vehicular bridges at the Texas-Mexico border serve primarily

social purposes, a fact that must be considered along with the increased flow of commercial traffic between the two countries.

Table 2. Major origins and destinations of auto traffic

US-Mexican City or Town	Binational Entry System	Major Origins	Major Destinations	Data Source
Brownsville-Matamoros, TAMP	Gateway	Brownsville	Matamoros	CTR surveys
Brownsville-Matamoros, TAMP	B&M	Brownsville	Matamoros	CTR surveys
Progreso-Nuevo Progreso, TAMP	Progreso	Donna, Harlingen, McAllen, Mercedes, Progreso, Weslaco	Las Flores, Nuevo Progreso, Rio Bravo	CTR surveys
Hidalgo-Reynosa, TAMP	Hidalgo	Hidalgo, McAllen, Mission, Pharr	Reynosa	CTR surveys
Rio Grande City-Ciudad Camargo, TAMP	Rio Grande	Rio Grande City	Cd. Camargo	Literature
Roma-Miguel Alemán, TAMP	Roma	Roma	Cd. Miguel Alemán	Literature
Eagle Pass-Piedras Negras, COAH	Eagle Pass	Eagle Pass	Piedras Negras	CTR surveys
Del Rio-Cd. Acuña, COAH	Del Rio	Del Rio	Cd. Acuña	CTR surveys
Presidio-Ojinaga, CHIH	Presidio	Presidio	Ojinaga	CTR surveys
Fabens-Caseta, CHIH	Fabens	Fabens, Tornillo, El Paso	Porfirio Parra, Praxedis, Guadalupe	CTR surveys
El Paso-Cd. Juárez, CHIH	Zaragoza	El Paso	Cd. Juárez	Literature
El Paso-Cd. Juárez, CHIH	BOTA	El Paso	Cd. Juárez	Literature
El Paso-Cd. Juárez, CHIH	Good Neighbor	El Paso	Cd. Juárez	Literature
El Paso-Cd. Juárez, CHIH	Paso del Norte	El Paso	Cd. Juárez	Literature

Truck traffic reflects primarily the truck-tractor movements of drayage companies — that is, those border companies specializing in hauling cargo between commercial zones. This study found that particular drayage practices, because they evolved locally and in isolation, differed from one gateway to another (this lack of uniformity was in fact another justification for the sector analysis approach). Implementation of NAFTA provisions will bring about different transportation rules and route choices; these in turn will occasion a need to update current origin and destination information.

Two survey findings of interest were an average auto occupancy of around 2 and the high percentage of unloaded trucks (around 40 percent) using border bridges with frequencies of at least three or four times a week, often more than daily. These findings suggest that overall efficiency could be improved through measures that foster higher auto occupancy and discourage single tractors.

Capacity and Demand Analyses of the Border Sectors

The bridges, dams, and ferries crossing the Texas-Mexico border form an interrelated system of transportation whose main objective is to move people and commodities from one country into the other. This system includes the inspection facilities as well as the links with the rest of the infrastructure. Each of the factors that influence the traffic processing output of a binational bridge entry system must be incorporated into any capacity analysis.

Capacity Analysis Approach: The capacity analysis approach was based on the disaggregation of the binational entry system into its main components, i.e., toll, inspection,

bridge span, and access/egress facilities. Each component was evaluated separately, and, when applicable, was assumed to be fully staffed and efficiently operated. The results represent the percent utilization of the total theoretical capacity of each component.

Since these components reflect a sequential traffic process, the overall binational entry system capacity is never greater than the lowest capacity of its individual components. The capacity analysis results are reported in terms of a volume-to-capacity ratio (v/c); they are based on limited data, requiring some assumptions about peak hours, inspection times, toll collection times, and non-international traffic at the access/egress component.

The capacity analysis indicates that, while there is no need for additional bridge lanes along the border, traffic circulation is satisfactory only at those sectors having low demand. Theoretically, expansion and improvement of the congested binational entry system components (i.e., inspection facilities) would have a higher impact on traffic circulation than additional bridge lane capacity. Nevertheless, additional binational entry systems may be the only feasible way to improve traffic circulation in sectors where the bridge access/egress and/or the border stations are congested and cannot be expanded.

