FINAL REPORT

SAN DIEGO REGION-BAJA CALIFORNIA CROSS-BORDER TRANSPORTATION STUDY

Prepared for
SAN DIEGO ASSOCIATION OF GOVERNMENTS

Prepared by
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In Association with
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San Diego Region - Baja California Cross-Border Transportation Study

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Glossary of Terms

AGEB – Area Geo Estadística Básica – Mexican geographical statistical area
COLEF – Colegio de la Frontera Norte – Baja California University specializing in border related issues and studies
DCL – Designated Commuter Lane – Special lane for commuters at Otay Mesa (new lane to be installed soon at San Ysidro)
INEGI – Instituto Nacional de Estadísticas Geografía e Informática – National Institute of Information and Geographic Statistics
IMPLAN – Instituto Municipal de Planeación, Municipio de Tijuana – Municipal Planning Institute
POE – Port of Entry – The physical area of the border crossing
Processing Time – The amount of time it takes a vehicle to pass through primary customs inspection
Queue Time – The amount of time waiting in a queue at the border crossing
SAHOPE – Secretaría de Asentamientos Humanos y Obras Públicas – Baja California Secretariat of Land Use and Public Works
SANDAG – San Diego Association of Governments
SCT – Secretaría de Comunicaciones y Transportes – Mexican Federal Secretariat of Transportation
SECOFI – Secretaría de Comercio y Fomento Industrial – Mexican Federal Secretariat of Business and Business Development
TFM – Travel Forecasting Model
Transmigrant – Someone who crosses the U.S.-Mexican border to work
USCS – United States Customs Service
Wait Time – The amount of time it takes a vehicle from arriving in queue at a border crossing (POE) until it leaves the inspection area (Queue Time plus Processing Time)

1 Introduction and Overview

1.1. Study Background and Objectives

The San Diego Association of Governments (SANDAG) in cooperation with the State of Baja California, Mexico and its municipalities has completed the San Diego Region-Baja California Cross-Border Transportation Study. The primary objectives of the study are as follows:

- Collect and update cross-border travel databases through traffic counts and origin and destination surveys at the Ports-of-Entry (POEs) (San Ysidro / Puerta Mexico, Otay Mesa /Mesa de Otay, and Tecate/Tecate), as well as through reviews of data files and information obtained from members of the Bi-State Transportation Technical Advisory Committee and other agencies.

- Develop a Cross-Border Travel Forecasting Model (TFM) that functions as an analytical tool to assist local, state and federal agencies with ongoing efforts to plan border area highways and roadway linkages/ infrastructure.

- Develop a range of future Cross-Border Alternatives that include potential new POEs at Virginia Avenue-El Chaparral, East Otay Mesa-Mesa de Otay II, and Jacumba-Jacumé, and use the newly developed model to test the effectiveness of the transportation alternatives in handling projected future cross-border traffic.

The consultant team was advised throughout the project by a working group which was comprised of representatives of all participating agencies. This group included representatives from the Secretariat of Land Use and Public Works for the State of Baja California (Secretaría de Asentamientos Humanos y Obras Públicas (SAHOPE)), the Municipal Planning Institute for the Municipality of Tijuana (Instituto Municipal de Planeación (IMPLAN)), the California Department of Transportation (Caltrans), the City of San Diego, and the County of San Diego and SANDAG.

1.2 Study Area

The study area for the Cross-Border Transportation Study encompasses the entire San Diego Region in California and the Municipalities of Tijuana, Tecate and Playas de Rosarito as well as the urbanized area of the Municipality of Ensenada in Baja California, Mexico.

As shown in Exhibit 1-1, the Cross-Border Transportation study area includes all three existing POEs that serve the greater study area. This coverage of all three POEs is important due to the interplay and shifting of cross-border traffic between these locations.

1.3 Model Development

The Cross-Border TFM is based upon the existing SANDAG Series 9 model, and using the same model software, TRANPLAN. This decision allowed the existing model for San Diego County to be used, allows for the easiest application of the cross-border model and was compatible with the Tijuana model.

The first step in any model development process is to collect all necessary travel and socioeconomic data for model validation / calibration. For the San Diego-Baja California Cross-Border TFM, the effort involved collecting and updating data on travel across the border, as well as conducting new counts at POEs and main roadways, surveying drivers and pedestrians at the POEs and interviewing POE operators. Once all data were collected, they were used in different steps of the model development process.

Traffic data were gathered for local and regional roadways in San Diego County and in northwestern Baja California. These data were used to validate base year runs of the model. The surveys of cross-border travelers were used to determine trip purpose and geographic distribution of cross-border trips. In addition to collecting data strictly necessary for model development, the survey was also designed to capture other crossing behavior of interest such as trip frequency and duration, auto registration and type of employment. The data collection and surveys conducted for this study are described in Chapter 2.

Survey and traffic count data were used together to quantify vehicle arrival and wait times and vehicle queues at the POEs. This process is described in Chapter 3 of this report.

Survey and traffic count data were also used to establish the cross-border component of the TFM. The TFM is a composite model with three separate components: a United States to United States component, represented by the existing SANDAG model, a Mexico to Mexico component, represented by modification and expansion of the existing Instituto Municipal de Planeación (IMPLAN) model for the municipality of Tijuana, and the cross-border component, created for this project. Following the completion of data collection and field surveying, the primary thrust of the study team was to develop an area wide traffic model

Exhibit 1-1
Study Area

to be used as an ongoing tool to evaluate cross-border vehicular, commercial trucking, and bus passenger travel.

As described in Chapter 4, Cross-Border TFM preparation included developing cross-border regional trip tables and highway networks; calibrating daily and peak hour assignments, summarizing statistics, and preparing draft technical memoranda that describe the methodology and document the calibration and validation process. Also described in Chapter 4 is the methodology for modification of the existing IMPLAN model to encompass more of northwestern Baja California and provide a more comprehensive intra-Mexico model component.

After development of the three model components a base year 1995 traffic forecast for passenger vehicles, trucks, and buses was developed and compared to collected ground counts for model validation. After calibration of the TFM, the base model accurately represents cross-border trips. Table 1-1 shows a comparison of existing cross-border trips, model estimated cross-border trips and a comparison of error for the AM Peak hour, PM Peak Hour and Off peak time periods.

Table 1-1
Model Validation (trips)

	1995
Observed Border Crossings	
AM Peak Hour	23,097
PM Peak Hour	26,478
Off Peak	73,564
Estimated Border Crossings	
AM Peak Hour	23,143
PM Peak Hour	26,509
Off Peak	73,904
Error %	
AM Peak Hour	0.20%
PM Peak Hour	0.12%
Off Peak	0.46%

Note: Error % = (Estimated – Observed)/Observed

The model, as developed, with its associated POE Spreadsheets, the POE delay sub-model, can be used to assess the impact on travel patterns of:

1. Average “wait times” at border crossings, including vehicular “queue times” and processing time.
2. Cross-border trips included in SANDAG’s Regional Transportation Model.
3. Roadway networks on both sides of the border as included within SANDAG’s Geographic Information System (GIS) roadway network.

Socioeconomic and economic data were obtained from the Mexican National Institute of Geographic Statistics and Information (Instituto Nacional de Estadísticas de Geografía e Informática (INEGI)) for the Baja California municipalities, including a variety of growth forecasts and from the SANDAG model for San Diego County. This information was used to develop the cross-border growth rates that are described in Chapter 5 of this report and the cross-border growth factors that are used to develop 2020 base year forecasts as described in Chapter 7. Tables 1-2 and 1-3 show these inputs to the model and the estimates of auto and truck trips based on these inputs for the base year 1995 and for the future base year 2020.

Table 1-2
Model Inputs

	1995	2020
San Diego Population	2,669,200	3,853,297
San Diego Employment	1,084,947	1,627,761
Mexico Study Area Cross-border Workers	24,341	86,264
NW Baja California Population	1,417,106	3,697,650
NW Baja California Employment	525,850	1,481,127

Table 1-3
Model Estimates (trips)

Auto Crossings	1995	2020
Mexico Home to U.S. Work	21,285	53,683
U.S. Home to Mexico Work	5,917	12,772
Mexico Home to U.S. Other	42,723	87,787
U.S. Home to Mexico Other	30,941	65,907
Mexico Non home based to U.S.	6,473	13,972
U.S. Non home based to Mexico	5,797	12,513
	113,136	246,634
Truck Crossings	5,004	10,008
Total Passenger Car Equivalents*	123,144	266,650

* Passenger Car Equivalents = Total Auto Crossings + (Total Truck Crossings *2)

1.4 Development of Alternatives and Forecasts

Three future year (2020) POE Alternatives were developed early in 2000 by the study working group. The alternatives are structured to build on existing POEs by adding one or more of the following POEs:

1. Virginia Ave.-El Chaparral POE: Requires potential highway modifications to Interstate 5 (I-5) and Interstate 805 (I-805) to allow for northbound non-commercial traffic to use the San Ysidro POE and southbound non-commercial traffic to use a new gate at Virginia Ave/El Chaparral.

2. East Otay Mesa-Mesa de Otay II POE: Connector roadways would be State Route (SR) 11 and Tijuana arterial streets leading to Mesa de Otay II POE.

3. Jacumba-Jacumé POE: Potential connecting roads are needed to Interstate 8 and Mexico's Highway 2D (toll road) and Highway 2 (free road). On the U.S. side, the POE would connect to Old ighway 80, east of Carrizo Gorge Road. At this time, the In-Ko-Pah Road interchange is the preferred interchange to serve the Jacumba-Jacumé POE.

The detailed definition of the three selected POE alternatives is described in Chapter 6 of this report.

After selection of the three future year alternatives, and after validation/calibration of the 1995 base year model, future year networks were developed that represent the 2020 base year scenario and for each future alternative. Chapter 7 discusses this process. The base future year 2020 network for Baja California included several new major roadway segments. All future year networks were reviewed and approved by the Study Committee. Once the future year networks were complete, the model was run incorporating future networks and projected future growth as determined in Chapter 5. Included in Chapter 7 are demand by POE by scenario and the corresponding delay at the POEs under each scenario.

In the future, the newly developed Cross-Border TFM can be used to analyze many potential options to improve access to POEs and test the efficiency of border crossing facilities between the San Diego Region and Baja California. The Cross-Border TFM has the capability of analyzing a large area encompassing all existing and potential future POEs. In addition, it can provide sufficient detail in its companion spreadsheets to

properly reflect operations at an individual POE level. Through development of this model, however, areas of improvement to the TFM have been identified. Chapter 8 describes possible future enhancements to the TFM to make it an even more powerful tool in cross-border planning and development.

2 Data Collection and Surveys of Ports of Entry

In order to estimate cross-border trip generation and to estimate traffic levels on major access roadways existing information about border crossings had to be gathered and collected. Information was gathered about current roadway traffic volumes and border crossings by mode (auto, bus, truck and pedestrian). New surveys were conducted especially for this study that identified trip origins, destinations, purpose and other relevant trip related data. The following sections describe the data collection process and results.

2.1 Collection of Existing Data

Traffic Data

Existing traffic counts on local and regional roadways were gathered from a number of different sources. For roadways within San Diego County traffic counts were obtained from databases maintained by SANDAG and Caltrans. For roadways within Baja California traffic counts were obtained from the Federal Secretariat of Transportation (Secretaría de Comunicaciones y Transportes (SCT)) and from the municipal government of Tijuana (Municipio de Tijuana). These counts were used to validate base year runs of the model.

New traffic counts were also conducted during the month of April 1999 to provide data from the days that the origin and destination survey was collected in the vicinity of the ports of entry. Due to the complexity of the roadway network near the ports of entry and the multiple paths that cars can travel, traffic count tubes were placed in several locations for each port. Exhibits 2-1, 2-2 and 2-3 show schematic drawings of the ports of entry. Traffic counts collected from these locations were at best rough guides of existing traffic conditions. Tubes were avoided in some locations and removed in other locations. Traffic counts were however, useful in determining peaking characteristics of drivers crossing the border. Information on volumes crossing the border was obtained from the U.S. Customs Service (USCS). Exhibits 2-4 through 2-7 show relative volumes by mode over the range of survey days. While these data were collected for all mid-week days to determine average daily traffic, surveys were only conducted on two mid-week days. Since no data on southbound crossings were readily available from federal sources and the manual traffic counts were suspect as discussed above, southbound crossing had to be assumed. Given the fact that some automobiles cross southbound at one location and northbound at another in Tijuana, total southbound crossing volumes for both Otay Mesa and San Ysidro were assumed to be the same as total northbound crossings. Southbound crossings at Tecate were assumed to be the same volumes as northbound crossings.

Exhibit 2-1
San Ysidro – Puerta Mexico Port of Entry

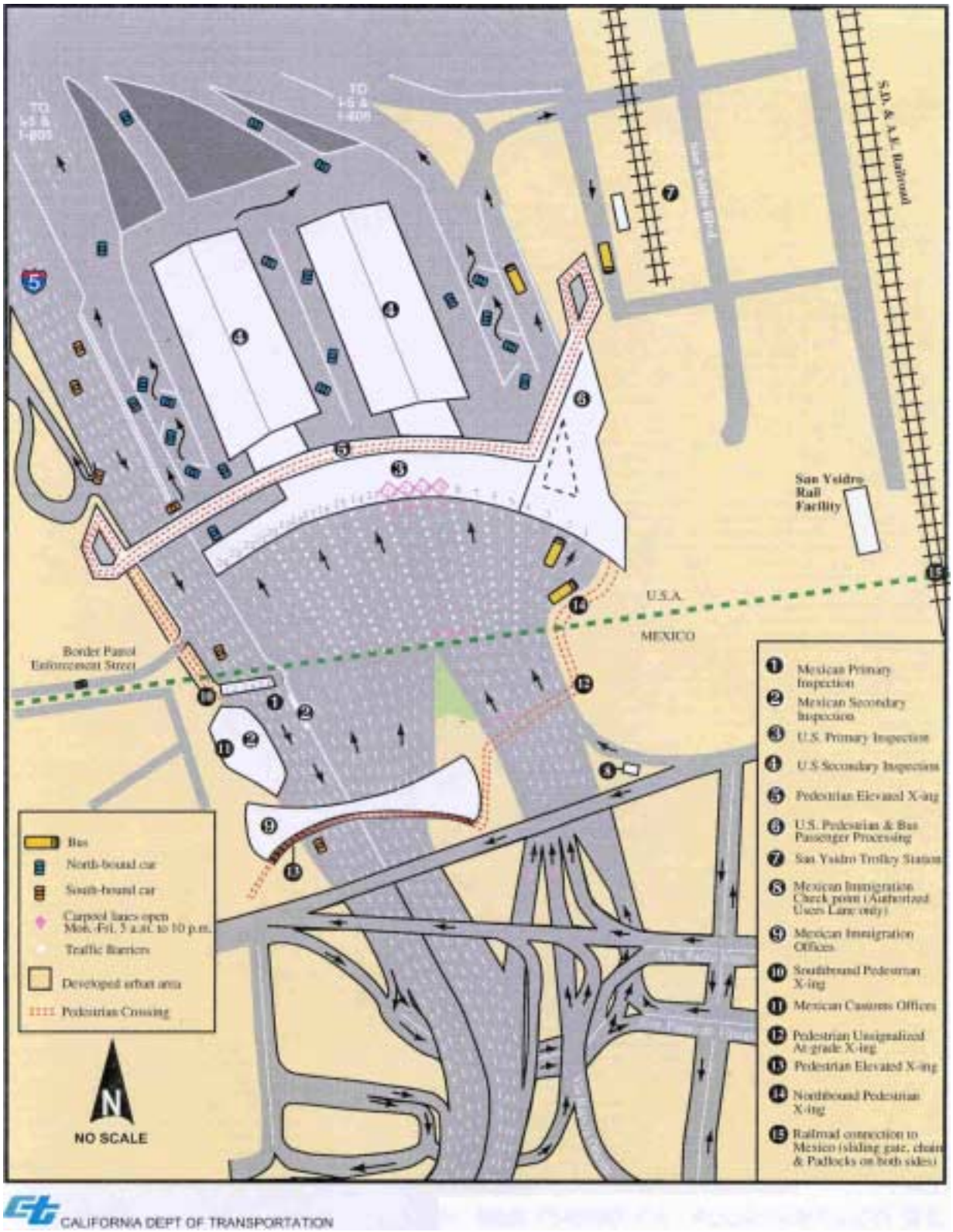


Exhibit 2-2
Otay Mesa-Mesa de Otay Port of Entry

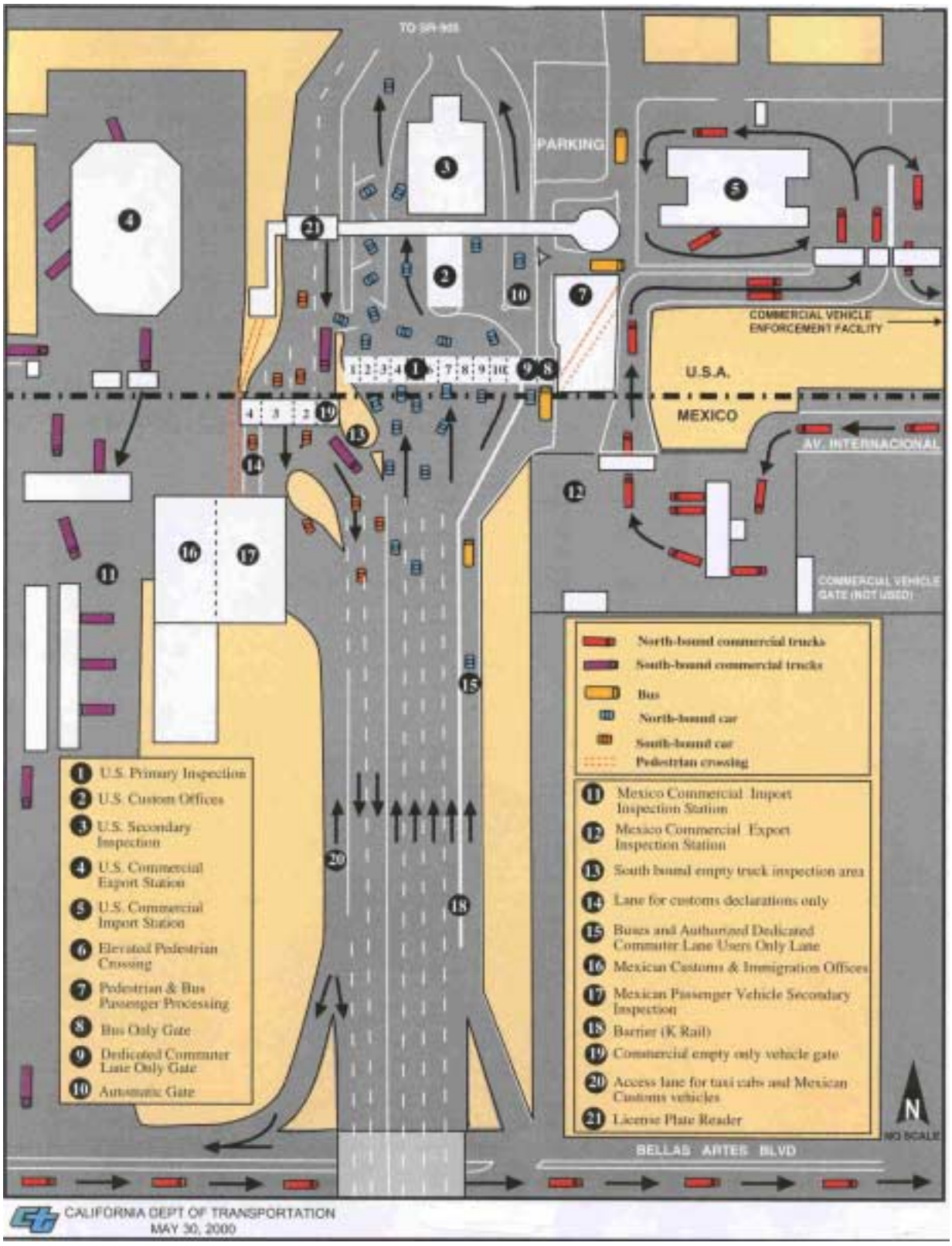
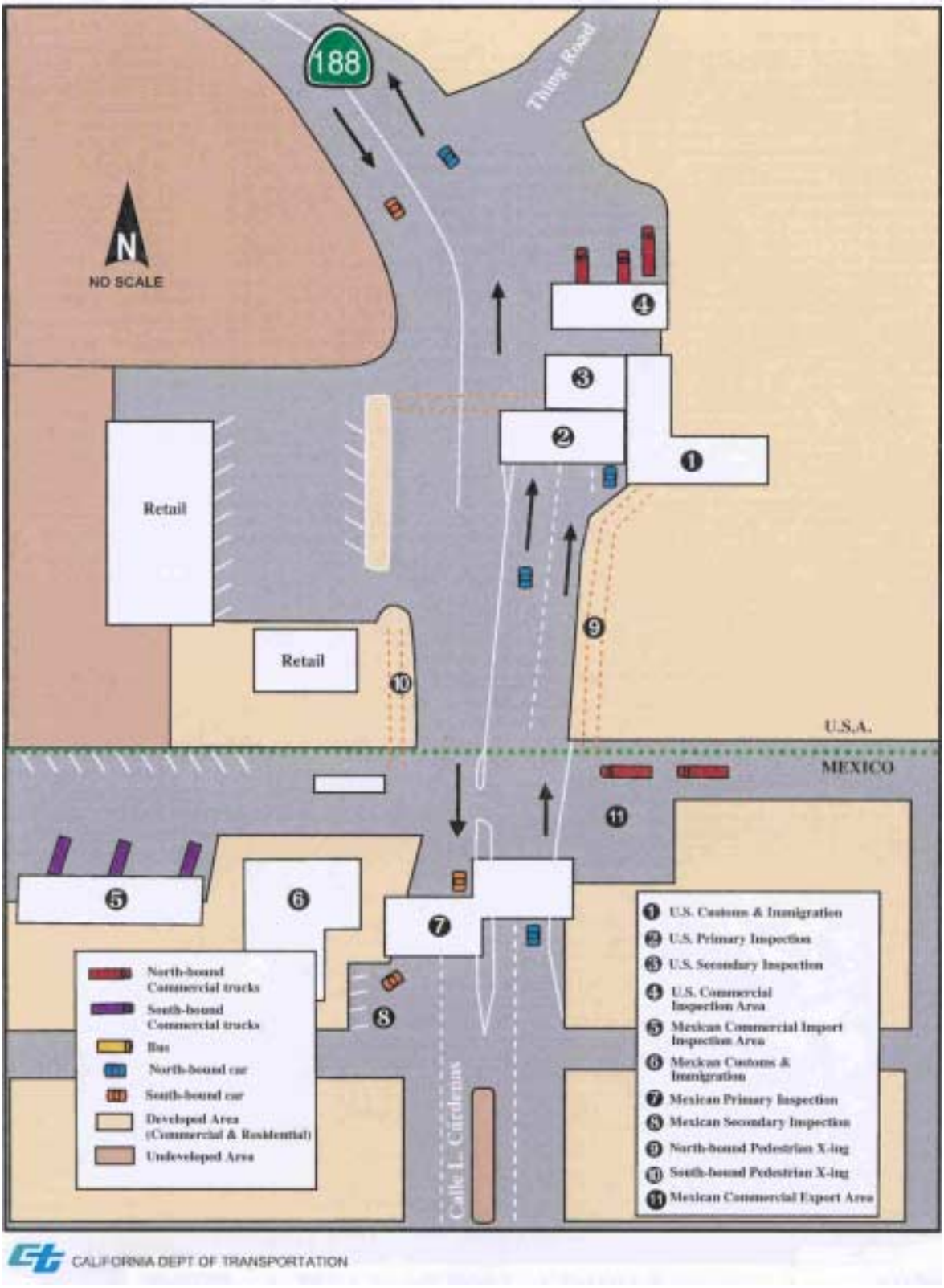


Exhibit 2-3
Tecate-Tecate Port of Entry



Economic and Population Data

Economic data were gathered from research conducted by CIC Research for the San Diego Region and by the Colegio de la Frontera Norte (COLEF) for the Municipalities of Tijuana, Tecate, Ensenada and Playas de Rosarito. Population data were gathered from SANDAG by traffic analysis zone for San Diego County. Population data by Basic Geographic Statistical Areas (Áreas Geoestadísticas Básicas (AGEB)) were gathered from the 1995 Mexican census collected and documented by INEGI for the State of Baja California. Mexican population data were then converted to traffic analysis zones based upon information contained in the Tijuana Regional Transportation Model. Economic and population data are discussed extensively in Chapter 5 of this report.

2.2 Origin and Destination Survey

Survey Design

Travel surveys were developed for the four modes of travel: passenger vehicles, trucks, buses and pedestrians. These surveys were designed to capture information about trip characteristics including the origin and destination of the trip and frequency of the trip. The surveys were further specialized for each mode of travel. Automobile surveys included information about the trip maker, including location of their home, the United States or Mexico and their type of work, and registration of their automobile, auto occupancy, trip purpose and trip duration. Pedestrian surveys also included information about the trip maker including location of their home, the United States or Mexico and their type of work, as well as origin and destination modes for their walk trip, the trip purpose and trip duration. Truck surveys included information about the type of truck, type of cargo, and process characteristics of the truck trip, including driver changes, broker processing and destinations. Bus surveys included information about number of bus passengers and number of bus stops on either side of the border. Copies of the surveys used are included in the appendix as Appendix A.

Surveys were designed for ease of use in the field and for ease of data entry. Surveys were one page in length and were written on one side in English and the other side in Spanish.

Exhibit 2-4
Survey Day Northbound Auto Crossings

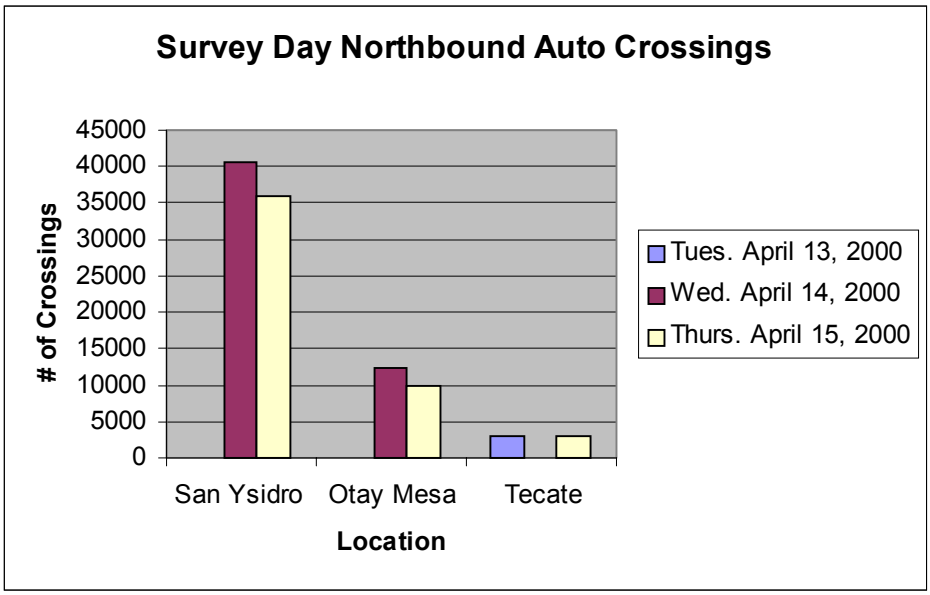


Exhibit 2-5
Survey Day Northbound Pedestrian Crossings

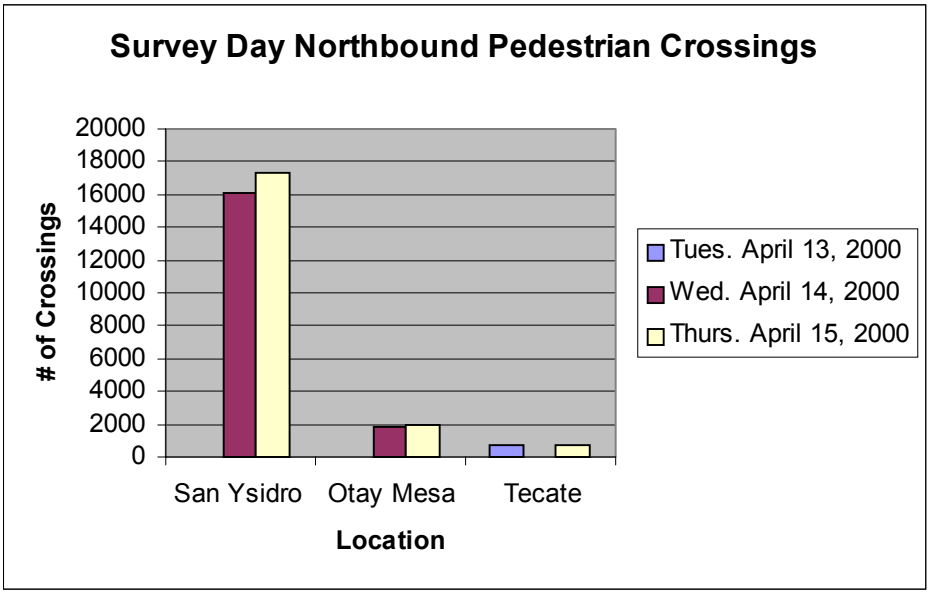


Exhibit 2-6
Survey Day Northbound Truck Crossings

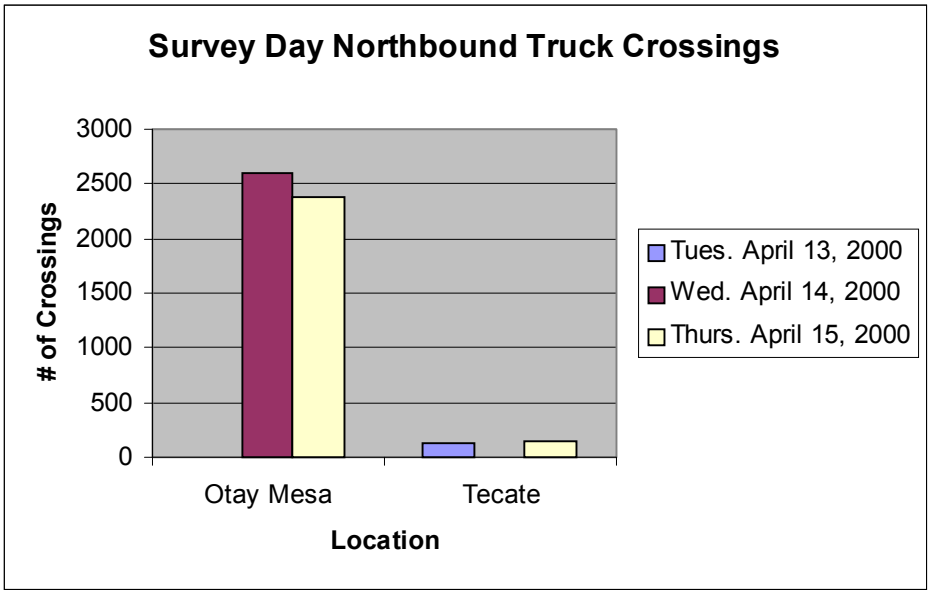
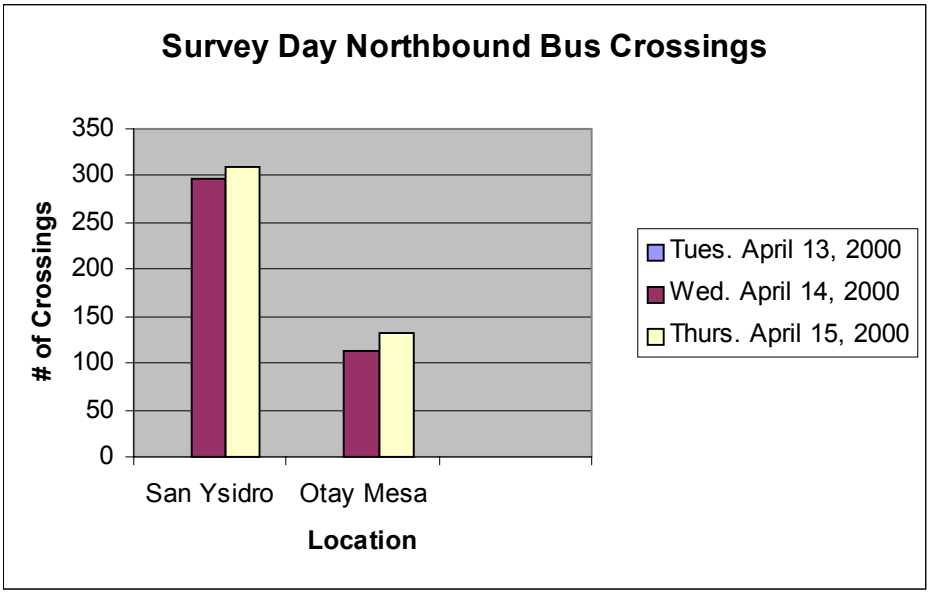


Exhibit 2-7
Survey Day Northbound Bus Crossings



Survey Implementation

Surveyors were given orientation sessions prior to conducting the survey. The orientation sessions were held to inform surveyors of the purpose and methodology of the survey and to establish the proper way to fill out the surveys for ease of data entry. All surveyors were bilingual and filled out the appropriate side of the survey depending on the responses given by the respondents.

Surveys were conducted at the three ports of entry, San Ysidro- Puerta Mexico, Otay Mesa-Mesa de Otay and Tecate-Tecate, during April 7-9 and April 13-15, 1999. Each port of entry was surveyed for two days. Survey hours were approximately from 6:00 am until 5:30 pm. The surveys were conducted during this time period to capture the majority of peak hour traffic as well as to capture information about daytime off-peak traffic. 2,881 surveys were collected on the survey days: 1,206 at Otay Mesa, 1,075 at San Ysidro, and 600 at Tecate. By type of survey, 1,973 auto surveys were collected, 559 pedestrian surveys, 277 truck surveys and 72 bus surveys.

2.3 Survey Results

Surveys were input to spreadsheets using alphanumeric codes based on the responses. After initial data entry, each record was double-checked with the original survey sheet. After the data entry check, records with missing information or conflicting information were again checked to ensure that no errors had been made. The survey origin and destinations were asked both at a general city level, and at a more specific level, neighborhood for City of San Diego respondents and colonia for Tijuana and Tecate respondents. Each survey was then geo-coded to a corresponding traffic area zone. In the instances where the respondent answered specific locations, such as Plaza Bonita or the shopping area and popular transit destination of 5 y 10 in Tijuana, where identifiable these were also geo-coded to a corresponding traffic area zone. Through this hand verification process many more surveys were able to be geo-coded and thus provide more information about origins and destinations. Surveys were then translated into a database where a variety of statistical summaries could be gathered. The remainder of this section describes results of the surveys based on the raw (unfactored) survey data. Surveys were then used as background material along with the control data at the ports of entry to develop the cross-border model trip-tables. This process is described in detail in Chapter 4 of this document.

San Ysidro

Surveys were conducted at the San Ysidro Port of entry on April 14 and 15, 1999. Passenger car, pedestrian and bus surveys were conducted at this location. There are no truck crossings at this POE. A total of 668 passenger car surveys (71% northbound, 29% southbound), 335 pedestrian surveys (49% northbound, 51% southbound) and 72 bus surveys (100% southbound) were conducted. Based on daily northbound border crossing data obtained from U.S. Customs, and projected southbound border crossing data, surveys were gathered for approximately 1 out of every 125 autos, 1 out of 109 pedestrians, and 1 out of 8 buses.

Table 2-1
Purpose by Mode: San Ysidro

Mode (# records)		Direction	Work	Shop	Other
Autos	(465)	NB	30%	42%	28%
	(175)	SB	28%	16%	56%
Pedestrians	(155)	NB	23%	41%	36%
	(170)	SB	22%	27%	51%

Table 2-2
Pedestrian Origin and Destination Modes: San Ysidro

Direction	Origin Mode	%	Destination Mode	%
NB	Taxi	58	Trolley	42
	Public Bus	16	Walk	17
	Auto Parked	10	Auto Pick-up	13
	Auto Drop-off	10	Public Bus	11
	Other	6	Other	17
SB	Trolley	34	Public Bus	30
	Public Bus	19	Taxi	23
	Auto Drop-off	17	Walk	19
	Walk	15	Auto Pick-up	14
	Auto Parked	14	Auto Parked	13
	Other	1	Other	1

Of the auto trips surveyed, nearly 40% make the trip daily, while 25% make the trip two times a month or more. 22% of surveyed auto trips stayed across the border for a normal workday (8-10 hours) and 34% trips stayed across the border between 2-4 hours. Of the pedestrian trips surveyed 29% make the trip daily, while 50% make the trip once a month or more. Pedestrians make shorter trips than cars with 39% of the trips between 2-4 hours. However, 20% of the trips stay across the border for a workday.

Otay Mesa

Surveys were conducted at the Otay Mesa Port of Entry on April 14 and 15, 1999. Passenger car, pedestrian and truck surveys were administered. A total of 736 passenger car surveys (100% northbound), 71 pedestrian surveys (93% northbound, 7% southbound) and 145 truck surveys (100% northbound) were conducted. Based on daily northbound border crossing data obtained from U.S. Customs, and projected southbound border crossing data, surveys were gathered for approximately 1 out of every 32 autos, 1 out of 48 pedestrians, and 1 out of 32 trucks.

Table 2-3
Purpose by Mode: Otay Mesa

Mode (# records)	Direction	Work	Shop	Other
Autos (718)	NB	44%	26%	30%
Pedestrians (66)	NB	57%	11%	32%
(5)	SB	40%	-	60%

Table 2-4
Pedestrian Origin and Destination Modes: Otay Mesa

Direction	Origin Mode	%	Destination Mode	%
NB	Auto Drop-off	26	Walk	26
	Public Bus	26	Public Bus	18
	Walk	17	Auto Pick-up	17
	Other	37	Auto Parked	12
			Taxi	11
			Other	16

Of the auto trips surveyed, 37% make the trip daily, while 23% make the trip more than once a week. 48% trips stayed across the border between 2-4 hours with only 17% of trips staying for a normal workday (8-10 hours). Of the pedestrian trips surveyed 36% make the trip daily. Pedestrians trip lengths were varied with no clear pattern. Only northbound autos were surveyed and the sample size for southbound pedestrians were small, therefore care must be taken when making a direct comparison to trip lengths and trip frequencies at the other two ports of entry.

Only northbound trucks were surveyed at Otay Mesa. 43% of these crossed daily, 29% weekly, 18% more than once a day and 10% monthly or less often. 88% of the truck trips originated in the Municipio of Tijuana and 88% of the trucks were destined to locations in San Diego County. Forty-eight percent of these trucks are destined to Otay Mesa, 17% to the City of San Diego, and the remaining 23% distributed throughout the county.

Tecate

Surveys were conducted at the Tecate Port of Entry on April 13 and 15, 1999. Passenger car, pedestrian and truck surveys were conducted at this location. A total of 349 passenger car surveys (61% northbound, 39% southbound), 119 pedestrian surveys (34% northbound, 66% southbound), and 132 truck surveys (35% northbound, 65% southbound) were conducted. Based on daily northbound border crossing data obtained from U.S. Customs Service, and projected southbound border crossing data, surveys were gathered for approximately 1 out of every 17 autos, 1 out of 15 pedestrians, and 1 out of every 3 trucks.

Of the auto trips surveyed, nearly 38% make the trip daily, while 27% make the trip at least once a month. In Tecate, many of the auto trips, 27%, are less than an hour in length, with another 26% of auto trips the length of a normal workday (8-10 hours. Of the pedestrian trips surveyed 31% make the trip daily. A large percentage of pedestrian trips, 43%, are also less than an hour long, and 32% between one and four hours.

Table 2-5
Purpose by Mode: Tecate

Mode (# records)		Direction	Work	Shop	Other
Autos	(206)	NB	57%	22%	21%
	(126)	SB	44%	2%	54%
Pedestrians	(40)	NB	45%	45%	10%
	(77)	SB	19%	3%	78%

Table 2-6
Pedestrian Origin and Destination Modes: Tecate

Direction	Origin Mode	%	Destination Mode	%
NB	Walk	53	Walk	88
	Auto Parked	25	Other	12
	Public Bus	11		
	Other	11		
SB	Walk	76	Walk	71
	Auto Drop-off	14	Auto Park	21
	Auto Parked	10	Other	8

Sixty-five percent of the surveyed northbound trucks cross daily, 19% cross more than once a day, 11% cross weekly and 4 % cross monthly or less frequently. Forty-eight percent of the surveyed southbound trucks cross daily, 3% cross weekly, 13% cross more than once a day, and 5% cross monthly. For northbound trucks, 74% of the surveyed trips began in Tecate, Baja California. 39% of these trips ended in Tecate, California while another 35% ended in San Diego County. For southbound trucks, 44% began in Tecate, California while another 35% originated in San Diego County. 84% of the southbound trucks end in Tecate, Baja California.

Major Trip Origins and Destinations by Mode and Location

The following tables describe major origins and destinations for auto, pedestrian and truck trips. Survey respondents could both specify the city they were destined to/coming from and the colonia or neighborhood they were destined to/coming from. For this reason, top origins and destinations are a mix between cities and colonias.

