Final Report

Impacts of Border Delays at California-Baja California Land Ports of Entry

Volume 2: Economic Impact Analysis Report

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In Coordination with T. Kear Transportation Planning and Management, Inc.

Contents

Executive Summary

Volume 2 of the Report for the Impacts of Border Delays at California-Baja California Land Ports of Entry presents the Economic Impact Analysis component of the study. This volume reviews the economic methodology, key inputs from the San Diego Association of Governments (SANDAG) Border Survey, and assumptions inherent to the analysis. The risk component and how it is incorporated in the analysis is also described. The results and recommendations of the Economic Impact Analysis are summarized at the conclusion and recommendations are made on how to reduce delays at the border.

The methodological framework used to quantify economic impacts of delays allowed for the estimation of three types of effects (direct effects, indirect effects, and induced effects). An input-output (IO) model was used in this study to estimate the impact of the change in the demand for goods and services due to border delay.[1] The key input to the IO model is the incremental change in spending or trade (i.e., direct effect) from both personal crossings (pedestrians and passenger vehicles) and freight movements resulting from border delays. Multipliers are applied to this initial change in demand to calculate the direct, indirect, and induced effects, in terms of output, value added, and employment. Both the methodology and the inputs used in the economic analysis were reviewed by a peer review panel to identify areas of improvement.

A formal risk analysis process was introduced to the estimation of economic impacts of delays at the border in order to account for the uncertainty related to data collected in the field, key assumptions and future values of the key inputs used in the study.[2] In particular, a Monte Carlo simulation was conducted using probability distributions for the key variables identified in the Peer-Review Process to address the three types of uncertainty identified. As such, the results presented in this Volume correspond to the most-likely outcome defined as the 50th percentile of the probability distribution for each output measure.

The base year (2016) border-crossing conditions that represent key inputs into the estimation of economic impacts of delays were identified using data collected in the field through the SANDAG Border Survey in 2016.[3] The key variables collected for the economic analysis consisted of average border-crossing spending per trip, alternate average spending in home country if a border-crossing trip is foregone, the elasticity of travel demand with respect to border delay, and the total border-crossing time that was transformed into a measure of delay after consultations with U.S. Customs and Border Protection (CBP). Using this information, the economic impacts of current delays were quantified in terms of output losses, labor income losses, and job losses across different geographies in the U.S. and Mexico.

[1] The estimation of impacts on the U.S. was performed using the IMPLAN IO model, while the estimation of impacts on the Mexican side was done using a Baja California IO model developed by Dr. Alejandro Brugués from COLEF.
[2] The risk analysis process was used to produce a probabilistic range of economic impacts.
[3] Data on the number of border crossing trips by mode is another key variable that was collected from the Bureau of Transportation Statistics (BTS) Border Crossing/Entry Data.

The next step consisted of defining a series of conceptual scenarios for the border region and identifying what the future values of key variables used in the economic analysis would be under each one of those scenarios. A future baseline scenario includes projects at the Land Ports of Entry (LPOEs) that are either funded or were anticipated to receive funding. The Baseline plus capacity enhancement and transit and active transportation scenario looked at the effect of projects that are still being planned, such as the modernization of the existing Otay Mesa POE, construction of the new Otay Mesa East (OME) POE, an expanded bridge over the All-American Canal at the Calexico East POE, and proposed transit improvements. Estimates of output losses, labor income losses, and job losses were developed for each scenario and for different geographies along the two sides of the California-Baja California border.

Broadly, the Economic Impact Analysis finds that the combined output losses in the U.S. and Mexico from base year (2016) delays at the border account for almost $3.4 billion. Of the total output losses estimated in 2016, about $2.1 billion correspond to output losses in the U.S. while the remaining $1.3 billion are estimated to be experienced by the Mexican economy. San Diego County is the region in the U.S. that bears the largest share of the output losses on the U.S. side, with more than 70 percent of the total U.S. impact.

The study found that economic losses continue to increase between years 2016 and 2025 in real terms despite the moderate increase of physical capacity at several of the POEs in the region. For example, total combined output losses for the U.S. and Mexico in year 2025 under the baseline scenario are equivalent to $5.1 billion, representing an increase of almost 50 percent in total output losses between 2016 and 2025.

The introduction of larger infrastructure capacity enhancements, such as the Otay Mesa East LPOE and the All-American Canal Bridge Expansion, in combination with transit and active transportation improvements, generate enough additional capacity to reduce anticipated future delays at key LPOEs and revert total combined output losses for the U.S. and Mexico to levels slightly below those estimated for year 2016.

The study identifies specific recommendations that help reduce wait times and delays at the border by increasing capacity, managing demand and operations, and promoting lower polluting, more efficient vehicles. The recommendations are broken down into five broad categories:

- Investment in POE Infrastructure and Physical Capacity
- Improved Operations at POEs
- Improved Access to POEs
- Corridor-Wide Improvements
- Support for Coordination on Long-Term Strategies

The Volume 2 Appendix (contained in a separate document) includes five reports in support of the content presented in Volume 2. Appendix A describes the methodology of the economic model. Appendix B contains a description of the Baja California I-O model. Appendix C summarizes the economic peer-review panel comments and responses. Appendix D presents

the 2016 economic impacts of delay for San Diego County's MSAs. Finally, Appendix E contains a breakdown of economic impact results by county.