Table 3. Major origins and destinations of truck traffic

U.S.-Mexican City or Town	Binational Entry System	Major Origins	Major Destinations	Data Source
Brownsville-Matamoros, TAMP	Gateway	Brownsville	Matamoros, Mexico City, Monterrey	CTR surveys
Progreso-Nuevo Progreso, TAMP	Progreso	Alamo, Brownsville, Progreso, Weslaco	COAH, Guadalajara, Monterrey, Nuevo Progreso, Rio Bravo	CTR surveys
Hidalgo-Reynosa, TAMP	Hidalgo	Hidalgo, McAllen, Mission, Pharr	Reynosa	CTR surveys
Rio Grande City-Ciudad Camargo, TAMP	Rio Grande	Rio Grande	Cd. Camargo	Literature
Roma-Miguel Alemán, TAMP	Roma	Roma	Cd. Miguel Alemán	Literature
Eagle Pass-Piedras Negras, COAH	Eagle Pass	Eagle Pass	Piedras Negras	CTR surveys
Del Rio-Cd. Acuña, COAH	Del Rio	Del Rio	Cd. Acuña	CTR surveys
El Paso-Cd. Juárez, CHIH	Zaragoza	El Paso	Cd. Juárez	Literature
El Paso-Cd. Juárez, CHIH	BOTA	El Paso	Cd. Juárez	Literature
El Paso-Cd. Juárez, CHIH	Good Neighbor	El Paso	Cd. Juárez	Literature
El Paso-Cd. Juárez, CHIH	Paso del Norte	El Paso	Cd. Juárez	Literature

Throughout the border area, U.S. inspection facilities are the primary source of congestion, followed by toll collection and bridge access/egress. Mexican inspection areas are also either congested or have little remaining capacity. The study results represent the maximum theoretical capacity, implying full staffing of all inspection and toll collection facilities, which rarely occurs.

Federal policies limit the staffing capabilities of U.S. and Mexican inspection agencies; and only when federal agencies provide full staffing will the construction of a new facility improve overall traffic flow. Thus, there is a need to balance personnel and infrastructure. As NAFTA lifts trade barriers, the consequent need to verify the origin of product components for

taxation will further complicate customs inspections. And as U.S.-Mexico traffic grows, these staffing problems will become more critical, especially if conventional planning solutions — i.e., building new bridges — continue to take precedence over innovative solutions based on coordinated binational planning.

At first sight, these findings appear to agree with those of a recently published report to Congress on the status of border crossings.¹ That study concluded that, based on its projection that truck traffic would increase by approximately 120 percent, facilities immediately at the border were adequate for the foreseeable future. However, the findings of the present study suggest that additional entry systems may be the only practical solution in congested urban areas where toll plazas, inspection facilities, and/or access/egress networks cannot be expanded. This may be particularly true where border cities are currently developing new loop and by-pass schemes. Thus, in real-world terms, it is bridge *location*, and not capacity, that should be the issue.

FEASIBILITY OF NEW BINATIONAL ENTRY SYSTEMS

In the U.S., a new binational entry system is usually proposed locally, with toll revenues repaying the initial investment. Thus, bridge financing, not traffic efficiency in a sector, is the central focus of any proposed binational entry system. Coordinated border transportation planning requires both a financial evaluation of a new binational entry system *and* an estimate of the capacity utilization of the available infrastructure, which together provide a better evaluation of border transportation needs.

Feasibility Analysis

This study developed a four-step feasibility analysis approach to estimate the potential feasibility of a new binational entry system. These four steps are:

- (1) traffic analysis, which provides an estimate of future traffic for the entire sector;
- (2) demand analysis, which provides an estimate of the sector traffic demand for the new (hypothetical) facility;
- (3) estimate of the sector potential gross revenues; and
- (4) financial analysis, which provides an estimate of potential net revenues of the new facility, as an indication of its feasibility.

The approaches developed by CTR for each of the four steps listed above were applied to all sectors except Eagle Pass and El Paso. For those two sectors, the demand and gross revenues estimates (step 3) were subcontracted to Wilbur-Smith Associates (WSA), primarily because that group had a previously calibrated El Paso bridge model.