Table 2-7
Major Auto Trip Origins/Destinations

Location	Direction	Top 5 Origins	Top 5 Destinations
San Ysidro	NB	La Mesa, Playas, Playas de Rosarito, Chapultepec, Centro/Libertad	Chula Vista, San Ysidro, Downtown SD, National City, San Diego
	SB	San Diego, Chula Vista, Los Angeles, National City, La Jolla	Tijuana, Centro, Playas de Rosarito, Playas, Ensenada
Otay Mesa	NB	Otay, Cacho, Playas, Hipodromo, Buena Vista, Libertad	Chula Vista, San Ysidro, Otay Mesa, National City, Downtown San Diego
Tecate	NB	Tecate (BC), Juarez, Cuauhtemoc, Refugio, Militar	Tecate(CA), Chula Vista, El Cajon, San Diego, Spring Valley
	SB	Tecate(CA), El Cajon, Chula Vista, Downtown San Diego	Centro, Moderna, Downey, Descanso, Tecate (BC)

Table 2-8
Major Pedestrian Trip Origins/Destinations

Location	Direction	Top 5 Origins	Top 5 Destinations
San Ysidro	NB	Centro, Playas de Rosarito, Playas, Lomas Taurinas, Libertad	San Ysidro, Chula Vista, Downtown SD, National City, Los Angeles
	SB	San Ysidro, Chula Vista, Downtown SD, National City, Los Angeles	Tijuana, Playas, Centro, Plaza Rio, Playas de Rosarito
Otay Mesa	NB	Otay, La Mesa*	Chula Vista, Otay Mesa, San Ysidro*
Tecate	NB	Militar, Colinas*	Tecate (CA)*
	SB	Tecate (CA), El Cajon*	Centro*

* remaining origin/destinations had 3 or fewer responses

Table 2-9
Major Truck Trip Origins/Destinations

Location	Direction	Top 5 Origins	Top 5 Destinations
Otay Mesa	NB	Otay, La Mesa, Ensenada, Col. Libertad, Sanchez Taboada*	Otay Mesa, Chula Vista, San Diego*
Tecate	NB	Tecate, Parque Industrial (Tecate)*	Tecate (CA), Los Angeles*
	SB	Tecate (CA), Los Angeles, La Mesa, San Diego*	Parque Industrial (Tecate), Col. Centro, Col. Industrial, Ensenada*

* remaining origin/destinations had 3 or fewer responses

Auto Registration

This final table outlines the number of U.S. vs. Mexican registered vehicles crossing the border at all three ports of entry.

Table 2-10
Auto Registration

Location	Direction	Registration (% U.S. / % MX)
San Ysidro	NB	37/63
	SB	77/23
Otay Mesa	NB	57/43
Tecate	NB	50/50
	SB	51/49

3 Vehicle Arrivals, Wait Times, and Queues at Ports of Entry

3.1 Queue Length Observations

Queue lengths were also measured or counted on the survey days. Once each hour the locations of the end of the queue in each approach lane both northbound and southbound at all three ports of entry were marked on a schematic drawing. These markings were then translated to number of cars based on a combination of aerial photography and site counting. Where queues were short such as at Tecate or Otay Mesa in the southbound direction, queues were actually counted. Where queues were longer, queues were counted to known distances to determine average number of cars per meter of queue and then total numbers in the queue were estimated based on the length of the queues as shown schematically on the maps. These queue lengths were used to help determine queuing delay for automobiles. This methodology is discussed below.

3.2 Estimates

Estimates of existing vehicle arrivals, queues and wait times have been developed for the three cross-border Ports of Entry (POEs); Otay Mesa, San Ysidro, and Tecate. Wait times for this report are defined as times from when a vehicle arrives in queue at the border until the time the vehicle leaves the inspection gates. For automobiles (and for empty trucks traveling southbound through auto lanes), time leaving is defined as the moment a car clears primary inspection. For all other trucks, time leaving is defined as the moment a truck leaves the truck inspection facility. Wait time is thus divided into two segments, time in queue and processing time at U.S. or Mexican Customs. The estimates shown in Tables 3-1 and 3-2 are both for autos and for trucks, and represent a typical weekday. They are based on the following data:

- Hourly and daily data from U.S. Customs for six separate weekdays in April, 1999;
- Ground counts taken at the three POEs between April 13 and April 15, 1999; and
- Manual counts of vehicles in queue at each POE on the days of the ground counts.

Table 3-1 shows arrivals, queues and typical wait times in minutes for the peak commute hours (8:00-9:00 AM and 5:00-6:00 PM). Table 3-2 shows

the arrivals, queues and wait times in minutes at each POE that generate the maximum queues. These maximums do not necessarily occur during the commute peak hours. This information is used to develop the POE delay sub-model, a component of the Cross-Border TFM discussed in Chapter 4.

Detailed tables showing the hourly arrivals, departures (vehicles processed), vehicles in queue, and average wait time are provided in Appendix B at the back of this report for each of the POEs.

3.3 Capacities

Auto Volumes and Capacity

The automobile capacity of the POEs is a direct function of the number of gates open at any point in time. Conditions at each of the three POEs are different, as described below.

At Otay Mesa, the seven northbound gates are open for most of the day. This means that the POE is operating at capacity. During the morning hours, at peak demand, capacity is slightly higher due to the use of the designated commuter lane (DCL) which in turn increases the average processing rate for all cars. Any increase in northbound volume will result in significant delays, assuming the processing rates of the gates remains the same as today. Southbound gates are nearly saturated as well, with all three gates open during the afternoon hours when traffic is highest.

At San Ysidro, all 24 northbound gates are open only during two hours in the early morning. There is still room for some growth at San Ysidro, since the gates can be opened longer during the high volume period. There is a tremendous amount of sensitivity in the way the POE is operated. Reducing the processing rate by 10 percent more than doubles the wait time for vehicles throughout the day, and causes queues that back up well into the city streets. It is apparent that U.S. Customs is carefully monitoring the vehicle queues and opening gates as necessary to keep the queues at a manageable level. For two hours a day, all 24 gates are open. This means that there is little that can be done to meet the peak hour demand if the volumes increase further. Opening all gates for the hours before and after the peak will help to reduce the amount of time that the very long queues exist.

During the highest peak hour in the southbound direction, traffic volumes at San Ysidro reach the capacity of the six southbound lanes. The queue lasts for less than an hour, however. This indicates that there remains some unused southbound capacity at San Ysidro.

Table 3 –1
Typical Weekday Estimates

	AM Peak Hour	PM Peak Hour
OTAY MESA AUTOS		
Northbound Arrivals	777	648
Northbound Queue	256	0
Northbound Wait Time	22.5	2.9
Southbound Arrivals	463	1,436
Southbound Queue	18	101
Southbound Wait Time	1.4	3.0
SAN YSIDRO AUTOS		
Northbound Arrivals	2,831	1,822
Northbound Queue	1,028	770
Northbound Wait Time	23.1	25.9
Southbound Arrivals	1,644	3,708
Southbound Queue	2	20
Southbound Wait Time	1.2	0.6
TECATE AUTOS		
Northbound Arrivals	297	40
Northbound Queue	31	0
Northbound Wait Time	3.8	0.3
Southbound Arrivals	173	272
Southbound Queue	0	1
Southbound Wait Time	0.2	0.3
OTAY MESA TRUCKS		
Northbound Arrivals	211	139
Northbound Queue	74	74
Northbound Wait Time	20.4	32.1
Southbound Arrivals	104	169
Southbound Queue	0	29
Southbound Wait Time	10	16.6
TECATE TRUCKS		
Northbound Arrivals	14	4
Northbound Queue	4	0
Northbound Wait Time	20.1	16.2
Southbound Arrivals	11	13
Southbound Queue	0	10
Southbound Wait Time	10	52.5

Table 3 –2
Maximum Estimates

	Maximum Value	Time
OTAY MESA AUTOS		
Northbound Arrivals	1,218	7:00-8:00
Northbound Queue	484	8:00
Northbound Wait Time	23.0	7:00-8:00
Southbound Arrivals	1,436	17:00-18:00
Southbound Queue	101	18:00
Southbound Wait Time	3.0	17:00-18:00
SAN YSIDRO AUTOS		
Northbound Arrivals	3,881	6:00-7:00
Northbound Queue	1,357	8:00
Northbound Wait Time	30.9	9:00-10:00
Southbound Arrivals	3,946	16:00-17:00
Southbound Queue	68	8:00
Southbound Wait Time	1.2	8:00-9:00
TECATE AUTOS		
Northbound Arrivals	387	14:00-15:00
Northbound Queue	31	9:00
Northbound Wait Time	3.9	9:00-10:00
Southbound Arrivals	320	15:00-16:00
Southbound Queue	12	16:00
Southbound Wait Time	1.5	15:00-16:00
OTAY MESA TRUCKS		
Northbound Arrivals	211	8:00-9:00
Northbound Queue	119	16:00
Northbound Wait Time	39	15:00-16:00
Southbound Arrivals	302	15:00-16:00
Southbound Queue	113	16:00
Southbound Wait Time	26.9	16:00-17:00
TECATE TRUCKS		
Northbound Arrivals	21	6:00-7:00
Northbound Queue	7	12:00
Northbound Wait Time	39.1	12:00-13:00
Southbound Arrivals	16	15:00-16:00
Southbound Queue	10	18:00
Southbound Wait Time	52.5	17:00-18:00

Demand at Tecate is quite low when compared to the other POEs. This is because Tecate is much further away from the City centers. Even in Tecate, demand during the high volume hours is close to total capacity in the northbound direction. Again, long queues will be experienced soon in Tecate if traffic continues to grow. There remains some unused capacity in the southbound direction.

In summary, all three POEs have sufficient capacity today to meet the traffic demand. There will soon be problems at all three POEs, however, if traffic demand grows very much. Otay Mesa will be the first POE to show the negative impacts of additional traffic growth.

Truck Volumes and Capacity

Truck wait times range from 10 to 40 minutes in the northbound direction, and from 10 to 30 minutes in the southbound direction at Otay Mesa. There is insufficient data to estimate the capability of the truck facilities to handle future growth. At Tecate, even a small truck queue can cause lengthy delays due to the fact that there is only a single gate for processing.

4 Base Year Model Development

4.1 Methodology and Assumptions

The cross border component to the SANDAG model was designed to incorporate the unique characteristics of cross border traffic. It achieves this by modeling cross-border traffic as a special generator. It was developed with the following characteristics in mind:

- It should seamlessly integrate into the existing SANDAG model.
- It should not introduce unnecessary complication to the operation of the SANDAG model.
- It should not introduce excessive overhead to the operation of the SANDAG model.

With that in mind the Cross-Border model was developed to be a "freestanding" component. One that could be kept as a constant for typical model operations yet easily be adjusted to analyze cross-border scenarios. This was accomplished by expanding the modeling area and by separating the regional trips into three components: United States to United States, Mexico to Mexico, and Cross-Border. For the United States to United States trips, the SANDAG model is used directly. For the Mexico to Mexico trips, an intra-Mexico model was developed. For the cross border trips, a Cross-Border special generator model was developed.

For any particular analysis, two of the three components can be held constant. That is, for typical SANDAG model application, the intra-Mexico and Cross-Border model components will be held constant. For modeling border crossing (POE) scenarios, the United States to United States trips and intra-Mexico components will be held constant.

In developing the intra-Mexico model component, the existing Tijuana model was used as a template. The Tijuana Regional Transportation model network and zone systems were re-created in the SANDAG model on a one to one basis. Since the network definitions are different between the SANDAG and Tijuana models, the relevant variables were translated into the SANDAG system. Networks and zones for the remaining Mexican area were added based on available data.

4.2 Base Year Network Definition and Zone System

In order to implement the Cross-Border model, the SANDAG modeling area was increased to encompass the border area of Baja California the full width of San Diego County, and as far south as Ensenada. The majority of detail of this addition is in the urbanized area of Tijuana, as well as in the city of Tecate. The remaining area is modeled in a sparse, aggregate manner.

The detail of the zones and network added to the SANDAG model are greatest at the developed areas near the border, and more aggregate further from the border. This was done because the level of detail needed to reflect where a trip will cross the border (e.g. San Ysidro or Otay Mesa) is less the further from the border that trip originates.

The zonal definition from the Tijuana model was used unchanged (save for zone numbering) for that area covered by the Tijuana model. For the remaining area, the zones were added at a level of detail required for model performance. That is, more detail in the developed area close to the border (e.g. Tecate) and at an aggregate level further from the border.

Exhibit 4-1 shows the zones added in Mexico to the SANDAG model. Exhibit 4-2 shows the zones added in Tijuana in more detail.

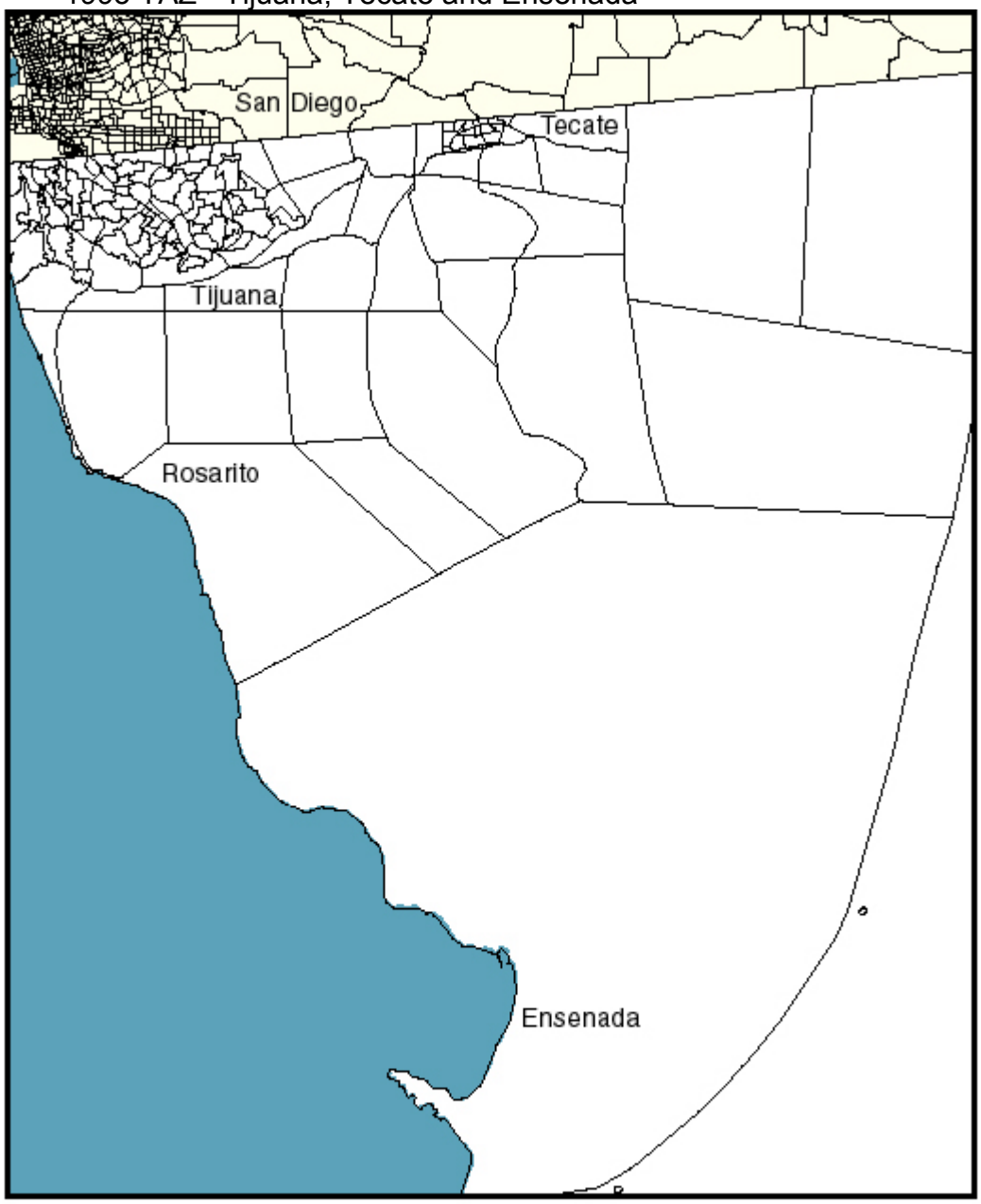
The network in San Diego County remained as defined in the SANDAG model. The network in the Tijuana model was used as a guide for that area. The set of Facility Types used in the Tijuana model differs from those in the SANDAG model. The link definitions from the Tijuana model were translated to match, as closely as possible, those in the SANDAG model. Other variables, such as delay curves, were also matched as closely as possible. This translation of data was not exact, since the two models had very different sets of values and variables.

The network for the remaining modeled area in Mexico was added using available data. These data included road maps and aerial photo-coverage from the SANDAG GIS data sets. Exhibit 4-3 shows the added network, and Exhibit 4-4 shows the Tijuana network in more detail.

4.3 Cross-Border Model Component

The Cross-Border model component is the heart of this model enhancement effort. This model was developed from the results of the very substantial survey efforts described in Chapter 2 and the derived data enumerated in Chapter 3. The surveys were used to develop the

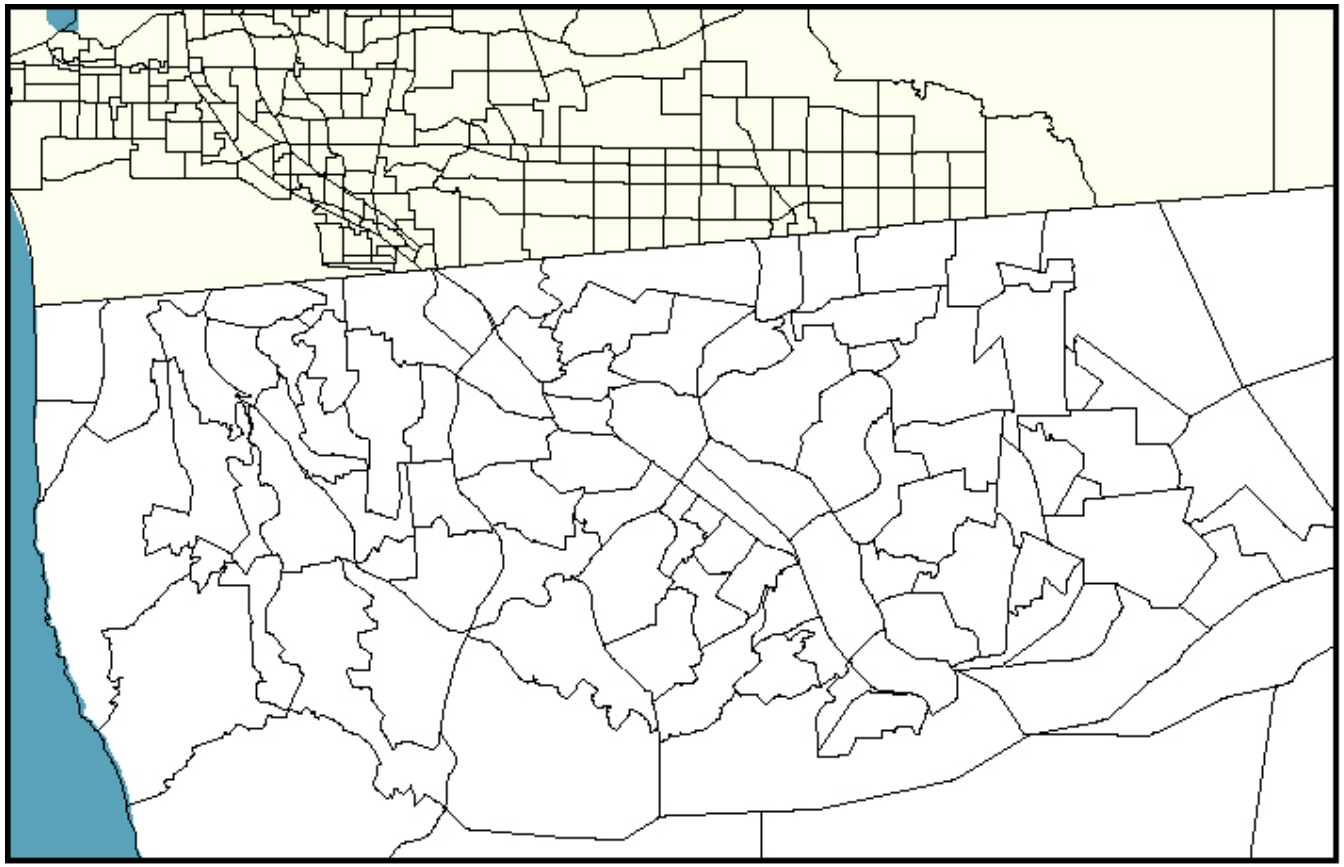
Exhibit 4-1
1995 TAZ - Tijuana, Tecate and Ensenada



Traffic Analysis Zones
Tijuana, Tecate, Playas de Rosarito and Ensenada

Exhibit 4-1

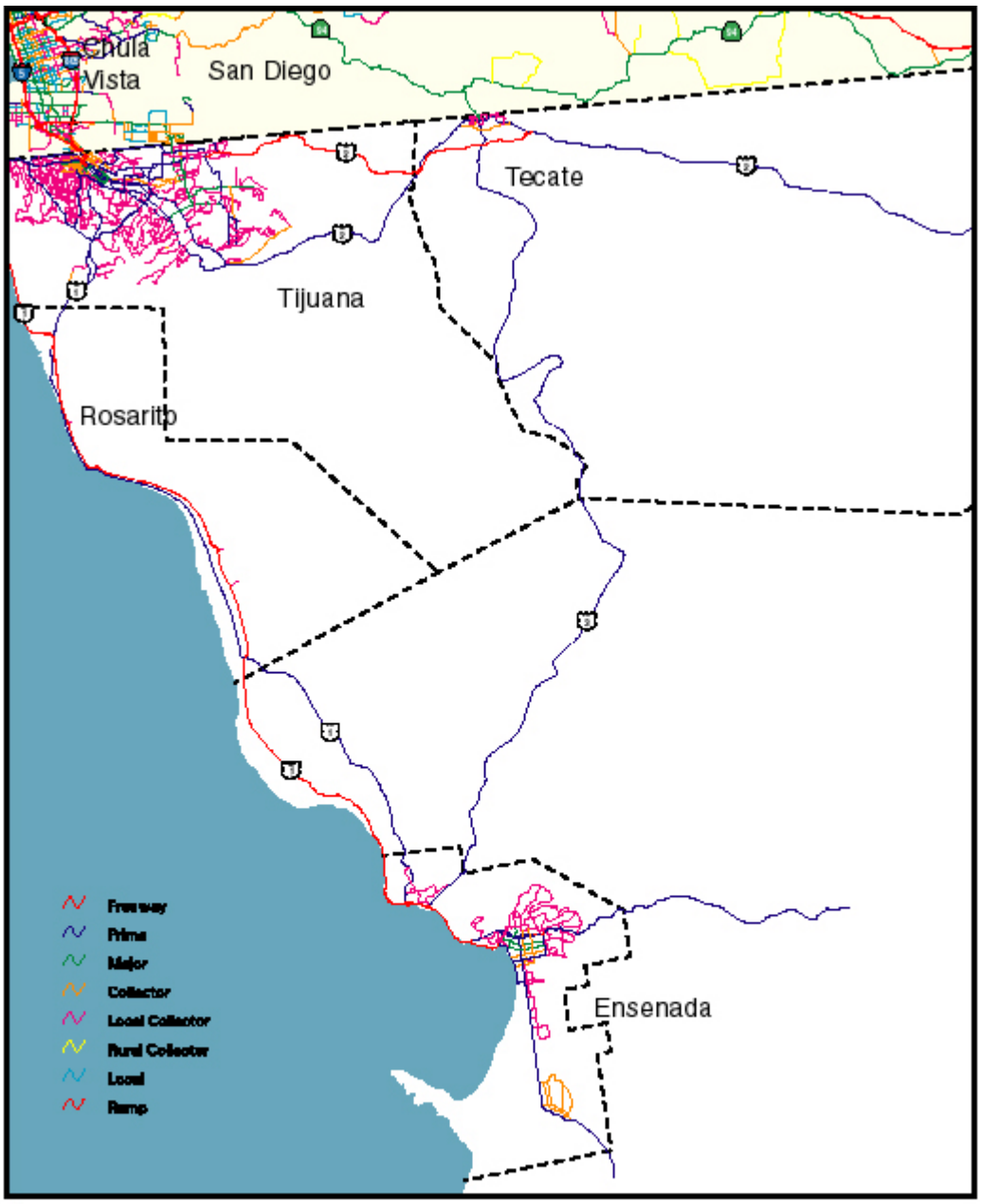
Exhibit 4-2
1995 TAZ – Tijuana



Traffic Analysis Zones
Tijuana

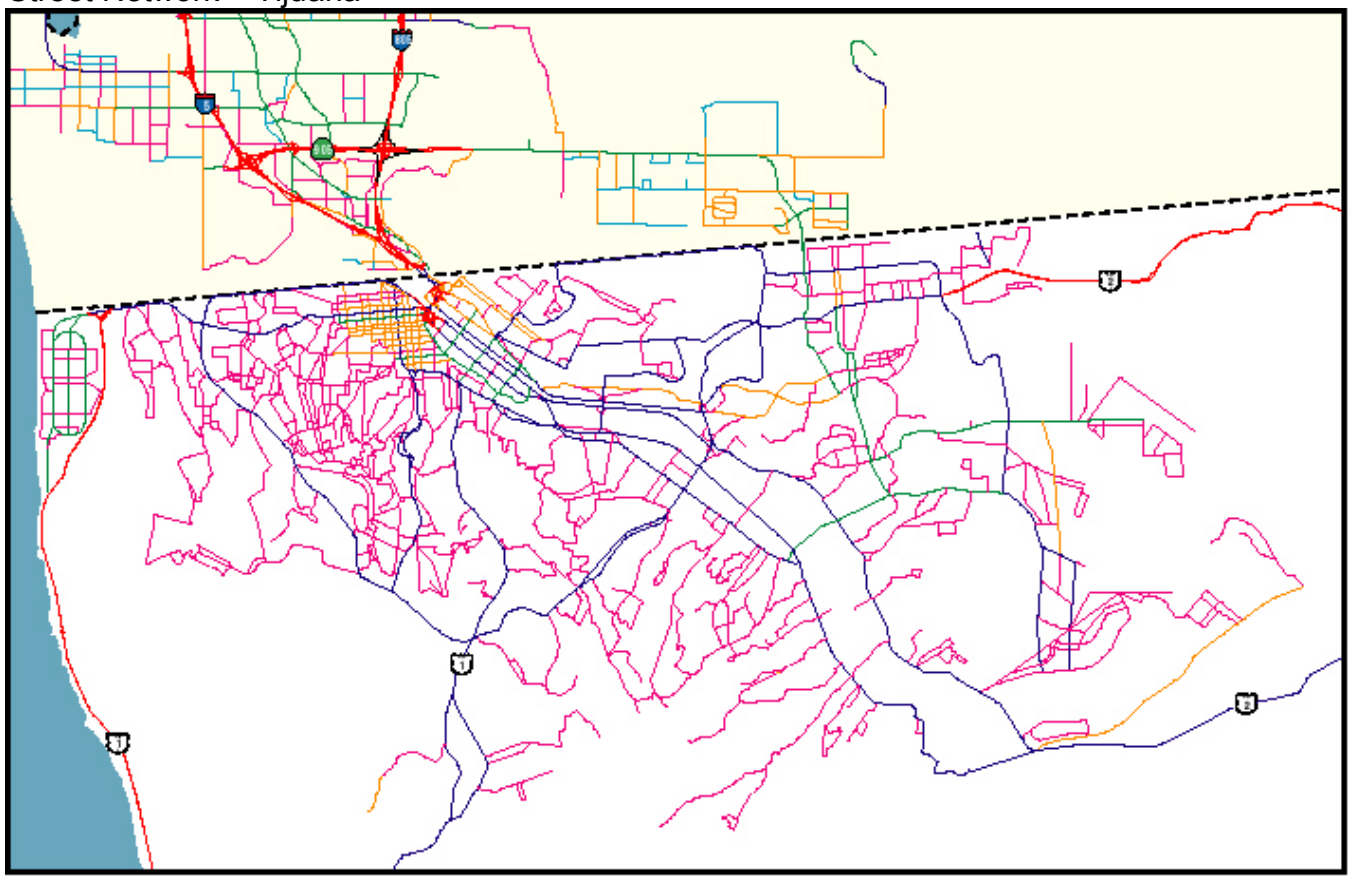
Exhibit 4-2

Exhibit 4-3
1995 Street Network - Tijuana, Tecate and Ensenada



1995 Street Network
Baseline Alternative
Tijuana, Tecate, Playas de Rosarito and Ensenada

Exhibit 4-4
1995 Street Network – Tijuana



1995 Street Network Tijuana
Baseline Alternative

detailed cross border trip tables used in this model component. The surveys of wait times and queues were used to develop the relationships used to implement the POE delay sub-model used in this model component.

Cross Border Trip Tables

Responses to the survey were expanded to the traffic volumes counted on April 13, 14 and 15, 2000 by direction and by POE (using the average daily volume). For purposes of the model development, these trips were separated by purpose, and by direction. Table 4-1 shows the successive summation of the trip records as they were resorted from the surveyed control totals by POE, to their final form for use in the cross border model. This re-organized the records from "Origin-Destination" (OD) format to "Production-Attraction" (PA) format by trip purpose. The production end of a trip is always assumed to be the home end. This takes into account the fact that, for instance, a Southbound Work to Home (an OD trip) is the transpose of a Northbound Home to Work (PA) trip. The top section of Table 4-1 establishes the totals. The middle section shows the totals directional trips by PA and by "AP" (transposes PA) in order to establish that the totals still match. The third section shows the totals, by trip purpose, in PA format, with the "AP" trips added in their PA direction.

Exhibit 4-5 shows schematically how the data were manipulated to create the PA trips by purpose. One hurdle to cross was that of converting the trips into the SANDAG zone structure. Survey respondents gave both specific origins and destinations, such as Plaza Bonita or 5 y 10 in Tijuana, and general origins and destinations, such as Downtown San Diego or La Mesa. Each of these responses, some of which were in potentially overlapping geographical areas, was given a survey zone number. These survey zones then had to be converted to the appropriate SANDAG zones, aggregating the more localized responses and dis-aggregating the more general responses. A correspondence was created between the SANDAG (including the new zones in Mexico) zone system and the survey zone system. In order to apportion trips to zones in the United States for this larger area, the total of Productions (P's) and Attractions (A's) were acquired from a recent SANDAG base year model run. For the zones in Mexico, the total population was used. All trips to an area were apportioned to the zones comprising that area in proportion to either the sum of the P's and A's (for U.S. zones) or the population (for Mexico zones).

Table 4-1
Summations of Expanded Auto Trips across the Border

Survey Totals - Auto	Surveyed NB	Assumed SB	Total
San Ysidro	41,780	43,562	85,342
15%			
Otay Mesa	11,881	10,099	21,980
Tecate	2,908	2,908	5,816
Total	56,569	56,569	113,138

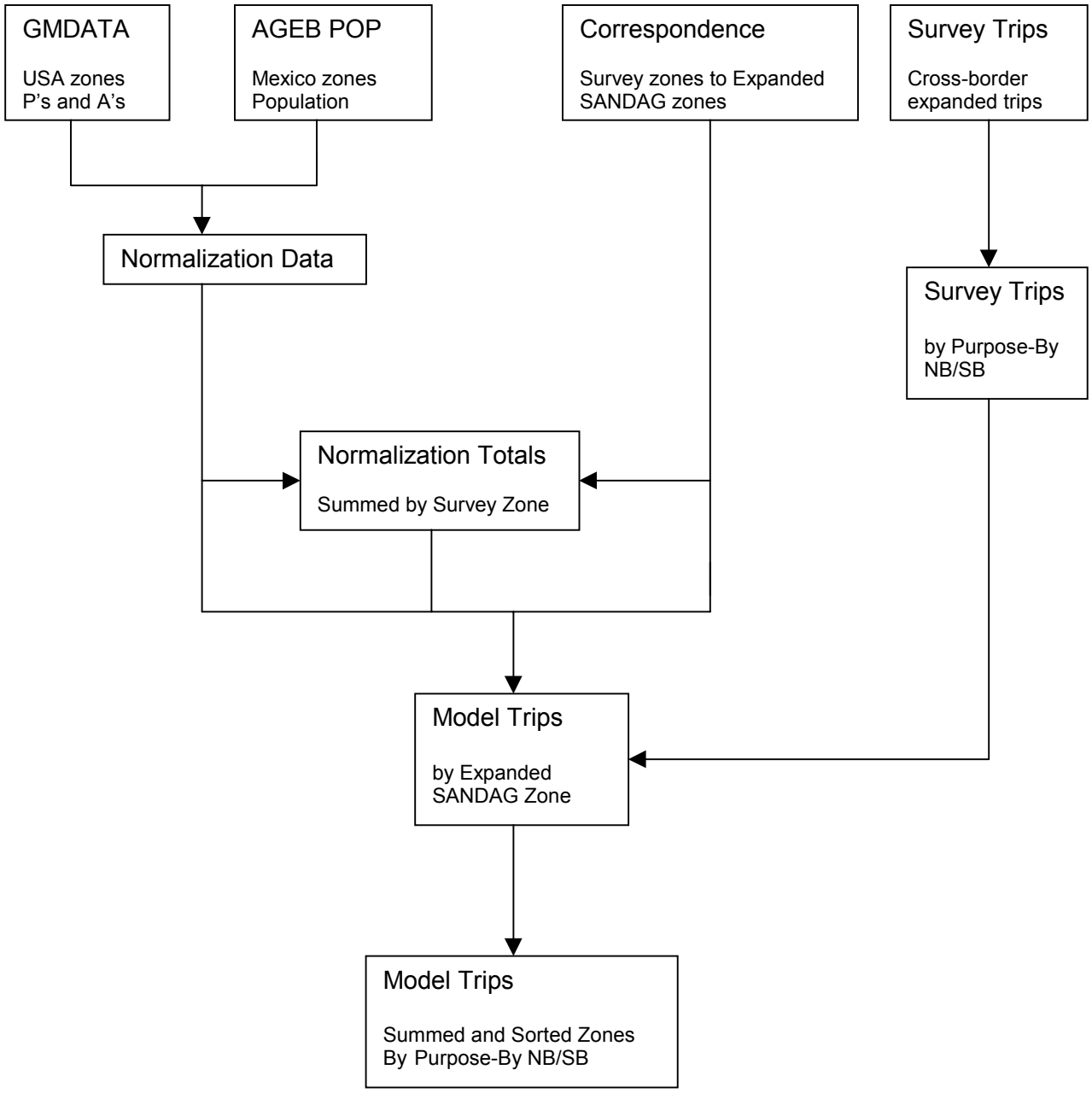
Note: 15% of northbound trips from Otay Mesa were assumed to return southbound through San Ysidro

"Un-Summed" "By Travel Direction"	NB PA	NB AP	SB PA	SB AP	Total
Home based Work	13,073	716	5,201	8,212	27,202
Home based Other	32,737	3,569	27,372	9,986	73,664
Other Other	6,473		5,797		12,270
Total	56,569		56,568		113,137

"Summed" "By PA Direction"	NB	SB	Total
Home based Work	21,285	5,917	27,202
Home based Other	42,723	30,941	73,664
Other Other**	12,270	12,270	12,270
Total	70,143	42,993	113,136

**Other Other Trips are stored as total trips in each of NB and SB tables for ease of application

Exhibit 4-5
Cross Border Trip Tables – Table Creation Process



Once the cross border trips are organized by purpose and in PA format, they are ready to create the trips by period required by the TRANPLAN software for assignment to the network. Table 4-2 shows the numeric values for the set of hand smoothed hourly demand curves that were developed to compute the period trips for assignment. On the right side of Table 4-2 is the number of trips processed through the POEs by hour from the survey. Next to that is the difference between the resulting volumes from the hourly demand curves and trips processed from the survey. The percentages from these curves are then used to create the trip table for assignment.

For example, the AM (6:00 to 9:00) trip table is composed of: 27.0% of the NB Home-Work PA trips in the PA direction, 0.0% of the NB Home-Work PA trips in the AP direction, 24.6% of the SB Home-Work PA trips in the PA direction, 0.0% of the SB Home-Work PA trips in the AP direction; 16.8% of the NB Home-Other PA trips in the PA direction, 0.3% of the NB Home-Other PA trips in the AP direction, 16.0% of the SB Home-Other PA trips in the PA direction, 2.7% of the SB Home-Other PA trips in the AP direction; and 5.1% of both the NB and SB Non-Home-Based trips.

Table 4-3 shows the same information for truck trips.

The reasonableness of the hand smoothed hourly demand curves can be checked by comparing them to similar information collected by Caltrans and reported in the 1991 Statewide Travel Survey. The diurnal distributions from the Caltrans survey are compared with those from the hourly demand cures in Exhibit 4-6. The values from the Caltrans survey are listed as Svy. The values from the hourly demand curves are listed as NB and SB. In general the distributions match well except where we expect differences. The cross border trips are generally longer than the average trip in San Diego County and they also experience greater peak congestion. From this we expect the peaks to be broader and to start earlier and end later than the average San Diego County trip. We see this in Exhibit 4-6. The Home to Work trips have a broader peak (especially in the AM) and are shifted earlier in the morning and later in the evening. The Home-Other trips generally avoid the PM peak. The Non-Home-Based trips, which don't fall in the peak, are virtually the same as the average San Diego County trip.

POE Delay Sub-Model

The delay information described in Chapter 3 was used to develop the POE delay sub-model. In addition to producing roadway volumes at POEs, queuing delays at the POEs are an important component for this sub-model.