As a reference to readers, Volume 1 has background information on the project and common inputs used in the Economic and Air Quality/Emissions analyses, while Volume 3 presents the Air Quality/Emissions Impact Analysis component of this study.

Methodological Framework

This section presents a brief summary of the methodology used in this study to estimate the economic impacts of delays at LPOEs along the California-Baja California border. This methodology builds upon that implemented for the original studies commissioned by SANDAG and Imperial Valley Association of Governments (IVAG).[4] The main differences from the previous methodology are the values of the key inputs used and the consideration of a "baseline" border-crossing time to represent the minimum time required to cross the border using a specific POE and transportation mode.

For a more technical discussion on the methodology and additional details see Appendix A to this Volume.

Literature Review

In developing the proposed methodology, the Project Team conducted a literature review that updates earlier reviews conducted in the *Economic Impacts of Wait Times at the San Diego–Baja California Border* for SANDAG (2006) and the *Imperial Valley – Mexicali Economic Delay Study* for IVAG (2007). The review focused on identifying recent developments on the estimation of the economic impacts of delays on personal trips and freight movements at the U.S. borders with Mexico and Canada. Five directly relevant studies published since 2010 were identified:

- Avetisyan, M., Heatwole, N., Rose, A., and Roberts, B., (2015) "Competitiveness and Macroeconomic Impacts of Reduced Wait Times at U.S. Land Freight Border Crossings". *Transportation Research Part A, 78*, 84-101.
- Brown, W. M., (2015) *How Much Thicker is the Canada-U.S. Border? The Cost of Crossing the Border by Truck in the Pre- and Post-9/11 Eras*. Statistics Canada, Economic Analysis Research Paper Series, 11F0027M No. 99.
- Koopman, R., Powers, W., Wang, Z., and Wei, S., (2010) *Give Credit Where Credit is Due: Tracing Value Added in Global Production Chains*. National Bureau of Economic Research, Working Paper 16426.
- Rajbhandari, R., Saman, S., Vadali, S., and Kang, D., (2012) "Dashboard Tool to Communicate Delays and Economic Cost of Delays at International Border Crossings". *Transportation Research Record: Journal of the Transportation Research Board, 2285*, 135-144.
- Roberts, B., Rose, A., Heatwole, N., Wei, D., Avetisyan, M., Chan, O., and Maya, I., (2014) "The Impact on the U.S. Economy of Changes in Wait Times at Ports of Entry". *Transport Policy,* 35, 162-175.

A summary of the findings from the review of these five studies is presented here. However, more details can be found in Appendix A to this Volume.

[4] SANDAG, *Economic Impacts of Wait Times at the San Diego–Baja California Border,* 2006 and IVAG, *Imperial Valley – Mexicali Economic Delay Study,* 2007.

Two of the analyses above (Avetisyan et al., 2015 and Roberts et al., 2014) show that adding one customs officer to POEs (and thereby increasing the processing rate and decreasing border wait times) would result in significant impacts on the U.S. economy in terms of GDP and employment. Brown (2015) assesses the impact of additional regulations, rather than the impact of border crossing delay, on the costs of shipping goods across the Canada-U.S. border. The author finds that crossborder *ad valorem* rates (i.e., the additional cost of moving goods across the Canada-U.S. border over moving goods across the same distance domestically) can have significant impacts on goods that cross the border at various points during the production process. This implies that additional costs due to border delay may also have significant impacts on this premium.

Rajbhandari et al. (2012) discuss the development of a dashboard that presents information on delays at the land border crossing in El Paso, Texas, and the related economic cost to commercial vehicles. The analysis describes the potential usefulness of the dashboard to freight businesses and policy makers, but does not explore border crossing wait time data collection methods in detail or quantify the impacts of changes in business decisions in response to the border crossing information.

Koopman et al. (2010) address the inaccuracy of official trade statistics in the representation of the value added by countries to goods produced through international supply chains. Their analysis traces the value each country adds in international trade (i.e., the domestic value added) by separating the value of gross exports into its underlying components and creating an inter-country input-output model that covers 26 countries and 41 sectors. The applications of their results are limited to the identification of international supply chain and trade patterns, and is not specific to border crossing impacts on these topics.

Ultimately, the body of research on impacts of border crossing delay on personal and commercial freight trips is limited and suggests little change to the methodology used in previous studies, particularly regarding border crossing data collection and the analysis of border wait time impacts.