¹*Assessment of Border Crossings and Transportation Corridors for North American Trade*. Report to Congress Pursuant to Intermodal Surface Transportation Efficiency Act of 1991. Public law 102-240, sections 1089 and 6015, January 1994.

Analysis Scenarios

There has been considerable (and often divergent) debate at both state and federal levels regarding the predicted impacts from NAFTA. For the purposes of utilizing forecasts for border traffic demand analysis, the various predictors can be grouped into three possible scenarios: high impact, moderate impact, and low impact. The high impact scenario assumes that excess regulations and protectionism hinder progress, and that elimination of these constraining forces will foster economic development and trade in all NAFTA countries (and, hence, the Texas-Mexico border). The moderate impact scenario maintains that primary deregulation has already taken place with Mexico's admission into the General Agreement on Tariffs and Trade (GATT) in 1986, and that further deregulation by NAFTA will lead to only marginal gains. (As against this, the high impact scenario suggests that GATT is but a preliminary indication of what further deregulation and increased competition can do for trade and economic development.) The low impact scenario maintains that deregulation and lack of taxation will hinder rather than foster economic development at the Texas-Mexico border by encouraging maquiladoras (and consequently U.S. retailers on the Texas side) to move away from the border. Although all three scenarios represent plausible courses of *general* economic development, it must be understood that NAFTA impacts will likely be variable throughout the border (which is to say that such development anywhere creates both winners and losers, and that while some border cities — under, say, the high impact scenario — will enjoy an economic boon, other border cities will be less affected). For this reason, the study results have been presented so as to reflect NAFTA's range of possible impacts on the Texas-Mexico border.

Financial Analysis

Costs of implementation and maintenance vary greatly from one binational entry system to another. They depend on specific project characteristics, right-of-way costs, current and future interest rates, and several other factors. However, since project feasibility cannot be evaluated without at least a rough estimate of the costs, CTR developed cost estimates for a financial model that evaluates the present value of the annual net revenues over a 20-year revenue bond analysis period. The cost estimates were used in conjunction with the gross revenues to estimate the net revenues and the bond coverage ratio, using a cash-flow model based on assumptions about stock market behavior, interest rates, and managerial decisions during the liability period. An important assumption of the model is that revenues from the new facility will be used exclusively for its operation, maintenance, and debt repayment. In addition, the analysis assumes no competing facilities will be constructed in the sector during the analysis period.

Feasibility Analysis Conclusions

Bond-financed new binational entry systems are highly feasible in sectors having heavy traffic (e.g., Laredo, El Paso, and the Central Valley), even under the most conservative post-NAFTA scenarios. Facilities for the Brownsville, Eastern Valley, and Eagle Pass sectors are feasible only if certain conservative assumptions used in the traffic analysis do not emerge. For example, a new binational entry system in the Brownsville sector would be feasible under an

optimistic post-NAFTA scenario if the analysis assumption (and study recommendation) of freight intermodalism does not materialize, and trucks remain the predominant mode. New binational entry systems were found to have low feasibility in Los Indios, Western Valley, Del Rio, and Presidio. In these sectors, feasibility would require a traffic demand at least three times higher than the most optimistic estimate of this study. Table 4 summarizes these study findings.

Table 4. Feasibility of new international toll bridge systems

Feasibility	Traffic Demand	Sectors
High	Heavy	Laredo, El Paso, Central Valley
Medium	Moderate	Brownsville, Eastern Valley, Eagle Pass
Low	Low	Los Indios, Western Valley, Del Rio, Presidio

It is important to note that the traffic demand forecasts were all based on conservative post-NAFTA multimodal assumptions. Data from the U.S. Commerce Department for the first 9 months of 1994, however, suggest that the magnitude of the trade impacts may be such that the potential feasibility will shift upwards.

RECOMMENDATIONS

Because the scope of this study is broad, its recommendations encompass a multitude of issues. This section summarizes only the recommendations regarding long-term regional transportation planning and those pertaining to future studies. The reader should refer to one or more of the five previous reports to locate recommendations pertaining to such specific issues as data base development and updating, organization of traffic surveys in binational environments, binational entry system layout, and traffic circulation in specific sectors.