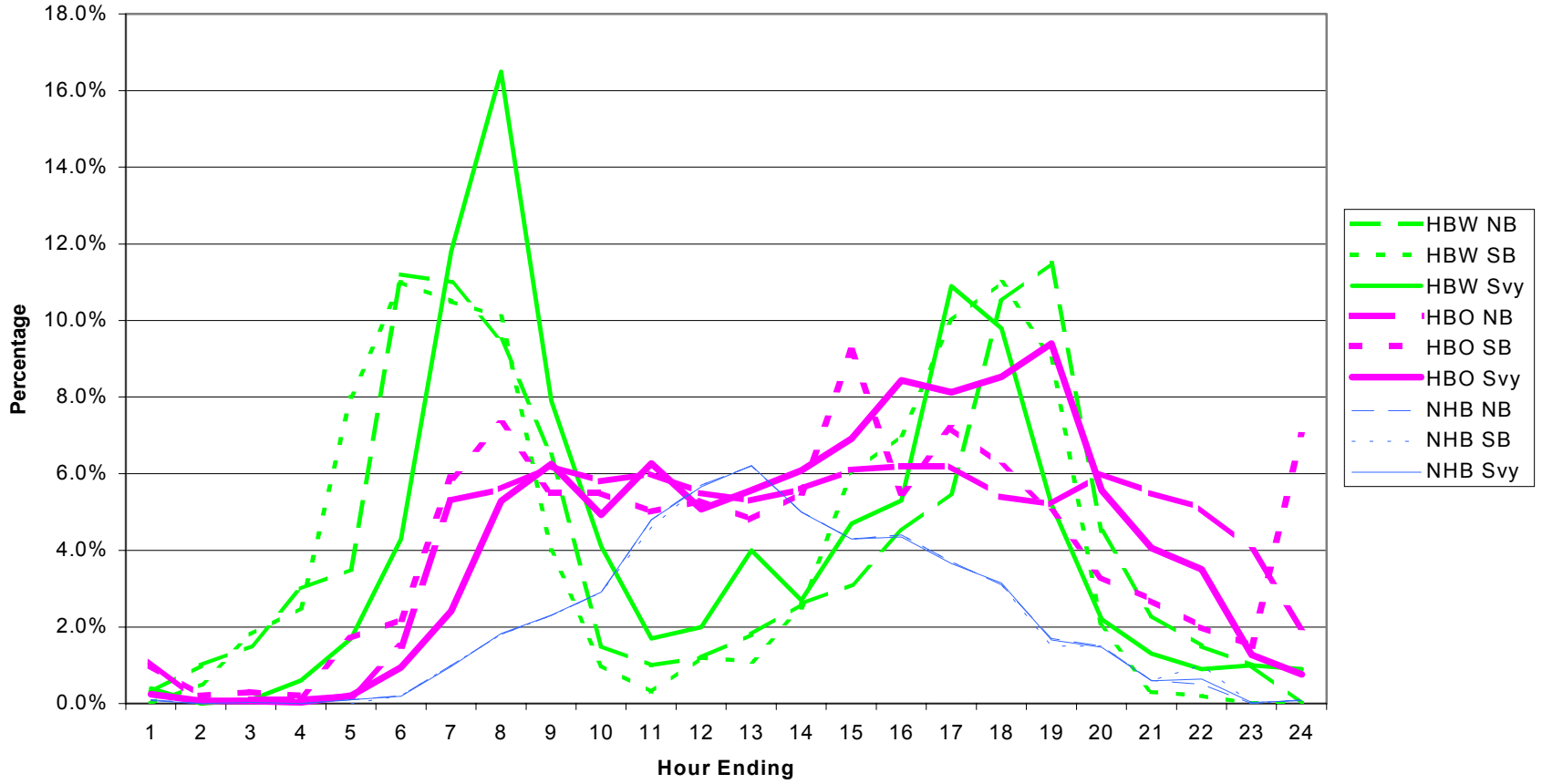
Table 4-2
Calculation Worksheet to Create Cross-Border Trip Tables – Autos

Auto Trips across the Border												113136				
		Home-Work				Home-Other				Non-Home-Based		TOTAL		Difference (Worksheet-Count)		Processed (Count)	
		NB		SB		NB		SB		NB	SB	NB	SB	NB	SB	NB	SB
		PA	AP	PA	AP	PA	AP	PA	AP								
Daily Total Trips		21285	5917	5917	21285	42723	30941	30941	42723	12270	12270	56568	56568				
(% of Total)		18.8%	5.2%	5.2%	18.8%	37.8%	27.3%	27.3%	37.8%	10.8%	10.8%	50.0%	50.0%				
Hour	0 > 1	0.3%					1.1%		1.0%	0.1%	0.1%	416	440	-13	39	429	401
	1 > 2	1.0%		0.5%					0.2%			213	115	6	-19	207	134
	2 > 3	1.5%		1.8%		0.1%		0.2%	0.1%			362	211	44	6	318	205
	3 > 4	3.0%		2.5%		0.1%		0.2%				681	210	33	22	648	188
	4 > 5	3.5%		8.0%		0.2%		1.5%	0.2%	0.1%		843	1,023	-21	29	864	994
	5 > 6	11.2%		11.0%		1.5%		1.7%	0.5%	0.2%	0.2%	3,049	1,415	33	22	3,016	1,393
	6 > 7	11.0%		10.5%		5.3%		5.0%	0.9%	1.0%	1.0%	4,728	2,676	-24	12	4,752	2,664
	7 > 8	9.5%		10.1%		5.5%	0.1%	6.0%	1.3%	1.8%	1.8%	4,624	3,230	-9	-22	4,633	3,252
	8 > 9	6.5%		4.0%		6.0%	0.2%	5.0%	0.5%	2.3%	2.3%	4,291	2,280	-24	6	4,315	2,274
	9 > 10	1.5%		1.0%		5.3%	0.5%	5.0%	0.5%	2.9%	2.9%	3,094	2,176	-32	9	3,126	2,167
	10 > 11	0.5%	0.5%	0.3%		5.0%	1.0%	4.5%	0.5%	4.8%	4.6%	3,171	2,188	14	21	3,157	2,167
	11 > 12	0.2%	1.0%	0.2%	1.0%	4.5%	1.0%	4.5%	0.8%	5.7%	5.7%	3,033	2,658	23	-6	3,010	2,664
	12 > 13	0.1%	1.7%	0.1%	1.0%	4.3%	1.0%	4.0%	0.8%	6.2%	6.2%	3,029	2,559	12	-23	3,017	2,582
	13 > 14	0.1%	2.5%		2.5%	4.2%	1.4%	4.0%	1.5%	5.0%	5.0%	3,010	3,024	-1	17	3,011	3,007
	14 > 15	0.1%	3.0%		6.0%	3.6%	2.5%	6.2%	3.0%	4.3%	4.3%	3,038	5,005	17	17	3,021	4,988
	15 > 16		4.5%		7.0%	2.6%	3.6%	1.0%	4.5%	4.4%	4.4%	3,031	4,262	14	-37	3,017	4,299
	16 > 17		5.5%		10.0%	1.2%	5.0%	1.0%	6.2%	3.7%	3.7%	2,839	5,541	-11	-12	2,850	5,553
	17 > 18		10.5%		11.0%	0.4%	5.0%	0.2%	6.0%	3.1%	3.1%	2,720	5,347	28	-13	2,692	5,360
	18 > 19		11.5%		9.0%	0.2%	5.0%		5.0%	1.7%	1.5%	2,522	4,236	-4	22	2,526	4,214
	19 > 20		4.5%		2.0%		6.0%		3.3%	1.5%	1.5%	2,307	2,020	12	-17	2,295	2,037
	20 > 21		2.3%		0.3%		5.5%		2.7%	0.6%	0.6%	1,911	1,291	-10	-42	1,921	1,333
	21 > 22		1.5%		0.2%		5.1%		2.0%	0.5%	1.0%	1,728	1,020	-20	-30	1,748	1,050
	22 > 23		1.0%				4.0%		1.5%			1,297	641	-30	-21	1,327	662
	23 > 24						2.0%		7.0%	0.1%	0.1%	631	3,003	-37	22	668	2,981
Total		50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	56,568	56,568	0	-1	56,568	56,569

Table 4-3
Calculation Worksheet to Create Cross-Border Trip Tables – Trucks

Truck Trips across the Border			2502					
			Percentage		Truck Trips		Difference (Worksheet-Count)		Processed (Count)	
			NB	SB	NB	SB	NB	SB	NB	SB
Hour	0 >	1	0.0%	0.0%	0	0	0	0	0	0
	1 >	2	0.0%	0.0%	0	0	0	0	0	0
	2 >	3	0.0%	0.0%	0	0	0	0	0	0
	3 >	4	0.0%	0.0%	0	0	0	0	0	0
	4 >	5	0.0%	0.0%	0	0	0	0	0	0
	5 >	6	0.0%	0.0%	0	0	0	0	0	0
	6 >	7	4.5%	0.2%	113	5	0	-1	113	6
	7 >	8	7.8%	1.6%	195	40	0	0	195	40
	8 >	9	7.8%	4.6%	195	115	0	0	195	115
	9 >	10	7.8%	8.2%	195	205	0	-1	195	206
	10 >	11	7.8%	9.3%	195	233	0	-1	195	234
	11 >	12	7.8%	10.2%	195	255	0	0	195	255
	12 >	13	7.8%	10.3%	195	258	0	1	195	257
	13 >	14	7.8%	10.3%	195	258	0	1	195	257
	14 >	15	7.8%	10.3%	195	258	0	1	195	257
	15 >	16	7.8%	10.3%	195	258	0	1	195	257
	16 >	17	7.8%	10.3%	195	258	0	1	195	257
	17 >	18	7.6%	10.3%	190	258	0	1	190	257
	18 >	19	4.8%	3.3%	120	83	-1	0	121	83
	19 >	20	3.9%	0.5%	98	13	1	1	97	12
	20 >	21	1.0%	0.3%	25	8	0	-1	25	9
	21 >	22	0.2%	0.0%	5	0	-1	0	6	0
	22 >	23	0.0%	0.0%	0	0	0	0	0	0
	23 >	24	0.0%	0.0%	0	0	0	0	0	0
Total			100.0%	100.0%	2,502	2,502	0	0	2,502	2,502

Exhibit 4-6
Diurnal Distributions



A significant element of the Cross-Border model, and the modeling of the POE choice, is the replication of the delay at the POE. This is accomplished with a POE delay sub-model. Delay at POEs is determined by the processing of vehicles in queue. Since a queue that develops in one time period will have a substantial effect on the queue length (and processing time) for the time period following, the sub-model must track queues for the entire day.

In order to calculate the POE queue delay for AM, PM, and Off Peak (OP) hours, volumes crossing each POE during these time periods, as well as the number of open gates and vehicle processing rates are used to calculate the estimated delay at each POE. This calculation is done with a series of spreadsheets similar to those in Chapter 3. Table 4-4 shows such a spreadsheet for San Ysidro northbound. Spreadsheets for the Otay Mesa, Tecate and for San Ysidro southbound are shown in Appendix B. The AM, PM, and OP volumes are entered, along with the assumed number of open gates and the processing rate, and the estimated delay is calculated.

Each spreadsheet is comprised of a number of sections. There are three primary data entry areas. The first are the processing rates. The top number is the base number of vehicles processed per gate per hour, followed by AM, then PM “acceleration factors.” These “acceleration factors” are applied to allow for faster processing for that peak period. No increase in processing rate is entered as an acceleration factor of 1.0.

Second are the numbers of gates open for each hour of the day. The processing rates and the gates open combine to calculate the number of vehicles that can be processed for each hour of the day.

The third standard input is the input vehicle volumes, for each direction of flow, for each of the AM, PM, and OP periods. The volumes are input in the top section, in the column labeled cars processed. These volumes by period (e.g. link volumes taken from a model assignment) are decomposed into arriving vehicles for each hour by a set of smoothed percentages taken from the initial delay calculation report. The percentage for each period, the three hour AM period, the three-hour PM period and the eighteen-hour OP period, sums to 100% separately.

When the data are entered into the POE queuing delay spreadsheet, the queues developed each hour are calculated. If a portion of a queue is not fully processed in one hour, that portion is carried over to the next hour. From the queue length and the processing rate, the queue delay is calculated for each hour of the day.

Table 4-4
San Ysidro Southbound – Queue Calculation

HOUR	Processing Rate Per Gate	Gates Open	Processing Rate (Supply)	Cars Processed	Arrival Percentage (per Period)	Cars Arriving	Arrival (surplus) Queue	Random Arrival Queue	TOTAL Arrival Queue	Queue Wait Time (Ave.)
Rate	**750**				AM	6564.2				
AM	**1.00**				PM	10559.9				
PM	**1.00**				OP	24287.9				
0:00-1:00	750	**1.00**	750	486	2%	486	0	0	0	0.1
1:00-2:00	750	**1.00**	750	243	1%	243	0	0	0	0.1
2:00-3:00	750	**1.00**	750	243	1%	243	0	0	0	0.1
3:00-4:00	750	**1.00**	750	243	1%	243	0	0	0	0.1
4:00-5:00	750	**1.50**	1,125	972	4%	972	0	2	2	0.1
5:00-6:00	750	**2.10**	1,575	1,214	5%	1,214	0	1	1	0.1
6:00-7:00	750	**4.00**	3,000	1,313	20%	1,313	0	0	0	0.1
7:00-8:00	750	**4.00**	3,000	2,626	40%	2,626	0	5	5	0.1
8:00-9:00	750	**3.00**	2,250	2,250	40%	2,626	376	0	376	5.2
9:00-10:00	750	**3.00**	2,250	1,833	6%	1,457	0	1	1	5.1
10:00-11:00	750	**3.00**	2,250	1,457	6%	1,457	0	1	1	0.1
11:00-12:00	750	**3.00**	2,250	1,700	7%	1,700	0	1	1	0.1
12:00-13:00	750	**3.00**	2,250	1,700	7%	1,700	0	1	1	0.1
13:00-14:00	750	**4.00**	3,000	1,943	8%	1,943	0	1	1	0.1
14:00-15:00	750	**6.00**	4,500	3,886	16%	3,886	0	7	7	0.1
15:00-16:00	750	**6.00**	4,500	3,696	35%	3,696	0	5	5	0.2
16:00-17:00	750	**6.00**	4,500	3,168	30%	3,168	0	2	2	0.1
17:00-18:00	750	**6.00**	4,500	3,696	35%	3,696	0	5	5	0.1
18:00-19:00	750	**5.00**	3,750	2,915	12%	2,915	0	3	3	0.1
19:00-20:00	750	**2.00**	1,500	1,214	5%	1,214	0	1	1	0.2
20:00-21:00	750	**2.00**	1,500	729	3%	729	0	0	0	0.1
21:00-22:00	750	**1.00**	750	729	3%	729	0	7	7	0.4
22:00-23:00	750	**2.00**	1,500	729	3%	729	0	0	0	0.2
23:00-24:00	750	**5.00**	3,750	2,429	10%	2,429	0	1	1	0.1
							0			
				41,412	300%	41,412				

Resulting Delay in Minutes			
Raw	"Tare"	Apply	
1.8	3.2	5.0	AM
0.1	11.7	11.8	PM
0.5	8.7	9.2	OP

The results are summarized in the appended box on the right of the spreadsheet. It summarizes the “raw” average delay for each time period, the “tare” or offset for model application, and the final value to be added to the link delay in the TFM network is shown on the right. The delay is entered in the model stream (entered in the file “border.del”), which expresses it as a delay time on the roadway link.

Since the gate delay at the POE affects the volume (via the network assignment) and the volume affects the delay calculated via the POE queuing delay spreadsheet, they must be iteratively computed. An initial assumption of the volume is made and the resulting delay is put in the model. The model is run, and new volumes are produced. If these new volumes result in a substantially different delay, the process is repeated until a stable set of volumes and delays are produced.

Care must be exercised when balancing the volumes. During assignment the various delays on each POE interact to spread the volumes across the POEs. During the calculation of the POE queuing delay, the queue in one time period can spill into another, inflating the delay for that period. When beginning the balancing process, the operator should take care that, for instance, a large PM delay is not imposed on a POE if the problem is due to OP queues spilling into the PM period. Remember that, as a queuing model, delays calculated at capacity and over capacity are large. This means that large delays may be produced. The operator should take this into consideration and perhaps input lesser delays for initial runs of the balancing process.

4.4 Intra-Mexico Model Component

This model component is used solely to provide approximate impedances for the cross border trips. It is not intended to be used for any analysis of demand on roads in Mexico. Therefore, in assigning traffic to model links it is most important that the relative difficulty of getting to the various border-crossing locations is reflected via delays and less relevant if a particular facility is over- or under-assigned.

Trip generation for the intra-Mexico component was based on the results of the Tijuana Regional Transportation model. Since the model must encompass all zones in the expanded SANDAG model which include zones in Mexico outside of the existing Tijuana zone structure, some approximations were required. For the new zones, only population was available. This meant that trip generation had to be re-created in a vastly simplified form. Regression analyses were performed on the Tijuana model’s AM peak hour vehicle trip table and on the population for those

(equivalent SANDAG) zones. This resulted in a set of equations for AM peak hour origins and destinations.

The regression equations for the Tijuana model origins and destinations are as follows:

Origins = 168.67 + 0.100125*(Population)
Destinations = 431.85 + 0.069808*(Population)

The Tijuana model uses a set of "conical" functions for its volume delay relationship. The SANDAG model uses its own set of locally developed delay curves. The various delay curves were examined and the closest match was made between the two sets.

Given the potential differences in travel time resulting from the use of differing delay curves, the expanded modeling area, and the greatly simplified trip generation model, it was inappropriate to import F-Factors, the set of factors that describe the propensity to travel various distances, from the Tijuana model. F-Factors, or "Friction Factors" define the relative propensity to choose where the trips go based on the relative distance (in minutes) between the zones. New F-Factors were assumed, based on the resulting assignments in the intra-Mexico model. Those F-Factors are listed in Appendix C.

These model components result in an AM peak-hour vehicle trip table. This table was expanded into the three assignment periods used in the SANDAG model. This was accomplished using AM Hour to Period factors from the SANDAG model:

AM period is 2.6 times the AM peak hour.
PM period is 4.5 times the (transpose of) the AM peak hour
OP period is 11.0 times the (symmetrized) AM peak hour

The PM factor was later reduced to 3.0 as described later in the calibration section.

4.5 Application of the SANDAG Model with the Cross-Border Model Components

As mentioned above, these model enhancements have been developed as a set of freestanding components that do not require attention or modification with every application of the SANDAG model. The

application flow of these enhancements is shown in Exhibit 4-7. As described above, these components can (and often should) be held constant for most applications.

For example, if the model is used for a typical corridor (in San Diego) analysis, the number of trips traveling from zones to zones in Mexico (intra Mexico trips) will certainly not change. Therefore, no modification will need to be made to this component. Likewise, the number of cross-border trips will most likely not change, and thus require no modification or attention. If the model is used to test modifications to the POEs, then the intra-Mexico and the intra-U.S. (standard SANDAG model) need no modification, while the cross-border trips will be modified to reflect reassignment of trips due to changes at the POEs.

The job stream used to run the cross border components is listed in Appendix D. A users guide to the model is included as Appendix E.

4.6 Validation/Calibration of Models

During the initial phases of the model calibration it became apparent that there was, initially, too much travel on the roadway system in Mexico. There were a number of reasons for this, which led to a pair of initial modifications.

First, the Tijuana model from which the trip generation equations were taken is primarily composed of the urbanized area, while the area added to the SANDAG model outside the urban area of Tijuana included a number of vacant or sparsely populated zones. This meant that the zonal constants were producing a large number of regional trips between sparsely populated zones. These constants were larger than they would have been if employment data were available for zones in the entire region.

In order to counter this, the zonal constants were reduced, yielding the following, final zonal trip rates for the AM hour:

Origins = 0.0 + 0.100125*(Population)
Destinations = 275.0 + 0.069808*(Population)

This reflected that fact that there were not only empty zones in intra-Mexico modeling area, but also separate cities, e.g. Ensenada, Tecate and Playas de Rosarito, of varying sizes.

Next, as mentioned previously, the AM hour to PM period factor was reduced from 4.5 to 3.0. The 4.5 factor implies that the AM is much less

congested than the PM. It is quite common for the AM and PM periods to be more closely matched. Since the AM hour to AM Period factor is 2.6, a PM factor of 4.5 implies that the PM has 73% more traffic than the AM. This is true of San Diego, but in many locations the disparity is much less severe. A 3.0 factor implies that the PM has 15% more traffic than the AM.

Tables 4-5 through 4-9 show comparisons between 1995 base year model generated data and from existing count data. Tables 4-5, 4-6 and 4-7 show AM, PM and Off peak comparisons at the POEs themselves. Table 4-8 shows comparisons on roadways in the Municipality of Tijuana, while Exhibit 4-8 identifies the locations of the traffic counts. Table 4-9 shows comparisons on major highways in the Baja California network.

As can be seen from this series of tables, cross border trips are being accurately modeled while the intra-Mexico trips are modeled less well. This indicates that for any modification to the existing POEs or for a new POE the model we expect the cross-border to accurately predict the demand. As we move further away from the POE locations, the assignment of traffic to individual links becomes less accurate. This is especially true for inter-city trips. However, at the POE locations, the model is highly accurate.

Exhibit 4-7
Cross Border Model – Application Process

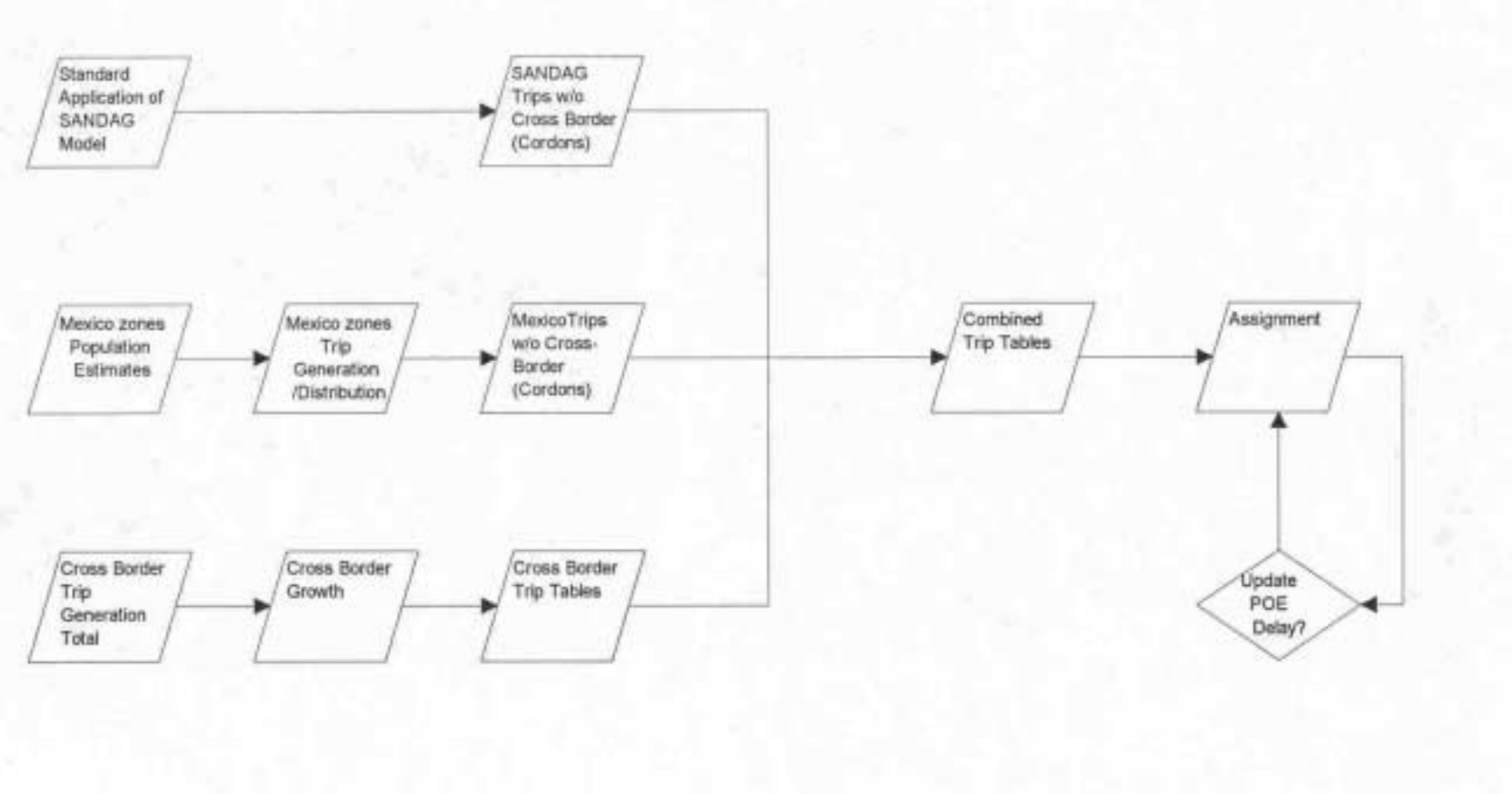


Table 4-5
AM Peak Counts vs. Baseline Volumes

AM 06:00-09:00		Count*	Model	Delay Tare**	Time entered in Queue Delay Submodel
San Ysidro SB	Queue Delay (minutes)	0.8	1.8	3.2	5.0
	Volume	6660	6564.2		
	Difference		-95.8		
	%Difference		-1.4%		
	% Total Direction		-1.1%		
San Ysidro NB	Queue Delay (minutes)	24.9	25.2	6.4	31.6
	Volume	10054	9925.2		
	Difference		-128.8		
	%Difference		-1.3%		
	% Total Direction		-0.9%		
Otay Mesa SB	Queue Delay (minutes)	0.8	0.2	0.0	0.2
	Volume	1374	1226.5		
	Difference		-147.5		
	%Difference		-10.7%		
	% Total Direction		-1.8%		
Otay Mesa NB	Queue Delay (minutes)	22.8	23.6	0.0	23.6
	Volume	3935	3932.0		
	Difference		-3.0		
	%Difference		-0.1%		
	% Total Direction		0.0%		
Tecate SB	Queue Delay (minutes)	0.2	0.2	12.0	12.2
	Volume	357	570.0		
	Difference		213.0		
	%Difference		59.7%		
	% Total Direction		2.5%		
Tecate NB	Queue Delay (minutes)	8.2	10.3	9.3	19.6
	Volume	717	925.4		
	Difference		208.4		
	%Difference		29.1%		
	% Total Direction		1.4%		

* Count total includes Truck Passenger Car Equivalent (1 Truck=2 Cars)
**Calibration offset (time added) component of delay

Table 4-6
PM Peak Counts vs. Baseline Volumes

PM 15:00-18:00		Count	Model	Delay Tare**	Time entered in Queue Delay Submodel
San Ysidro SB	Queue Delay (minutes)	0.7	0.1	11.7	11.8
	Volume	10721	10559.9		
	Difference		-161.1		
	%Difference		-1.5%		
	% Total Direction		-1.0%		
San Ysidro NB	Queue Delay (minutes)	27.4	11.6	11.4	23.0
	Volume	5832	5867.7		
	Difference		35.7		
	%Difference		0.6%		
	% Total Direction		0.2%		
Otay Mesa SB	Queue Delay (minutes)	1.5	1.9	0.0	1.9
	Volume	5140	5184.3		
	Difference		44.3		
	%Difference		0.9%		
	% Total Direction		0.3%		
Otay Mesa NB	Queue Delay (minutes)	8.3	8.0	0.0	8.0
	Volume	3322	3244.3		
	Difference		-77.7		
	%Difference		-2.3%		
	% Total Direction		-0.5%		
Tecate SB	Queue Delay (minutes)	1.1	2.0	10.2	12.2
	Volume	898	932.5		
	Difference		34.5		
	%Difference		3.8%		
	% Total Direction		0.2%		
Tecate NB	Queue Delay (minutes)	4.2	3.6	8.4	12.0
	Volume	565	720.0		
	Difference		155.0		
	%Difference		27.4%		
	% Total Direction		0.9%		

* Count total includes Truck Passenger Car Equivalent (1 Truck=2 Cars)
**Calibration offset (time added) component of delay

Table 4-7
Off Peak Counts vs. Baseline Volumes

OP		Count	Model	Delay Tare**	Time entered in Queue Delay Submodel
San Ysidro SB	Queue Delay (minutes)		0.5	8.7	9.2
	Volume	24399	24287.9		
	Difference		-111.1		
	%Difference		-0.5%		
	% Total Direction		-0.3%		
San Ysidro NB	Queue Delay (minutes)		17.0	11.0	28.0
	Volume	25890	25995.6		
	Difference		105.6		
	%Difference		0.4%		
	% Total Direction		0.3%		
Otay Mesa SB	Queue Delay (minutes)		1.6	0.0	1.6
	Volume	10073	9323.0		
	Difference		-750.0		
	%Difference		-7.4%		
	% Total Direction		-2.1%		
Otay Mesa NB	Queue Delay (minutes)		20.2	0.0	20.2
	Volume	9330	9353.7		
	Difference		23.7		
	%Difference		0.3%		
	% Total Direction		0.1%		
Tecate SB	Queue Delay (minutes)		0.3	10.1	10.4
	Volume	1951	2849.0		
	Difference		898.0		
	%Difference		46.0%		
	% Total Direction		2.5%		
Tecate NB	Queue Delay (minutes)		1.2	17.0	18.2
	Volume	1921	2095.0		
	Difference		174.0		
	%Difference		9.1%		
	% Total Direction		0.5%		

* Count total includes Truck Passenger Car Equivalent (1 Truck=2 Cars)
**Calibration offset (time added) component of delay

Table 4-8
Peak Hour Traffic Counts vs. Baseline Volumes
Municipality of Tijuana

Location of Count	Peak Hour Volumes (1998)*	Baseline Model Volume (1995)
1. Blvd. de los Fundadores	650	1,100
2. Blvd. Agua Caliente	2,000	5,600
3. Av. Sanchez Taboada	1,700	850
4. Paseo de los Heroes	2,550	900
5. Av. Independencia	2,400	2,000
6. Av. Cuaúhtemoc	2,350	4,800
7. Blvd. Agua Caliente	4,000	4,750
8. Blvd. G. Díaz Ordaz	3,200	5,300
9. Blvd. los Insurgentes	5,100	4,200
10. Blvd. los Insurgentes	2,250	4,000
11. Calzada Tecnológico	1,800	4,650

* from the Programa de Desarrollo Urbano del Centro de Población, Tijuana

Exhibit 4-8
Traffic Count Locations

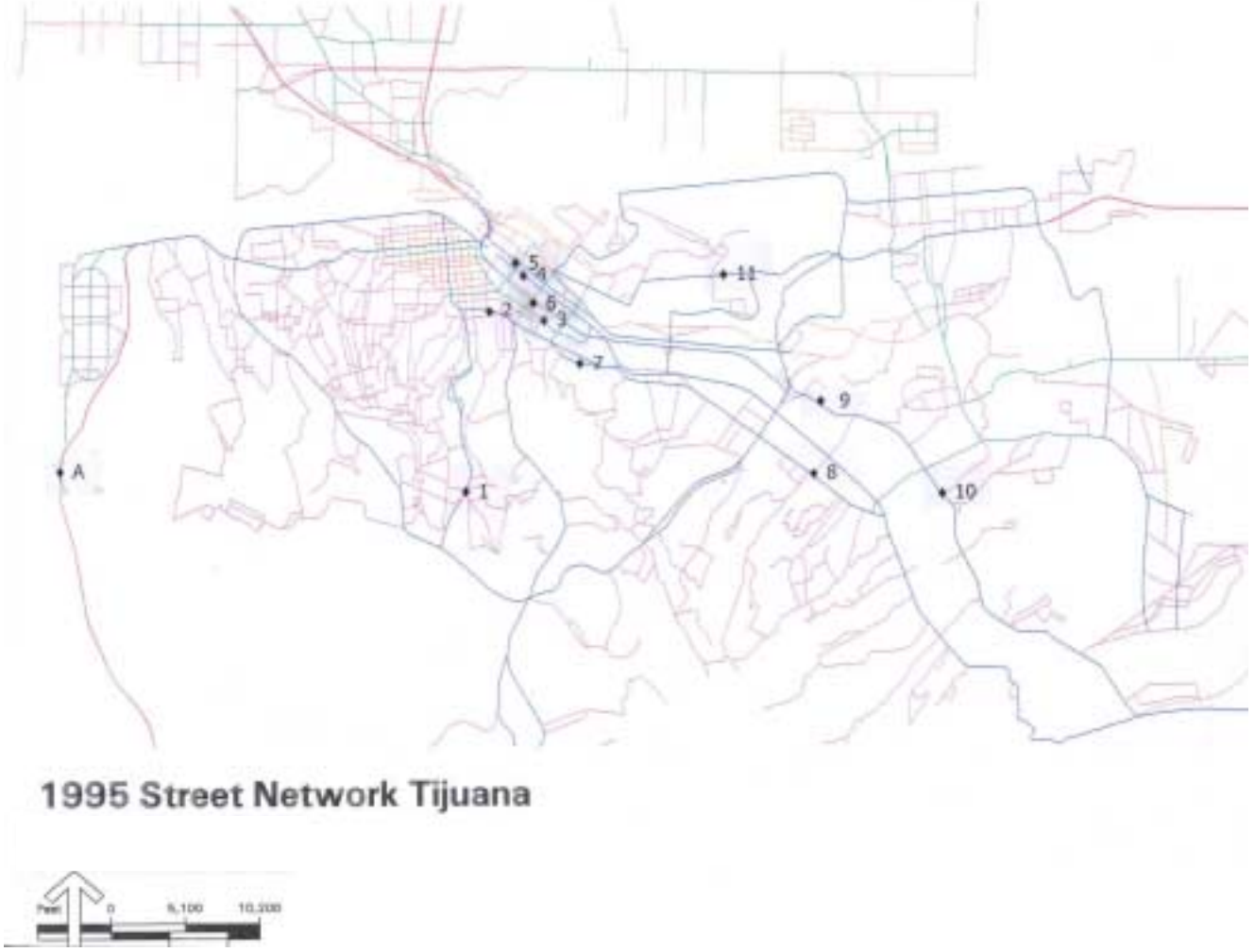


Table 4-9
Average Annual Daily Counts vs. Baseline Volumes

Facility - Location	Average Annual Daily Volume*	(Year)	Baseline Model Volume (1995)
MX 1 (Toll)			
Tijuana-Ensenada			
near Tijuana**	8,000	1993	11,000
near Ensenada	13,000	1993	14,000
MX 2 (Toll)			
Tecate-Tijuana			
in Tecate	2,800	1995	21,000
Tecate-Tijuana	2,600	1995	60,000
MX 3			
Tecate-Ensenada			
near Tecate	3,400	1993	10,000
near Ensenada	4,000	1997	100

* counts from the Secretaría de Transporte y Comunicación.
** location shown on Exhibit 4-8 as location A.

5 GROWTH FORECASTS FOR THE CROSS-BORDER REGION AND INFLUENCES ON CROSS-BORDER TRAVEL

This chapter presents the results of research that has been conducted as to the influences of cross-border travel. The first section of the chapter discusses the peso-dollar exchange rate and its historical influence on cross-border travel. The chapter also presents demographic growth projections for the San Diego and Northwest Baja California Regions and describes overall demographic and economic trends. Finally, the chapter recommends cross-border growth factors for the six-selected trip purposes being modeled for this study:

- Home in Mexico to Work in United States
- Home in the United States to Work in Mexico
- Home in Mexico to Other in the United States
- Home in the United States to Other in Mexico
- Non-Home based in Mexico to the United States
- Non-Home based in the United States to Mexico

5.1 Overview

A variety of factors affect the magnitude of current trip making across the U.S. - Mexican border between San Diego and Northwest Baja California. As described in this chapter, economic and monetary exchange rates are a major influence. The effects of fluctuations in exchange rates are two-fold in that the growth of population near the border is affected and the magnitude of cross-border trip making is impacted.

Of course, the other major factor that has a major influence on cross-border trip growth over time is socioeconomic growth on both sides of the border. The magnitude of growth in population, resident workers, and employment on both sides of the border will gradually increase the number of cross-border work trips, home-based other trips, and non-home based travel in both directions.

The following sections present projections of the economic/demographic landscape of the region composed of San Diego County and the adjacent municipalities of Baja California: Tijuana and Tecate, and the two municipalities along the coastal corridor, Playas de Rosarito and Ensenada. As these areas experience economic and population growth, more pressure will be placed on the transportation linkages between them.

5.2 Growth Forecasts for Northwest Baja California

Forecasts of population, employment and other socioeconomic variables have been developed for Northwest Baja California to the year 2020. These forecasts are the result of a collaborative effort by Parsons Transportation Group, Inc., El Colegio de la Frontera Norte (COLEF), and CIC Research, Inc. They are based on historical trends, both long-term and short-term. They also reflect projections about future economic conditions in Mexico, relative to the United States. A detailed set of forecasts is provided in Appendix F. Summaries of the forecasts, as well as assumptions and sources used in developing the forecasts are provided below.

History has shown that there is a strong correlation between nationwide economic conditions in Mexico and growth along the northern Mexican border. When the Mexican economy is stable, growth along the border is relatively slow. When the economy is unstable, many people leave the central and southern regions of Mexico and migrate to the northern border areas where greater economic opportunity is found. Therefore, an assumption about the economic stability in Mexico, measured in terms of the peso/dollar exchange rate, was necessary to complete the growth forecasts.

Population Growth Assumptions

Total population forecasts by municipality (numbers rounded to the nearest 50) are shown in the following table:

Table 5-1
Population Growth

MUNICIPALITY	1995	2020	ANNUAL GROWTH RATE
Tijuana	991,600	2,279,800	3.39 %
Playas de Rosarito	46,600	313,200	7.92 %
Tecate	62,650	231,900	5.38 %
Ensenada (Study Area Portion)	198,750	548,400	4.14 %
TOTAL STUDY AREA	1,299,600	3,373,300	

Forecasts for each municipality were estimated separately, and are based on the growth rates for the area between 1970 and 1990. This period was selected in determining the future growth rate because it represented a period of relative economic stability. Data sources and assumptions are described below.

Tijuana

Tijuana has experienced different rates of growth throughout its history, which have been greatly influenced by the economic conditions in the rest of the country. During the period 1990-1995, which included the economic recession of 1994, population grew at a rate of 9.2 percent per year. About 60 percent of this growth was due to in-migration from other areas in Mexico. Development of year 2020 forecasts included an assumption that overall economic conditions in Mexico will improve in the future, so that Tijuana will experience less in-migration, and grow at lower rates. A growth rate of just less than 3.39 percent per year was assumed for the years 1995 through 2020. This is the rate experienced during the years 1970-1990, a period when the economic situation was more stable. It is the lowest growth rate measured since 1950.

About 97 percent of Tijuana's population lived in the urbanized city in 1995 (the "Old City"). The Old City is not large enough geographically to house all of the future growth in the Municipality. A large portion of the growth will therefore need to be located in what is now the rural area. By the year 2020, the entire municipality of Tijuana is assumed to become urbanized. No rural areas will be left in Tijuana by 2020.

The population density of the Old City is assumed to increase by 18 percent from an existing 43.6 persons/hectare (108 persons/acre)(1995) to 51.5 persons/hectare (127 persons/acre) by the year 2020. This represents about 14 percent of all population growth. The remaining 86 percent of the growth will occur in what are now considered rural areas, and will change the character of these areas from rural to urban.

Playas de Rosarito

Playas de Rosarito is assumed to grow at a rate of nearly 7.92 percent per year. This growth rate, which occurred between 1970 and 1990, is the lowest growth rate measured since 1950.[1] Large areas of available land make Playas de Rosarito attractive to growth.

About 25 percent of the population growth will occur in the Old City (1995 urbanized area) of Playas de Rosarito. This will increase the population

[1] Playas de Rosarito became a municipality in 1995, but data are available from the areas that used to belong to Tijuana.

density in the Old City from 13.3 (1995) to 37.1 persons/hectare (or 33 to 92 persons/acre). About 75 percent of the growth will occur in adjacent rural areas, and become part of the expanded city. No population growth is expected to occur in what will remain rural areas.

Tecate

Tecate is assumed to grow at a rate of 5.38 percent per year. This is the growth rate for the period 1970-1990.

About 25 percent of the population growth will occur in the Old City (1995 urbanized area) of Tecate. This will increase the population density in the Old City from 34.8 (1995) to 43.5 persons/hectare (or 88 to 107 persons/acre). Another 67 percent of the growth will occur in adjacent rural areas, and become part of the expanded city. Only 7 percent of the growth will occur in what will remain rural areas.

Ensenada

Ensenada is assumed to grow at a rate just over 4.00 percent per year. This is the lowest growth rate measured since 1950.

Because of its distance from the U.S.-Mexican border, the percentage of growth, which is to occur in the Old City of Ensenada, the percentage that will become part of an expanded city, and the percentage of growth in rural areas are not itemized. Instead, the urban population growth is assumed to occur in or near the Old City. Roughly 5 percent of the existing rural area of Ensenada is assumed to be within the study area for the Cross-Border Model study. Both the urban and rural areas are assumed to grow at the same annual rate.

Resident Workers (Labor Force Participation)

The figures used for this indicator were the published data on *Economically Active Population* (PEA) for the State of Baja California, available at the municipal level. A summary of the assumptions used in forecasting resident workers is provided in the following table.

Table 5-2
Resident Workers per Population

MUNICIPALITY	1995	2020
Tijuana	0.38	0.41
Playas de Rosarito	0.38	0.41
Tecate	0.38	0.41
Ensenada (Study Area Portion)	0.34	0.37

The proportion of resident workers in the population was found to be 0.38 in 1997 (urban and rural activities) in Tijuana. This will grow to 0.41 by the year 2020. The assumption of an overall improvement in the economic conditions of the population by the year 2020 was used in this forecast. Tijuana's existing and future labor participation rates are assumed for Playas de Rosarito and Tecate. In Ensenada, somewhat lower rates are assumed. In 1995, the assumed rate is 0.34 workers per population. This grows 0.37 in 2020.

The overall numbers of labor participation for 2020, resulting from the corresponding ratios for each municipality, were distributed according to the same assumptions made for the population distribution.

Employment

Six sectors were considered for employment, using the available data for 1995:

- Manufacturing;
- Construction;
- Commerce;
- Services;
- Agriculture; and
- Residents that work in the United States.

Forecasts of employment by sector are summarized in Table 5-3.[2] Because of an improving Mexican economy, manufacturing jobs will increase significantly in all municipalities. Agricultural jobs will decline slightly as much of the rural area is transformed into the expanded cities. Even though the Mexican economy will be stable and improving, it will still be grow at a lower rate than the economy of the United States. As a result, the percentage of workers who work in the United States will increase slightly. The combined effect of these factors will be a decline of employment in the Commerce and Services sectors.

Personal and Household Income

Personal and household income forecasts are summarized in the Table 5-4. Available data at the state level were desegregated in three income groups by number of minimum salaries. One minimum salary is roughly equal to $107 per month in 1995 U.S. dollars (USD). The USD value of the minimum salary remains constant over time. From the basic

[2] The information for this table and for the following table is from work presented at the 5th National Meeting on Regional Development in Mexico held in Hermosillo, Sonora, Mexico 1999. The paper was titled Transmigración y Maquila: Tendencias Recientes and was authored by Tito Alegria.

Table 5-3
Employment by Sector

YEAR	SECTOR	TIJUANA	PLAYAS DE ROSARITO	TECATE	ENSENADA (Study Area)
1995	Manufacturing	0.284	0.120	0.190	0.145
1995	Construction	0.059	0.048	0.076	0.058
1995	Commerce	0.187	0.263	0.144	0.320
1995	Services	0.382	0.359	0.296	0.446
1995	Agricultural	0.026	0.203	0.249	0.031
1995	Work in U.S.	0.061	0.008	0.045	0.000
2020	Manufacturing	0.380	0.281	0.345	0.194
2020	Construction	0.050	0.048	0.046	0.058
2020	Commerce	0.148	0.233	0.138	0.281
2020	Services	0.340	0.388	0.315	0.436
2020	Agricultural	0.000	0.030	0.075	0.031
2020	Work in U.S.	0.082	0.019	0.075	0.000

Table 5-4
Income Assumptions

YEAR	INCOME LEVEL	TIJUANA	PLAYAS DE ROSARITO	TECATE	ENSENADA (Study Area)
PERSONAL INCOME					
1995	Low Income	0.385	0.425	0.425	0.425
1995	Medium Income	0.420	0.420	0.420	0.420
1995	High Income	0.195	0.155	0.155	0.155
2020	Low Income	0.360	0.400	0.400	0.400
2020	Medium Income	0.450	0.450	0.450	0.450
2020	High Income	0.190	0.150	0.150	0.150
HOUSEHOLD INCOME					
1995	Low Income	0.155	0.195	0.195	0.195
1995	Medium Income	0.379	0.379	0.379	0.379
1995	High Income	0.466	0.426	0.426	0.426
2020	Low Income	0.144	0.184	0.184	0.184
2020	Medium Income	0.401	0.401	0.401	0.401
2020	High Income	0.455	0.415	0.415	0.415

distribution obtained, the following assumptions were made for each municipality:

- **General (1995)** - The relative participation of the medium income group was considered to be the same for all municipalities;

- **General (2020)** - More favorable economic conditions assumed for all cities, therefore the relative participation of the medium income group was assumed to increase in all municipalities;

- **Tijuana (1995)** - More favorable conditions than the rest of the state, resulting in a lower proportion of persons assumed in the lowest income group, and a higher proportion of persons for the highest income group;

- **Tijuana (2020)** - Better economic conditions, resulting in a decrease in the relative participation of the lowest income group;

- **Playas de Rosarito, Tecate and Ensenada (1995)** - Less favorable conditions than the rest of the state, therefore a higher proportion of persons was assumed for the lowest income group, and a lower proportion of persons for the highest income group; and

- **Playas de Rosarito, Tecate and Ensenada (2020)** - Better economic conditions result in a decrease in the relative participation of the lowest income group for that year.