Methodology Overview

The methodological framework used in this study to estimate economic impacts of delays distinguishes between the impacts of border delays for personal trips (i.e., personal vehicles and pedestrians) and those for freight movements (i.e., commercial trucks). Traditionally, an Economic Impact Analysis involves the estimation of three types of effects, commonly referred to as direct effects, indirect effects, and induced effects.[5] The total economic impact is the sum of these direct, indirect, and induced effects. The indirect and induced effects are sometimes

[5] Direct effects refer to the economic activity occurring as a result of direct spending by businesses (e.g., import/export companies) or agencies located in the study area. Indirect effects refer to the economic activity resulting from purchases by local firms who are the suppliers (e.g., electrical equipment manufacturers) to the directly affected businesses or agencies. Induced effects represent the increase in economic activity – over and above the direct and indirect effects – associated with increased labor income that accrue to workers (of directly and indirectly affected businesses) and is spent on household goods and services purchased from businesses within the study area. Additional economic activity further down the production chain is generated by the spending by supplier firms for labor, goods, and services necessary for the production of their own goods or services, and household consumption from increased labor income.

referred to as “multiplier effects” since they can make the total economic impact substantially larger than the direct effect alone. Typically, economic impacts are measured in terms of output (total volume of sales), value added (the regional equivalent is GDP), employment (number of jobs created for a full year), and labor income.

In the case of personal trips (i.e., those taken by pedestrians or passenger vehicle users), delays at the border have a direct impact on the number of border-crossing trips taken. Higher wait times at the border normally discourage crossers, resulting in fewer border-crossing trips. The number of “foregone” crossborder trips due to high wait times has an impact in the local economy on each side of the border, since each trip represents a potential for purchase of goods and services at the other side of the border from where the trip began. When a border-crossing trip is foregone, the amount of expenditure associated with that trip is either postponed for a future occasion (that may or may not occur) or is spent in the country where the foregone trip was supposed to begin.

In the case of commercial trips (i.e., those made using commercial vehicles), the effects of delays at the border in the local economies are felt through different channels compared to personal trips. The reduction in trade (or demand for exported goods) due to border delays affects the export manufacturing industries, thereby reducing the need for inputs (purchases) of labor, materials, equipment, and services, which are supplied by local (and non-local) producers. To the extent that the reduction in these purchases results in reduced productivity and/or reduced levels of labor force utilization (employment), it will cause a decline in the local economy with attendant costs of lower employment, personal income, business profits, and tax revenue.

An input-output (IO) model[6] is used in this study to estimate the impact of the change in the demand for goods and services due to border delay.[7] The key input to the IO model is the incremental change in spending or trade (i.e., direct effect) from both personal crossings and freight movements resulting from border delays. Multipliers are applied to this initial change in demand to calculate the direct, indirect, and induced effects, in terms of output, value added, and employment. Several adjustments were made to help ensure that all impact estimates are truly incremental and specific to the study area.[8] For a more detailed description of the methods used in this study see Appendix A to this Volume.

The methodological framework used in this study to estimate the economic impacts of border delays is presented separately for personal trips and freight movements in the following subsections.

[6] An input-output approach is followed in this study, drawing on an extensive body of research and experience with successful applications to transportation projects. An IO model calculates impact multipliers, which are then used to compute direct, indirect, and induced effects in terms of output, employment and income generated per dollar of direct spending for labor, goods, and services.
[7] The specific IO models used in this study are IMPLAN’s 2015 model (for the US side of the border) and the Baja California IO model developed by Alejandro Brugués from COLEF (for the Mexican side of the border). See Appendix B to this Volume for a brief description of the Baja California IO model.
[8] These include adjustments due to inflation and modifications using regional purchase coefficients.

PERSONAL TRIPS

Personal trips are comprised of trips made by pedestrians and trips made using privately-owned vehicles (POVs). The estimation of economic impacts of delays in personal trips was broken down into these two subgroups (or modes) since some of the values for key inputs (such as expenditures and elasticities with respect to delays) differ between these two subgroups of personal crossers. However, there are no differences in the methodologies used to estimate economic impacts from pedestrians and POVs and therefore the approach described in this section refers to personal trips as a whole.

The economic impacts of delays at the border on personal trips are grouped into three categories: 1) impacts of foregone recreation, shopping, and vacation trips; 2) impacts of foregone work trips; and, 3) productivity losses from impaired crossborder movements.

In addition to lost work trips, border delays have a significant impact on productivity in the crossborder region. They cause workers to be late at work, spend less time with their family, and make trips at less desirable times. While some of this effect is not directly related to the macro-economic impact, reduced working time has a direct effect on productivity and is therefore included in the Economic Impact Analysis.

The methodology takes into account the sensitivity of each type of trip to border delay, thereby allowing the study to estimate the number of trips foregone. Based on the trip destination, trip duration, and average spending per trip, the study derives the direct economic impact in terms of net revenue losses and loss of productivity. The indirect and induced effects are then estimated by means of input-output analysis. The economic impacts are estimated separately on both sides of the border using economic multipliers specific to the region of interest (for instance, San Diego County, Imperial County, or the State of California on the U.S. side). The estimation of the economic impacts is conducted within a risk analysis framework to account for uncertainty surrounding some input variables (e.g., elasticity of border-crossing trips to delays).