Development of a Border Information System

This study determined that the concept of a centralized border-related data base could be further expanded in two areas: data reporting capabilities and scope. Enhanced data reporting could be achieved through the development of a user-friendly Geographical Information System (GIS) interface, one that could produce (especially for those unfamiliar with data base language) standard reports and map displays. And an expanded data base scope calls for the implementation of a *centralized* Border Information System, one that would eliminate the duplication of efforts observed among different agencies housing data bases of border-related information. The TRANSBORDER data base can be regarded as a first step toward such a Border Information System. Ideally, this coordinated Border Information System would form part of a more comprehensive framework for statewide multimodal transportation planning.

Framework for Coordinated Border Transportation Planning

The provision of a bridge over the Rio Grande requires coordinating all inspection agencies, since additional infrastructure may disrupt traffic circulation even further if adequate staffing is not provided. Agencies do not at present routinely cooperate, and neither the U.S. nor the Mexican Presidential permit procedures encourage early cooperation.

A coordinated transportation planning framework capable of accommodating the different perspectives and interests would improve the provision of binational border infrastructure. One way to implement such binational transportation planning for the U.S.-Mexico border would be to create a committee of both U.S. and Mexican federal, state, and local officials to represent the various interested parties (supported by technical consultants when appropriate). This bi-level, binational, multi-agency committee could ensure that all parties have representation, and that they cooperate in data collection and/or release, study financing, and harmonization of infrastructure plans and implementation. Such an arrangement could, moreover, ensure that any new proposed infrastructure serves the interests of both countries.

In Texas, binational border planning is now unfolding, stimulated by state and federal support in both countries. TxDOT's International Relations Office (IRO), TTA's International Coordinating Committee for Texas-Nuevo León, the IRO Border Technology Exchange Program, and the Southwest Border Transportation Alliance research initiative — all these efforts serve to some degree as prototypes for international cooperation. These are, in fact, the types of binational planning initiatives advocated by this study.

Border Transportation Efficiency Programs

Growing U.S.-Mexico trade, coupled with the need for optimizing time and staff required for inspection procedures, suggests that a better way to achieve border transportation efficiency is the implementation of mass transit for passengers and multimodal and intermodal options for cargo. A border transportation efficiency program should thus focus on the following:

- (1) Expediting toll collection and inspection procedures, which are the main sources of congestion in most sectors;
- (2) Freight efficiency, which should be investigated for each mode, under a total system cost analysis framework that takes into account the emerging changes from NAFTA harmonization;
- (3) Monitoring the development of loop and bypass systems in border cities to improve traffic flows. Such new systems may require relocation of bridge sites; and
- (4) Mass transit to provide economies of scale in the provision of public transport for the efficient movement of non-vehicular bridge users, and to stimulate a shift away from auto use.

The proposed super-crossing concept is based on these perspectives. The specific design of a super-crossing would incorporate state-of-the-art inspection equipment and facilities for pre-cleared commodities; such upgrades would simultaneously minimize delays and inspection staff, while improvement of intermodal links at the border would provide a higher level of commercial service and improve traffic circulation as well. Both U.S. Customs and GSA have shown interest in this study's super-crossing concept.

The high cost of providing exclusive commercial roadways and state-of-the-art inspection facilities mandates that super-crossings be constructed at international trade corridors capable of generating sufficient commercial traffic. Currently, three ports of entry have the potential market

for a super-crossing: El Paso (Ysleta Bridge), Laredo (Colombia Bridge), and Brownsville (Los Indios Bridge). These binational entry systems, having already several of the super-crossing characteristics in place, could with additional investment be converted into full-blown super-crossings. Demand projections and prefeasibility studies for super-crossings could be funded through the Intermodal Surface Transportation Efficiency Act (ISTEA).

Several simple, low-cost programs to improve transportation efficiency are already being proposed by border cities (e.g., Cd. Juárez). The following are selected study recommendations of this type.

- (1) Create pre-clearance systems for both frequent auto travelers and truck cargo.
- (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 in queues.
- (3) Discourage single tractors.
- (4) Implement and encourage the use of pre-paid toll coupons (auto and truck travelers average three to four trips per week).
- (5) Implement for drayage trucks an automatic scanning system that would obviate the need to stop at toll booths.