Number Of Occupied Households

Available 1995 data at the municipality level were used for number of occupied households and household size, as shown in the table below (numbers rounded to the nearest 50). The number of persons per household in each municipality was considered to remain unchanged in the year 2020, considering the expansion of the cities into low-density areas, and the density increase in central (old) city parts.

Table 5-5
Occupied Households

MUNICIPALITY	PERSONS/ HOUSEHOLD	1995 HOUSEHOLDS	2020 HOUSEHOLDS
Tijuana	4.22	234,700	540,250
Playas de Rosarito	4.08	11,400	76,750
Tecate	4.44	14,100	52,200
Ensenada (Study Area)	4.14	49,700	137,050
TOTAL STUDY AREA		309,900	806,250

Growth in the Maquiladora Industry

Because much of the growth in the Mexican border region is related to continued rapid expansion of the Maquiladora (twin-plant or assembly plant) industry, a brief analysis is made of this industry.

The following table and graphics list the historical growth in the number of maquiladora plants and employment for Baja California over the last 18 years. Although the maquiladora data has been subject to large revisions and does illustrate periods of stops and starts, overall the growth has been very strong in terms of the number of plants and total employment. Employment opportunities afforded by the maquiladora have accounted for a large measure of the in-migration to Baja California.

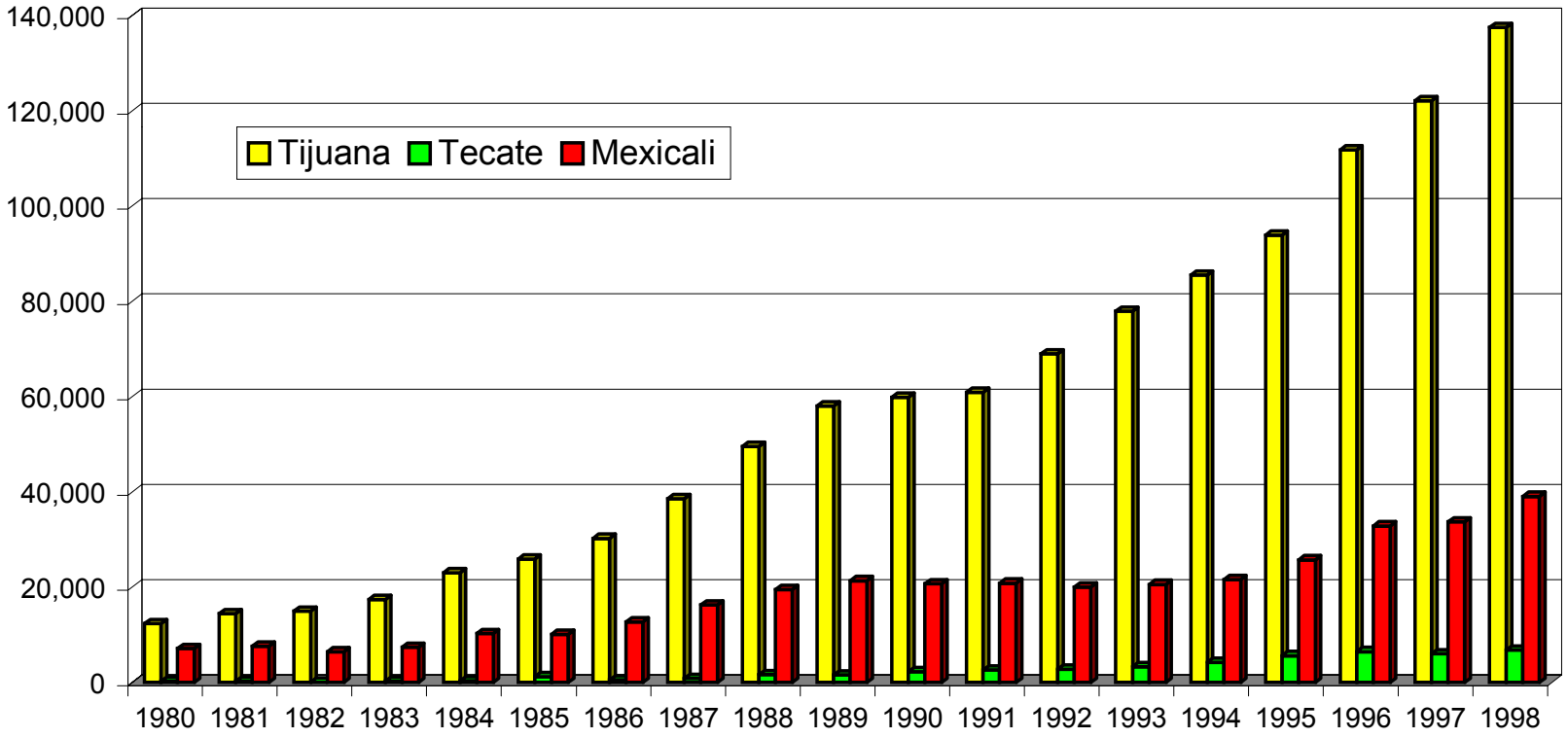
During the last five years the number of maquiladora plants in Tijuana has increased 13% while the amount of employment has increased by 76%. Similar growth rates have occurred in Mexicali and Tecate, although the base amounts differ greatly, with Tijuana accounting for three-quarters of maquiladora employment in Baja California. This growth is shown graphically on Exhibit 5-1.

Table 5-6
Maquiladora Plants and Employment in Selected Baja California Cities

	Tijuana		Tecate		Mexicali	
Year	Plants	Employees	Plants	Employees	Plants	Employees
1980	111	12,342	23	257	74	7,147
1981	124	14,482	3	267	68	7,628
1982	124	14,959	5	57	54	6,434
1983	131	17,423	6	269	55	7,392
1984	148	23,046	8	340	67	10,265
1985	192	25,913	8	1,209	76	10,098
1986	238	30,248	8	547	87	12,727
1987	297	38,575	10	856	109	16,312
1988	355	49,545	22	1,658	135	19,493
1989	436	58,029	32	1,556	147	21,374
1990	414	59,870	31	2,243	122	20,729
1991	466	60,896	36	2,597	131	20,846
1992	515	68,960	39	2,798	139	20,023
1993	531	77,943	45	3,334	140	20,589
1994	502	85,521	49	4,231	124	21,570
1995	477	93,899	50	5,626	121	25,722
1996	529	111,807	51	6,485	128	32,863
1997p	573	122,092	56	6,040	132	33,669
1998p	599	137,476	59	6,801	151	39,056

Source: Secretary of Commerce and Industrial Development (SECOFI).

Exhibit 5-1
Maquiladora Employment



5.3 Growth Forecasts for the San Diego Region

As shown in Table 5-7, San Diego County's population is projected to expand by 44 percent from 1995 to 2020 and civilian employment during the same period by 50 percent. These projections are based on SANDAG'S Demographic/Economic Forecasting Model (DEFM). By introducing land use density constraints into the forecasts, SANDAG is able to arrive at projections of population and employment by sub-areas of the county. Table 5-7 shows population forecasts for 18 cities in the county and the unincorporated area. Table 5-8 shows employment forecasts for the same region. Exhibit 2 shows the locations of the different regions.

Exhibit 5-2
The San Diego Region

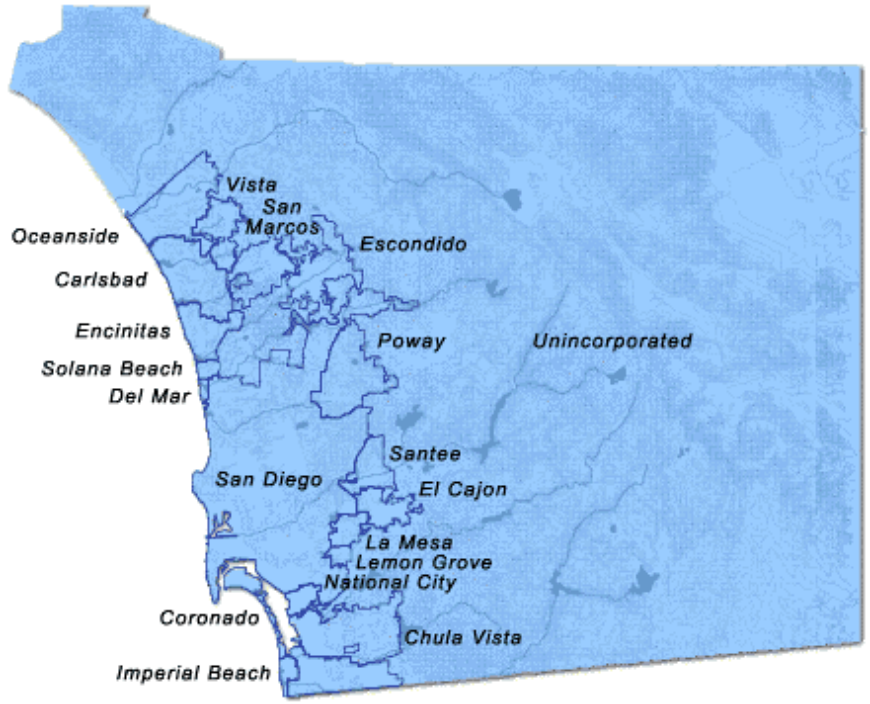


Table 5-7
2020 Cities/County Forecast Total Population

Jurisdictions:	1995	2005	2010	2020	Increase 1995 to 2020	
					Num.	Pct.
Carlsbad	67,167	97,446	109,332	132,232	65,065	97%
Chula Vista	151,093	208,107	233,313	275,455	124,362	82%
Coronado	28,705	29,166	29,209	29,719	1,014	4%
Del Mar	5,093	5,543	5,736	6,079	986	19%
El Cajon	91,464	99,337	101,964	104,563	13,099	14%
Encinitas	56,788	66,564	68,440	70,750	13,962	25%
Escondido	117,525	136,211	140,490	143,228	25,703	22%
Imperial Beach	27,732	29,230	30,180	33,333	5,601	20%
La Mesa	56,254	61,752	63,979	66,828	10,574	19%
Lemon Grove	24,605	27,887	29,342	30,238	5,633	23%
National City	54,120	57,949	58,580	58,977	4,857	9%
Oceanside	145,903	184,138	196,613	202,592	56,689	39%
Poway	45,161	50,904	52,031	53,338	8,177	18%
San Diego	1,174,422	1,403,874	1,499,437	1,693,533	519,111	44%
San Marcos	47,360	67,453	75,356	91,557	44,197	93%
Santee	53,593	68,561	73,607	74,856	21,263	40%
Solana Beach	13,531	14,714	15,103	16,127	2,596	19%
Vista	79,506	95,616	101,364	103,316	23,810	30%
Unincorporated	429,178	519,022	553,621	666,576	237,398	55%
Region	2,669,200	3,223,474	3,437,697	3,853,297	1,184,097	44%

Source: San Diego Association of Governments, 1999.

Table 5-8
2020 Cities/County Forecast Total Civilian Employment

Jurisdictions:	1995	2005	2010	2020	Increase 1995 to 2020	
					Num.	Pct.
Carlsbad	41,225	69,592	73,858	86,156	44,931	109%
Chula Vista	45,996	67,643	73,200	87,533	41,537	90%
Coronado	14,900	15,209	15,266	15,331	431	3%
Del Mar	3,183	3,549	3,589	3,589	406	13%
El Cajon	39,810	46,397	47,650	50,908	11,098	28%
Encinitas	22,645	27,191	27,685	27,779	5,134	23%
Escondido	45,809	57,207	59,079	63,431	17,622	38%
Imperial Beach	3,291	4,054	4,212	4,354	1,063	32%
La Mesa	23,286	25,417	25,794	27,317	4,031	17%
Lemon Grove	6,991	8,083	8,277	8,450	1,459	21%
National City	21,844	25,356	26,048	28,056	6,212	28%
Oceanside	34,551	54,746	57,876	67,149	32,598	94%
Poway	14,432	33,113	35,236	38,776	24,344	169%
San Diego	606,561	747,084	768,152	836,913	230,352	38%
San Marcos	24,121	40,436	42,837	49,566	25,445	105%
Santee	14,738	20,052	21,043	22,570	7,832	53%
Solana Beach	8,662	9,179	9,279	9,696	1,034	12%
Vista	25,748	50,403	54,068	63,034	37,286	145%
Unincorporated	87,154	114,633	118,785	137,153	49,999	57%
Region	1,084,947	1,419,344	1,471,934	1,627,761	542,814	50%

Source: San Diego Association of Governments, 1999.

The San Diego Economy

Since the recession of 1990-92 the San Diego economy has experienced steady economic expansion. The recession was brought about by a substantial decline in defense related manufacturing. The rate of unemployment peaked in 1993 at 7.7 percent then declined steadily to 3.5 percent in 1998. (see Table 5-9 and Exhibit 5-3)

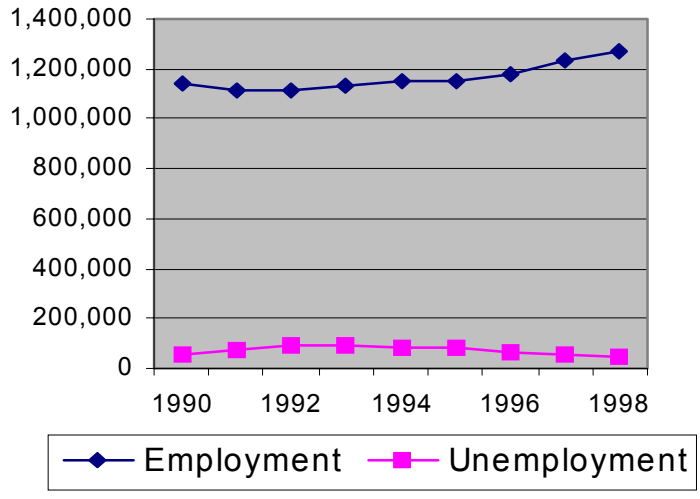
Although the recession resulted in the loss of thousands of high paying jobs in San Diego, the remaining economy remained strong and per capita income increased throughout the period. Still, San Diego per capita personal income of $24,965 in 1997 lagged California ($26,314) and the Nation ($25,288) as a whole. This can be seen in Exhibit 5-4. This and the much higher cost of living (mainly housing costs) in San Diego relative to other California cities and the rest of the nation make San Diego a difficult stretch for many of its residents.

Table 5-9
Employment/Unemployment in San Diego 1990-1998

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Employment	1,145,700	1,115,000	1,113,000	1,131,600	1,149,500	1,155,300	1,175,900	1,230,700	1,273,000
Unemployment	56,100	74,900	88,000	94,700	87,000	78,600	65,300	54,300	46,400
Unemployment Rate	4.70%	6.30%	7.30%	7.70%	7.00%	6.40%	5.30%	4.20%	3.50%

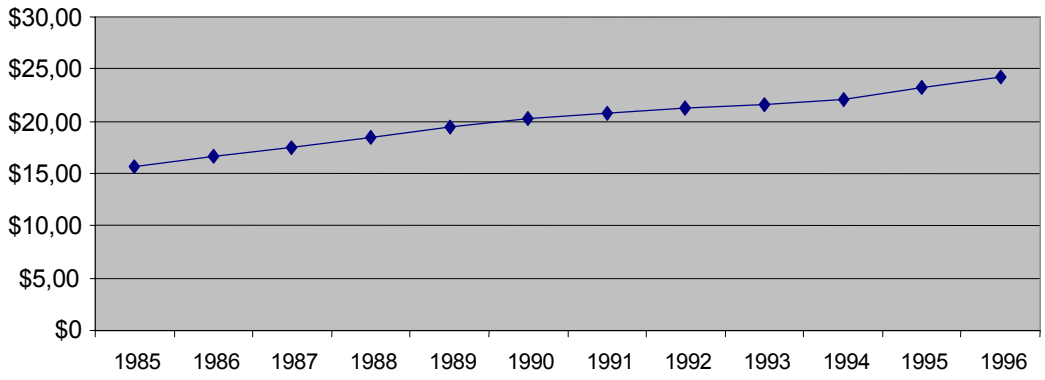
Source: California Employment Development Department

Exhibit 5-3
Employment/Unemployment in San Diego 1990-1998



Source: California Employment Department

Exhibit 5-4
San Diego Per Capita Personal Income 1985-1996

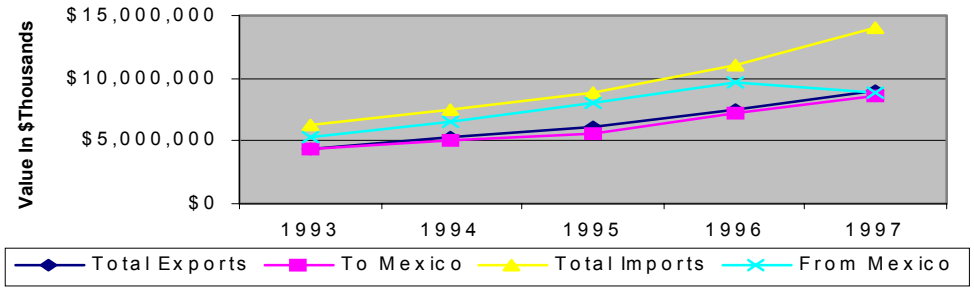


Source California Department of Finance

San Diego Foreign Trade

A very important underlying stimulus for the economic expansion during the latter part of the 1990's was exports. Exports to Mexico were easily the largest and most dynamic element of this growth, and electronic equipment was the principal growth commodity. However, note that these growth rates declined as the unemployment rate in San Diego declined. Moreover, the latest data indicate a decline from February 1998 to February 1999 (-3.2 percent).[3] Exhibits 5-5 through 5-7 display import and export growth. Table 5-10 quantifies exports by product sector.

Exhibit 5-5
Exports /Imports Through San Diego

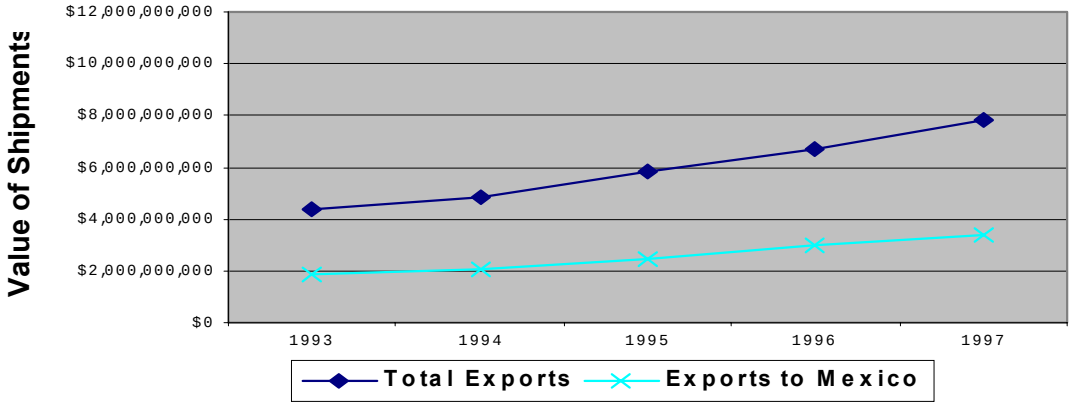


Source: Exporter Location Series, Census Bureau

[3] Source: Greater San Diego Chamber of Commerce Economic Bulletin –"Trade Through San Diego Customs District Included with San Diego/Tijuana Economic Indicators." May, 1999.

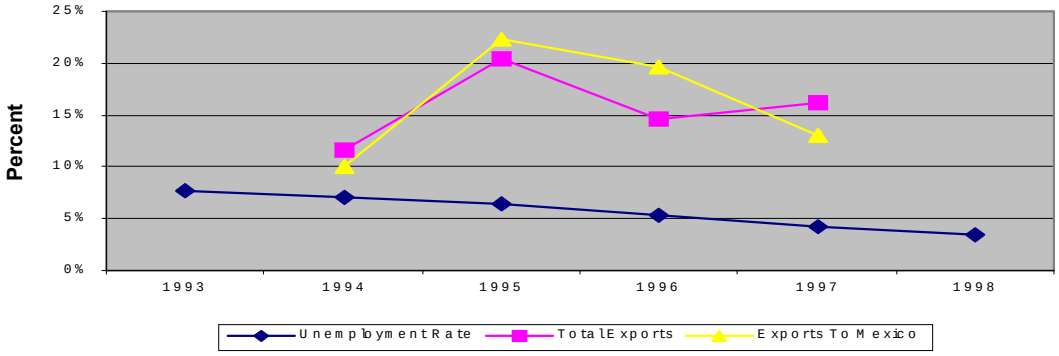
Prepared by: Office of Trade and Economic Analysis, International Trade Administration, Dept. of Commerce

Exhibit 5-6
San Diego Exports



Source: Greater San Diego Chamber of Commerce Economic Bulletin – "International Trade" Vol. 47 No. 2, 1999.

Exhibit 5-7
Export Growth Rates



Source: Greater San Diego Chamber of Commerce Economic Bulletin – "International Trade" Vol.47 No. 2, 1999.

Table 5-10
San Diego Merchandise Exports to the World by Product Sector

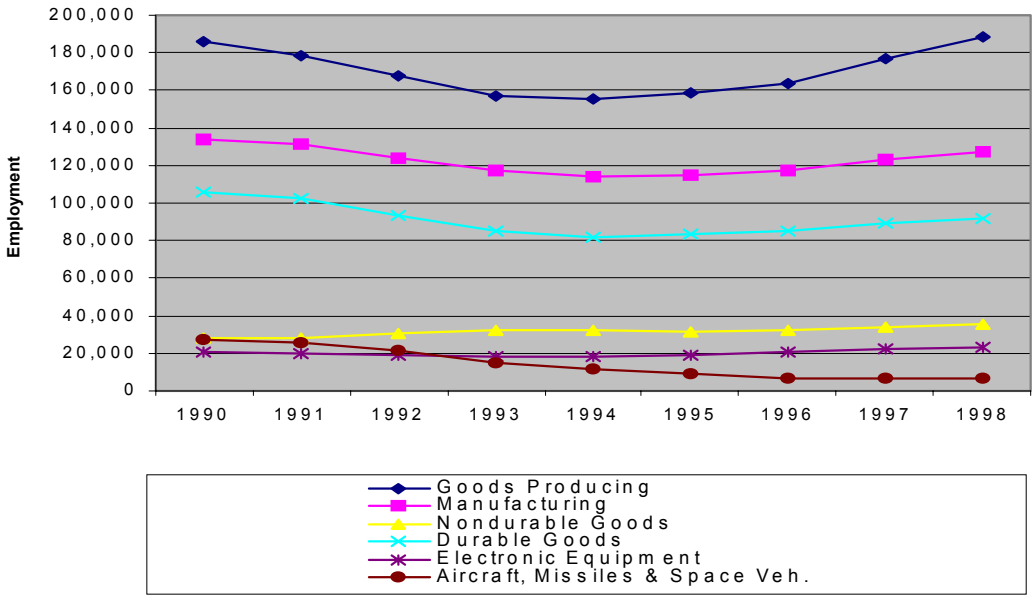
Product Description	1993	1994	1995	1996	1997
Total Exports Manufactured Goods	$4,261,925,542	$4,753,981,228	$5,752,914,257	$6,582,982,191	$7,649,408,061
Food & Tobacco Products	$193,304,179	$209,020,222	$185,584,549	$137,093,626	$172,119,666
Textile Mill Products	$16,022,703	$22,422,767	$20,995,935	$29,815,734	$36,262,252
Apparel	$97,676,915	$98,647,045	$111,182,154	$128,400,186	$115,655,953
Lumber & Wood Products	$169,487,215	$134,852,306	$64,510,609	$76,912,640	$83,770,391
Furniture & Fixtures	$23,230,684	$33,998,112	$26,475,461	$37,301,414	$39,828,505
Paper Products	$85,045,595	$117,260,556	$149,133,088	$170,781,032	$204,483,939
Printing & Publishing	$64,661,735	$65,904,745	$57,517,432	$55,158,640	$65,635,170
Chemical Products	$182,937,897	$209,399,740	$255,942,483	$302,616,044	$349,618,814
Refined Petroleum Products	$11,079,514	$10,464,570	$10,223,235	$11,074,213	$18,308,946
Rubber & Plastic Products	$158,349,920	$208,476,499	$257,586,052	$316,368,890	$324,604,352
Leather Products	$12,033,885	$18,483,253	$23,341,631	$29,207,337	$22,007,050
Stone, Clay, & Glass Products	$29,275,236	$29,923,615	$32,998,327	$31,912,793	$41,736,724
Primary Metals	$129,879,237	$134,399,417	$170,929,962	$188,517,154	$216,115,393
Fabricated Metal Products	$162,037,533	$141,886,618	$167,668,870	$222,125,166	$187,096,696
Industrial Machinery & Computers	$873,910,219	$989,848,779	$1,066,888,432	$1,237,593,822	$1,295,886,906
Electric & Electronic Equipment	$1,129,106,403	$1,432,037,015	$2,122,560,368	$2,489,716,944	$3,078,466,417
Transportation Equipment	$238,694,727	$182,214,780	$236,784,857	$211,892,747	$299,542,464
Scientific & Measuring Inst.	$507,774,039	$470,125,622	$490,849,029	$552,860,320	$617,975,918
Miscellaneous Manufactures	$146,823,807	$211,353,502	$270,930,934	$323,429,531	$441,528,754
Unidentified Manufactures	$30,594,099	$33,262,065	$30,810,849	$30,203,958	$38,763,751
Non-manufactured Commodities	$95,823,814	$113,297,183	$108,025,519	$136,423,026	$160,595,270
TOTAL EXPORTS	$4,357,749,356	$4,867,278,411	$5,860,939,776	$6,719,405,217	$7,810,003,331
Exports to Mexico	$1,847,451,606	$2,032,230,443	$2,484,708,183	$2,973,933,686	$3,362,572,417
Percent to Mexico	43.3%	42.7%	43.2%	45.2%	44.0%
Percent Increase to Mexico	N/A	10.0%	22.3%	19.7%	13.1%
Percent Increase Total	N/A.	11.7%	20.4%	14.6%	16.2%
Percent Increase Electronic	N/A.	26.8%	48.2%	17.3%	23.6%

Prepared by: Office of Trade and Economic Analysis, International Trade Administration, Dept. of Commerce

Trends in San Diego Employment by Industry

Since the San Diego "Defense downsizing" recession in San Diego in the early 1990's, employment growth has been steady and unemployment steadily declining after 1993. These trends are shown on Exhibits 5-8 and 5-9 and on Table 5-11.

Exhibit 5-8
Trends in San Diego Employment by Industry



5.4 Mexican Peso-Dollar Exchange Rate and its Influences on Cross-Border Travel

The influence of the effects of the peso-dollar exchange rate on border crossing is clearly demonstrated by historical data. Exhibits 5-10 through 5-17 and Tables 5-12 through 5-19 show a comparison of the peso-dollar exchange rate and cross-border trip making for a ten-year period (1990-1999) for all three studied crossings: San Ysidro, Otay Mesa and Tecate. Breakdowns are also provided by mode of Transport. Comparisons with the exchange rate are made for the following breakdowns of cross-border person travel:

- Bus Passenger
- Passenger Vehicle
- Pedestrian
- Truck
- Total Person Travel

As indicated by the data, since the major revaluation of the peso in 1993, the declining peso-dollar exchange rate has contributed to a decline in total cross-border trip making. As shown in the exhibits, the most direct correlation between increased peso dollar exchange rate and reduction in cross-border travel is for pedestrian and passenger vehicles. Since these two categories clearly dominate the movement across the border, the effects of the exchange rate on cross-border growth is evident. Clearly the

Exhibit 5-9
Projections of Employment by Major Industry Groupings

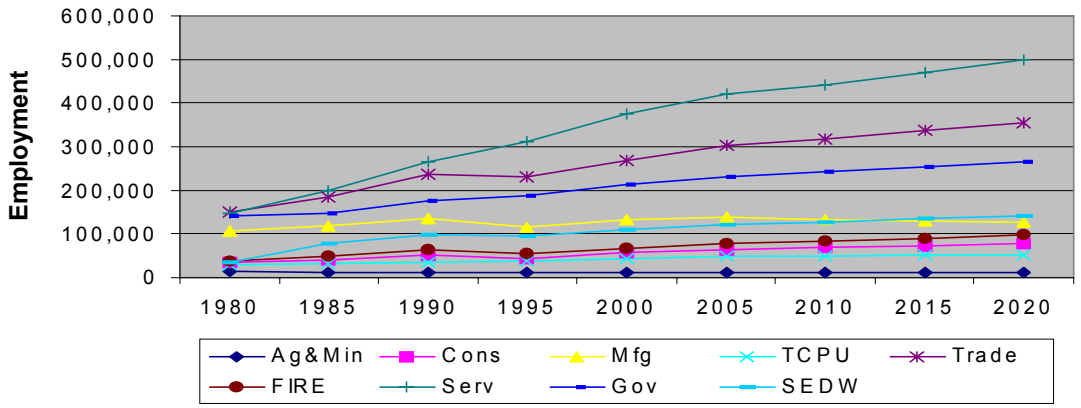


Table 5-11
Projections of Employment by Major Industry Groupings

	SIC Codes	1995	2005	2010	2020	'95-'20
Agriculture and Mining	15-17	11,100	12,400	11,900	11,700	5%
Construction	20-39	43,600	64,900	68,000	77,200	77%
Manufacturing	40-49	114,900	139,200	131,600	126,900	10%
Trans. Com. & Public Utilities	50-59	37,400	48,100	49,000	52,700	41%
Wholesale and Retail Trade	60-67	229,500	304,000	318,600	356,100	55%
Finance, Insurance & Real Estate	70-89	55,800	76,500	82,300	96,800	73%
Services	90-94	310,900	422,500	441,300	499,400	61%
Government		186,100	229,900	242,200	264,600	42%
Self Employed & Domestic Workers		95,700	121,900	127,100	142,400	49%

Source: San Diego Association of Governments, 1999.

exchange rate must be factored into cross-border travel growth rates. However over the long range, no predictable value for peso-dollar exchange can be made.

Research by El Colegio De La Frontera Norte (COLEF), as part of this study, has quantified the relationship of the exchange rate to the total employment in Tijuana, as well as to the number of workers who commute into the United States. As part of the COLEF work, a series of regression equations was developed and calibrated to data collected over a ten-year period. The period used in the analysis included 1994-1995, which was a very unstable time for the Mexican economy involving a major devaluation of the peso. The regression equations were modified by COLEF so that they would reflect a more stable economy over the 25-year future time horizon.

The assumption that greater economic stability in Mexico will happen in the future, is not inconsistent with the expected peso-dollar exchange as calculated for 2020. From September 1976 (the year when President Luis Echeverría devalued the peso for the first time since 1950) to date, the Mexican currency has experienced a total devaluation of 75,100%. This has meant a devaluation rate of 33.37% per year. Despite this condition, the Mexican economy has shown periods of growth over the past 26 years.

The conclusion of the analysis was two-fold: first it is expected, at least within the 2020 horizon, that continued devaluation will be present in Mexico's future. On the other hand, the past behavior of the Mexican economy indicates that growth is possible with inflation present.

Exhibit 5-10
Historic Border Crossing Trends Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Annual Persons at all Three POEs by Conveyance

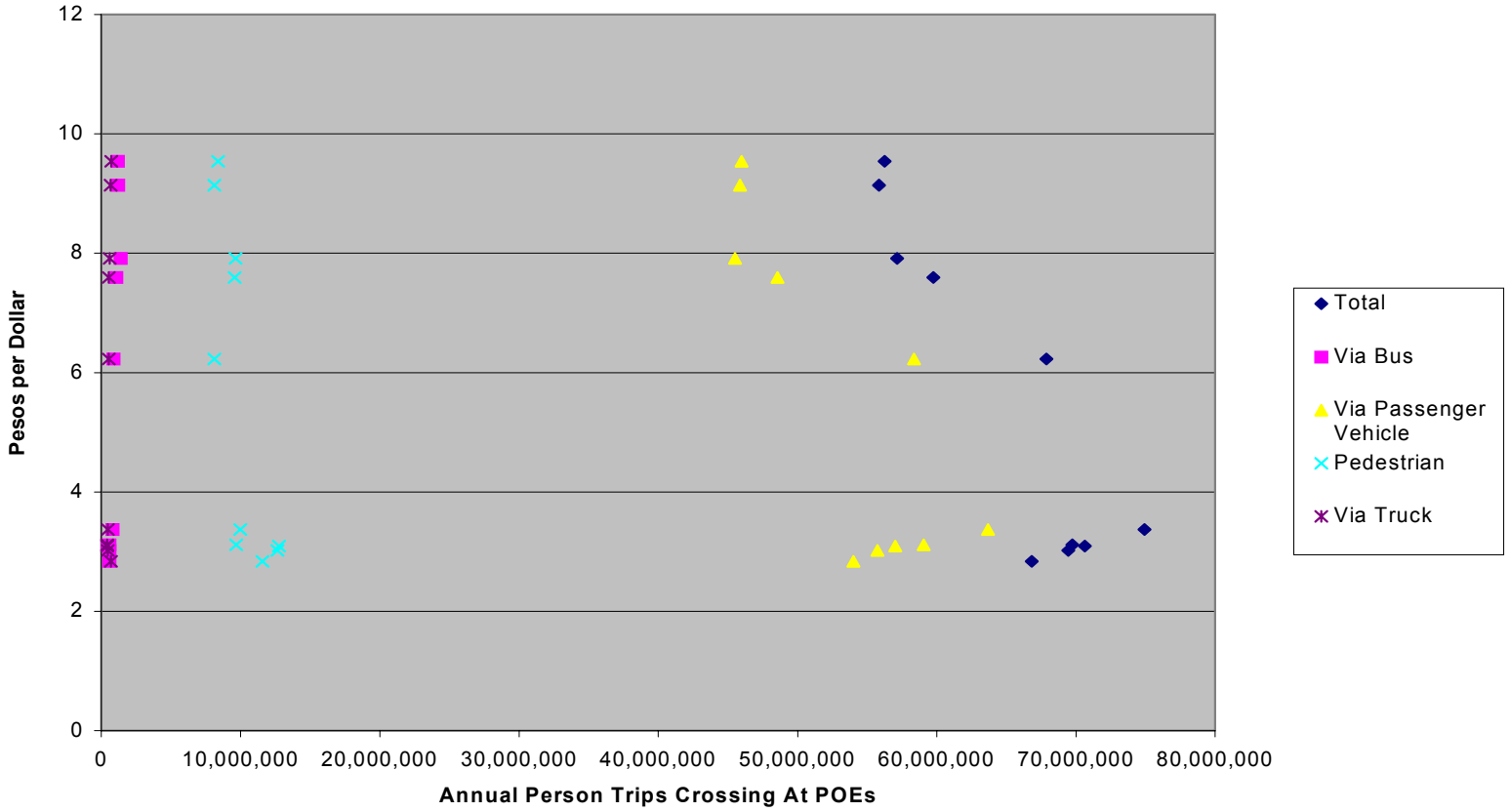


Exhibit 5-11
Historic Border Crossing Trends Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Annual Persons at all Three POEs

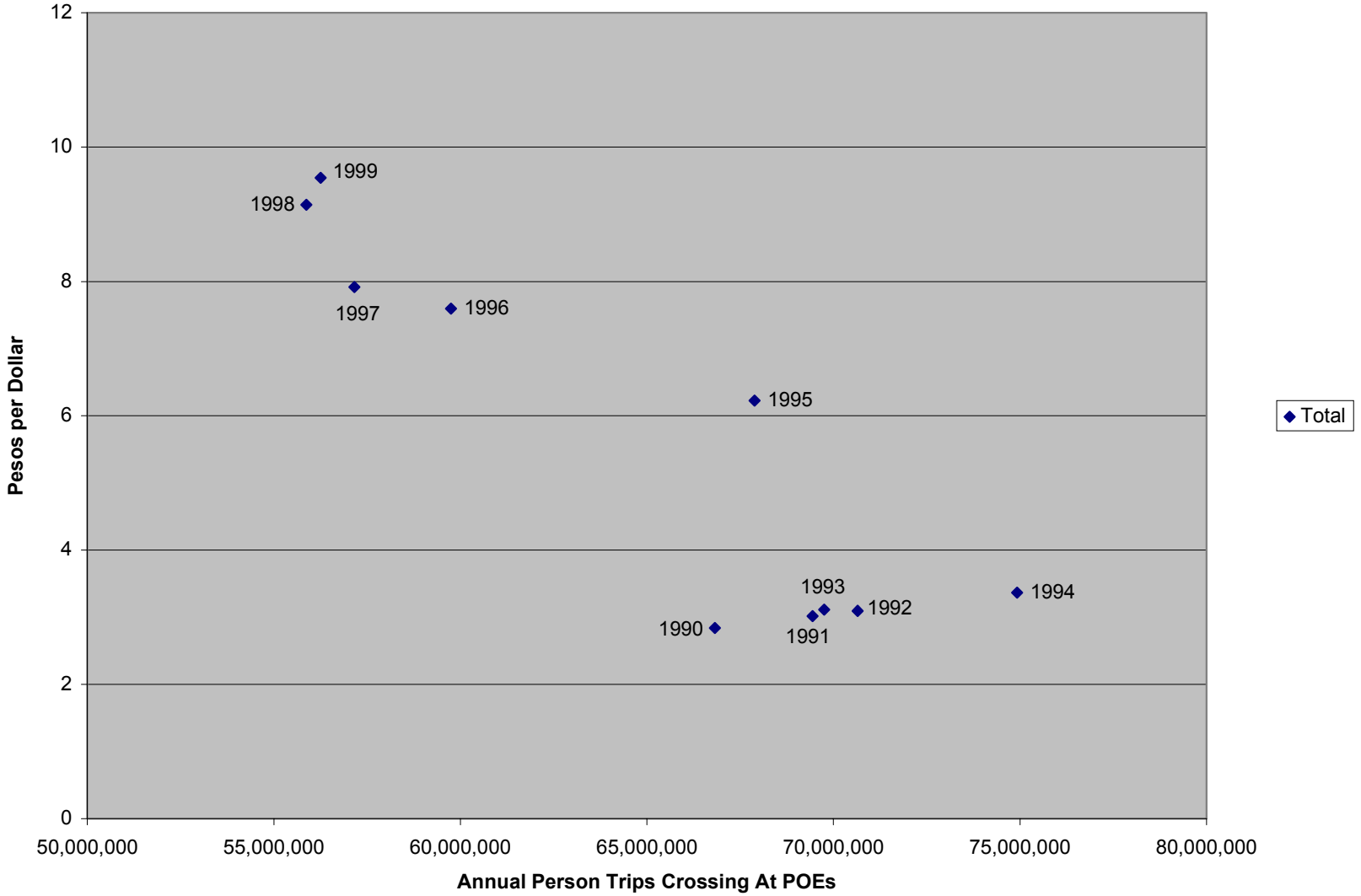


Exhibit 5-12
Historic Border Crossing Trends Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Annual Persons crossing via Truck at all Three POEs