The SANDAG Border Survey was an extensive survey of crossborder travelers conducted for this study at LPOEs located along the California-Baja California border in the summer and fall of 2016 (see Volume 1 for an overview of this survey). The survey responses provide key inputs to the Economic Impact Analysis, such as trip origin and destination, trip purpose, anticipated delays at the border, sensitivity to increased wait times, average spending per trip, and alternative local spending if the trip were not made. One of the important differences between this study's approach and SANDAG's original border delay study (2006) is the use of the SANDAG Border Survey to estimate the elasticity of crossborder trips with respect to wait time (previously the elasticities were taken from the literature).

FREIGHT FLOWS

The methodology to estimate the economic impacts of border delays on freight movements relies on the fundamental principles of the theory of trade between two countries. From a theoretical examination of the general process for production and management decisions in a situation of increasing delays at the border, it is apparent that increased wait times and unpredictable wait times affect businesses through different avenues. However, both ultimately result in a reduction of output. Therefore, the effects of increasing wait times are estimated separately from the effects of wait time uncertainty, and the final result is an estimation of the change in output of exporting firms.

The estimation of output impacts is broken down into industries for which timing of inputs is important for production processes (i.e., just-in-time (JIT) industries) and other industries that trade primarily finished goods. Examples of JIT industries include Machinery and Equipment and Manufactured Goods, whereas Agricultural and Food Products or Mining and Mineral Products are examples of industries that trade primarily in finished goods. Various elasticities, derived from the literature[9], are used to estimate the economic impacts on JIT industries and other industries separately.[10]

For the industries dealing in finished goods, border delays result in a reduction in output through 1) the reduction in output due to a loss of competitive advantage in export markets related to transportation times; and 2) the reduction in output due to higher transportation costs. This reduction is offset by an increase in output of local or domestic producers competing with imports (imported goods become more expensive and less attractive, and local producers experience a stronger demand). The reduction in export demand is also partially offset by domestic sales, or export substitution. In other words, it is assumed in the methodology that exporters are able to sell some of the lost exports to the domestic market.

Once the percentage change in output is calculated for each type of industry, it is multiplied by the freight value at each port of entry to obtain the total output impact. Multipliers from input-output models are subsequently used to derive the direct, indirect, and induced effects of border delays.

Economic Impact Peer-Review Process

The goal of the peer review process was to elicit feedback from subject matter experts and project stakeholders on the economic impact methodology to be used in the Economic Impacts of Border Delays study for the partner agencies (SANDAG, California Department of Transportation (Caltrans), and the Imperial County Transportation Commission (ICTC)). The feedback focused on the inputs, estimation process and outputs proposed for the assessment of the economic impacts of this study.

[9] See Blanchard, 1996.
[10] These elasticities are subject to risk analysis as part of this study.

The peer-review was conducted in two sessions. The methodology and inputs were presented by the Project Team and participants made comments and suggestions in a roundtable setting. The first session was held on April 20, 2017, and focused on the conceptual framework and technical aspects of the methodology, in which the participants were subject matter experts. The second session, held on April 27, 2017, focused on the values of the key inputs to the economic analysis and the data collection methods, and the participants were both subject matter experts and project stakeholders. The format used is transparent and encouraged consensus building.

The following topics were covered as part of the peer-review session.

- Background – review of previous studies and the scope of the current analysis of economic impacts.
- Key inputs – identification of key inputs collected from primary or secondary sources; overview of methodology used to collect key inputs; preliminary values of key input data used in analysis, including average spending by expenditure type.
- Detailed economic impact methodology – Structure and Logic (S&L) diagrams and/or equations used in the estimation of direct, indirect and induced economic impacts; discussion of both U.S. and Mexican input-output (I-O) multipliers used and proposed geographical aggregation of estimated impacts.
- Anticipated outputs – discussion on the specific format and characteristics of the anticipated outputs to be produced as part of this study.

Table 1 lists the technical group of peer-reviewers who attended the first and second sessions.

Table 1. Economic Peer Review Panel, Subject Matter Expert Attendance

Category	Country	Participant	Group/Organization
Federal	**US**	Don Pickrell	Volpe Institute
State	**US**	Barry Padilla	Caltrans, Transportation Economics Branch
		Rose Agacer	Caltrans, Transportation Economics Branch
Local/ Academia	**US**	Annie Nam	Southern California Association of Governments
		Juan Villa [+]	Texas A&M, Texas Transportation Institute
		Jeff Tayman * [+]	University of California, San Diego
		Daniel Leff *	University of California, San Diego
	Mexico	Alejandro Brugués [^]	Departamento de Estudios Económicos, El Colegio de la Frontera Norte
		Noé Fuentes *	Departamento de Estudios Económicos, El Colegio de la Frontera Norte

Note: Panelists who attended only the first session are noted with an asterisk (*). All others attended both sessions.
[+] Jeff Tayman and Juan Villa sent written comments for the first session, but could not attend in person.
[^] Alejandro Brugués called in for the second session.