The above recommendations are not incompatible with the implementation of super-crossings. Indeed, they are complementary. Ideally, each sector having a major commercial hub (e.g., Laredo or El Paso) should implement both a super-crossing and as many of these simpler programs as possible at its other binational entry systems.

Environment and Transportation Interaction

The border maquiladora industry, along with its related transportation needs, has degraded border groundwater and air quality. Border traffic congestion further compounds the environmental problem, combining as it does safety issues with those associated with mobile source emissions. Concerned about such environmental impacts, Texas state agencies, including TxDOT, are pursuing binational mitigation policies through contacts with the contiguous Mexican border states. In recognizing the link between trade, transportation, border congestion, and mobile emissions, this study suggests that environmental impacts can be mitigated through state and federally funded programs that improve border transportation efficiency.

High-load Facilities

One of the many important issues raised by NAFTA is the harmonization of truck loads. With current Mexican legal truck loads about 30 percent heavier than those allowed in Texas, state transportation officials are understandably concerned about the potential damage to Texas highways; on the other hand, in some specific sectors there may be enough demand to implement toll facilities that are designed for heavier loads. For example, the proposed Port of Brownsville facility encompasses a binational entry system and a toll highway to the Port that would

accommodate the heavier Mexican legal load. The financial feasibility of a high-load facility warrants further investigation, especially in sectors that contain short-distance commercial routes that may not be cost-effective for rail. This might be especially true in the Gulf Coast region (and elsewhere) if future harmonization of legal truck loads on public roads creates a market for private toll roads that accept higher load limits.

Opportunities in Border Transportation Provision

Joint ventures with local jurisdictions represent a possible mechanism for border involvement by TTA. The process for obtaining approval for new bridge facilities is expensive. Many smaller cities and counties with numerous unincorporated areas might be amenable to joint ventures with TTA to construct new bridges where traffic is increasing. Construction of new bridges near such communities has the potential to spur commercial development and job creation in an area of otherwise high unemployment.

As discussed before, however, implementation of high-occupancy and mass transit facilities seems a more efficient solution than new bridges in most cases. Obtaining permits to expand existing bridges is much easier than obtaining permits for new facilities. In communities like Brownsville, McAllen, Laredo, and some of the other smaller cities in the Lower Rio Grande Valley, implementing mass transportation on existing bridges would seem to be viable both economically and politically. TTA could enter into joint ventures with local governments or transit authorities, or even with Mexican partners, to construct, operate, and maintain international mass transit service. Given ISTEA's strong endorsement of mass transit, federal funding for start-up and operating costs could be available from that source.

If it is within its charter, TTA could explore the significant opportunities that exist with multimodal facilities. Currently, surface trade is channeled through a few distinct transportation corridors, the most important being IH-35, which links the key industrial regions of both the state and the U.S. TTA could explore the potential for a multimodal ground corridor that includes rail tracks. Commodities would move through this corridor at speeds higher than those allowed on current routes that traverse urban networks. Class 1 rail companies could lease the tracks in an arrangement similar to that proposed for the Alameda Corridor in California. This facility could be linked directly to a super-crossing, which in turn would extend the corridor to the Mexican network, providing an effective mode of transportation consonant with ISTEA's vision of multimodalism.

CONCLUSION

A shift in border transportation patterns is underway, spurred by the acceleration of U.S.-Mexico trade and, more specifically, by NAFTA. But precise impacts are always difficult to predict. For example, while NAFTA will certainly bring about changes in transborder commercial and auto traffic, the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) may also encourage changes in border transportation modes, especially for commercial traffic. By presenting three post-NAFTA scenarios to illustrate the range of possible impacts, and by developing the border sector analysis concept, this study has to a large degree addressed the

problem of the “moving target.” Ultimately, actual NAFTA impacts on border communities may be a combination of the three basic scenarios investigated in this study. In the meantime, it is important that we recognize that the border area is intensely dynamic, and that, as such, it calls for a broad transportation planning perspective, one based on constant monitoring of economic activity and traffic levels through coordinated binational transportation planning. It requires, in short, proactive involvement. The Texas Department of Transportation, through its International Relations Office and through its implementation of a Statewide Multimodal Plan, has committed itself to this kind of strategy.