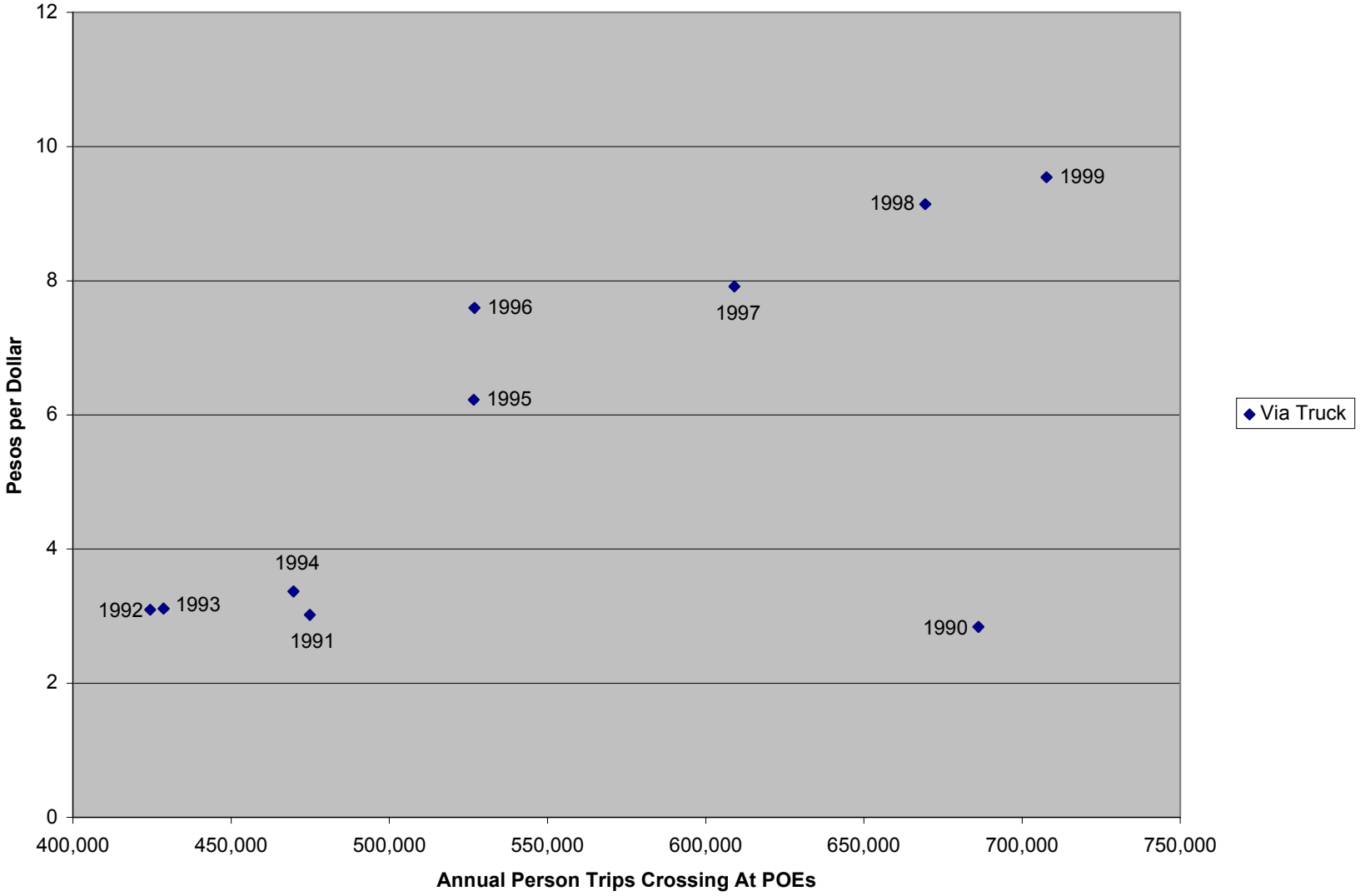


Exhibit 5-13
Historic Border Crossing Trends Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Annual Persons crossing via Bus at all Three POEs

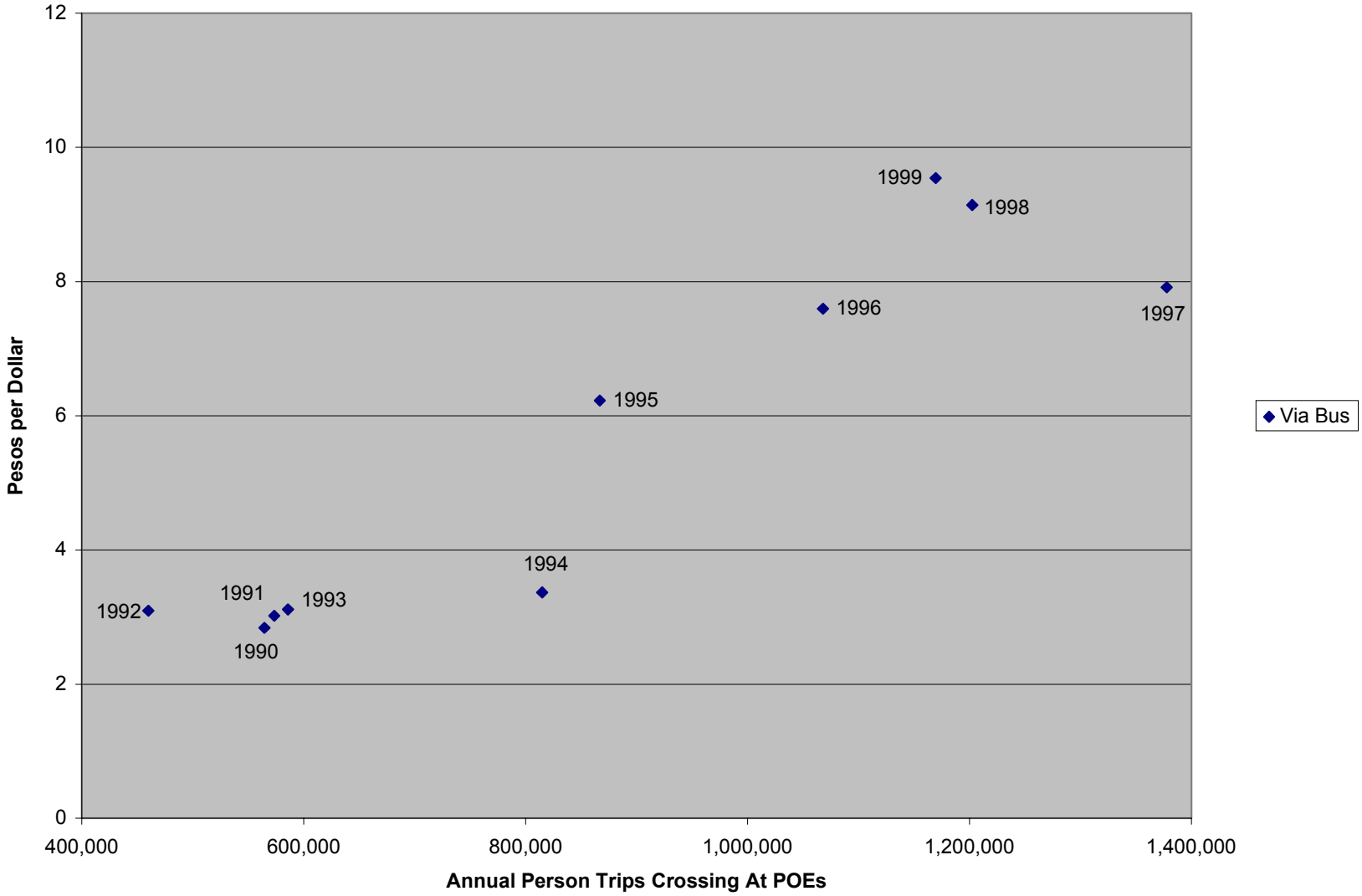


Exhibit 5-14
Historic Border Crossing Trends Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Annual Persons crossing via Passenger Vehicle at all Three POEs

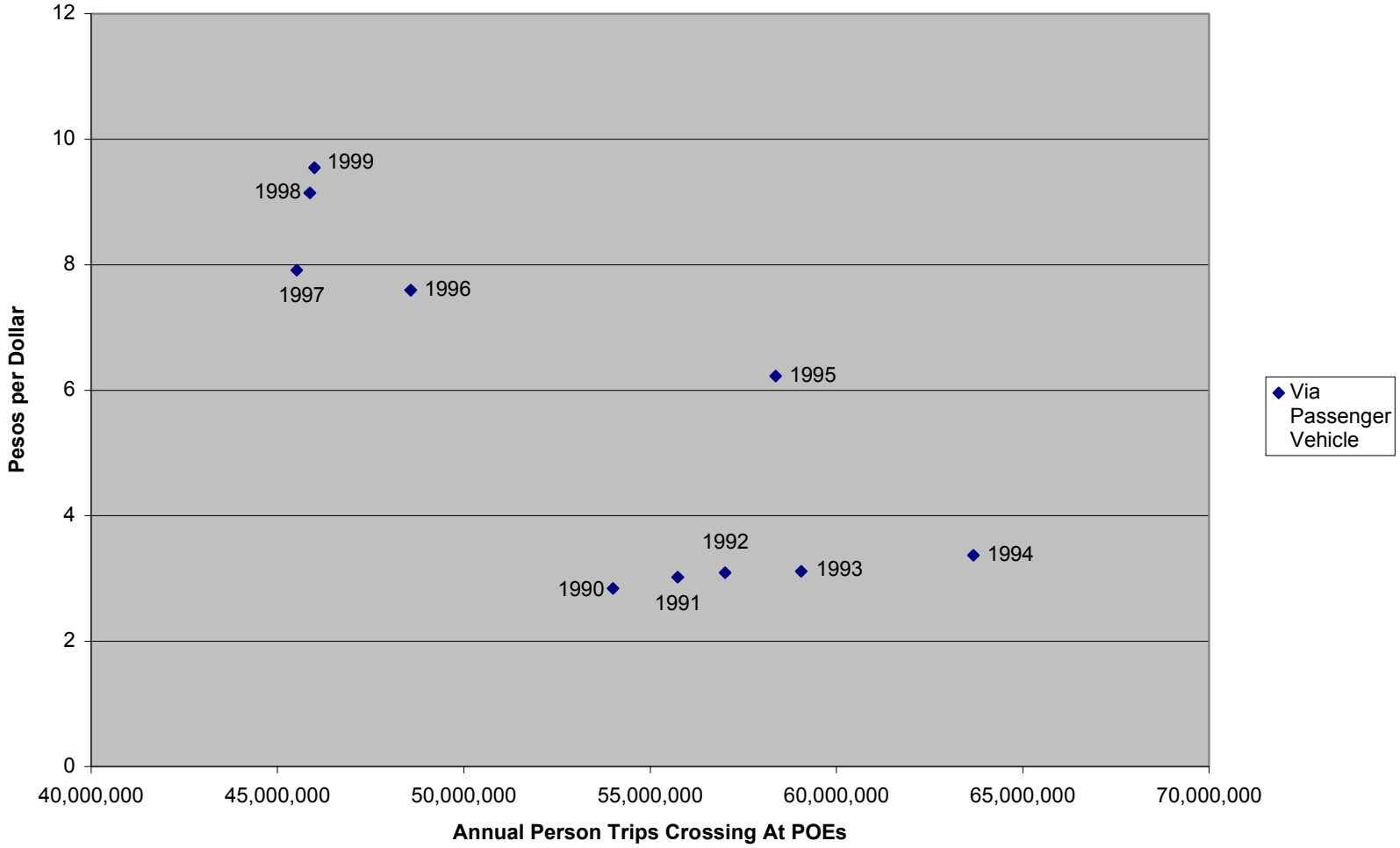


Exhibit 5-15
Historic Border Crossing Trends Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Annual Persons crossing on Foot at all Three POEs

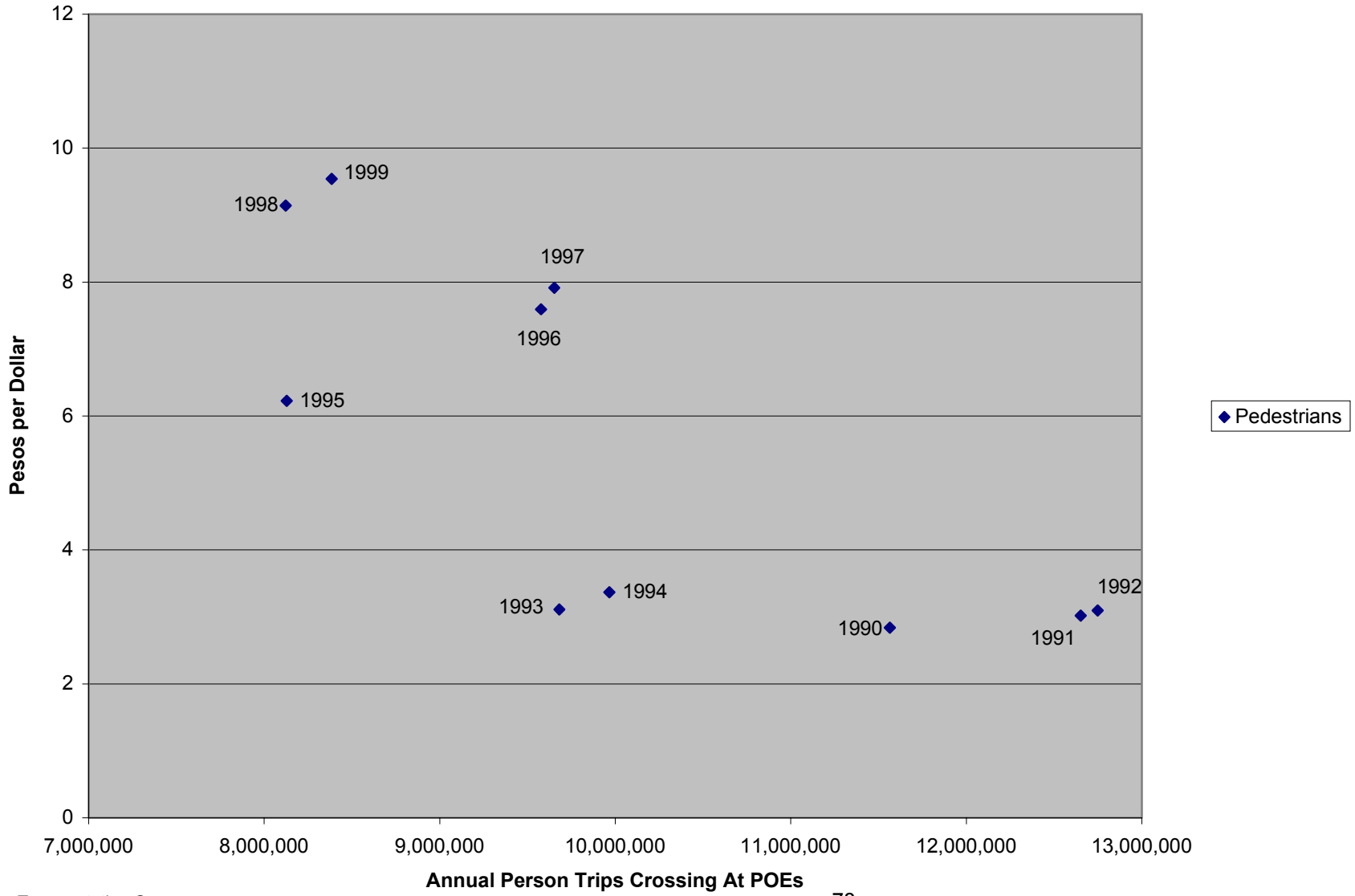


Exhibit 5-16
Historic Border Crossing Trends Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Annual Persons at all Three POEs by Conveyance (Excluding Trucks)

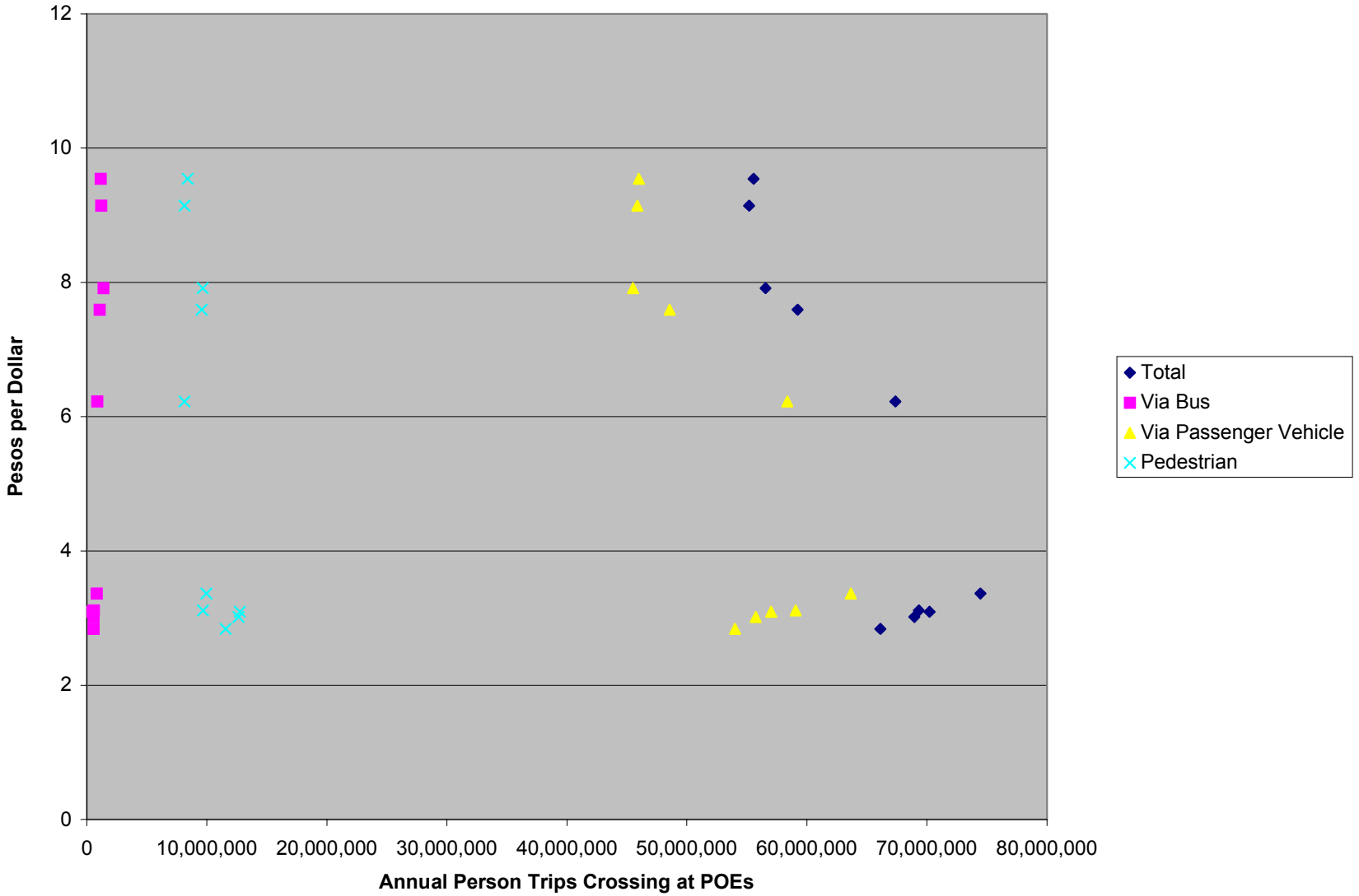


Exhibit 5-17
Historic Border Crossing Trends Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Annual Persons at all Three POEs (Excluding Trucks)

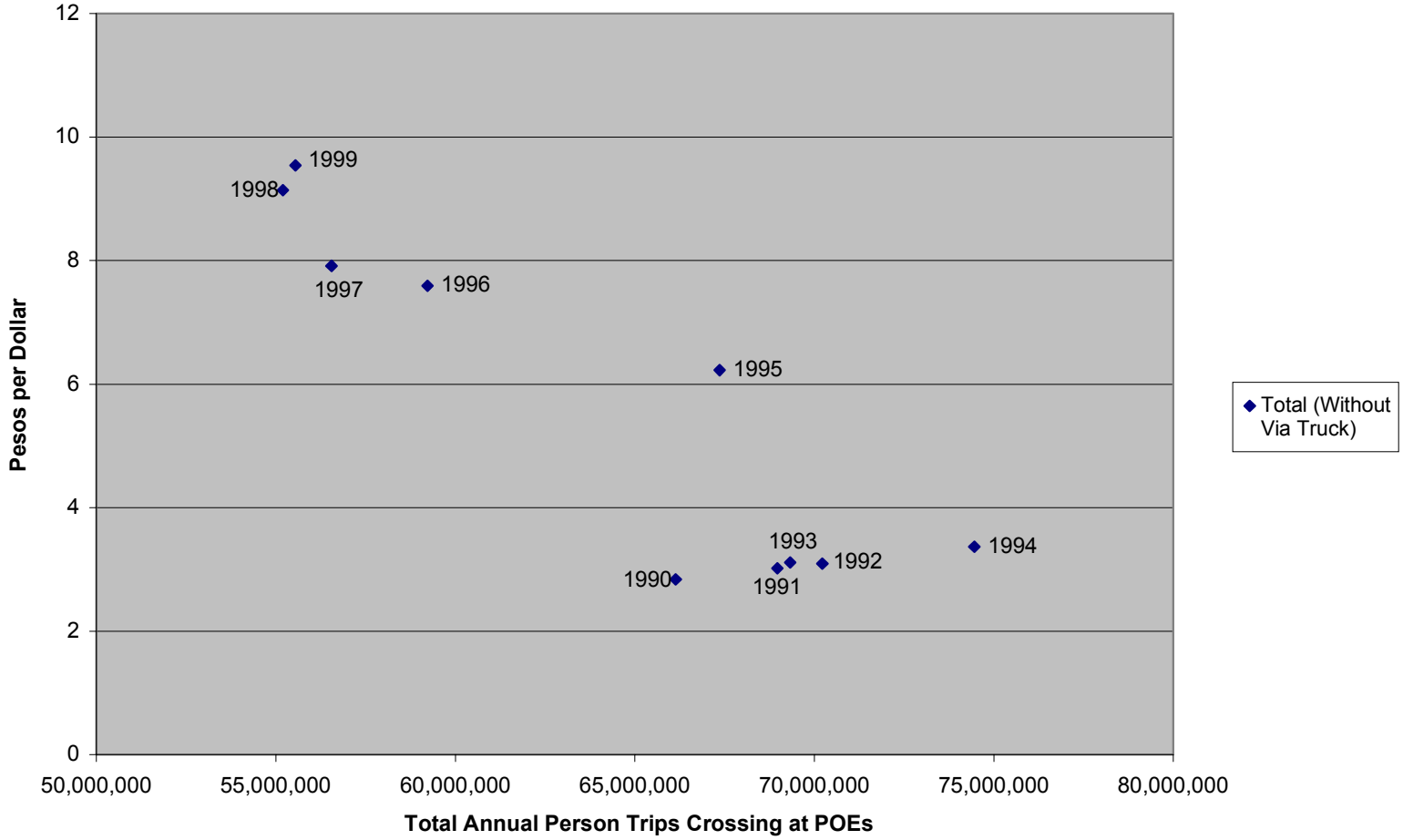


Table 5-12
Historical Border Crossing Trends as Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Persons Crossing at all Three POEs

TOTAL PERSONS CROSSING AT ALL THREE LOCATIONS						
Year	Exchange Rate Mexican Pesos per US Dollar (Average)	Via Truck	Via Bus	Via Passenger Vehicle	Pedestrians On Foot	Total
1990	2.8390	686,136	564,512	54,007,604	11,564,531	66,822,783
1991	3.0189	474,868	573,548	55,739,438	12,651,880	69,439,734
1992	3.0937	424,427	459,896	57,012,443	12,749,331	70,646,097
1993	3.1128	428,666	585,878	59,055,871	9,681,443	69,751,858
1994	3.3676	469,693	814,827	63,671,964	9,967,354	74,923,838
1995	6.2258	526,667	866,840	58,364,185	8,129,057	67,886,749
1996	7.5936	526,915	1,067,967	48,574,913	9,578,104	59,747,899
1997	7.9146	609,039	1,377,598	45,517,237	9,653,518	57,157,392
1998	9.1418	669,415	1,202,356	45,872,038	8,122,851	55,866,660
1999	9.5431	707,691	1,169,467	45,992,160	8,385,609	56,254,927
Average	**5.5851**	**552,352**	**868,289**	**53,380,785**	**10,048,368**	**64,849,794**

On January 4 of 1993, the Mexican Peso was revalued, at a rate of 1,000 old Pesos to one new Peso. All of the old Peso values (1990-1992) have been converted for the purposes of comparison.

Table 5-13
Historical Border Crossing Trends as Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Persons Crossing at all Three POEs (Except Truck Crossings)

TOTAL PERSONS CROSSING AT ALL THREE LOCATIONS (W/O TRUCKS)					
Year	Exchange Rate Mexican Pesos per US Dollar (Average)	Via Bus	Via Passenger Vehicle	Pedestrians On Foot	Total
1990	2.8390	564,512	54,007,604	11,564,531	66,136,647
1991	3.0189	573,548	55,739,438	12,651,880	68,964,866
1992	3.0937	459,896	57,012,443	12,749,331	70,221,670
1993	3.1128	585,878	59,055,871	9,681,443	69,323,192
1994	3.3676	814,827	63,671,964	9,967,354	74,454,145
1995	6.2258	866,840	58,364,185	8,129,057	67,360,082
1996	7.5936	1,067,967	48,574,913	9,578,104	59,220,984
1997	7.9146	1,377,598	45,517,237	9,653,518	56,548,353
1998	9.1418	1,202,356	45,872,038	8,122,851	55,197,245
1999	9.5431	1,169,467	45,992,160	8,385,609	55,547,236
Average	**5.5851**	**868,289**	**53,380,785**	**10,048,368**	**64,297,442**

On January 4 of 1993, the Mexican Peso was revalued, at a rate of 1,000 old Pesos to one new Peso. All of the old Peso values (1990-1992) have been converted for the purposes of comparison.

Table 5-14
Historical Border Crossing Trends as Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Persons Crossing at San Ysidro

PERSON ARRIVALS AT SAN YSIDRO						
Year	Exchange Rate Mexican Pesos per US Dollar (Average)	Via Truck	Via Bus	Via Passenger Vehicle	Pedestrians On Foot	Total
1990	2.8390	220,650	480,581	39,500,031	11,060,771	51,262,033
1991	3.0189	73,809	495,523	40,871,557	11,983,630	53,424,519
1992	3.0937	88	80,185	40,349,602	11,647,190	52,077,065
1993	3.1128	0	296,161	43,707,877	8,828,312	52,832,350
1994	3.3676	0	622,509	48,293,190	9,267,088	58,182,787
1995	6.2258	0	656,730	41,224,201	7,467,712	49,348,643
1996	7.5936	0	843,103	36,554,873	8,747,231	46,145,207
1997	7.9146	0	996,838	33,597,344	8,736,505	43,330,687
1998	9.1418	0	977,799	33,216,242	7,234,716	41,428,757
1999	9.5431	0	852,974	33,097,282	7,406,921	41,357,177
Average	**5.5851**	**29,455**	**630,240**	**39,041,220**	**9,238,008**	**48,938,923**

On January 4 of 1993, the Mexican Peso was revalued, at a rate of 1,000 old Pesos to one new Peso. All of the old Peso values (1990-1992) have been converted for the purposes of comparison.

All truck crossings were discontinued at San Ysidro in January of 1991; prior to that date, only empty trucks arrived at San Ysidro; subsequent to that date, all trucks were inspected at Otay Mesa only.

During the period from December 1991 to March 1993, all buses were rerouted from San Ysidro to Otay Mesa due to construction at San Ysidro.

Table 5-15
Historical Border Crossing Trends as Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Persons Crossing at San Ysidro (Except Truck Crossings)

PERSON ARRIVALS AT SAN YSIDRO (W/O TRUCKS)					
Year	Exchange Rate Mexican Pesos per US Dollar (Average)	Via Bus	Via Passenger Vehicle	Pedestrians On Foot	Total
1990	2.8390	480,581	39,500,031	11,060,771	51,041,383
1991	3.0189	495,523	40,871,557	11,983,630	53,350,710
1992	3.0937	80,185	40,349,602	11,647,190	52,076,977
1993	3.1128	296,161	43,707,877	8,828,312	52,832,350
1994	3.3676	622,509	48,293,190	9,267,088	58,182,787
1995	6.2258	656,730	41,224,201	7,467,712	49,348,643
1996	7.5936	843,103	36,554,873	8,747,231	46,145,207
1997	7.9146	996,838	33,597,344	8,736,505	43,330,687
1998	9.1418	977,799	33,216,242	7,234,716	41,428,757
1999	9.5431	852,974	33,097,282	7,406,921	41,357,177
Average	**5.5851**	**630,240**	**39,041,220**	**9,238,008**	**48,909,468**

On January 4 of 1993, the Mexican Peso was revalued, at a rate of 1,000 old Pesos to one new Peso. All of the old Peso values (1990-1992) have been converted for the purposes of comparison.

All truck crossings were discontinued at San Ysidro in January of 1991; prior to that date, only empty trucks arrived at San Ysidro; subsequent to that date, all trucks were inspected at Otay Mesa only.

During the period from December 1991 to March 1993, all buses were rerouted from San Ysidro to Otay Mesa due to construction at San Ysidro.

Table 5-16
Historical Border Crossing Trends as Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Persons Crossing at Otay Mesa

PERSON ARRIVALS AT OTAY MESA						
Year	Exchange Rate Mexican Pesos per US Dollar (Average)	Via Truck	Via Bus	Via Passenger Vehicle	Pedestrians On Foot	Total
1990	2.8390	381,554	76,629	10,343,225	134,295	10,935,703
1991	3.0189	341,513	69,438	10,498,237	274,275	11,183,463
1992	3.0937	374,141	370,865	12,291,397	659,481	13,695,884
1993	3.1128	384,615	277,312	11,059,978	521,426	12,243,331
1994	3.3676	428,086	175,493	11,093,211	377,435	12,074,225
1995	6.2258	477,390	190,739	13,682,756	388,220	14,739,105
1996	7.5936	475,427	210,407	9,004,748	566,737	10,257,319
1997	7.9146	558,383	367,472	8,849,383	628,285	10,403,523
1998	9.1418	599,001	216,264	9,407,609	604,333	10,827,207
1999	9.5431	638,210	306,728	9,798,301	697,791	11,441,030
Average	**5.5851**	**465,832**	**226,135**	**10,602,885**	**485,228**	**11,780,079**

On January 4 of 1993, the Mexican Peso was revalued, at a rate of 1,000 old Pesos to one new Peso. All of the old Peso values (1990-1992) have been converted for the purposes of comparison.

All truck crossings were discontinued at San Ysidro in January of 1991; prior to that date, only empty trucks arrived at San Ysidro; subsequent to that date, all trucks were inspected at Otay Mesa only.

During the period from December 1991 to March 1993, all buses were rerouted from San Ysidro to Otay Mesa due to construction at San Ysidro.

Table 5-17
Historical Border Crossing Trends as Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Persons Crossing at Otay Mesa (Except Truck Crossings)

PERSON ARRIVALS AT OTAY MESA (W/O TRUCKS)					
Year	Exchange Rate Mexican Pesos per US Dollar (Average)	Via Bus	Via Passenger Vehicle	Pedestrians On Foot	Total
1990	2.8390	76,629	10,343,225	134,295	10,554,149
1991	3.0189	69,438	10,498,237	274,275	10,841,950
1992	3.0937	370,865	12,291,397	659,481	13,321,743
1993	3.1128	277,312	11,059,978	521,426	11,858,716
1994	3.3676	175,493	11,093,211	377,435	11,646,139
1995	6.2258	190,739	13,682,756	388,220	14,261,715
1996	7.5936	210,407	9,004,748	566,737	9,781,892
1997	7.9146	367,472	8,849,383	628,285	9,845,140
1998	9.1418	216,264	9,407,609	604,333	10,228,206
1999	9.5431	306,728	9,798,301	697,791	10,802,820
Average	**5.5851**	**226,135**	**10,602,885**	**485,228**	**11,314,247**

On January 4 of 1993, the Mexican Peso was revalued, at a rate of 1,000 old Pesos to one new Peso. All of the old Peso values (1990-1992) have been converted for the purposes of comparison.

All truck crossings were discontinued at San Ysidro in January of 1991; prior to that date, only empty trucks arrived at San Ysidro; subsequent to that date, all trucks were inspected at Otay Mesa only.

During the period from December 1991 to March 1993, all buses were rerouted from San Ysidro to Otay Mes due to construction at San Ysidro.

Table 5-18
Historical Border Crossing Trends as Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Persons Crossing at Tecate

PERSON ARRIVALS AT TECATE						
Year	Exchange Rate Mexican Pesos per US Dollar (Average)	Via Truck	Via Bus	Via Passenger Vehicle	Pedestrians On Foot	Total
1990	2.8390	83,932	7,302	4,164,348	369,465	4,625,047
1991	3.0189	59,546	8,587	4,369,644	393,975	4,831,752
1992	3.0937	50,198	8,846	4,371,444	442,660	4,873,148
1993	3.1128	44,051	12,405	4,288,016	331,705	4,676,177
1994	3.3676	41,607	16,825	4,285,563	322,831	4,666,826
1995	6.2258	49,277	19,371	3,457,228	273,125	3,799,001
1996	7.5936	51,488	14,457	3,015,292	264,136	3,345,373
1997	7.9146	50,656	13,288	3,070,510	288,728	3,423,182
1998	9.1418	70,414	8,293	3,248,187	283,802	3,610,696
1999	9.5431	69,481	9,765	3,096,577	280,897	3,456,720
Average	**5.5851**	**57,065**	**11,914**	**3,736,681**	**325,132**	**4,130,792**

On January 4 of 1993, the Mexican Peso was revalued, at a rate of 1,000 old Pesos to one new Peso. All of the old Peso values (1990-1992) have been converted for the purposes of comparison.

Table 5-19
Historical Border Crossing Trends as Compared to the Mexican Peso-Dollar Exchange Rate (1990-1999) – Total Persons Crossing at Tecate (Except Truck Crossings)

PERSON ARRIVALS AT TECATE (W/O TRUCKS)					
Year	Exchange Rate Mexican Pesos per US Dollar (Average)	Via Bus	Via Passenger Vehicle	Pedestrians On Foot	Total
1990	2.8390	7,302	4,164,348	369,465	4,541,115
1991	3.0189	8,587	4,369,644	393,975	4,772,206
1992	3.0937	8,846	4,371,444	442,660	4,822,950
1993	3.1128	12,405	4,288,016	331,705	4,632,126
1994	3.3676	16,825	4,285,563	322,831	4,625,219
1995	6.2258	19,371	3,457,228	273,125	3,749,724
1996	7.5936	14,457	3,015,292	264,136	3,293,885
1997	7.9146	13,288	3,070,510	288,728	3,372,526
1998	9.1418	8,293	3,248,187	283,802	3,540,282
1999	9.5431	9,765	3,096,577	280,897	3,387,239
Average	**5.5851**	**11,914**	**3,736,681**	**325,132**	**4,073,727**

On January 4 of 1993, the Mexican Peso was revalued, at a rate of 1,000 old Pesos to one new Peso. All of the old Peso values (1990-1992) have been converted for the purposes of comparison.

Regression equations

The regression equations were developed by COLEF as indicated above to estimate the exchange rate for the year 2020. These two functions come from a study made by COLEF on the historical tendency of transmigration, that is people that live in Tijuana and work on the San Diego side. As part of the study, two regression equations were fitted using historical data. In the first case, the relationship between the levels of labor force participation in Tijuana, and the proportion of transmigrants in that workforce were examined. The findings in this respect pointed to the fact that although transmigration has grown historically in a parallel fashion to the economically active population in the city; the rate of this growth is decreasing, as more transmigrants integrate to the city's economic base. The second part of the analysis referred to the effect that variations in the exchange rate have on the levels of transmigrant workers at any one time. The results pointed to the presence of increases in the numbers of transmigrant workers any time a devaluation of the peso took place. The interpretation of this finding has several implications, but an important factor has to do with the need for those workers to work in the United States if possible, to earn dollars to compensate the loss in buying power.

In order to make use of the two statistical functions derived in the aforementioned study, three basic assumptions were preliminary made:

- The amount of labor force participation varies with the population changes.
- The exchange rate is associated with the amount of labor force participation.
- In the year 2020, it is projected that the proportion of Mexican workers commuting to the U.S. will be lower than it is presently due to more favorable economic conditions in Mexico, that will attract more workers to work in Baja California that previously worked in the United States.

The number of resident workers for 1995 were selected directly from the published data on *Economically Active Population* (PEA) for the State of Baja California available at the municipality level. This provided data necessary to derive the proportion of workers that crossed the border out of total population in 1995. With this as a starting point, the COLEF analysis also derived future year rates of labor force participation (e.g. a 0.41 ratio of resident workers to total population in 2020 was assumed for Tijuana, Tecate and Playas de Rosarito). In the case of Ensenada, the ratio for 1997 was 0.34, and the assumed proportion for 2020, 0.37.

The overall numbers of labor participation for 2020, resulting from the corresponding ratios for each municipality, were distributed according to

the assumptions made on the population distribution, and used to estimate the number of commuting workers for that year, via the function:

$$y = 0.0017x^{1.2949}$$

where:
the constants are determined from the regression,
y = commuting workers, 2020, and
x = resident workers, 2020.

Finally, the exchange rate was estimated substituting the number of commuting workers in the year 2020, in the other function:

$$y = 14635x^{0.3541}$$

where:
the constants are determined from the regression,
y = commuting workers, 2020, and
x = exchange rate, 2020

Using the modified regression equations, the growth forecasts are consistent with the exchange rates shown in Table 5-20.

Table 5-20
Exchange Rates

YEAR	AVERAGE PESOS PER DOLLAR
1985	0.401
1990	2.837
1995	6.451
1999	10.025
2010	41.544
2020	107.185

5.5 Recommended Cross-Border Travel Growth Factors

Given the unpredictability of monetary exchange rates over time, an initial set of year 2020 cross-border growth factors were developed separately for the six trip purposes purely based on socioeconomic growth projections for both sides of the border.

This approach provides future year (2020) border-crossing volumes that are based on current trip propensities and per capita rates. While not

taking into account the peso-dollar exchange, these forecasts rely on the most generally accepted future indicators. The approach will fully test the three selected future year cross-border capacity expansion alternatives.

As shown in Tables 5-21 and 5-22. Demographics on both sides of the border would result in a more than doubling of cross-border demand if average ratios are applied for all six purposes. The highest growth is projected to occur in work trip purposes: 2.5 fold growth in Home-In-Mexico-to work-in-U.S. and 2.16, Home in U.S. to work in Mexico.

While these growth rates may seem high, a comparison of historical data shows that cross-border trip-making behavior could increase at a rate even higher. Table 5-23 shows historic border crossing information at the three studied ports of entry by type of conveyance. Table 5-24 shows average annual growth in border crossings. Tables 5-25 and 5-26 show historic population and employment information and growth respectively. Based on these historic growth rates, using the growth rates shown in Table 5-22 is reasonable.

Table 5-21
Composite Cross-Border Growth Factors by Trip Purpose

Cross Border Trip Generation

Ratios to compute growth of Cross-Border Trip Table
Recommended for model application Year 1995 (Existing Conditions) to Year 2020

1. Home-in-Mexico-to-work-in-U.S.:

Production Growth = Growth of Mexico Cross-Border workers			***Attraction Growth = Growth of SD County Employment***		
Existing Conditions (1995)			**Existing Conditions (1995)**		
Y1995 Mexico Cross-Border Workers	=	24341 (1)	Y1995 SD County Employment	=	1084947 (2)
Future Conditions			**Future Conditions**		
Y2020 Mexico Cross-Border Workers	=	86264 (1)	Y2020 SD County Employment	=	1627761 (2)
Ratio (Y2020/Y1995 cross-brdr workers)	=	3.543979	Ratio (Y2020 empl/Y1995 empl)	=	1.500314

2. Home-in-U.S.-to-work-in-Mexico:

Production Growth = Growth of SD County Employment			***Attraction Growth = Growth of Mexico Study Area Employment***		
Existing Conditions (1995)			**Existing Conditions (1995)**		
Y1995 SD County Employment	=	1084947 (2)	Y1995 Mexico Study Area Employment	=	525850 (1)
Future Conditions			**Future Conditions**		
Y2020 SD County Employment	=	1627761 (2)	Y2020 Mexico Study Area Employment	=	1481127 (1)
Ratio (Y2020 empl/Y1995 empl)	=	1.500314	Ratio (Y2020 empl/Y1995 empl)	=	2.816634

3. Home-in-Mexico-to-other-in-U.S.:

Production Growth = Growth of Mexico Study Area Population			***Production Growth = Growth of SD County Employment***		
Existing Conditions (1995)			**Existing Conditions (1995)**		
Y1995 Mexico Study Area Population	=	1417106 (1)	Y1995 SD County Employment	=	1084947 (2)
Future Conditions			**Future Conditions**		
Y2020 Mexico Study Area Population	=	3697650 (1)	Y2020 SD County Employment	=	1627761 (2)
Ratio (Y2020 pop/Y1995 pop)	=	2.609297	Ratio (Y2020 empl/Y1995 empl)	=	1.500314

4. Home-in-U.S.-to-other-in-Mexico:

Production Growth = Growth of SD County Population			***Attraction Growth = Growth of Mexico Study Area Employment***		
Existing Conditions (1995)			**Existing Conditions (1995)**		
Y1995 SD County Population	=	2669200 (2)	Y1995 Mexico Study Area Employment	=	525850 (1)
Future Conditions			**Future Conditions**		
Y2020 SD County Population	=	3853297 (2)	Y2020 Mexico Study Area Employment	=	1481127 (1)
Ratio (Y2020 pop/Y1995 pop)	=	1	Ratio (Y2020 empl/Y1995 empl)	=	2.816634021

Table 5-21 (Continued)
Composite Cross-Border Growth Factors by Trip Purpose

5. Non-Home-Based-Mexico-to-U.S.:

Production Growth = Growth of Mexico Study Area Employment			***Production Growth = Growth of SD County Employment***		
Existing Conditions (1995)			**Existing Conditions (1995)**		
Y1995 Mexico Study Area Employment	=	525850 (1)	Y1995 SD County Employment	=	1084947 (2)
Future Conditions			**Future Conditions**		
Y2020 Mexico Study Area Employment	=	1481127 (1)	Y2020 SD County Employment	=	1627761 (2)
Ratio (Y2020 empl/Y1995 empl)	=	2.816634	Ratio (Y2020 empl/Y1995 empl)	=	1.500314

6. Non-Home-Based-U.S.-to-Mexico:

Production Growth = Growth of SD County Employment			***Attraction Growth = Growth of Mexico Study Area Employment***		
Existing Conditions (1995)			**Existing Conditions (1995)**		
Y1995 SD County Employment	=	1084947 (2)	Y1995 Mexico Study Area Employment	=	525850 (1)
Future Conditions			**Future Conditions**		
Y2020 SD County Employment	=	1627761 (2)	Y2020 Mexico Study Area Employment	=	1481127 (1)
Ratio (Y2020 empl/Y1995 empl)	=	1.500314	Ratio (Y2020 empl/Y1995 empl)	=	2.816634

References:
(1) Growth forecasts for NW Baja California, Mexico
(2) San Diego Association of Governments (SANDAG). ***2020 Cities / County Forecast, 1999.*** January 31, 2000.