Table 2 presents the institutions represented at the second session as regional stakeholders.

Table 2. Regional Stakeholder Attendance

Category	Country	Participant	Group/Organization
Federal	US	Sylvia Grijalva	U.S. Federal Highway Administration
		Antonio Pombrol	U.S. Customs and Border Protection
		Eduardo Castorena	U.S. Customs and Border Protection
		Ramon Riesgo	U.S. General Services Administration, Southern Border Program Office
	Mexico	Jesús López	Consulate General of Mexico in San Diego
State	Mexico	Victor Rangel	Secretaría de Infraestructura y Desarrollo Urbano de Baja California
		José Alberto Casas Vargas	Secretaría de Turismo
		Karlo Limón	Secretaría de Turismo
Local/ Academia	US	Mike Jones	Southern California Association of Governments
		Paola Avila	San Diego Regional Chamber of Commerce
		Cindy Gompper-Graves	South San Diego County Economic Development Council
		Efrain Ibarra Jr.	South San Diego County Economic Development Council
		Mayor John Minto	East County Economic Development Council
		Flavio Olivieri	Cali Baja Bi-national Mega-Region
		Gustavo de la Fuente	Smart Borders Coalition
		Nathan Owens	University of California, San Diego - Extended Studies and Public Programs - Global CONNECT
		Armando Freire	Transportation and Logistics
		Esperanza Colio Warren	Imperial County
	Mexico	Brenda Andalón	INDEX Tijuana - Maquiladora Association

The peer-reviewers' comments were received from the workshop sessions through panel discussion and written notes on data summary sheets, which were distributed a few days before and collected after each session. The comments covered several of the inputs presented, from the preliminary crossing volume forecasts and growth rates, to the behavioral patterns and characteristics of individual border crossers, including spending patterns, trip purpose, average wage, and elasticity of travel demand with respect to border delay. The Project Team responded to each comment and incorporated the necessary changes in the methodology and inputs (see Appendix C to this Volume for a list of the comments and responses from the Peer-Review Process).

Accounting for Uncertainty through Risk Analysis

A formal risk analysis process was introduced to the estimation of economic impacts of delays at the border in order to account for the uncertainty stemming from three potential sources: 1) the margin of error surrounding some of the answers provided as part of the SANDAG Border Survey,[11] which affect the 2016 values of the key variables included in the analysis; 2) unknown or missing information surrounding international trade and commerce at the border; and 3) the

[11] See Volume 1 for an overview of the SANDAG Border Survey.

forecasting error surrounding some of the future values of the key inputs used in the study. In particular, a Monte Carlo simulation was conducted using probability distributions for the key variables identified in the Peer-Review Process to address the three types of uncertainty identified.

The key variables that were used in the estimation of economic impacts of delays are the following, identified by border-crossing mode:

- Personal trips (pedestrians and POVs): border-crossing volumes, delays / excess wait time,[12] average expenditures during border-crossing trips, average expenditures in home country if border-crossing trip is forgone, and elasticity of border-crossing trips to delays
- Commercial vehicles: border-crossing volumes, delays / excess wait time, value per border-crossing loaded truck, share of border-crossing loaded / empty trucks, and elasticity of border-crossing trips to delays

Of the key variables listed above, those potentially affected by uncertainty related to the margin of error of the SANDAG Border Survey are:

- Personal trips: delays / excess wait time,[13] average expenditures during border-crossing trips, average expenditures in home country if border-crossing trip is forgone, and elasticity of border-crossing trips to delays
- Commercial trips: delays / excess wait time[14]

Similarly, those variables affected by uncertainty related to international trade are:

- Commercial trips: value per border-crossing loaded truck, share of border-crossing loaded / empty trucks, and elasticity of border-crossing trips to delays

Finally, those potentially affected by uncertainty related to forecasting errors are:

- Personal trips: border-crossing volumes, delays / excess wait time
- Commercial vehicles: border-crossing volumes, delays / excess wait time

For the majority of the key input variables, addressing the sources of uncertainty using risk analysis was relatively straightforward. This was accomplished by adding a probability range to the median values of the inputs derived from the SANDAG Border Survey, the forecast procedure, and secondary sources. In the case of the input delays / excess wait time, which can be traced back to the two sources of uncertainty, the solution consisted of adding one probability distribution to the 2016 median value of the input gathered through the SANDAG

[12] The concept of delays / excess wait times at the border is a slight departure from the traditional concept of wait time at the border, since it involves the estimation of a "baseline" border-crossing time (see Volume 1 for more details on this distinction). This study focuses on the estimation of economic and air quality impacts as a result of delays at the border, with the terms "delays" and "excess wait time" used interchangeably to denote delays.
[13] The study collected responses from pedestrians on perceived border-crossing wait times and measured POVs border-crossing times that were used to develop a measure of delay.
[14] The study measured commercial vehicle border-crossing times that were used to develop a measure of delay.

Border Survey and one probability distribution to the future values of this input created through the forecasting procedures.

The development of the probabilistic distributions associated to each key input variable was based on a combination of the following sources:

- Primary data collected through the SANDAG Border Survey;
- Historical data from published secondary sources (such as the Bureau of Transportation Statistics); and
- Subject Matter Expert feedback provided as part of the Economic Peer-Review Process.

More details about the probability ranges applied to variables related to personal trips are given in the Personal Trips: Incorporating Uncertainty to Base Year Condition Values for Key Variables section of this Volume. Details about probability ranges applied to variables related to freight trips are given in the Freight Trips: Incorporating Uncertainty to Base Year Condition Values for Key Variables section of this Volume. Details about the probability ranges applied to future conditions of each scenario are given in the Future Values and Uncertainty Ranges for Border-Crossing Volumes in Conceptual Scenarios section of this Volume.

The result of applying this risk analysis process is the estimation of probability ranges for the economic impact outcomes identified in the methodology. In other words, the addition of risk analysis to the study allowed the generation of probabilistic outcomes, from which most-likely values are reported in this Volume.[15]

Assumptions Used in Quantification of Economic Impact Analysis

Just as it is important to describe the key inputs used in the quantitative analysis of economic impacts of delays (see upcoming sections in this report), it is important to describe the key assumptions that were used in the economic analysis to produce these results. The key assumptions are presented by category of trip used to cross the border (i.e., personal trips, commercial trips).

ASSUMPTIONS FOR PERSONAL TRIPS

Table 3 presents the assumptions for the economic impact of personal trips in the model not explicitly stated elsewhere. These apply to all relevant conceptual scenarios. These assumptions are derived from the SANDAG Border Survey, and more information can be found in Appendix C to Volume 1.

[15] This is in contrast with methods that generate deterministic (i.e., single-value) outcomes.

Table 3. Assumptions for Personal Trips, Constant in all Conceptual Scenarios

Assumption	POEs	Most Likely Value	Range for risk analysis	Source
Average Hourly Wages[16] ($ per hour)	San Diego County	$7.17	+/- 10 percent of most likely value	SANDAG Border Survey and Peer Review Process
	Imperial County	$5.46		
Northbound Crossers who would Work 1 Hour Less	San Diego County	25%	+/- 10 percent of most likely value	SANDAG Border Survey
	Imperial County	31%		
Southbound Crossers who would Work 1 Hour Less	All POEs	17%	+/- 10 percent of most likely value	SANDAG Border Survey
Adjustment Factor in Survey to Account for Bias in Responses Accounting for Driver vs. Passengers in Car (average spending passengers per vehicle)	All POEs	1.2	1.17 to 1.24	SANDAG Border Survey

ASSUMPTIONS FOR COMMERCIAL TRIPS

Table 4 summarizes the assumptions for the economic impact of commercial trips in the model not explicitly stated elsewhere. These apply to all relevant conceptual scenarios.

Table 4. Assumptions for Commercial Trips, Constant in all Conceptual Scenarios

Variable	POEs	Most Likely Value	Range for risk analysis	Source
Average length of haul per trip	All POEs	50 miles	20 to 100 miles	Motor Carrier Industry Profile, University of Maryland, 2000
Average Speed (excluding border crossing)	All POEs	25 mph	n/a	HDR assumption

*Note: Values for Otay Mesa East are assumed equal to Otay Mesa.

[16] The average hourly wage is applied to people crossing for work, to quantify productivity losses due to border delay. It is assumed representative of both Northbound and Southbound commuters. This variable was discussed during the Peer Review Process and the responses informed the final values and ranges used in this study.

Identification of Base Year Conditions, 2016

The first step to quantify the economic impacts of delays in the California-Baja California region consisted of identifying the key variables that capture the relationship between economic impacts and delays at the border. Based on the literature review and the methodology developed for this study, a few variables were considered key inputs to the quantification of economic impacts of delays, based on the particular mode analyzed:

- Personal trips (pedestrians and POVs): border-crossing volumes, delays / excess wait time, average expenditures during border-crossing trips, average expenditures in home country if border-crossing trip is forgone, and elasticity of border-crossing trips to delays
- Commercial vehicles: border-crossing volumes, delays / excess wait time, value per border-crossing loaded truck, share of border-crossing loaded / empty trucks, and elasticity of border-crossing trips to delays

Once these key input variables were identified, the following step consisted of quantifying them under both base year and future conditions. The main source of information for determining the base year values for the key variables related to personal trips was the SANDAG Border Survey, since it was used to collect information on behavior by border crossers including expenditure habits and attitudes toward wait times.[17] Base year values for key variables relating to commercial vehicles were largely gathered from published secondary sources. Development of future values for these key variables was done using forecasting methods, as described in Volume 1.