Note:
a. Mexico Study Area includes the following municipalities: Tijuana, Playas de Rosarito, Tecate, and Ensenada.
b. SD Proximity Cities include Chula Vista, Coronado, Imperial Beach, La Mesa, Lemon Grove, National City, San Diego, and Santee.

Table 5-22
Composite Cross-Border Growth Factors by Trip Purpose

Home in Mexico to Work in US	
Mexico worker ratio:	3.5440
US employment ratio:	1.5003
Average ratio:	**2.5221**

Home in US to Work in Mexico	
US worker ratio:	1.5003
Mexico employment ratio:	2.8166
Average ratio:	**2.1585**

Home in Mexico to Other in US	
Mexico population ratio:	2.6093
US employment ratio:	1.5003
Average ratio:	**2.0548**

Home in US to Other in Mexico	
San Diego population ratio:	1.4436
Mexico employment ratio:	2.8166
Average ratio:	**2.1301**

Non Home Based Mexico to US	
Mexico employment ratio:	2.8166
US employment ratio:	1.5003
Average ratio:	**2.1585**

Non Home Based US to Mexico	
US employment ratio:	1.5003
Mexico employment ratio:	2.8166
Average ratio:	**2.1585**

Table 5-23
Historic Border Crossing Data

Port of Entry	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[A]	1993[A]	1994[A]	1995[A]
San Ysidro													
Vehicles	10,719,718	11,214,247	9,678,077	9,712,320	10,296,336	12,143,249	12,919,019	13,510,854	14,045,810	13,540,135	14,667,073	15,933,956	13,833,715
Trucks	220,002	235,743	186,360	231,798	305,209	371,074	393.,646	381,824	24,138[B]	88	0	0	0
Pedestrians	4,560,479	4,245,939	4,558,788	5,831,213	7,468,459	10,055,216	11,255,879	10,937,873	12,206,703	11,647,190	8,828,312	9,267,088	7,467,712
	15,500,199	15,695,929	14,423,225	15,775,331	18,070,004	22,569,539	24,175,937	24,830,551	26,276,651	25,187,413	23,495,385	25,201,044	21,301,427
Otay Mesa													
Vehicles	C	C	1,538,540	2,085,585	2,141,586	2,416,171	3,313,379	3,411,665	3,654,273	4,132,417	3,711,402	3,821,390	4,591,529
Trucks	C	C	88,426	145,039	207,405	235,545	275,057	216,185	315,650	374,141	384,615	428,086	477,390
Pedestrians	C	C	7,954	13,337	24,371	47,963	63,755	177,603	336,376	659,481	521,426	377,435	388,220
			1,634,920	2,243,961	2,373,362	2,699,679	3,652,191	3,805,453	4,306,299	5,166,039	4,617,443	4,626,911	5,457,139
Tecate													
Vehicles	620,909	635,261	571,232	663,448	725,319	800,768	921,763	1,049,020	1,106,510	1,092,861	1,072,014	1,081,790	1,042,030
Trucks	43,781	44,873	41,328	38,915	50,686	58,168	52,154	45,605	49,478	50,198	44,051	41,607	49,277
Pedestrians	218,139	235,793	314,914	264,606	233,247	446,671	421,312	359,380	419,438	442,660	331,705	322,831	273,125
	882,829	915,927	927,474	966,969	1,009,252	1,305,607	1,395,229	1,454,005	1,575,426	1,585,719	1,447,770	1,446,228	1,364,432
Total Trips	16,383,028	16,611,856	16,985,619	18,986,261	21,452,618	26,574,835	29,223,357	30,090,009	32,158,376	31,939,171	29,560,598	31,274,183	28,122,998

A= Information for Fiscal Years (July to June)
B= Fiscal Year information
C= Otay Mesa was constructed in 1985

Source: U.S. Customs Service

Table 5-24
Average Annual Growth Rate of the Three Border Crossings

Year	Average Annual Growth Rate
1983-1984	1.4%
1984-1985	2.2%
1985-1986	11.8%
1986-1987	13.0%
1987-1988	23.9%
1988-1989	10.0%
1989-1990	3.0%
1990-1991	6.9%
1991-1992	-2.4%
1992-1993	-5.8%
1993-1994	5.7%
1994-1995	-10.1%

Table 5-25
Population and Employment Data

Factor	1980	1990	1995	1998
Employment				
Baja California[A]	232,604	373,725		
San Diego	816,500	1,195,811	1,186,837	
Population				
Baja California[A]	667,222	1,058,917	1,416,106	
San Diego	1,873,300	2,498,016		2,853,258[B]

A – Includes Municipalities of Ensenada, Tijuana, Tecate and Playas de Rosarito
B – Forecast of population by SANDAG January 1, 1999

Source: Data for Baja California from INEGI
Data for San Diego from SANDAG

Table 5-26
Population and Employment Growth Rates

Employment	
Baja California	
1980-1990	4.9%
San Diego	
1980-1990	3.9%
1990-1995	-0.1%
Population	
Baja California	
1980-1990	4.7%
1990-1995	6.0%
San Diego	
1980-1990	2.9%
1990-1998	1.7%

6 Definition of Future Year Alternatives for Ports of Entry

6.1. Process for Defining Alternatives

Numerous proposals have been made over the last few years to add new Ports of Entry at the International border between California and Baja California. SANDAG in response to these proposals commissioned this cross-border modeling study to develop a tool for evaluating and prioritizing the various proposals for new Ports of Entry (POE).

The first step in our process for defining the alternatives to be considered was to identify the potential new or expanded POE. This information was developed by SANDAG. The SANDAG and Parsons team then identified the infrastructure improvements that would be needed to support each proposed POE improvement.

A preliminary listing of the three alternatives to be evaluated was then developed and presented to the Study Committee. The alternatives were presented in a sequential manner with one building on the next. The committee reviewed each of the alternatives along with the infrastructure proposed to support each alternative. A prioritized listing was then developed based on expectations of infrastructure availability and likely funding scenarios. Parsons was directed to use this in the future year travel forecasts.

6.2 Key Parameters for Ports of Entry

The Cross-Border Transportation Study Committee adopted a prioritized listing of POE improvements to be evaluated. This listing builds from the baseline scenario and adds additional improvements with each alternative as opposed to three independent alternatives. The following paragraphs describe each of the alternatives and the accompanying infrastructure.

Baseline: Existing POE at San Ysidro, Otay Mesa and Tecate

- No new POEs.
- Add Tijuana 2000 Corridor, SR 905 and SR 125 South

Alternative 1: Virginia Ave/El Chaparral POE

This alternative splits the existing San Ysidro/Puerta Mexico Port of Entry so that northbound traffic will utilize the entire existing crossing thus

expanding the number of northbound gates from 24 to 36. Southbound traffic is then rerouted approximately 1,500 feet to the west to utilize the former commercial POE at Virginia Avenue/El Chaparral, which would contain 16 southbound gates. The related infrastructure improvements include:

- Modify I-5 and I-805 to accommodate split POE
- Modify Mexico 1 and local Tijuana road system to accommodate split POE
- Add Tijuana 2000 Corridor, SR 905 and SR 125 South

Alternative 2: East Otay Mesa/Mesa de Otay II

This alternative adds a new POE approximately 2 miles east of the existing Otay Mesa/Mesa de Otay POE. The infrastructure to support this alternative in addition to alternative 1 includes:

- Constructing SR 11 from the SR 905/SR 125 east to the new POE
- Constructing a road between the new POE that connects the Tijuana 2000 bypass and that connects to Mexico 1 near Playas de Rosarito.

Alternative 3: Jacumba/Jacumé

This alternative adds a new POE in the eastern portion of San Diego County connecting the country towns of Jacumba with Jacumé. The infrastructure to support this alternative in addition to alternatives 1 and 2 includes:

- Constructing a road connecting Old Hwy 80 and I-8 to the new POE
- Constructing a road to connect the new POE with Mexico 2 (both the free and toll roads).

Exhibit 6-1 shows the location of the alternative POEs discussed above. For the POE delay (queuing) model, the characteristics of the new or expanded POEs were taken from the most similar existing POE. That is, each gate in the expanded San Ysidro POE was modeled with the flow rates, etc. of the existing San Ysidro POE, the East Otay POE was given identical characteristics as the existing Otay POE, and the Jacumba/Jacumé, POE was given the same characteristics as the Tecate POE. The Jacumba/Jacumé, POE would most likely be built to a "bigger" standard, but since the model is not assigning large volumes to it, the analysis is not affected.

Exhibit 6-1
Location of Future Year Alternatives

7 Future Year (2020) Travel Forecasts For Cross-Border Alternatives

This chapter describes the development of a future year 2020 baseline roadway for the study area and presents forecasts of travel across the border for horizon year 2020 for the Baseline and the three selected alternatives described in Chapter 6.

7.1 Future Year Roadway Networks

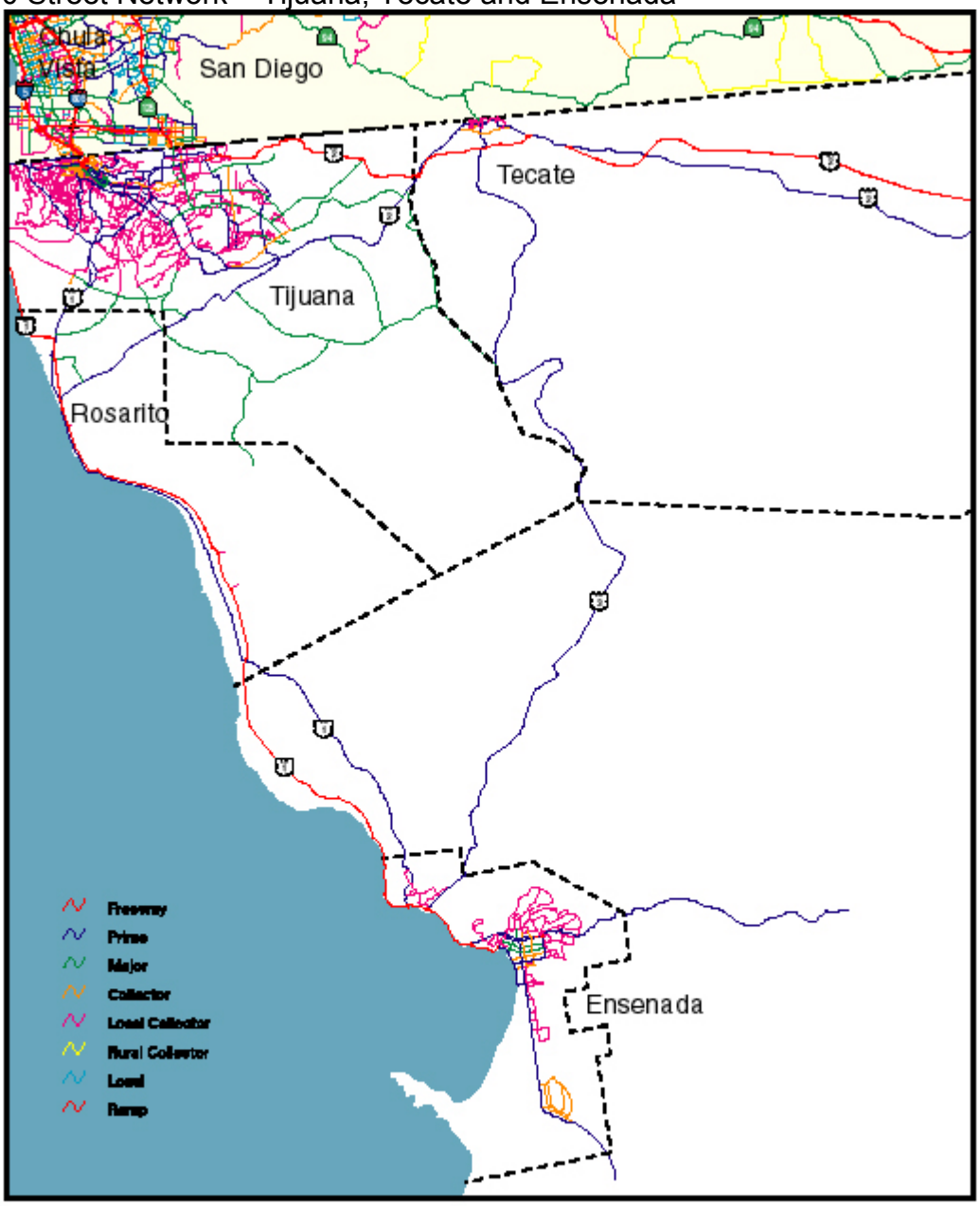
As described earlier in Chapter 4 of this report, the first step in the network development process was to increase the SANDAG modeling area to encompass the border area of Baja California the full width of San Diego County to include the Jacumba/Jacumé area. The modeling area was extended as far south as Ensenada. The majority of detail for this addition is within the Municipalities of Tijuana and Tecate because of their proximity to the border. The remaining area is modeled in a less aggregate (more schematic) manner.

As mentioned in Chapter 4, the network from the Tijuana model formed the centerpiece for the Baja California network. It was used as a guide for identifying roadway capacity and type for future network additions. The Base Year 1995 network forms the starting point for the 2020 network development.

Once the base year network had been checked, plotted and presented to the representatives of the study committee, work began on defining a horizon year 2020 roadway network for the Baja California portion of the study area. A list of major regional roadway improvements was developed based on information from the State of Baja California's *Programa Regional de Desarrollo Urbano del Corredor Tijuana-Rosarito 2000,* prepared by SAHOPE in December 1999. These roadway improvements were presented to the Cross-Border Study Committee and were reviewed by both SAHOPE and IMPLAN for completeness and accuracy.

Exhibits 7-1 and 7-2 show the 2020 Street Network for the Tijuana Modeling Area and the entire Northwest Baja California modeling area. The networks are TRANPLAN based and are coded in Geographic Information System (GIS) format. The Baseline future year network was tested against ground counts and other available traffic information, as a logic check.

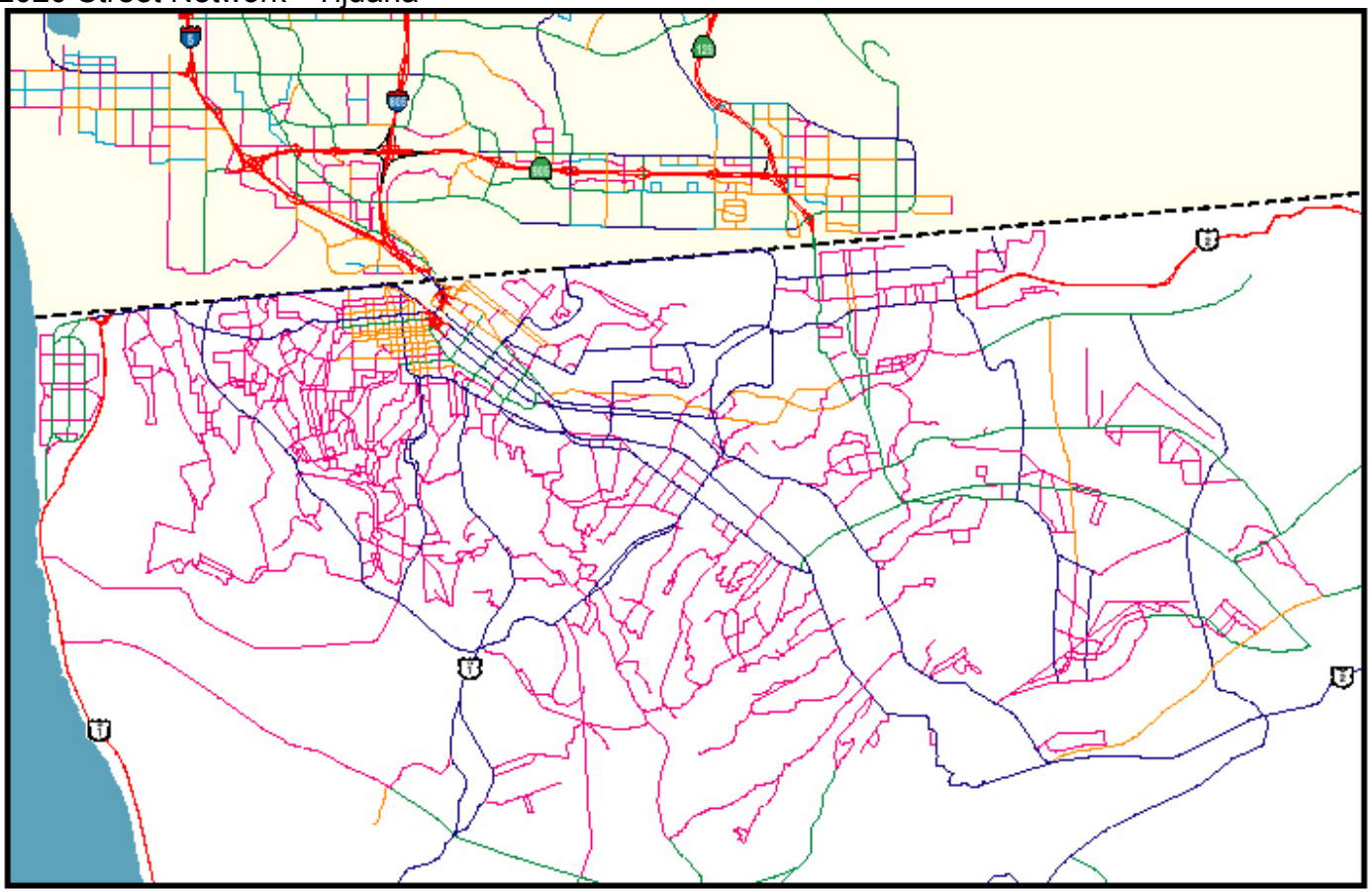
Exhibit 7-1
2020 Street Network – Tijuana, Tecate and Ensenada



2020 Street Network
Baseline Alternative
Tijuana, Tecate, Playas de Rosarito and Ensenada

Exhibit 7-1

Exhibit 7-2
2020 Street Network - Tijuana



2020 Street Network Tijuana
Baseline Alternative

Exhibit 7-2

For the San Diego side of the border, SANDAG's adopted regional roadway network was used. The only modifications to this network were added roadway links at the new border crossings for each alternative, connecting the new Ports of Entry to the horizon year roadway network in both San Diego County and northern Baja California.

7.2 Results of Forecasts For POE Alternatives- Performance of POE Additions.

Future year forecasts for horizon year 2020 were developed for the Baseline POE Alternative and the three selected study alternatives described in Chapter 6 of this report. The future year forecasts were governed by the cross-border travel growth rates that were established in Chapter 5 for the six primary trip purposes modeled.

The growth projected for cross-border trips is quite substantial, and will strain the capacities of the POEs to accommodate the demand. Making full use of the capacity for Otay Mesa/Mesa de Otay (which currently operates 7 of its 13 northbound gates) and a comparable capacity for East Otay Mesa/Mesa de Otay II, both Alternatives 2 and 3 are projected to operate at about current conditions.

Currently, during congested periods, the POEs process more cars per gate-hour than in uncongested periods. This observed difference indicates that the processing rate fluctuates not only due to available capacity but also due to policy issues. Therefore, the processing rate is not absolute. A second analysis tested what level of "accelerated processing" would be required for the baseline and each of the alternatives in order to bring the queue delays to today's levels. Such accelerated processing would represent a policy change on the processing at the gates.

Table 7-1 shows the queue delays for the 2020 scenarios tested. This table shows the results of the assignments, as well as two alternatives analyzed under "accelerated processing" as described in the following section. From Table 7-1 we see that the 2020 Baseline has substantial delays northbound in all time periods and southbound in the PM and Off Peaks. The northbound delay builds in the morning, and increases throughout the day. This analysis probably underestimates the AM delay, because the arrival behavior (percentage of trips arriving each hour) is modeled based on existing arrival rates measured by the survey. As traffic increases over time, and with it congestion and queues, vehicles would likely queue up earlier to avoid periods of maximum congestion and the AM queues would become more equivalent to the PM and Off Peak queues. The baseline alternative queues of 200 to 300 minutes indicate that the POEs cannot serve the future demand.

Table 7-1
Volumes and Delays

AM 06-09		1995	2020 Baseline	2020 Alternative 1	2020 Alternative 2	2020 Alternative 3	Accelerated Flow Baseline	Accelerated Flow Alternative 1
San Ysidro SB	Delay	1.8	0.1	0.1	0.1	0.1	0.1	0.1
	Volume	6,564	12,577	12,649	12,595	12,596	12,577	12,649
San Ysidro NB	Delay	25.2	121.6	64.3	25.6	25.8	24.0	24.6
	Volume	9,925	17,831	21,156	17,199	17,202	17,831	21,156
Otay Mesa SB	Delay	0.2	0.3	0.2	0.1	0.1	0.1	0.1
	Volume	1,227	4,296	4,236	2,978	2,969	4,296	4,236
Otay Mesa NB	Delay	23.6	105.5	59.8	20.0	19.8	23.6	23.6
	Volume	3,932	12,585	9,637	7,067	7,056	12,585	9,637
East Otay Mesa SB	Delay				0.1	0.1		
	Volume				1,347	1,105		
East Otay Mesa NB	Delay				20.4	18.4		
	Volume				7,098	6,964		
Tecate SB	Delay	0.2	0.1	0.1	0.1	0.1	0.1	0.1
	Volume	570	1,084	1,073	1,037	759	1,084	1,073
Tecate NB	Delay	10.0	56.7	37.1	10.8	4.4	9.2	10.1
	Volume	925	2,815	2,439	1,868	1,563	2,815	2,439
Jacumba/Jacumé SB	Delay					0.2		
	Volume					596		
Jacumba/Jacumé NB	Delay					0.2		
	Volume					512		
Total SB		8,361	17,957	17,958	17,958	18,023	17,957	17,958
Total NB		14,782	33,231	33,232	33,232	33,297	33,231	33,232

PM 15-18		1995	2020 Baseline	2020 Alternative 1	2020 Alternative 2	2020 Alternative 3	Accelerated Flow Baseline	Accelerated Flow Alternative 1
San Ysidro SB	Delay	0.1	73.1	0.1	0.1	0.1	0.7	0.1
	Volume	10,560	23,397	28,010	23,087	23,183	23,397	28,010
San Ysidro NB	Delay	11.6	352.7	123.9	17.9	0.7	11.2	10.9
	Volume	5,868	12,918	7,522	12,249	12,587	12,918	7,522
Otay Mesa SB	Delay	19.0	71.0	13.0	17.4	10.7	18.1	9.0
	Volume	5,184	10,727	6,561	7,069	6,278	10,727	6,561
Otay Mesa NB	Delay	8.0	210.2	69.5	0.7	0.5	8.1	8.0
	Volume	3,244	6,794	12,547	4,378	4,587	6,794	12,547
East Otay Mesa SB	Delay				1.1	4.9		
	Volume				4,917	5,564		
East Otay Mesa NB	Delay				0.5	3.4		
	Volume				3,234	2,156		
Tecate SB	Delay	2.0	0.2	0.1	0.1	0.1	0.2	0.1
	Volume	933	3,421	2,974	2,473	2,085	3,421	2,974
Tecate NB	Delay	3.6	198.1	97.9	5.8	0.2	0.1	0.2
	Volume	720	1,141	784	991	944	1,141	784
Jacumba/Jacumé SB	Delay					0.2		
	Volume					502		
Jacumba/Jacumé NB	Delay					0.2		
	Volume					646		
Total SB		16,677	37,545	37,545	37,545	37,612	37,545	37,545
Total NB		9,832	20,853	20,853	20,853	20,921	20,853	20,853

Table 7-1 (Continued)
Volumes and Delays

Off Peak 18-06,09-15		1995	2020 Baseline	2020 Alternative 1	2020 Alternative 2	2020 Alternative 3	Accelerated Flow Baseline	Accelerated Flow Alternative 1
San Ysidro SB	Delay	0.5	23.7	0.1	0.1	0.1	0.5	0.1
	Volume	24,288	66,316	63,396	52,608	51,621	66,316	63,396
San Ysidro NB	Delay	17.0	318.7	88.3	17.0	8.3	19.0	17.8
	Volume	25,996	51,930	63,527	49,965	43,397	51,930	63,527
Otay Mesa SB	Delay	1.6	39.9	7.9	17.6	10.5	4.8	3.5
	Volume	9,323	4,663	9,261	11,750	11,684	4,663	9,261
Otay Mesa NB	Delay	20.2	318.1	99.4	1.7	3.6	26.5	6.4
	Volume	9,354	24,857	13,803	12,596	15,269	24,857	13,803
East Otay Mesa SB	Delay				0.4	2.8		
	Volume				9,113	9,696		
East Otay Mesa NB	Delay				3.9	14.3		
	Volume				15,264	17,516		
Tecate SB	Delay	0.3	0.1	0.1	0.1	0.1	0.1	0.1
	Volume	2,849	7,838	6,159	5,346	4,055	7,838	6,159
Tecate NB	Delay	1.2	122.5	60.0	15.8	2.2	2.2	4.0
	Volume	2,095	4,106	3,563	3,068	2,682	4,106	3,563
Jacumba/Jacumé SB	Delay					0.2		
	Volume					1,998		
Jacumba/Jacumé NB	Delay					0.2		
	Volume					2,266		
Total SB		36,460	78,817	78,817	78,817	79,055	78,817	78,817
Total NB		37,444	80,892	80,892	80,892	81,130	80,892	80,892

Daily		1995	2020 Baseline	2020 Alternative 1	2020 Alternative 2	2020 Alternative 3	Accelerated Flow Baseline	Accelerated Flow Alternative 1
San Ysidro SB	Delay	0.6	32.1	0.9	0.1	0.1	0.5	0.9
	Volume	41,412	102,290	104,055	88,290	87,400	102,290	104,055
San Ysidro NB	Delay	18.2	281.5	85.7	19.0	11.1	18.9	18.9
	Volume	41,789	82,679	92,205	79,413	73,186	82,679	92,205
Otay Mesa SB	Delay	7.2	48.2	8.0	15.2	9.1	11.0	4.6
	Volume	15,734	19,686	20,058	21,797	20,931	19,686	20,058
Otay Mesa NB	Delay	18.6	241.0	78.4	6.9	7.3	22.8	11.5
	Volume	16,530	44,236	35,986	24,042	26,912	44,236	35,986
East Otay Mesa SB	Delay				0.6	3.3		
	Volume				15,377	16,365		
East Otay Mesa NB	Delay				8.1	14.5		
	Volume				25,596	26,637		
Tecate SB	Delay	0.7	0.1	0.1	0.1	0.1	0.1	0.1
	Volume	4,352	12,343	10,206	8,856	6,899	12,343	10,206
Tecate NB	Delay	3.8	110.2	55.1	12.5	2.5	4.4	4.7
	Volume	3,740	8,062	6,787	5,927	5,189	8,062	6,787
Jacumba/Jacumé SB	Delay					0.2		
	Volume					3,095		
Jacumba/Jacumé NB	Delay					0.2		
	Volume					3,424		
Total SB		61,498	134,319	134,319	134,319	134,690	134,319	134,319
Total NB		62,058	134,976	134,977	134,977	135,348	134,976	134,977

With Alternative 1, the expansion of San Ysidro, there is substantial improvement in the queue delays, but the northbound demand is still not satisfied. Northbound queue delays are in the one to two hour range. The southbound traffic operates much as is does currently.

The addition of the POE at East Otay Mesa (Alternative 2) brings the operation of the POEs to the level of their current operation. It must be noted that this assumes all gates are open while the POE is operating, with no margin for variation. Given the nonlinearity of queue formation and dissipation, we can speculate that this alternative would have substantial queues develop on days where vehicle arrivals are not spread out as on typical days. On days when an "incident" (car stalls in queue, etc.) compromises the efficiency of one or more of the gates, the "incident queue" would take far longer to dissipate as the POEs are working at far closer to capacity than they are now.

Alternative 3, with the addition of a POE at Jacumba/Jacumé, shows only a slight improvement over Alternative 2. This is expected because this POE is rather remote to the currently modeled and surveyed (San Ysidro, Otay Mesa, Tecate) POEs. The opportunity for trips that now pass through the modeled POEs to use a new Jacumba/Jacumé POE is marginal. The model shows only 500 to 600 vehicles in each of the (3 hour) peaks, and about 2,000 in the (18 hour) Off Peak. This is not a full assessment of the traffic at the new POE, but only an assessment of how much relief it can provide the modeled POEs.

7.3 Accelerated Processing required for the Baseline and Alternative 1.

As mentioned in the previous section, the processing rate (vehicles per gate per hour) is subject to variation based on policy issues. This section documents how much the processing rates for the POEs would need to increase in order to satisfy the demand volumes from the previous section at the levels of queuing found today. This is not intended to imply these accelerated processing rates are feasible or desirable, but is included as a comparison.

Table 7-2 shows the level of the processing rates (relative to the base modeling rates developed from the survey) that are required to result in the delays found in the two rightmost columns in Table 7-1

As expected, the Baseline would require the greatest increase in processing rates with the southbound San Ysidro in the PM requiring a rate nearly five times as great as currently achieved. The baseline

northbound San Ysidro in the PM would require a near doubling of the current processing rate.

Table 7-2
Accelerated Processing Rates

Accelerated Processing Rates		
	Baseline	Alternative 1
San Ysidro SB		
AM	150%	100%
PM	450%	100%
Off-Peak	150%	100%
San Ysidro NB		
AM	158%	124%
PM	195%	118%
Off-Peak	150%	124%
Otay Mesa SB		
AM	150%	100%
PM	150%	100%
Off-Peak	150%	110%
Otay Mesa NB		
AM	172%	132%
PM	144%	138%
Off-Peak	140%	100%
Tecate SB		
AM	100%	100%
PM	100%	100%
Off-Peak	100%	100%
Tecate NB		
AM	100%	100%
PM	100%	100%
Off-Peak	170%	140%

The accelerated processing rates for Alternative 1 are more modest, but still substantial, with the northbound Otay Mesa in the PM period, and northbound Tecate in the Off Peak period requiring a 40% increase.

While the accelerated rates for Alternative 1 may not appear onerous, this also assumes every gate open throughout the entire day. A practice not currently observed nor budgeted by the federal inspection services.

8 Future Model Enhancements

The new Cross-Border component to the SANDAG model is a substantial improvement to the treatment of POEs in the model stream. It is an initial model improvement and the lessons learned in the development of this model point to potential future model enhancements.

8.1 Potential improvements to the Intra-Mexico component

As discussed earlier, the intra-Mexico model component to the model was the best available with very sparse data. Improving the intra-Mexico component would allow the model to predict volumes on roadways in Mexico. The current model was forced to use only population data. This (and the forced usage of different delay functions than the Tijuana model) made it impossible to implement the Tijuana model procedures directly.

The most important element required to improve this model component is the acquisition of more detailed socioeconomic data for all of the zones in the Mexican area. The acquisition of employment data by zone (for all modeled years) would significantly improve the location of the attraction end of the trip. This alone would improve the flows of intra-Mexico trips, and hence, improve the assignment on the local streets in Mexico.

Improvements to trip distribution, and refinement of the period trip totals (trip generation), are also possible, but represent a greater effort for a lesser return.

8.2 Potential improvements to the POE treatment

The POE delay model is independent of the assignment procedure, which is a traditional demand model. This means that the queues are “vertical queues”, that is, they are treated as if they are of zero length. An operational (micro-simulation) model might be developed to take into account the effects of queue lengths and their effects “downstream.” For example, northbound trips that queue beyond a certain point force trips to be diverted to Otay Mesa. This is not currently reflected in the model. An operational analysis MAY be able to reflect this within the full demand-modeling framework.

APPENDICES

APPENDIX A – Origin and Destination Surveys

APPENDIX B - Hourly arrivals, Departures (vehicles processed), Vehicles in queue, and Average wait time

APPENDIX C – F-Factors

APPENDIX D – Cross-Border Components Job Stream

APPENDIX E – Cross-Border Model Users' Guide

APPENDIX F – Growth Forecasts for Baja California

APPENDIX A – Origin and Destination Surveys

LOCATION _____ DATE _____ SERIAL # _____

SOUTHBOUND AUTO INTERVIEW TIME _____ INITIALS_____

Dear Traveler:

I am working for a traffic engineering company that is studying traffic conditions at the border crossings. We are doing this for a county-wide planning agency in San Diego. In order to improve traffic conditions at the ports of entry, we need to understand the travel characteristics of people who cross the border. I would like to ask you a few simple questions about your trip today.

1. Where Did You Start This Trip? HOME WORK OTHER
   Where Is That Located? **(Refer to Maps)**

   - City/Community _____
   - What Part? (San Diego City only)_____
   - Other_____

2. Where Will You End This Trip? HOME WORK OTHER
   Where Is That Located? (**Refer to Maps)**

   - City/Community _____
   - What Part / Colonia (Tijuana or Tecate only)_____
   - Other_____

3. How Many People (Including the Driver) Are In Your Vehicle? _____

4. What Is the Purpose of Your Trip?

Going to/from work	Recreation or Visiting	Visiting friends/relatives
Business or work related	Vacation or Tourism	Entertainment
Shopping or errands	Airport	
School	Other _____	

5. What Highways Did You / Will You Take?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

6. Where Is Your Home? U. S. Mexico

TYPE OF WORK

Restaurant	**Retail**
Construction	**Manufacturing**
Agriculture	**Service**
Hotel/Motel	**Other_____**

Interviewer Note Vehicle Registration: U. S. Mexico

7. How Long Did You/Will You Stay Across the Border? _____Hours _____ Days

8. How Often Do You Make This Trip? ___per day ___per month ___per year less

LOCATION _____ DATE _____ SERIAL # _____

AUTOS HACIA AL SUR Tiempo del sondeo _____ Iniciales _____

Buenos Días:

Estoy trabajando para una compañía de ingeniería que está estudiando congestionamiento vehícular en la frontera. Este proyecto es para un grupo de agencias del gobierno en San Diego. Para que podamos mejorar el flujo de tráfico, necesitamos saber las características de los viajeros que cruzan la frontera. Quisiera preguntarle unas pocas preguntas sobre su viaje hoy.

1. ¿Dónde empezó este viaje? En su casa En su lugar de empleo en otro lugar
   ¿Dónde su ubica? **(vea los mapas)**

   - Ciudad _____
   - ¿Que parte/colonia? (solo en la Ciudad de San Diego)_____
   - Otro_____

2. ¿Dónde terminará este viaje? ? En su casa En su lugar de empleo en otro lugar
   ¿Dónde su ubica? **(vea los mapas)**

   - Ciudad _____
   - ¿Que parte/colonia? (solo Tijuana o Tecate)_____
   - Otro_____

3. ¿Cuántas personas (incluyendo el chofer) están en el vehículo? _____

4. ¿Cuál es el propósito de este viaje?

Ir a /salir del trabajo	Recreación/Visitar personas	Visitar Parientes/Amigos
Un viaje de negocios	Vacación/Viaje de Turista	Diversión
Ir de compras o mandados	Aeropuerto	
Escuela	Otro _____	

5. ¿Qué carreteras tomó/tomará?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

6. ¿Dónde está su casa? U. S. México

Tipo de Trabajo

Restaurante	**Comerciante**
Construcción	**Fabricación**
Agrícola	**Servicio**
Hotel/Motel	**Otro_____**

(Encuestador anote Ud. el registro del vehículo(placas)) U. S. México

7. ¿Cuánto tiempo se quedó/quedará Ud. al otro lado) _____Horas _____ Días

8. ¿Con qué frecuencia hace Ud. este viaje? ___veces por día ___veces por mes ___veces por año

LOCATION _____ DATE _____ SERIAL # _____

NORTHBOUND AUTO INTERVIEW TIME _____ INITIALS_____

Dear Traveler:

I am working for a traffic engineering company that is studying traffic conditions at the border crossings. We are doing this for a county-wide planning agency in San Diego. In order to improve traffic conditions at the ports of entry, we need to understand the travel characteristics of people who cross the border. I would like to ask you a few simple questions about your trip today.

1. Where Did You Start This Trip? HOME WORK OTHER
   Where Is That Located? **(Refer to Maps)**

   - City/Community _____
   - What Part? (Tijuana or Tecate only)_____
   - Other_____

2. Where Will You End This Trip? HOME WORK OTHER
   Where Is That Located? (**Refer to Maps)**

   - City/Community _____
   - What Part / Colonia (San Diego City only)_____
   - Other_____

3. How Many People (Including the Driver) Are In Your Vehicle? _____

4. What Is the Purpose of Your Trip?

Going to/from work	Recreation or Visiting	Visiting friends/relatives
Business or work related	Vacation or Tourism	Entertainment
Shopping or errands	Airport	
School	Other _____	

5. What Highways Did You / Will You Take?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

6. Where Is Your Home? U. S. Mexico

TYPE OF WORK

Restaurant	**Retail**
Construction	**Manufacturing**
Agriculture	**Service**
Hotel/Motel	**Other_____**

Interviewer Note Vehicle Registration: U. S. Mexico

7. How Long Did You/Will You Stay Across the Border? _____Hours _____ Days

8. How Often Do You Make This Trip? ___per day ___per month ___per year less

LOCATION _____ DATE _____ SERIAL # _____

AUTOS HACIA AL NORTE Tiempo del sondeo _____ Iniciales _____

Buenos Días:

Estoy trabajando para una compañía de ingeniería que está estudiando congestionamiento vehícular en la frontera. Este proyecto es para un grupo de agencias del gobierno en San Diego. Para que podamos mejorar el flujo de tráfico, necesitamos saber las características de los viajeros que cruzan la frontera. Quisiera preguntarle unas pocas preguntas sobre su viaje hoy.

1. ¿Dónde empezó este viaje? En su casa En su lugar de empleo en otro lugar
   ¿Dónde su ubica? **(vea los mapas)**

   - Ciudad _____
   - ¿Que parte/colonia? (solo Tijuana o Tecate)_____
   - Otro_____

2. ¿Dónde terminará este viaje? ? En su casa En su lugar de empleo en otro lugar
   ¿Dónde su ubica? **(vea los mapas)**

   - Ciudad _____
   - ¿Que parte/colonia? (solo en la Ciudad de San Diego)_____
   - Otro_____

3. ¿Cuántas personas (incluyendo el chofer) están en el vehículo? _____

4. ¿Cuál es el propósito de este viaje?

Ir a /salir del trabajo	Recreación/Visitar personas	Visitar Parientes/Amigos
Un viaje de negocios	Vacación/Viaje de Turista	Diversión
Ir de compras o mandados	Aeropuerto	
Escuela	Otro _____	

5. ¿Qué carreteras tomó/tomará?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

6. ¿Dónde está su casa? U. S. México

Tipo de Trabajo

Restaurante	**Comerciante**
Construcción	**Fabricación**
Agrícola	**Servicio**
Hotel/Motel	**Otro_____**

(Encuestador anote Ud. el registro del vehículo(placas)) U. S. México

7. ¿Cuánto tiempo se quedó/quedará Ud. al otro lado) _____Horas _____ Días

8. ¿Con qué frecuencia hace Ud. este viaje? ___veces por día ___veces por mes ___veces por año
   con menos frecuencia

LOCATION _____ DATE _____ SERIAL # _____

SOUTHBOUND PEDESTRIAN INTERVIEW TIME _____INITIALS_____

Dear Traveler:

I am working for a traffic engineering company that is studying traffic conditions at the border crossings. We are doing this for a county-wide planning agency in San Diego. In order to improve traffic conditions at the ports of entry, we need to understand the travel characteristics of people who cross the border. I would like to ask you a few simple questions about your trip today.

1. Where Did You Start This Trip? HOME WORK OTHER
   Where Is That Located? **Refer to Maps)**

   - City/Community_____
   - What Part? (San Diego City only)_____
   - Other_____

2. Where Will You End This Trip? HOME WORK OTHER
   Where Is That Located? (**Refer to Maps)**

   - City/Community_____
   - What Part? (Tijuana or Tecate only)_____
   - Other_____

3. How Did You Get Here Today?

Auto – Parked	Public Bus	Bicycle
Auto – Dropped off	Private Bus/Shuttle	Walk
Taxi	Trolley	Other

4. How Will You Get To Where You Are Going?

Auto – Parked	Public Bus	Bicycle
Auto – Dropped off	Private Bus/Shuttle	Walk
Taxi	Trolley	Other _____

5. What Is the Purpose of Your Trip?

Going to/from work	Recreation or Visiting	Visiting friends/relatives
Business or work related	Vacation or Tourism	Entertainment
Shopping or errands	Airport	
School	Other _____	

6. Where Is Your Home? U. S. Mexico

TYPE OF WORK

Restaurant	**Retail**
Construction	**Manufacturing**
Agriculture	**Service**
Hotel/Motel	**Other_____**

7. How Long Did You/Will You Stay Across the Border? ____Hours ____Days

8. How Often Do You Make This Trip? ___per day ___per month ___per year less

LOCATION _____ DATE _____ SERIAL # _____

PEATONES HACIA AL SUR Tiempo del sondeo _____Iniciales_____
Buenos Días:

Estoy trabajando para una compañía de ingeniería que está estudiando congestionamiento vehícular en la frontera. Este proyecto es para un grupo de agencias del gobierno en San Diego. Para que podamos mejorar el flujo de tráfico, necesitamos saber las características de los viajeros que cruzan la frontera. Quisiera preguntarle unas pocas preguntas sobre su viaje hoy.