Personal Trips: Survey Results for Key Variables

This section summarizes the results of the SANDAG Border Survey used to identify the base year (i.e., 2016) values of the following key variables: average expenditures during border-crossing trips, average expenditures in home country if border-crossing trip is forgone, and elasticity of border-crossing trips to delays. Information on these key variables was collected through the SANDAG Border Survey as part of the economic section of the survey instrument (for background information on the SANDAG Border Survey plan and efforts, see Volume 1, section Data Needs and Data Collection Efforts).[18]

The economic section of the SANDAG Border Survey collected information on a wide array of economic variables, but this section presents the summary results (based on statistical analysis) only on those considered key to the economic analysis component of the study. Therefore, the summary results for the following variables are presented in this section:[19]

- Average Border-Crossing Trip Spending
- Alternate Average Spending in Home Country
- Elasticity of Travel Demand with respect to Border Delay

[17] Information on base year wait times for border crossers was also collected as part of this study. Details about this key input are provided in Volume 1.
[18] For more detail on the variables presented in this section and further description of the values of these variables, see Appendix C to Volume 1.
[19] These variables were discussed during the Risk Analysis Session of the Economic Peer-Review.

The Project Team also produced summary results for the following variables: primary and secondary trip purpose, border-crossing trip spending by category, spending in home country by category, and wages from the SANDAG Border Survey data.[20] These results, and more details about the variables reviewed in this section, can be found in Appendix C to Volume 1. Since the economic questions of the SANDAG Border Survey were collected from border crossers engaged in personal trips, the summary results for each variable in this section are presented separately for the different "modes" of transportation considered under personal trips (i.e., POVs and pedestrians).

AVERAGE BORDER-CROSSING TRIP SPENDING

The SANDAG Border Survey also collected information on expenditure patterns by border crossers to better understand the impact to the economy of foregone trips due to long wait times on either side of the border. In particular, it elicited information on the amount of expenditure during border crossing trips, the categories of expenditure, and expenditure behavior in case a border crossing trip had to be cancelled (i.e., the degree by which the expenditure would be deferred for another crossborder trip or substituted in the home country). For more information on expenditure data validation and the distribution of expenses across expenditure categories, see Appendix C to Volume 1.

All respondents were asked how much they spent or would spend on their border-crossing trip to Mexico or the United States. The expenditure data are particularly skewed right (i.e., not normally distributed), meaning that though many respondents listed expenses from $0 to $100, a significant number of respondents also listed more than $500 in expenses, some listing thousands of dollars in expenditure. About 80 percent of the data is contained within the range of $7 to $350.[21] Some, but not all, of the large expenses may be explained by vacations on either side of the border.

Weighted average expenditure per trip is displayed in Table 5. In general, the survey data indicates that average spending per trip ranges from $112 to $220, across travel modes, border counties, and north and southbound trips.[22] On average, crossers living in Mexico spend less per trip than people living in the U.S., except for vehicle drivers who cross through San Diego County, where spending appears similar for north and southbound trips. People crossing in Imperial County spend less per trip than people crossing in San Diego County, except for people who live in the United States and cross in a vehicle. For border crossers through Imperial County, the average pedestrian spends less than the average person driving across the border, whereas spending patterns across travel mode for crossers in San Diego County display the opposite relationship.

[20] The summary results presented in this document correspond to the weighted average for the key variables presented, where the weights correspond to the border-crossing volumes observed during 2016. The median results for border-crossing trip expenditure, alternate spending in home country, wage, and others were also calculated and are presented in Appendix C to Volume 1.
[21] The statistic used to introduce uncertainty to this variable in the estimation of economic impacts of delays at the border is the median, since trip expenditure values tend to be skewed (in a statistical sense) and the median captures the behavior of the individual at the center of the distribution of possible expenditure levels.
[22] Recall that northbound trips correspond to crossers who stated they live primarily in Mexico, and southbound trips are taken by those who responded they primarily live in the United States.

Table 5. Average Spending per Border Crossing Trip

Average Spending per Border Crossing Trip, Dollars	Imperial County	San Diego County
Pedestrians		
Crossers Living in Mexico	$112	$182
Crossers Living in the U.S.	$142	$220
Vehicles		
Crossers Living in Mexico	$147	$166
Crossers Living in the U.S.	$165	$165

ALTERNATE AVERAGE SPENDING IN HOME COUNTRY

The SANDAG Border Survey asks questions concerning the respondents' spending patterns in case they were to cancel their current trip (for example, if they decided not to take the trip due to long border wait times). In particular, interviewees were asked to consider their actions if they canceled their current border-crossing trip, and whether they would spend all or part of their anticipated trip expenditure in their home country or defer the expenditure until a future border-crossing trip.

Based on the survey responses, people are generally more likely to defer their spending rather than spend it at their home county, but this varies. Crossers who live in the U.S. are more likely to spend in their home country when a border-crossing trip is not taken, compared to crossers who live in Mexico, except for pedestrians in Imperial County. The percent of respondents that would spend at their home country if the border crossing trip was not taken is presented in

Table 6.

About half of pedestrians through Imperial County and one third of pedestrians through San Diego County stated that they would spend their money at their home country versus deferring their spending for another trip. About one third of vehicle crossers through both counties stated they would spend at their home country instead, with a greater portion of vehicle crossers living in the U.S. crossing through San Diego County stating they would spend at home in case of a canceled trip.