1. ¿Dónde empezó este viaje? En su casa En su lugar de empleo en otro lugar
   ¿Dónde su ubica? **(vea los mapas)**

   - Ciudad _____
   - ¿Que parte/colonia? (solo en la Ciudad de San Diego)_____
   - Otro_____

3. ¿Dónde terminará este viaje? ? En su casa En su lugar de empleo en otro lugar
   ¿Dónde su ubica? **(vea los mapas)**

   - Ciudad _____
   - ¿Que parte/colonia? (solo Tijuana o Tecate)_____
   - Otro_____

3. ¿Cómo llegó aquí hoy?

En coche (estacionado)	Autobús Público	Bicicleta
En Coche (lo dejaron)	Autobús Privado/Shuttle	Caminando
Taxi	Tren Ligero	Otro_____

4. ¿Cómo va a ir a su destino?

En coche (estacionado)	Autobús Público	Bicicleta
En Coche (lo dejaron)	Autobús Privado/Shuttle	Caminando
Taxi	Tren Ligero	Otro_____

5. ¿Cuál es el propósito de este viaje?

Ir a /salir del trabajo	Recreación/Visitar personas	Visitar Parientes/Amigos
Un viaje de negocios	Vacación/Viaje de Turista	Diversión
Ir de compras o mandados	Aeropuerto	
Escuela	Otro _____	

6. ¿Dónde está su casa? U. S. México

Tipo de Trabajo

Restaurante	**Comerciante**
Construcción	**Fabricación**
Agrícola	**Servicio**
Hotel/Motel	**Otro_____**

7. ¿Cuánto tiempo se quedó/quedará Ud. al otro lado) _____Horas _____ Días

8. ¿Con qué frecuencia hace Ud. este viaje? ___veces por día ___veces por mes ___veces por año
   con menos frecuencia

LOCATION _____ DATE _____ SERIAL # _____

NORTHBOUND PEDESTRIAN INTERVIEW TIME _____INITIALS_____

Dear Traveler:
I am working for a traffic engineering company that is studying traffic conditions at the border crossings. We are doing this for a county-wide planning agency in San Diego. In order to improve traffic conditions at the ports of entry, we need to understand the travel characteristics of people who cross the border. I would like to ask you a few simple questions about your trip today.

1. Where Did You Start This Trip? HOME WORK OTHER
   Where Is That Located? **Refer to Maps)**

   - City/Community_____
   - What Part? (Tijuana or Tecate only)_____
   - Other_____

2. Where Will You End This Trip? HOME WORK OTHER
   Where Is That Located? (**Refer to Maps)**

   - City/Community_____
   - What Part? (San Diego City only)_____
   - Other_____

3. How Did You Get Here Today?

Auto – Parked	Public Bus	Bicycle
Auto – Dropped off	Private Bus/Shuttle	Walk
Taxi	Trolley	Other

4. How Will You Get To Where You Are Going?

Auto – Parked	Public Bus	Bicycle
Auto – Dropped off	Private Bus/Shuttle	Walk
Taxi	Trolley	Other _____

5. What Is the Purpose of Your Trip?

Going to/from work	Recreation or Visiting	Visiting friends/relatives
Business or work related	Vacation or Tourism	Entertainment
Shopping or errands	Airport	
School	Other _____	

6. Where Is Your Home? U. S. Mexico

TYPE OF WORK

Restaurant	**Retail**
Construction	**Manufacturing**
Agriculture	**Service**
Hotel/Motel	**Other_____**

7. How Long Did You/Will You Stay Across the Border? ____Hours ____Days

8. How Often Do You Make This Trip? ___per day ___per month ___per year less

LOCATION _____ DATE _____ SERIAL # _____

PEATONES HACIA AL NORTE Tiempo del sondeo _____Iniciales_____

Buenos Días:

Estoy trabajando para una compañía de ingeniería que está estudiando congestionamiento vehícular en la frontera. Este proyecto es para un grupo de agencias del gobierno en San Diego. Para que podamos mejorar el flujo de tráfico, necesitamos saber las características de los viajeros que cruzan la frontera. Quisiera preguntarle unas pocas preguntas sobre su viaje hoy.

1. ¿Dónde empezó este viaje? En su casa En su lugar de empleo en otro lugar
   ¿Dónde su ubica? **(vea los mapas)**

   - Ciudad _____
   - ¿Que parte/colonia? (solo Tijuana o Tecate)_____
   - Otro_____

6. ¿Dónde terminará este viaje? ? En su casa En su lugar de empleo en otro lugar
   ¿Dónde su ubica? **(vea los mapas)**

   - Ciudad _____
   - ¿Que parte/colonia? (solo en la Ciudad de San Diego)_____
   - Otro_____

3. ¿Cómo llegó aquí hoy?

En coche (estacionado)	Autobús Público	Bicicleta
En Coche (lo dejaron)	Autobús Privado/Shuttle	Caminando
Taxi	Tren Ligero	Otro_____

4. ¿Cómo va a ir a su destino?

En coche (estacionado)	Autobús Público	Bicicleta
En Coche (lo dejaron)	Autobús Privado/Shuttle	Caminando
Taxi	Tren Ligero	Otro_____

5. ¿Cuál es el propósito de este viaje?

Ir a /salir del trabajo	Recreación/Visitar personas	Visitar Parientes/Amigos
Un viaje de negocios	Vacación/Viaje de Turista	Diversión
Ir de compras o mandados	Aeropuerto	
Escuela	Otro _____	

6. ¿Dónde está su casa? U. S. México

Tipo de Trabajo

Restaurante	**Comerciante**
Construcción	**Fabricación**
Agrícola	**Servicio**
Hotel/Motel	**Otro_____**

7. ¿Cuánto tiempo se quedó/quedará Ud. al otro lado) _____Horas _____ Días

8. ¿Con qué frecuencia hace Ud. este viaje? ___veces por día ___veces por mes ___veces por año con menos frecuencia

LOCATION _____ DATE _____ SERIAL # _____

SOUTHBOUND BUS INTERVIEW TIME _____ INITIALS _____

Dear Traveler:

I am working for a traffic engineering company that is studying traffic conditions at the border crossings. We are doing this for a county-wide planning agency in San Diego. In order to improve traffic conditions at the ports of entry, we need to understand the travel characteristics of people who cross the border. I would like to ask you a few simple questions about your trip today.

1. Where Did You Start This Trip (First Stop)? **(Refer to Maps)**

    - Just Outside the Border
    - City/Community_____
    - What Part (San Diego City only)_____
    - Other_____

2. Where Will This Trip End (Last Stop)?

    - Just Outside the Border
    - City/Community_____
    - What Part/Colonia (Tijuana or Tecate only)_____
    - Other

3. How Many People (Including the Driver) Are In Your Vehicle Now?_____

4. How Many Interim Stops Did You Make On Your Way to the Border Crossing?

    One Two Three Four or More

5. How Many Interim Stops Will You Make On Your Way to Your Destination?

    One Two Three Four or More

6. What Highways Did You / Will You Take?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

7. How Often Does This Bus Trip Occur?

    More than one a day Once a day Once a week or more Less often

8. How Often Do Your Typical Riders Make This Trip?

    3 times a week or more 1-2 times a week Less than once a week

LOCATION _____ DATE _____ SERIAL # _____

AUTOBUS HACIA AL SUR Tiempo del sondeo _____ Iniciales_____

Buenos Días:

Estoy trabajando para una compañía de ingeniería que está estudiando congestionamiento vehícular en la frontera. Este proyecto es para un grupo de agencias del gobierno en San Diego. Para que podamos mejorar el flujo de tráfico, necesitamos saber las características de los viajeros que cruzan la frontera. Quisiera preguntarle unas pocas preguntas sobre su viaje hoy.

1. ¿Dónde empezó este viaje (primera parada)? **(vea los mapas**)

- Apenas afuera de la frontera
- Ciudad_____
- Qué parte/ Colonia (solo la ciudad de San Diego)_____
- Otro_____

2. ¿Dónde terminará este viaje (ultima parada)? **(vea los mapas**)

- Apenas afuera de la frontera
- Ciudad_____
- Qué parte/ Colonia (solo Tijuana o Tecate)_____
- Otro_____

3. ¿Cuántos pasajeros están en su vehiculo (incluyendo Ud.)? _____

4. ¿Cuántas paradas hizo en su camino hacia la frontera?

Una Dos Tres Cuatro o más

5. ¿Cuántas paradas hará hasta su destino?

Una Dos Tres Cuatro o más

6. ¿Qué carreteras tomó/tomará?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

7. ¿Con qué frecuencia ocurre este viaje del autobús?
más que una vez cada día cada día una o más veces cada semana con menos frecuencia

8. ¿Con qué frecuencia hacen sus pasajeros típicos este viaje?
3 veces cada semana o más 1 a 2 veces cada semana menos que una vez cada semana

LOCATION _____ DATE _____ SERIAL # _____

NORTHBOUND TRUCK INTERVIEW TIME _____ INITIALS _____

Dear Traveler:

I am working for a traffic engineering company that is studying traffic conditions at the border crossings. We are doing this for a county-wide planning agency in San Diego. In order to improve traffic conditions at the ports of entry, we need to understand the travel characteristics of people who cross the border. I would like to ask you a few simple questions about your trip today.

Interviewer Note Type of Truck:

Pick-Up/Van Truck # Axles _____
Tractor With Trailer Bob-Tail/Tractor (no Trailer)

1. Where Did This Truck Start This Trip? **(Refer to Maps)**

   - City/Community_____
   - What Part / Colonia (Tijuana or Tecate only)_____
   - Other_____

2. Where Will This Trip End? Nearby Brokerage/Distribution Center Other_____

   - City/Community_____
   - What Part? (San Diego City only)_____
   - Other_____

3. What Type of Cargo Is This Truck Carrying?

   Empty Don't Know SCTG Code _____
   Description _____

4. Did You or Will You Change Drivers Here At the Border? Yes No

5. Did You Stop Here At the Border To Process Papers with Brokers Before Entering Customs Inspection?

   No Yes – How Long Did It Take_____

6. Do You Make This Same Trip:

   More Than Once A Day Every Day
   Every Week Every Month Less Often

7. What Highways Did You / Will You Take?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

LOCATION _____ DATE _____ SERIAL # _____

SOUTHBOUND TRUCK INTERVIEW TIME _____ INITIALS _____

Dear Traveler:

I am working for a traffic engineering company that is studying traffic conditions at the border crossings. We are doing this for a county-wide planning agency in San Diego. In order to improve traffic conditions at the ports of entry, we need to understand the travel characteristics of people who cross the border. I would like to ask you a few simple questions about your trip today.

Interviewer Note Type of Truck:

Pick-Up/Van Truck # Axles _____
Tractor With Trailer Bob-Tail/Tractor (no Trailer)

1. Where Did This Truck Start This Trip? **(Refer to Maps)**
   - City/Community_____
   - What Part / Colonia (San Diego City only)_____
   - Other_____

2. Where Will This Trip End? Nearby Brokerage/Distribution Center Other
   - City/Community_____
   - What Part? (Tijuana or Tecate only)_____
   - Other_____

3. What Type of Cargo Is This Truck Carrying?
   Empty Don't Know SCTG Code _____
   Description _____

4. Did You or Will You Change Drivers Here At the Border? Yes No

5. Did You Stop Here At the Border To Process Papers with Brokers Before Entering Customs Inspection?

   No Yes – How Long Did It Take_____

7. Do You Make This Same Trip:

   More Than Once A Day Every Day
   Every Week Every Month Less Often

8. What Highways Did You / Will You Take?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

LOCATION _____ DATE _____ SERIAL # _____

CAMIONES HACIA AL NORTE Tiempo del sondeo _____ Iniciales_____

Buenos Días:

Estoy trabajando para una compañía de ingeniería que está estudiando congestionamiento vehícular en la frontera. Este proyecto es para un grupo de agencias del gobierno en San Diego. Para que podamos mejorar el flujo de tráfico, necesitamos saber las características de los viajeros que cruzan la frontera. Quisiera preguntarle unas pocas preguntas sobre su viaje hoy.

Encuestador, marque Ud. el tipo de camión

Camioneta/Pick-Up/Van Camión # Ejes _____
Tractor con Remolque Tractor sin Remolque

1. ¿Dónde empezó este viaje del camión? **(vea los mapas**)

   - Ciudad_____
   - Qué parte/ Colonia (solo Tijuana o Tecate)_____
   - Otro_____

2. ¿Dónde terminará este viaje? en un Centro de Distribución Local en otro lugar **(vea los mapas**)

   - Ciudad_____
   - Qué parte/ Colonia (solo en la Ciudad de San Diego)_____
   - Otro_____

3. ¿Qué tipo de carga trae este camión?

   Vacío No sabe Código SCTG (Opcional) _____
   Descripción _____

4. ¿Cambió o cambiará choferes en la frontera? Si No

5. ¿Paró en la frontera para hacer trámites con agentes aduanales antes que cruzar?

   No Si -- ¿Cuánto tiempo lo duró

6. ¿Hace este mismo viaje?

   Más que una vez cada día Cada día
   Cada semana Cada mez Con menos frecuencia

7. ¿Qué carreteras tomó/tomará?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

LOCATION _____ DATE _____ SERIAL # _____

CAMIONES HACIA AL SUR Tiempo del sondeo _____ Iniciales_____

Buenos Días:

Estoy trabajando para una compañía de ingeniería que está estudiando congestionamiento vehícular en la frontera. Este proyecto es para un grupo de agencias del gobierno en San Diego. Para que podamos mejorar el flujo de tráfico, necesitamos saber las características de los viajeros que cruzan la frontera. Quisiera preguntarle unas pocas preguntas sobre su viaje hoy.

Encuestador, marque Ud. el tipo de camión

Camioneta/Pick-Up/Van Camión # Ejes _____
Tractor con Remolque Tractor sin Remolque

1. ¿Dónde empezó este viaje del camión? **(vea los mapas**)

   - Ciudad_____
   - Qué parte/ Colonia (solo en la ciudad de San Diego)_____
   - Otro_____

2. ¿Dónde terminará este viaje? en un Centro de Distribución Local en otro lugar
   (vea los mapas)

   - Ciudad_____
   - Qué parte/ Colonia (solo Tijuana o Tecate)_____
   - Otro_____

3. ¿Qué tipo de carga trae este camión?

   Vacío No sabe Código SCTG (Opcional) _____
   Descripción _____

4. ¿Cambió o cambiará choferes en la frontera? Si No

5. ¿Paró en la frontera para hacer trámites con agentes aduanales antes que cruzar?

   No Si -- ¿Cuánto tiempo lo duró

6. ¿Hace este mismo viaje?

   Más que una vez cada día Cada día
   Cada semana Cada mez Con menos frecuencia

7. ¿Qué carreteras tomó/tomará?

MX-001	MX-001D ($)	I-5	Rt-94
MX-002	MX-002D ($)	I-8	I-805
MX-003		I-15	Rt-905

APPENDIX B - Hourly arrivals, Departures (vehicles processed), Vehicles in queue, and Average wait time

SAN YSIDRO
CAR ARRIVALS AND QUEUES

HOUR	NB ARR CARS 14-Apr	NB ARR CARS 15-Apr	NB ARR CARS AVE	NB PROC CARS 14-Apr	NB PROC CARS 15-Apr	NB PROC CARS AVE	NB PROC CARS Per Gate	NB GATES CARS BASE	NB PROC CAR RATE	NB CARS PROCESS	NB ARR CARS % (3)	NB ARR CARS BASE	NB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	NB WAIT CARS BASE
Total Trips (1)												41,780				
Average Processing Rate Per Gate (2)									108							
Commuter Factor (5:00-9:00) (2)									1.33							
0:00-1:00	0.83%	1.10%	0.965%	336	394	365	108	4	432	429	0.965%	403	0	2	2	2.5
1:00-2:00	0.51%	0.48%	0.495%	195	165	180	108	3	324	207	0.495%	207	0	0	0	0.7
2:00-3:00	0.68%	0.84%	0.760%	252	283	268	108	3	324	318	0.760%	318	0	5	5	1.0
3:00-4:00	1.21%	2.02%	1.615%	447	691	569	108	6	648	648	1.615%	675	27	0	27	2.0
4:00-5:00	2.34%	2.40%	2.370%	858	794	826	108	8	864	864	2.370%	990	153	0	153	6.8
5:00-6:00	8.89%	7.46%	8.175%	3,430	2,546	2,988	144	21	3,016	3,016	8.175%	3,416	553	0	553	7.4
6:00-7:00	9.13%	9.45%	9.290%	3,343	3,121	3,232	144	24	3,447	3,447	9.290%	3,881	987	0	987	13.8
7:00-8:00	9.43%	8.84%	9.135%	3,694	3,424	3,559	144	24	3,447	3,447	9.135%	3,817	1,357	0	1,357	20.8
8:00-9:00	6.89%	6.66%	6.775%	2,860	2,641	2,751	144	22	3,160	3,160	6.775%	2,831	1,028	0	1,028	23.1
9:00-10:00	5.71%	5.24%	5.475%	2,219	1,835	2,027	108	20	2,160	2,160	5.475%	2,287	1,155	0	1,155	30.9
10:00-11:0	4.66%	4.82%	4.740%	2,142	1,633	1,888	108	20	2,160	2,160	4.740%	1,980	975	0	975	30.1
11:00-12:0	4.81%	3.44%	4.125%	2,142	1,288	1,715	108	19	2,052	2,052	4.125%	1,723	646	0	646	24.3
12:00-13:0	4.74%	4.26%	4.500%	1,859	1,406	1,633	108	19	2,052	2,052	4.500%	1,880	474	0	474	16.9
13:00-14:0	5.59%	5.85%	5.720%	2,300	1,954	2,127	108	19	2,052	2,052	5.720%	2,390	812	0	812	19.4
14:00-15:0	5.20%	5.46%	5.330%	2,113	1,989	2,051	108	19	2,052	2,052	5.330%	2,227	987	0	987	26.9
15:00-16:0	4.97%	4.71%	4.840%	2,018	1,684	1,851	108	19	2,052	2,052	4.840%	2,022	957	0	957	29.0
16:00-17:0	4.41%	4.07%	4.240%	1,790	1,488	1,639	108	18	1,944	1,944	4.240%	1,771	784	0	784	27.4
17:00-18:0	4.15%	4.57%	4.360%	1,688	1,646	1,667	108	17	1,836	1,836	4.360%	1,822	770	0	770	25.9
18:00-19:0	3.45%	3.15%	3.300%	1,661	1,357	1,509	108	16	1,728	1,728	3.300%	1,379	421	0	421	21.2
19:00-20:0	3.16%	3.40%	3.280%	1,411	1,336	1,374	108	14	1,512	1,512	3.280%	1,370	279	0	279	14.4
20:00-21:0	3.31%	3.60%	3.455%	1,409	1,351	1,380	108	13	1,404	1,404	3.455%	1,443	318	0	318	13.3
21:00-22:0	2.61%	3.42%	3.015%	1,091	1,260	1,176	108	12	1,296	1,296	3.015%	1,260	282	0	282	14.4
22:00-23:0	2.27%	2.76%	2.515%	937	1,007	972	108	12	1,296	1,296	2.515%	1,051	37	0	37	7.9
23:00-24:0	1.06%	2.01%	1.525%	438	732	585	108	6	648	648	1.525%	637	26	0	26	3.5
	100.01%	100.01%	100.000%	40,633	36,025	38,329				41,780	100.000%	41,780				

(1) Average of six days from Customs (Apr 6,7,8,13,14,15 1999)
(2) Based on Otay Mesa Survey findings
(3) Average of two days from Customs and Surveys (Apr 14 and Apr 15, 1999)

SAN YSIDRO
CAR ARRIVALS AND QUEUES

HOUR	SB ARR CARS 14-Apr	SB ARR CARS 15-Apr	SB ARR CARS AVE	SB PROC CARS 14-Apr	SB PROC CARS 15-Apr	SB PROC CARS AVE	SB PROC CARS Per Gate	SB GATES CARS BASE	SB PROC CARS RATE	SB CAR PROCESS	SB ARR CARS %	SB ARR CARS BASE	SB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	SB WAIT CARS BASE
Total Trips (1)												41,780				
Average Processing Rate Per Gate (2)							650		650							
0:00-1:00	0.96%	0.96%	0.960%	390	346	368	650	1	650	401	0.960%	401	0	0	0	0.1
1:00-2:00	0.32%	0.32%	0.320%	130	115	123	650	1	650	134	0.320%	134	0	0	0	0.1
2:00-3:00	0.49%	0.49%	0.490%	199	177	188	650	1	650	205	0.490%	205	0	0	0	0.1
3:00-4:00	0.45%	0.45%	0.450%	183	162	173	650	1	650	188	0.450%	188	0	0	0	0.1
4:00-5:00	2.38%	2.38%	2.380%	967	857	912	650	1.5	975	975	2.380%	994	19	0	19	0.7
5:00-6:00	3.18%	3.18%	3.180%	2,283	2,025	2,154	650	2.1	1,365	1,348	3.180%	1,329	0	14	14	0.8
6:00-7:00	5.62%	5.62%	5.620%	1,292	1,146	1,219	650	4	2,600	2,348	5.620%	2,348	0	6	6	0.3
7:00-8:00	6.36%	6.41%	6.385%	2,580	2,288	2,434	650	4	2,600	2,600	6.385%	2,668	68	0	68	0.9
8:00-9:00	3.90%	3.97%	3.935%	1,581	1,401	1,491	650	3	1,950	1,712	3.935%	1,644	0	2	2	1.2
9:00-10:00	3.60%	3.52%	3.560%	1,463	1,297	1,380	650	3	1,950	1,487	3.560%	1,487	0	1	1	0.1
10:00-11:0	3.25%	3.31%	3.280%	1,304	1,156	1,230	650	3	1,950	1,370	3.280%	1,370	0	1	1	0.1
11:00-12:0	4.17%	4.14%	4.155%	1,703	1,509	1,606	650	3	1,950	1,736	4.155%	1,736	0	4	4	0.2
12:00-13:0	4.06%	4.03%	4.045%	1,650	1,463	1,557	650	3	1,950	1,690	4.045%	1,690	0	3	3	0.2
13:00-14:0	4.82%	4.87%	4.845%	1,959	1,736	1,848	650	4	2,600	2,024	4.845%	2,024	0	2	2	0.2
14:00-15:0	9.32%	9.35%	9.335%	3,783	3,354	3,569	650	6	3,900	3,900	9.335%	3,900	0	0	0	0.1
15:00-16:0	7.37%	7.31%	7.340%	2,999	2,659	2,829	650	6	3,900	3,067	7.340%	3,067	0	3	3	0.1
16:00-17:0	9.42%	9.47%	9.445%	3,823	3,390	3,607	650	6	3,900	3,900	9.445%	3,946	46	0	46	0.5
17:00-18:0	8.83%	8.92%	8.875%	3,579	3,174	3,377	650	6	3,900	3,754	8.875%	3,708	0	20	20	0.6
18:00-19:0	6.77%	6.66%	6.715%	2,763	2,450	2,607	650	5	3,250	2,806	6.715%	2,806	0	5	5	0.3
19:00-20:0	2.73%	2.68%	2.705%	1,117	991	1,054	650	2	1,300	1,130	2.705%	1,130	0	2	2	0.3
20:00-21:0	1.74%	1.72%	1.730%	711	630	671	650	2	1,300	723	1.730%	723	0	0	0	0.1
21:00-22:0	1.54%	1.52%	1.530%	626	555	591	650	1	650	639	1.530%	639	0	10	10	0.6
22:00-23:0	1.59%	1.58%	1.585%	647	573	610	650	2	1,300	662	1.585%	662	0	0	0	0.3
23:00-24:0	7.13%	7.14%	7.135%	2,901	2,572	2,737	650	5	3,250	2,981	7.135%	2,981	0	9	9	0.2
	100.00%	100.00%	100.000%	40,633	36,026	38,330				41,780	100.000%	41,780				

(1) Same number assumed as northbound trips
(2) Processing rate calibrated based on queue data

OTAY MESA
CAR ARRIVALS AND QUEUES

HOUR	NB ARR CAR+BUS 14-Apr	NB ARR CAR+BUS 15-Apr	NB ARR CAR+BUS AVE	NB PROC CAR+BUS 14-Apr	NB PROC CAR+BUS 15-Apr	NB PROC CAR+BUS AVE	NB PROC CAR+BUS Per Gate (Calibr)	NB GATES CAR BASE	NB PROC CAR+BUS RATE	NB CARS +BUS PROCESS	NB ARR CAR+BUS % (2)	NB ARR CAR+BUS BASE (3)	NB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	NB WAIT CAR+BUS BASE
Total Trips (1)												11,881				
Average Processing Rate Per Gate (2)						711	108		108							
Commuter (Carpool Lane) Factor (6:00-9:00) (2)						1.30	1.33		1.33							
0:00-1:00	0.00%	0.00%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
1:00-2:00	0.00%	0.00%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
2:00-3:00	0.00%	0.00%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
3:00-4:00	0.00%	0.00%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
4:00-5:00	0.00%	0.00%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
5:00-6:00	2.43%	3.26%	2.845%	0	0	0	0	0	0	0	2.845%	338	338	#DIV/0!	#DIV/0!	#DIV/0!
6:00-7:00	6.62%	9.17%	7.895%	913	976	945	144	7	1,005	1,005	7.895%	938	271	0	271	#DIV/0!
7:00-8:00	8.79%	11.71%	10.250%	1,065	912	989	144	7	1,005	1,005	10.250%	1,218	484	0	484	23.0
8:00-9:00	7.26%	5.82%	6.540%	958	740	849	144	7	1,005	1,005	6.540%	777	256	0	256	22.5
9:00-10:00	6.97%	5.14%	6.055%	964	553	758	108	7	756	756	6.055%	719	219	0	219	19.4
10:00-11:0	6.70%	4.88%	5.790%	864	556	782	108	7	756	756	5.790%	688	151	0	151	15.2
11:00-12:0	7.19%	5.99%	6.590%	864	601	805	108	7	756	756	6.590%	783	178	0	178	13.6
12:00-13:0	6.67%	6.04%	6.355%	830	579	774	108	7	756	756	6.355%	755	177	0	177	14.6
13:00-14:0	6.65%	6.82%	6.735%	816	679	816	108	7	756	756	6.735%	800	221	0	221	16.3
14:00-15:0	6.25%	6.36%	6.305%	836	654	698	108	7	756	756	6.305%	749	214	0	214	17.8
15:00-16:0	5.77%	5.49%	5.630%	733	637	640	108	7	756	756	5.630%	669	127	0	127	14.1
16:00-17:0	5.97%	5.60%	5.785%	797	558	638	108	7	756	756	5.785%	687	58	0	58	7.9
17:00-18:0	5.70%	5.21%	5.455%	658	561	569	108	7	756	706	5.455%	648	0	1	1	2.9
18:00-19:0	5.91%	6.75%	6.330%	762	673	718	108	6	648	648	6.330%	752	104	0	104	5.4
19:00-20:0	5.32%	5.19%	5.255%	689	558	623	108	6	648	648	5.255%	624	80	0	80	9.1
20:00-21:0	2.96%	2.77%	2.865%	393	317	302	108	5	540	420	2.865%	340	0	0	0	5.0
21:00-22:0	2.84%	3.80%	3.320%	379	419	184	108	4	432	396	3.320%	396	0	1	1	0.6
22:00-23:0	0.00%	0.00%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
23:00-24:0	0.00%	0.00%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
	100.00%	100.00%	100.000%	12,521	9,973	11,090				11,881	100.000%	11,881				

(1) Average of six days from Customs (Apr 6,7,8,13,14,15 1999)
(2) Average of two days from Customs and Surveys (Apr 14 and Apr 15, 1999)
(3) One percent of these vehicles are buses

OTAY MESA
CAR ARRIVALS AND QUEUES

HOUR	SB ARR CAR+BUS 14-Apr	SB ARR CAR+BUS 15-Apr	SB ARR CAR+BUS AVE	SB PROC CAR+BUS 14-Apr	SB PROC CAR+BUS 15-Apr	SB PROC CAR+BUS AVE	SB PROC CAR+BUS Per Gate	SB GATES CAR BASE	SB PROC CAR+BUS RATE	SB CAR +BUS PROCESS	SB ARR CAR+BUS % (2)	SB ARR CAR+BUS BASE (3)	SB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	SB WAIT CAR+BUS BASE
Total Trips (1)												11,881				
Average Processing Rate Per Gate (2)							445		445							
0:00-1:00	0.00%	0.00%	0.000%	0	0	0	445	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
1:00-2:00	0.00%	0.00%	0.000%	0	0	0	445	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
2:00-3:00	0.00%	0.00%	0.000%	0	0	0	445	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
3:00-4:00	0.00%	0.00%	0.000%	0	0	0	445	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
4:00-5:00	0.00%	0.00%	0.000%	0	0	0	445	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
5:00-6:00	0.03%	0.00%	0.015%	0	0	0	445	0	0	0	0.015%	2	2	#DIV/0!	#DIV/0!	#DIV/0!
6:00-7:00	1.95%	1.95%	1.950%	243	193	218	445	1	445	234	1.950%	232	0	0	0	#DIV/0!
7:00-8:00	3.47%	3.45%	3.460%	432	344	388	445	1	445	411	3.460%	411	0	1	1	0.2
8:00-9:00	3.91%	3.89%	3.900%	489	390	440	445	1	445	445	3.900%	463	18	0	18	1.4
9:00-10:00	4.74%	4.78%	4.760%	594	473	534	445	1.3	578	578	4.760%	566	6	6	12	1.7
10:00-11:0	5.18%	5.19%	5.185%	648	517	583	445	2	890	622	5.185%	616	0	0	0	0.5
11:00-12:0	5.57%	5.60%	5.585%	706	562	634	445	2	890	664	5.585%	664	0	1	1	0.2
12:00-13:0	5.87%	5.55%	5.710%	687	548	618	445	2	890	678	5.710%	678	0	1	1	0.2
13:00-14:0	5.57%	5.72%	5.645%	723	576	650	445	2	890	671	5.645%	671	0	1	1	0.2
14:00-15:0	6.34%	6.59%	6.465%	816	650	733	445	2	890	768	6.465%	768	0	1	1	0.2
15:00-16:0	8.44%	8.40%	8.420%	1,054	839	947	445	2.3	1,023	1,000	8.420%	1,000	0	12	12	0.5
16:00-17:0	11.29%	11.18%	11.235%	1,369	1,090	1,230	445	3	1,335	1,335	11.235%	1,335	0	27	27	1.0
17:00-18:0	12.15%	12.03%	12.090%	1,545	1,232	1,389	445	3	1,335	1,335	12.090%	1,436	101	0	101	3.0
18:00-19:0	10.32%	10.43%	10.375%	1,306	1,040	1,173	445	3	1,335	1,334	10.375%	1,233	0	4	4	2.5
19:00-20:0	6.93%	6.98%	6.955%	874	696	785	445	3	1,335	826	6.955%	826	0	0	0	0.2
20:00-21:0	4.77%	4.80%	4.785%	601	478	540	445	2	890	569	4.785%	569	0	0	0	0.1
21:00-22:0	3.47%	3.46%	3.465%	434	346	390	445	2	890	411	3.465%	411	0	0	0	0.1
22:00-23:0	0.00%	0.00%	0.000%	0	0	0	445	1	445	0	0.000%	0	0	0	0	0.1
23:00-24:0	0.00%	0.00%	0.000%	0	0	0	445	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
	100.00%	100.00%	100.000%	12,521	9,974	11,248				11,881	100.000%	11,881				

(1) Same number assumed as northbound trips
(2) Processing rate calibrated based on queue data
(3) One percent of these vehicles are buses

TECATE
CAR ARRIVALS AND QUEUES

HOUR	NB ARR CARS 13-Apr (3)	NB ARR CARS 15-Apr (3)	NB ARR CARS AVE	NB PROC CARS 13-Apr	NB PROC CARS 15-Apr	NB PROC CARS AVE	NB PROC CARS Per Gate	NB GATES CARS BASE	NB PROC CAR RATE	NB CARS PROCESS	NB ARR CARS % (3)	NB ARR CARS BASE	NB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	NB WAIT CARS BASE
Total Trips (1)												2,908				
Average Processing Rate Per Gate (2)						112	150		150							
Carpool Lane Factor (5:00-9:00) (2)						1.00	1.00									
0:00-1:00	0.00%		0.00%	0	0	0	150	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
1:00-2:00	0.00%		0.00%	0	0	0	150	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
2:00-3:00	0.00%		0.00%	0	0	0	150	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
3:00-4:00	0.00%		0.00%	0	0	0	150	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
4:00-5:00	0.00%		0.00%	0	0	0	150	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
5:00-6:00	0.00%		0.00%	0	0	0	150	3	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
6:00-7:00	10.38%		10.38%	321	341	331	150	2	300	300	10.38%	302	2	0	2	#DIV/0!
7:00-8:00	6.17%		6.17%	191	203	197	150	1.5	225	181	6.17%	179	0	0	0	0.7
8:00-9:00	6.50%		6.50%	202	214	208	150	1	150	150	6.50%	189	39	0	39	8.2
9:00-10:00	6.23%		6.23%	193	205	199	150	1.4	210	210	6.23%	181	10	0	10	7.4
10:00-11:0	7.96%		7.96%	247	261	254	150	2	300	241	7.96%	231	0	0	0	1.4
11:00-12:0	6.95%		6.95%	215	228	222	150	2	300	202	6.95%	202	0	0	0	0.4
12:00-13:0	7.18%		7.18%	223	236	229	150	2	300	209	7.18%	209	0	0	0	0.4
13:00-14:0	6.97%		6.97%	216	229	223	150	2	300	203	6.97%	203	0	0	0	0.4
14:00-15:0	7.34%		7.34%	227	241	234	150	2	300	213	7.34%	213	0	0	0	0.4
15:00-16:0	7.17%		7.17%	222	236	229	150	1.5	225	209	7.17%	209	0	0	0	0.4
16:00-17:0	5.75%		5.75%	178	189	184	150	1	150	150	5.75%	167	17	0	17	3.8
17:00-18:0	5.38%		5.38%	167	177	172	150	1	150	150	5.38%	156	23	0	23	8.4
18:00-19:0	4.99%		4.99%	155	164	159	150	1	150	150	4.99%	145	18	0	18	8.6
19:00-20:0	4.02%		4.02%	125	132	128	150	1	150	135	4.02%	117	0	0	0	4.0
20:00-21:0	3.32%		3.32%	103	109	106	150	1	150	97	3.32%	97	0	0	0	0.4
21:00-22:0	1.91%		1.91%	59	63	61	150	1	150	56	1.91%	56	0	0	0	0.4
22:00-23:0	1.07%		1.07%	33	35	34	150	1	150	31	1.07%	31	0	0	0	0.4
23:00-24:0	0.68%		0.68%	21	22	22	150	1	150	20	0.68%	20	0	0	0	0.4
	100.00%	0.00%		3,098	3,284	3,191				2,907	100.000%	2,907				
				3098	3284											

TECATE
CAR ARRIVALS AND QUEUES

HOUR	SB ARR CARS 13-Apr (3)	SB ARR CARS 15-Apr (3)	SB ARR CARS AVE	SB PROC CARS 13-Apr	SB PROC CARS 15-Apr	SB PROC CARS AVE	SB PROC CARS Per Gate	SB GATES CARS BASE	SB PROC CARS RATE	SB CAR PROCESS	SB ARR CARS %	SB ARR CARS BASE	SB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	SB WAIT CARS BASE
Total Trips (1)												2,908				
Average Processing Rate Per Gate (2)							310		310							
0:00-1:00	0.00%	0.00%	0.000%	0	0	0	310	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
2:00-3:00	0.00%	0.00%	0.000%	0	0	0	310	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#REF!
3:00-4:00	0.00%	0.00%	0.000%	0	0	0	310	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
4:00-5:00	0.00%	0.00%	0.000%	0	0	0	310	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
5:00-6:00	0.00%	0.00%	0.000%	0	0	0	310	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
6:00-7:00	2.12%	2.16%	2.140%	66	70	68	310	1	310	62	2.140%	62	0	0	0	#DIV/0!
7:00-8:00	2.92%	2.83%	2.875%	89	94	92	310	1	310	84	2.875%	84	0	0	0	0.2
8:00-9:00	5.88%	6.03%	5.955%	183	193	188	310	1	310	173	5.955%	173	0	0	0	0.2
9:00-10:00	5.72%	5.76%	5.740%	178	188	183	310	1	310	167	5.740%	167	0	0	0	0.2
10:00-11:0	3.92%	3.93%	3.925%	121	128	125	310	1	310	114	3.925%	114	0	0	0	0.2
11:00-12:0	6.29%	6.15%	6.220%	194	205	200	310	1	310	181	6.220%	181	0	0	0	0.2
12:00-13:0	8.93%	9.26%	9.095%	278	293	286	310	1	310	264	9.095%	264	0	0	0	0.2
13:00-14:0	7.55%	7.16%	7.355%	237	250	244	310	1	310	214	7.355%	214	0	0	0	0.2
14:00-15:0	10.66%	10.78%	10.720%	330	348	339	310	1	310	310	10.720%	312	2	0	2	0.4
15:00-16:0	11.01%	10.99%	11.000%	343	362	353	310	1	310	310	11.000%	320	12	0	12	1.5
16:00-17:0	7.93%	8.04%	7.985%	250	264	257	310	1	310	244	7.985%	232	0	0	0	1.4
17:00-18:0	9.34%	9.38%	9.360%	290	306	298	310	1	310	272	9.360%	272	0	1	1	0.3
18:00-19:0	7.48%	7.37%	7.425%	236	249	243	310	1	310	216	7.425%	216	0	0	0	0.3
19:00-20:0	6.01%	6.00%	6.005%	187	197	192	310	1	310	175	6.005%	175	0	0	0	0.2
20:00-21:0	2.79%	2.80%	2.795%	87	92	90	310	1	310	81	2.795%	81	0	0	0	0.2
21:00-22:0	1.45%	1.36%	1.405%	45	45	45	310	1	310	41	1.405%	41	0	0	0	0.2
22:00-23:0	0.00%	0.00%	0.000%	0	0	0	310	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
23:00-24:0	0.00%	0.00%	0.000%	0	0	0	310	0	0	0	0.000%	0	0	#DIV/0! #DIV/0!	#DIV/0!	#DIV/0!
	100.00%	100.00%	100.000%	3,114	3,284	3,199				2,908	100.000%	2,908				

(1) Same number assumed as northbound trips
(2) Processing rate calibrated based on queue data

OTAY MESA
TRUCK ARRIVALS AND QUEUES

HOUR	NB ARR TRUCKS 14-Apr	NB ARR TRUCKS 15-Apr	NB ARR TRUCKS AVE		NB PROC TRUCKS 14-Apr	NB PROC TRUCKS 15-Apr	NB PROC TRUCKS AVE	NB PROC TRUCKS Per Gate	NB GATES TRUCKS BASE	NB PROC TRUCKS RATE	NB TRUCKS PROCESS	NB ARR TRUCKS % (3)	NB ARR TRUCKS BASE	NB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	NB WAIT TRUCKS BASE
Total Trips (1)													2,353				
Average Processing Rate (2)							94	94		92							
0:00-1:00	0.00%	0.00%	0.000%		0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
1:00-2:00	0.00%	0.00%	0.000%		0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
2:00-3:00	0.00%	0.00%	0.000%		0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
3:00-4:00	0.00%	0.00%	0.000%		0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
4:00-5:00	0.00%	0.00%	0.000%		0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
5:00-6:00	1.77%	1.54%	1.655%		0	0	0	0	0	0	0	1.655%	42	42	#DIV/0!	#DIV/0!	#DIV/0!
6:00-7:00	5.01%	4.39%	4.700%		150	80	115	94	1	92	92	4.700%	118	68	0	68	#DIV/0!
7:00-8:00	6.94%	9.70%	8.320%		150	160	155	94	2	184	184	8.320%	163	47	0	47	19.4
8:00-9:00	8.96%	3.58%	6.270%		144	238	191	94	2	184	184	6.270%	211	74	0	74	20.4
9:00-10:00	8.84%	6.24%	7.540%		160	201	181	94	2	184	184	7.540%	208	98	0	98	28.7
10:00-11:0	8.33%	3.70%	6.015%		181	192	187	94	2	184	184	6.015%	196	110	0	110	34.6
11:00-12:0	8.21%	10.85%	9.530%		250	188	219	94	2	184	184	9.530%	193	119	0	119	38.0
12:00-13:0	7.20%	8.31%	7.755%		153	179	166	94	2	184	184	7.755%	169	104	0	104	37.0
13:00-14:0	7.58%	9.24%	8.410%		171	180	176	94	2	184	184	8.410%	178	98	0	98	33.6
14:00-15:0	8.59%	5.54%	7.065%		191	216	204	94	2	184	184	7.065%	202	116	0	116	35.5
15:00-16:0	7.95%	10.16%	9.055%		228	187	208	94	2	184	184	9.055%	187	119	0	119	39.0
16:00-17:0	7.83%	10.16%	8.995%		175	159	167	94	2	184	184	8.995%	184	119	#DIV/0!	#DIV/0!	#DIV/0!
17:00-18:0	5.89%	7.62%	6.755%		197	209	203	94	2	184	184	6.755%	139	74	0	74	#DIV/0!
18:00-19:0	3.54%	4.58%	4.060%		118	152	135	94	1.25	115	115	4.060%	83	42	0	42	30.9
19:00-20:0	2.10%	2.73%	2.415%		106	187	147	94	1	92	91	2.415%	49	0	0	0	14.3
20:00-21:0	1.05%	1.39%	1.220%		0	69	35	94	1	92	25	1.220%	25	0	0	0	10.0
21:00-22:0	0.21%	0.27%	0.240%		0	0	0	94	1	92	6	0.240%	6	0	0	0	10.0
22:00-23:0	0.00%	0.00%	0.000%		0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
23:00-24:0	0.00%	0.00%	0.000%		0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
	100.00%	100.00%	100.000%		2,374	2,597	2,486			2,507	2,353	100.000%	2,353				

(1) Average of six days from Customs (Apr 6,7,8,13,14,15 1999)
(2) Average of two days from Customs and Surveys (Apr 14 and Apr 15, 1999)
(3) Avarage arrival rates from surveys (Apr 14 and Apr 15, 1999)

OTAY MESA
TRUCK ARRIVALS AND QUEUES

HOUR	SB ARR TRUCKS 14-Apr	SB ARR TRUCKS 15-Apr	SB ARR TRUCKS AVE		SB PROC TRUCKS 14-Apr	SB PROC TRUCKS 15-Apr	SB PROC TRUCKS AVE	SB PROC TRUCKS Per Gate	SB GATES TRUCKS BASE	SB PROC TRUCKS BASE	SB TRUCKS PROCESS	SB ARR TRUCKS % (3)	SB ARR TRUCKS BASE	SB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	SB WAIT TRUCKS BASE
Total Trips (1)					2,374	2,597							2,353				
Average Processing Rate (2)					244	267	255	255		245							
0:00-1:00	0.00%	0.00%	0.000%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
1:00-2:00	0.00%	0.00%	0.000%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
2:00-3:00	0.00%	0.00%	0.000%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
3:00-4:00	0.00%	0.00%	0.000%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
4:00-5:00	0.00%	0.00%	0.000%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
5:00-6:00	0.00%	0.00%	0.000%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
6:00-7:00	0.17%	0.04%	0.105%	0.000%	0	0	0	255	1	2	2	0.105%	2	0	0	0	#DIV/0!
7:00-8:00	1.60%	1.46%	1.530%	0.010%	0	0	0	255	1	36	36	1.530%	36	0	0	0	10.0
8:00-9:00	4.38%	4.43%	4.405%	1.370%	33	36	35	255	1	104	104	4.405%	104	0	0	0	10.0
9:00-10:00	8.26%	8.66%	8.460%	4.370%	104	113	109	255	1	199	199	8.460%	199	0	0	0	10.0
10:00-11:0	9.98%	9.20%	9.590%	8.460%	201	220	211	255	1	226	226	9.590%	226	0	1	1	10.0
11:00-12:0	11.12%	11.59%	11.355%	9.290%	221	241	231	255	1	245	245	11.355%	267	22	0	22	10.0
12:00-13:0	10.24%	9.90%	10.070%	11.450%	272	297	285	255	1	245	245	10.070%	237	14	0	14	10.0
13:00-14:0	9.98%	10.90%	10.440%	10.160%	241	264	253	255	1	245	245	10.440%	246	15	0	15	10.0
14:00-15:0	12.26%	12.05%	12.155%	10.280%	244	267	256	255	1	245	245	12.155%	286	56	0	56	10.0
15:00-16:0	12.68%	13.02%	12.850%	12.510%	297	325	311	255	1	245	245	12.850%	302	113	0	113	20.9
16:00-17:0	10.15%	9.97%	10.060%	12.600%	299	327	313	255	1	245	245	10.060%	237	105	0	105	26.9
17:00-18:0	7.41%	6.97%	7.190%	9.490%	225	246	236	255	1	245	245	7.190%	169	29	0	29	16.6
18:00-19:0	1.77%	1.81%	1.790%	8.230%	195	214	205	255	1	71	71	1.790%	42	0	0	0	12.5
19:00-20:0	0.00%	0.00%	0.000%	1.790%	42	46	44	255	1	0	0	0.000%	0	0	0	0	#DIV/0!
20:00-21:0	0.00%	0.00%	0.000%	0.000%	0	0	0	0	1	0	0	0.000%	0	0	0	0	#DIV/0!
21:00-22:0	0.00%	0.00%	0.000%	0.000%	0	0	0	0	1	0	0	0.000%	0	0	0	0	#DIV/0!
22:00-23:0	0.00%	0.00%	0.000%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
23:00-24:0	0.00%	0.00%	0.000%	0.000%	0	0	0	0	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
	100.00%	100.00%	100.000%	100.010%	2,374	2,596	2,485			2,353	2,353	100.000%	2,353				

(1) Average of six days from Customs (Apr 6,7,8,13,14,15 1999)
(2) Average of two days from Customs and Surveys (Apr 14 and Apr 15, 1999)
(3) Avarage arrival rates from surveys (Apr 14 and Apr 15, 1999)

TECATE
TRUCK ARRIVALS AND QUEUES

HOUR	NB ARR TRUCKS 13-Apr (3)	NB ARR TRUCKS 15-Apr (3)	NB ARR TRUCKS AVE		NB PROC TRUCKS 13-Apr	NB PROC TRUCKS 15-Apr	NB PROC TRUCKS AVE	NB PROC TRUCKS Per Gate	NB GATES TRUCKS BASE	NB PROC TRUCKS BASE	NB TRUCKS PROCESS	NB ARR TRUCKS % (3)	NB ARR TRUCKS BASE	NB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	NB WAIT TRUCKS BASE
Total Trips (1)													149				
Average Processing Rate (2)					8.67	11.22	10.22	10.22		11							
Empty Truck Factor (6:00-7:00)							1.90	1.90		1.90							
0:00-1:00	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
1:00-2:00	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
2:00-3:00	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
3:00-4:00	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
4:00-5:00	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
5:00-6:00	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
6:00-7:00	13.91%	13.91%	13.910%		16	21	19	10	1	21	21	13.910%	21	0	0	0	#DIV/0!
7:00-8:00	8.70%	7.95%	8.325%		9	12	11	10	1	11	11	8.325%	12	1	0	1	10.0
8:00-9:00	10.43%	8.61%	9.520%		10	12	11	10	1	11	11	9.520%	14	4	0	4	20.1
9:00-10:00	6.09%	8.61%	7.350%		9	12	11	10	1	11	11	7.350%	11	4	0	4	28.2
10:00-11:0	6.96%	7.95%	7.455%		8	11	10	10	1	11	11	7.455%	11	4	0	4	28.2
11:00-12:0	9.57%	8.61%	9.090%		9	11	10	10	1	11	11	9.090%	14	7	0	7	36.4
12:00-13:0	6.96%	5.30%	6.130%		8	10	9	10	1	11	11	6.130%	9	5	0	5	39.1
13:00-14:0	4.35%	7.95%	6.150%		8	11	10	10	1	11	11	6.150%	9	3	0	3	28.2
14:00-15:0	9.57%	5.30%	7.435%		8	10	9	10	1	11	11	7.435%	11	3	0	3	22.8
15:00-16:0	6.96%	11.92%	9.440%		9	12	11	10	1	11	11	9.440%	14	6	0	6	31.0
16:00-17:0	3.48%	5.96%	4.720%		6	7	7	10	1	11	11	4.720%	7	2	0	2	28.2
17:00-18:0	5.22%	0.00%	2.610%		6	7	7	10	1	6	6	2.610%	4	0	0	0	16.2
18:00-19:0	4.35%	3.97%	4.160%		5	6	6	10	1	6	6	4.160%	6	0	0	0	10.0
19:00-20:0	3.48%	3.97%	3.705%		4	6	5	10	1	6	6	3.705%	6	0	0	0	10.0
20:00-21:0	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
21:00-22:0	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
22:00-23:0	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
23:00-24:0	0.00%	0.00%	0.000%		0	0	0	10	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
	100.03%	100.01%	100.000%		115	148	136			149	149	100.000%	149				

(1) Average of six days from Customs (Apr 6,7,8,13,14,15 1999)
(2) Average of two days from Customs and Surveys (Apr 14 and Apr 15, 1999)
(3) Hourly arrivals calculated from customs daily vehicles processed, ground counts (%), and queue counts for Apr 13, 15, 1999

TECATE
TRUCK ARRIVALS AND QUEUES

HOUR	SB ARR TRUCKS 13-Apr (3)	SB ARR TRUCKS 15-Apr (3)	SB ARR TRUCKS AVE		SB PROC TRUCKS 13-Apr	SB PROC TRUCKS 15-Apr	SB PROC TRUCKS AVE	SB PROC TRUCKS Per Gate	SB GATES TRUCKS BASE	SB PROC TRUCKS BASE	SB TRUCKS PROCESS	SB ARR TRUCKS % (3)	SB ARR TRUCKS BASE	SB ARR QUEUE BASE	RANDOM ARRIVAL QUEUE	TOTAL ARRIVAL QUEUE	SB WAIT TRUCKS BASE
Total Trips (1)					115	148							149				
Average Processing Rate (2)					10.13	13.13	12.00	12.00		12							
Empty Truck Factor (6:00-7:00)							1.00	1.00		1.00							
0:00-1:00	0.00%	0.00%	0.000%		0	0	0	12	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
1:00-2:00	0.00%	0.00%	0.000%		0	0	0	12	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
2:00-3:00	0.00%	0.00%	0.000%		0	0	0	12	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
3:00-4:00	0.00%	0.00%	0.000%		0	0	0	12	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
4:00-5:00	0.00%	0.00%	0.000%		0	0	0	12	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
5:00-6:00	0.68%	0.68%	0.680%		1	1	1	12	0	0	0	0.680%	1	1	#DIV/0!	#DIV/0!	#DIV/0!
6:00-7:00	2.03%	2.03%	2.030%		2	2	2	12	1	12	4	2.030%	3	0	0	0	#DIV/0!
7:00-8:00	2.70%	2.70%	2.700%		3	4	4	12	1	12	4	2.700%	4	0	0	0	10.0
8:00-9:00	7.43%	6.76%	7.095%		9	12	11	12	1	12	11	7.095%	11	0	0	0	10.0
9:00-10:00	4.05%	4.73%	4.390%		4	6	5	12	1	12	7	4.390%	7	0	0	0	10.0
10:00-11:0	5.41%	4.73%	5.070%		6	7	7	12	1	12	8	5.070%	8	0	0	0	10.0
11:00-12:0	6.76%	6.76%	6.760%		10	13	12	12	1	12	10	6.760%	10	0	0	0	10.0
12:00-13:0	8.11%	9.46%	8.785%		11	14	13	12	1	12	12	8.785%	13	1	0	1	10.0
13:00-14:0	7.43%	6.76%	7.095%		9	12	11	12	1	12	12	7.095%	11	0	0	0	10.0
14:00-15:0	10.81%	10.14%	10.475%		11	14	13	12	1	12	12	10.475%	16	4	0	4	15.0
15:00-16:0	9.46%	12.16%	10.810%		13	17	15	12	1	12	12	10.810%	16	8	0	8	35.0
16:00-17:0	8.11%	8.78%	8.445%		10	13	12	12	1	12	12	8.445%	13	9	0	9	47.5
17:00-18:0	9.46%	8.11%	8.785%		9	11	10	12	1	12	12	8.785%	13	10	0	10	52.5
18:00-19:0	7.43%	6.08%	6.755%		8	11	10	12	1	12	12	6.755%	10	8	0	8	50.0
19:00-20:0	6.08%	6.08%	6.080%		4	6	5	12	1	12	12	6.080%	9	5	0	5	37.5
20:00-21:0	2.70%	2.70%	2.700%		2	2	2	12	1	12	9	2.700%	4	0	0	0	17.5
21:00-22:0	1.35%	1.34%	1.345%		1	1	1	12	1	12	0	1.345%	0	0	0	0	10.0
22:00-23:0	0.00%	0.00%	0.000%		1	1	1	12	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
23:00-24:0	0.00%	0.00%	0.000%		0	0	0	12	0	0	0	0.000%	0	0	#DIV/0!	#DIV/0!	#DIV/0!
	100.00%	100.00%	100.000%		114	147	135				149	100.000%	149				

(1) Average of six days from Customs (Apr 6,7,8,13,14,15 1999)
(2) Average of two days from Customs and Surveys (Apr 14 and Apr 15, 1999)
(3) Hourly arrivals calculated from customs daily vehicles processed, ground counts (%), and queue counts for Apr 13, 15, 1999

APPENDIX C – F-Factors

```
GF    1 1  999999
GF    2 1  799999
GF    3 1  639999
GF    4 1  511999
GF    5 1  409600
GF    6 1  327680
GF    7 1  262144
GF    8 1  209715
GF    9 1  167772
GF   10 1  134218
GF   11 1  107374
GF   12 1   85899
GF   13 1   68719
GF   14 1   54976
GF   15 1   43980
GF   16 1   35184
GF   17 1   28147
GF   18 1   22518
GF   19 1   18014
GF   20 1   14412
GF   21 1   11529
GF   22 1    9223
GF   23 1    7379
GF   24 1    5903
GF   25 1    4722
GF   26 1    3778
GF   27 1    3022
GF   28 1    2418
GF   29 1    1934
GF   30 1    1547
GF   31 1    1238
GF   32 1     990
GF   33 1     792
GF   34 1     634
GF   35 1     507
GF   36 1     406
GF   37 1     325
GF   38 1     260
GF   39 1     208
GF   40 1     166
GF   41 1     133
GF   42 1     106
GF   43 1      85
GF   44 1      68
GF   45 1      54
GF   46 1      44
GF   47 1      35
GF   48 1      28
GF   49 1       0
GF   50 1       0
GF   51 1       0
GF   52 1       0
GF   53 1       0
GF   54 1       0
GF   55 1       0
GF   56 1       0
GF   57 1       0
GF   58 1       0
GF   59 1       0
GF   60 1       0
```

APPENDIX D – Cross-Border Components Job Stream

```
rm =output/*
touch =output/00-Begin

cd ..
runhc > =assign/=output/runhc.out
arc \&r hwyattpltj.aml > =assign/=output/attraml-tj.out
arc \&r hwyattmex.aml  > =assign/=output/attraml-mex.out
arc \&r hwyattall.aml  > =assign/=output/attraml-all.out
cd =assign

mv ../hwyatt*.hp2 =output
cp ../hwynet*.out =output
touch =output/01-NetBlt

rm hwyskim
cp hwyskim.usmx.op.in trnpln.in
tranplan
mv TRNPLN.OUT =output/hwyskim.usmx.op.out
$P91/izmex
touch =output/02-Skim

rm trips.mx-mx.op
cp gmodel.mx.in trnpln.in
tranplan
mv TRNPLN.OUT =output/gmodel.mx.out
touch =output/03-Gravity

rm trips.mx-mx.am
rm trips.mx-mx.pm
rm trips.mx-mx.op
$P91/dtripmex
touch =output/04-Period

cp sqzam.in trnpln.in
tranplan
mv TRNPLN.OUT =output/sqzam.out
cp sqzpm.in trnpln.in
tranplan
mv TRNPLN.OUT =output/sqzpm.out
cp sqzop.in trnpln.in
tranplan
mv TRNPLN.OUT =output/sqzop.out
touch =output/05-SqzSum

rm lodhist.usmx.am
cp eqlod.usmx.am.in trnpln.in
tranplan
mv TRNPLN.OUT =output/eqlod.usmx.am.out
cp rephwyxam.in trnpln.in
tranplan
mv TRNPLN.OUT =output/rephwyxam.out
```

```
touch =output/06-LoadAM


rm lodhist.usmx.pm
cp eqlod.usmx.pm.in trnpln.in
tranplan
mv TRNPLN.OUT =output/eqlod.usmx.pm.out
cp rephwyxpm.in trnpln.in
tranplan
mv TRNPLN.OUT =output/rephwyxpm.out
touch =output/07-LoadPM


rm lodhist.usmx.op
cp eqlod.usmx.op.in trnpln.in
tranplan
mv TRNPLN.OUT =output/eqlod.usmx.op.out
cp rephwyxop.in trnpln.in
tranplan
mv TRNPLN.OUT =output/rephwyxop.out
touch =output/08-LoadOP

$P91/postlod
arc \&r ../tjvolam.aml  > =output/tjvolam.out
arc \&r ../tjvolpm.aml  > =output/tjvolpm.out
arc \&r ../tjvol24.aml  > =output/tjvol24.out
arc \&r ../mexvolam.aml > =output/mexvolam.out
arc \&r ../mexvol24.aml > =output/mexvol24.out
arc \&r ../allvolam.aml > =output/allvolam.out
arc \&r ../allvol24.aml > =output/allvol24.out
mv *vol*.hp2 =output
touch =output/09-PlotVol

ls -l =output/0?-* > =output/10-Times.txt
```

APPENDIX E – Cross Border Model Users' Guide

Cross-Border Model Users' Guide

1 Overview

The cross-border component to the SANDAG model was designed to incorporate the unique characteristics of cross-border traffic, while allowing for simple application. For the majority of model applications the cross-border components may be kept constant. Those components are:

- Mexico area network.
- Intra-Mexico Trip Table.
- Cross-Border Trip Table.
- Queue delay on POE links.

The Mexico area network is maintained as part of the regional transportation network. Each of the remaining components are described in more detail in the following sections. The overall application of the cross-border components of the model are executed using the batch file *runmodel.bat* which currently resides in a subdirectory *(=assign*) below the standard alternative subdirectory on the SANDAG modeling computers. The relationship of these components is shown in Figure 1 (see end of Appendix E). A listing of *runmodel.bat* is shown below.

```
rm =output/*
touch =output/00-Begin

cd ..
runhc > =assign/=output/runhc.out
arc \&r hwyattpltj.aml > =assign/=output/attraml-tj.out
arc \&r hwyattmex.aml  > =assign/=output/attraml-mex.out
arc \&r hwyattall.aml  > =assign/=output/attraml-all.out
cd =assign

mv ../hwyatt*.hp2 =output
cp ../hwynet*.out =output
touch =output/01-NetBlt

rm hwyskim
cp hwyskim.usmx.op.in trnpln.in
tranplan
mv TRNPLN.OUT =output/hwyskim.usmx.op.out
$P91/izmex
touch =output/02-Skim

rm trips.mx-mx.op
cp gmodel.mx.in trnpln.in
tranplan
mv TRNPLN.OUT =output/gmodel.mx.out
touch =output/03-Gravity
```

```
rm trips.mx-mx.am
rm trips.mx-mx.pm
rm trips.mx-mx.op
$P91/dtripmex
touch =output/04-Period

cp sqzam.in trnpln.in
tranplan
mv TRNPLN.OUT =output/sqzam.out
cp sqzpm.in trnpln.in
tranplan
mv TRNPLN.OUT =output/sqzpm.out
cp sqzop.in trnpln.in
tranplan
mv TRNPLN.OUT =output/sqzop.out
touch =output/05-SqzSum

rm lodhist.usmx.am
cp eqlod.usmx.am.in trnpln.in
tranplan
mv TRNPLN.OUT =output/eqlod.usmx.am.out
cp rephwyxam.in trnpln.in
tranplan
mv TRNPLN.OUT =output/rephwyxam.out
touch =output/06-LoadAM


rm lodhist.usmx.pm
cp eqlod.usmx.pm.in trnpln.in
tranplan
mv TRNPLN.OUT =output/eqlod.usmx.pm.out
cp rephwyxpm.in trnpln.in
tranplan
mv TRNPLN.OUT =output/rephwyxpm.out
touch =output/07-LoadPM


rm lodhist.usmx.op
cp eqlod.usmx.op.in trnpln.in
tranplan
mv TRNPLN.OUT =output/eqlod.usmx.op.out
cp rephwyxop.in trnpln.in
tranplan
mv TRNPLN.OUT =output/rephwyxop.out
touch =output/08-LoadOP

$P91/postlod
arc \&r ../tjvolam.aml  > =output/tjvolam.out
arc \&r ../tjvolpm.aml  > =output/tjvolpm.out
arc \&r ../tjvol24.aml  > =output/tjvol24.out
```

```
arc \&r ../mexvolam.aml > =output/mexvolam.out
arc \&r ../mexvol24.aml > =output/mexvol24.out
arc \&r ../allvolam.aml > =output/allvolam.out
arc \&r ../allvol24.aml > =output/allvol24.out
mv *vol*.hp2 =output
touch =output/09-PlotVol

ls -l =output/0?-* > =output/10-Times.txt
```

Each section of *runmodel.bat* (above) ends with a "touch" command that creates an empty file, thereby marking the time that section finishes. *Runmodel.dat* can be made into a batch file that can be run entirely in the background by removing the lines beginning with "arc." Those lines are for documentary plots. Such plots are very useful as a matter of record. In addition to the "standard" SANDAG model elements, this batch file "expects" the following:

- The standard SANDAG trip tables (US-US) are ready
- The intra-Mexico Os, Ds, and F-Factors are in the file *=assign/mxgmdata*
- The Cross-border trips (e.g. *amper.tp*) are in *=assign/=crosstrips*
- The POE delay values are in the file *border.del*

2 Intra-Mexico Trip Table

The intra-Mexico trip table is intended to provide a rough estimate of the congestion delay encountered traveling to or from the various POEs. It is a simple function of the population in the zones in Mexico. From the population, Origin and Destination trips are generated. A "skim" of the empty network is used to distribute the trips using assumed F-Factors. As long as the network is unchanged and the population estimate for the zones in Mexico are unchanged, the same trip table can be used.

The section ending in "touch =output/02-Skim" skims the network, calculates the travel time amongst the zones. This section only needs to be run if the network has changed.

The section ending in "touch =output/03-Gravity" applies the gravity model to the intra-Mexico trips. This only needs to be run if the network or the population has changed. If the population has changed, the file "*mxgmdata*" will need to be updated.

Creating a new mxgmdata file.

The batch file *mx-tg.bat* (in the *=assign* subdirectory) helps apply the awk script *mx-tg.awk* to create P's and A's (in this instance, actually O's and D's) for the gravity model. The batch file is currently set to read as input the file "*agebpop20.prn*" which is a file containing the zone number and the projected population for that zone number in a free format, space delimited ASCII file.

The file *2020pop.xls* was used to create *agebpop20.prn*. A copy of this file was included on the CD-ROM containing the Final Report and this Users Guide. The various zones were grouped into districts so that the population could be increased relative to existing population (for the currently urban areas) or relative to zone size (for outlying areas). This file can be used as a starting point to test other population growth assumptions. Make a copy of the "2020PopCalc" page within the workbook and implement the new assumptions. Then copy the zone and population to another page, sort by zone, and write out as an ASCII file. This ASCII file will replace (or be the new) *agebpop20.prn.*

The result of *mx-tg.bat* is a file named *mx-tg.prn*. This file need only be combined with the file *ff.prn* to create the new *mxtgdata* file. E.g. cat mx-tg.prn ff.prn > mxtgdata

Updating intra-Mexico trips.

Since this process is very quick, we do not store the intra-Mexico trip table. That table is re-created whenever the cross-border model is run. In general, whenever there is a substantial change in the population projections or the roadway network in Mexico, we would edit the network in Mexico and/or create a new *mxtgdata* file and run the model to see the effects on the POE demands. Remember that the Mexico model is only used for an approximation of the relative delays to the various POEs. Only substantial changes in the population, or a major change to the intra-Mexico transportation system (or a change close to a POE) would require an update to the intra Mexico data, and a re-run of the model.

3 Cross-Border Trip Table

The Cross-Border trip tables should be prepared before submitting the model stream, and they should reside in the subdirectory =*crosstrips*. They are named "*amper.tp*" "*pmper.tp*" and "*opper.tp*" for the AM, PM, and off-peak trip tables respectively.

The current files were created via the following process: First, growth factors were developed by purpose and direction. For example, Home in Mexico and Work in US. These growth factors (see Table 5-22 of the *Final Report of the San Diego Region – Baja California Cross - Border Transportation Study*) were used in the script file *cross20.awk*. The base-year cross border trips by purpose (*allpurp.prn*) were expanded to the future (*allpurp20.prn*) using the batch file *cross20.bat*. *Cross20.bat* calls the script file *cross20.awk*, which applies the growth factors by purpose and direction.

The batch file *make2020.bat* takes the trips by purpose (described above, *allpurp20.prn*) and summarizes them (*minmax.awk*), applies the diurnal factors (*toamper.awk*, *topmper.awk*, and *toopper.awk*) Bucket rounds them

(*bucket.awk*), then builds them (*buildam.in, buildpm.in, buildop.in*) as TRANPLAN trip tables "*amper.tp*" "*pmper.tp*" and "*opper.tp*".

Applying modified growth assumptions

To analyze a different set of growth assumptions simply modify the factors in *cross20.awk* and create new cross-border trip tables with *cross20.bat*. *Cross20.bat* will produce a new *allpurp20.prn* file, which is the input file for *make2020.bat.* After running *cross20.bat, make2020.bat* will produce the new "*amper.tp*" "*pmper.tp*" and "*opper.tp*" TRANPLAN trip tables for the model.

The best approach would be to rename both of these (*cross20.awk cross20.bat*) files, editing the "bat" file for the new name. This will leave the original and new growth assumptions in the now separate "awk" files for future reference.

Whenever a variation of the growth assumptions is to be tested, a new set of trip tables needs to be created. Then the model must be run, and those (new) trips are assigned.

4 Queue delay on POE links

The queue delay component input to the model is contained in the file "*border.del*" which resides above the "=*assign*" subdirectory. The Queue delay on POE links can be analyzed and/or balanced using the file (included on the CD-ROM containing the Final Report and this Users Guide) *delaycalc.xls*. This file contains the delay calculations for each POE linked to a summary for each time period.

The first four pages of this workbook are the period (AM, PM, OP) summaries, and a daily summary. Followed by a page representing each POE/direction. Each POE page refers to the period summary page for input of volumes, and has areas to input the gates open by hour and the base processing rate, as well as the "acceleration rates" for the AM and PM peaks. These input areas are bold.

Each summary page starts with a column identifying the POE/direction and its associated link. Column B shows the current delays in minutes (total above, and "tare" amount below. These are described in the Final Report) based on the volumes being analyzed. Following those, there are columns for the input of the volumes and delays for various iterations of the model runs. At the far right (in a column labeled "For Calculation") are the volumes that will be calculated. Those far right volumes are linked to the individual POE sheets. The data for each iteration of the balancing process will be added to the right of the previous data. The "For Calculation" references must be updated to the appropriate column as new data are entered. I prefer updating the "For Calculation" references over copying the data into that column for clarity's sake. As references, the analyst has greater flexibility.

There are a few columns of sample data to guide you. I typically put the delay values that I will enter into the file *border.del* into a new column in the period summary sheets. After the model is run, the volumes can be taken from the files

"*rephwyxam.out*" "*rephwyxam.out*" "*rephwyxam.out*" (found in the *=assign/=output* subdirectory) for the AM, PM, and off-peak periods respectively, and entered below the delay values.

After the data are entered and all references under the "for Calculation" column are updated, the latest resultant delays will appear in column B. Copy the delay values from column B and "paste as values" to the adjacent column to the right of the volume values you just entered. Update the daily delay worksheet to reflect the latest iteration by copying the sample columns or the last iteration (in pairs) to the columns where the newly entered data were input on the other (AM, PM, OP) pages to obtain the daily average delay

With the volumes and delays (and previous iterations) you can estimate what values to enter into the *border.del* file for the next iteration. When balancing the POE delays it is important to note that the delays are very sensitive to the volumes. If you were to simply apply the result of one iteration as input to the next, the process would oscillate wildly. The user must use judgement in moderating the values, perhaps intentionally entering a higher or lower value for a POE delay in order to moderate this oscillation.

Another effect to remember is that the time periods are linked. It is possible that e.g. a PM delay will suddenly increase when no PM volumes have changed. This could happen if the off-peak becomes highly congested for that iteration. The analyst should judge if this (off-peak congestion) will remain, or if it is a temporary result of an off-peak that is not yet balanced, and therefor, will not remain in the final balanced volumes/times.

There is a limitation in the current software implementation of the model sets that limits the maximum delay value to approximately 40 minutes. Delays above that value have no additional effect. Because of this, the analyst must assess the distribution amongst gates under hyper-congested conditions. This may mean that the delay values don't match the result of the queue analysis, but are set to maintain an appropriate distribution among POEs. For example, POE A may show a delay of 300 minutes, and POE B may show a delay of 45 minutes when both have input (*border.del*) delays of 40 minutes. The analyst should reduce the input delay of POE B to even out the usage of the POEs.

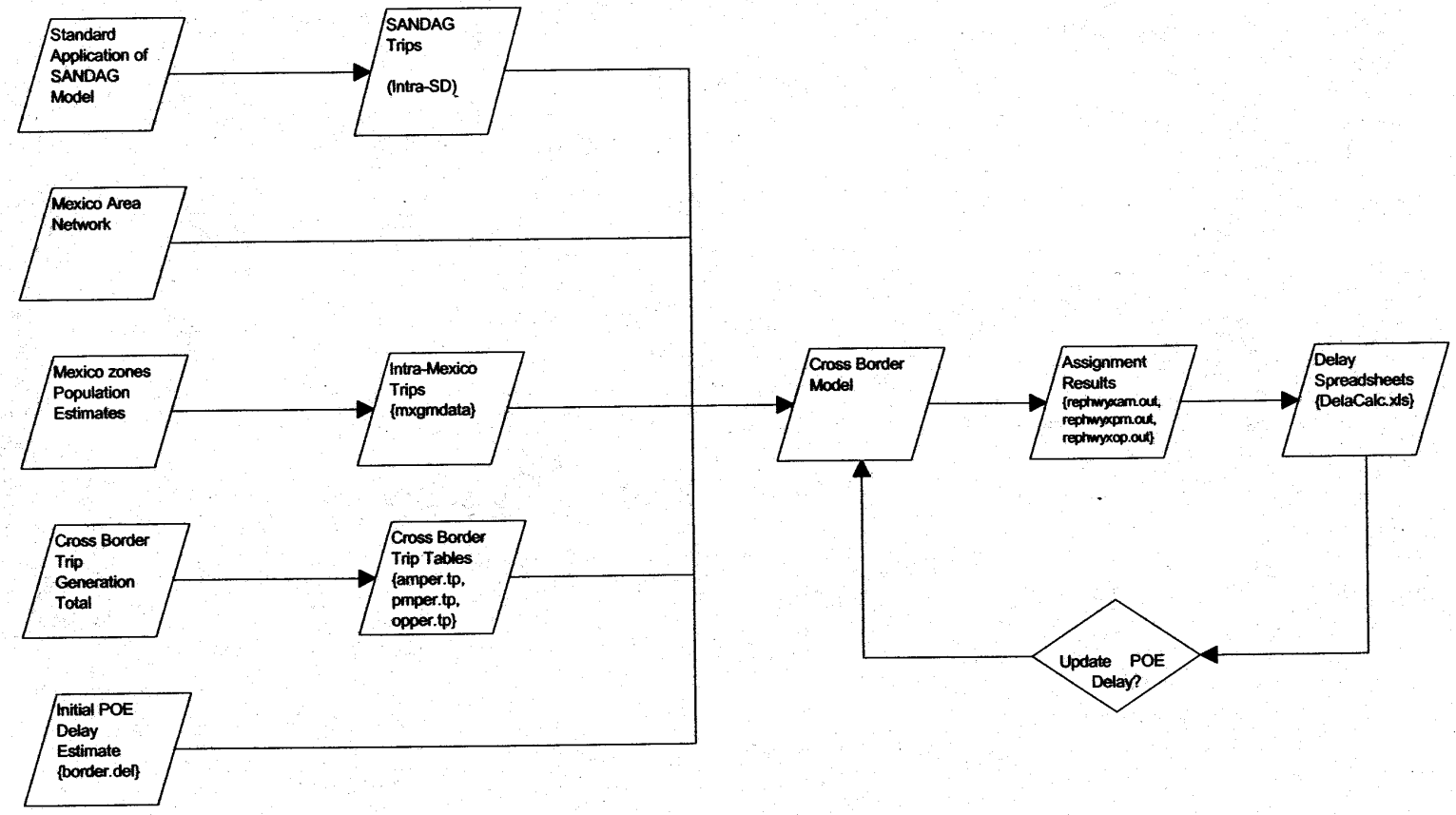
Differing applications of the delay spreadsheets

The delay spreadsheets can be used for much more than balancing POE volumes. They can also be used to determine the effects of various policy changes to the number of gates open or the processing rate at each POE. Many applications will use a static distribution of trips at the POEs under various policy scenarios to determine (before redistribution amongst POEs) the resultant delays.

The analyst can also approximate the redistribution amongst POEs by manually redistributing trips between POEs in the spreadsheet (respecting the northbound and southbound totals at the bottom) to get an estimate of that the model would

show. This would allow a much quicker estimate of a range of scenarios, especially if they reflect very high congestion.

Figure 1
Cross Border Model
Application Process



APPENDIX F – Growth Forecasts for Baja California

GROWTH FORECASTS FOR NORTHWEST BAJA CALIFORNIA

CATEGORY	TIJUANA				ROSARITO				TECATE				ENSENADA			
	Old City (1995 Urban)	Expanded City (Future Urban)	Rural	Total Municip.	Old City (1995 Urban)	Expanded City (Future Urban)	Rural	Total Municip.	Old City (1995 Urban)	Expanded City (Future Urban)	Rural	Total Municip.	Old City (1995 Urban)	Study Area Rural	Other Rural	Total Municip.
Population																
1995	966,097	0	25,495	991,592	37,121	0	9,475	46,596	47,005	0	15,624	62,629	192,550	6,187	117,552	316,289
Pop Density 1995	43.6				13.3				34.8							
Growth Rate				0.033862				0.079192				0.053759				0.041435
2020	1,141,751	1,138,052	0	2,279,803	103,771	199,950	9,475	313,196	58,756	155,831	17,317	231,904	531,310	17,072	324,365	872,747
Pop Density 2020	51.5				37.1				43.5							
Resid. Workers																
1995%	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.34	0.34	0.34	0.34
1990 Workers	367,117	0	9,688	376,805	14,106	0	3,601	17,707	17,862	0	5,937	23,799	65,467	2,104	39,968	107,539
2020%	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.37	0.37	0.37	0.37
2020 Workers	468,118	466,601	0	934,719	42,546	81,980	3,885	128,411	24,090	63,891	7,100	95,081	196,585	6,317	120,015	322,917
Employment																
Manuf 1995 %	0.292	0.292	0.000	0.284	0.150	0.150	0.000	0.120	0.253	0.253	0.000	0.190	0.150	0.000	0.000	0.091
Constr 1995 %	0.061	0.061	0.000	0.059	0.060	0.060	0.000	0.048	0.101	0.101	0.000	0.076	0.060	0.000	0.000	0.037
Comm 1995 %	0.192	0.192	0.000	0.187	0.330	0.330	0.000	0.263	0.192	0.192	0.000	0.144	0.330	0.000	0.000	0.201
Service 1995 %	0.392	0.392	0.000	0.382	0.450	0.450	0.000	0.359	0.394	0.394	0.000	0.296	0.460	0.000	0.000	0.280
Agricul 1995 %	0.000	0.000	1.000	0.026	0.000	0.000	1.000	0.203	0.000	0.000	1.000	0.249	0.000	1.000	1.000	0.391
Work in US 1995 %	0.063	0.063	0.000	0.061	0.010	0.010	0.000	0.008	0.060	0.060	0.000	0.045	0.000	0.000	0.000	0.000
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Manuf 1995	107,198	0	0	107,198	2,116	0	0	2,116	4,519	0	0	4,519	9,820	0	0	9,820
Constr 1995	22,394	0	0	22,394	846	0	0	846	1,804	0	0	1,804	3,928	0	0	3,928
Comm 1995	70,486	0	0	70,486	4,655	0	0	4,655	3,430	0	0	3,430	21,604	0	0	21,604
Service 1995	143,910	0	0	143,910	6,348	0	0	6,348	7,038	0	0	7,038	30,115	0	0	30,115
Agricul 1995	0	0	9,688	9,688	0	0	3,601	3,601	0	0	5,937	5,937	0	2,104	39,968	42,072
Work in US 1995	23,128	0	0	23,128	141	0	0	141	1,072	0	0	1,072	0	0	0	0
	367,116	0	9,688	376,804	14,106	0	3,601	17,707	17,863	0	5,937	23,800	65,467	2,104	39,968	107,539
Manuf 2020 %	0.380	0.380	0.000	0.380	0.290	0.290	0.000	0.281	0.380	0.380	0.000	0.352	0.200	0.000	0.000	0.122
Constr 2020 %	0.050	0.050	0.000	0.050	0.050	0.050	0.000	0.048	0.050	0.050	0.000	0.046	0.060	0.000	0.000	0.037
Comm 2020 %	0.148	0.148	0.000	0.148	0.240	0.240	0.000	0.233	0.149	0.149	0.000	0.138	0.290	0.000	0.000	0.177
Service 2020 %	0.340	0.340	0.000	0.340	0.400	0.400	0.000	0.388	0.340	0.340	0.000	0.315	0.450	0.000	0.000	0.274
Agricul 2020 %	0.000	0.000	1.000	0.000	0.000	0.000	1.000	0.030	0.000	0.000	1.000	0.075	0.000	1.000	1.000	0.391
Work in US 2020 %	0.082	0.082	0.000	0.082	0.020	0.020	0.000	0.019	0.081	0.081	0.000	0.075	0.000	0.000	0.000	0.000
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Manuf 2020	177,885	177,308	0	355,193	12,338	23,774	0	36,112	9,154	24,279	0	33,433	39,317	0	0	39,317
Constr 2020	23,406	23,330	0	46,736	2,127	4,099	0	6,226	1,205	3,195	0	4,400	11,795	0	0	11,795
Comm 2020	69,281	69,057	0	138,338	10,211	19,675	0	29,886	3,589	9,520	0	13,109	57,010	0	0	57,010
Service 2020	159,160	158,644	0	317,804	17,018	32,792	0	49,810	8,191	21,723	0	29,914	88,463	0	0	88,463
Agricul 2020	0	0	0	0	0	0	3,885	3,885	0	0	7,100	7,100	0	6,317	120,015	126,332
Work in US 2020	38,386	38,261	0	76,647	851	1,640	0	2,491	1,951	5,175	0	7,126	0	0	0	0
	468,118	466,600	0	934,718	42,545	81,980	3,885	128,410	24,090	63,892	7,100	95,082	196,585	6,317	120,015	322,917

GROWTH FORECASTS FOR NORTHWEST BAJA CALIFORNIA

CATEGORY	TIJUANA				ROSARITO				TECATE				ENSENADA			
	Old City (1995 Urban)	Expanded City (Future Urban)	Rural	Total Municip.	Old City (1995 Urban)	Expanded City (Future Urban)	Rural	Total Municip.	Old City (1995 Urban)	Expanded City (Future Urban)	Rural	Total Municip.	Old City (1995 Urban)	Study Area Rural	Other Rural	Total Municip.
Personal Income																
0-1.99 Min Sal 1995 (1)	0.385	0.385	0.385	0.385	0.425	0.425	0.425	0.425	0.425	0.425	0.425	0.425	0.425	0.425	0.425	0.425
2-4.99 Min Sal 1995 (1)	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420
5+ Min Sal 1995 (1)	0.195	0.195	0.195	0.195	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155	0.155
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
0-1.99 Min Sal 2020 (1)	0.360	0.360	0.360	0.360	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
2-4.99 Min Sal 2020 (1)	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450	0.450
5+ Min Sal 2020 (1)	0.190	0.190	0.190	0.190	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Households																
Occ Hhlds 1995	228,665	0	6,034	234,699	9,041	0	2,371	11,412	10,392	0	3,705	14,097	48,270	1,409	26,767	76,446
Occ Hhlds 2020	270,557	269,681	0	540,238	25,248	49,128	2,369	76,745	12,999	35,097	4,104	52,200	133,160	3,889	73,887	210,936
Persons/Hhld 1995	4.22		4.23	4.22	4.11		4.00	4.08	4.52		4.22	4.44	3.99	4.39	4.39	4.14
Persons/Hhld 2020	4.22	4.22	4.23	4.22	4.11	4.07	4.00	4.08	4.52	4.44	4.22	4.44	3.99	4.39	4.39	4.14
Household Income																
0-1.99 Min Sal 1995 (1)	0.155	0.155	0.155	0.155	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195	0.195
2-4.99 Min Sal 1995 (1)	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.379
5+ Min Sal 1995 (1)	0.466	0.466	0.466	0.466	0.426	0.426	0.426	0.426	0.426	0.426	0.426	0.426	0.426	0.426	0.426	0.426
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
0-1.99 Min Sal 2020 (1)	0.144	0.144	0.144	0.144	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184
2-4.99 Min Sal 2020 (1)	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401
5+ Min Sal 2020 (1)	0.455	0.455	0.455	0.455	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

(1) One minimum salary is approximately $107 (USD) per month in 1995, and stays constant in real USD over time.