Table 6. Respondents that Would Spend at Home Country if Border Crossing Trip was Not Taken

Respondents that would spend at home country if border trip is not taken, percent	Imperial County	San Diego County
Pedestrians		
Crossers Living in Mexico	51.4%	27.7%
Crossers Living in the U.S.	50.6%	38.5%
Vehicles		
Crossers Living in Mexico	31.4%	36.1%
Crossers Living in the U.S.	38.3%	50.4%

The survey asked those individuals that would spend at home their expenditure when a border crossing trip is cancelled, to report the amount of money they would spend at their home country.[23] The average spending at home if a border trip is not taken is reported in Table 7. The average expenditure ranges from $79 for pedestrians living in the U.S. and crossing through San Diego County POEs to $167 for vehicle occupants living in Mexico and crossing through POEs in Imperial County.[24] In general, crossers living in Mexico have higher average expenditures in their home country than crossers living in the U.S. across modes when a border crossing trip is not taken. The exception are pedestrian crossers using Imperial County POEs, since crossers living in the U.S. average $111 dollars of home country expenditure when a border trip is not taken compared to $99 for crossers living in Mexico. A possible explanation for this is that the expenditure categories include groceries, shopping and restaurants, which are more expensive in the United States.

Table 7. Average Spending at Home if a Border Trip is Not Taken

Average Spending at Home if Border Trip is not taken, per Trip, Dollars	Imperial County	San Diego County
Pedestrians		
Crossers Living in Mexico	$99	$128
Crossers Living in the U.S.	$111	$79
Vehicles		
Crossers Living in Mexico	$167	$130
Crossers Living in the U.S.	$102	$95

In the majority of cases the average expenditure at home if a border trip is not taken is smaller than the average spending for border crossing trips made (i.e. people spend less overall if they

[23] As in the case of border-crossing trip expenditures, the statistic that is used to introduce risk analysis to this variable is the median, since expenditure values when a trip is not taken tend to be skewed (in a statistical sense) and the median captures the behavior of the individual at the center of the distribution of possible expenditure levels.
[24] It is worth noting that the behavior of home-country expenditure differs by mode and POE location of the forgone crossing. The percentage of respondents that reported that they would spend at their home country in case a border trip is not taken (by travel mode) is presented in Appendix C to Volume 1 for each specific expenditure category.

forgo the trip entirely, without any deferral of expense). The exception is vehicle crossers that live in Mexico and cross through Imperial County POEs, whose at-home average spending if a trip is not taken is higher than their average spending while on a crossborder trip. There could be several explanations to this result, including price differences between goods and services and the distribution of expenditures across categories by this group of border-crossers when a border trip is not taken.

ELASTICITIES OF TRAVEL DEMAND WITH RESPECT TO BORDER DELAY

A key question of the survey asked respondents to report how much longer (compared to their perception of currently-anticipated wait time) they would be willing to wait before deciding to cancel a crossborder trip they had already planned. Respondents were given a series of time intervals representing additional wait times (ranging from 5 minutes to more than 4 hours) to choose from. Using this information, an estimate of the elasticity of travel demand with respect to border delays was derived using a standard formula for the estimation of elasticities for work and non-work trip purposes.[25]

This variable represents the percentage change in border crossings associated with a one percent increase in wait time at the border, so an elasticity of -0.03 (reported for pedestrians crossing for work or business purposes in Imperial County) means that a 1 percent increase in wait times at the pedestrian crossings in Imperial would represent a reduction of 0.03 percent in the number of pedestrian crossings through these POEs for this type of crossing purpose.

The estimates of the elasticities derived from the SANDAG Border Survey are presented in

[25] In particular, for every time interval included in the survey, the percentage change in the number of respondents that reported would cancel the trip was estimated and compared to the percentage change that the additional wait time represents over the current wait time.

Table 8 for different types of crossers, trip purposes and counties where the crossings occur.[26] These elasticities were combined in the economic analysis with the average delays estimated in this study (see Volume 1) and the future delays calculated through the methodology described in Volume 1 to assess the economic impact of delays.

[26] Since the survey asked about a range of potential additional wait times, several sets of elasticities were estimated based on their answers (one for each potential range). The elasticities listed in

Table 8 correspond to the median elasticity, since that represents the most-likely response.

Table 8. Elasticity of Travel Demand With Respect to Border Delays

Elasticity of Travel Demand With Respect to Border Delays	Imperial County	San Diego County
Pedestrians		
Crossing for work or business	-0.03	-0.07
Crossing for a non-work purpose	-0.05	-0.09
Vehicles		
Crossing for work or business	-0.09	-0.08
Crossing for a non-work purpose	-0.12	-0.11

The survey data shows that the response of border crossers to increased wait times is fairly inelastic across all crossing types and across counties where the POEs are located. For example, a one percent increase in wait times for pedestrians crossing for work or business through San Diego County POEs will translate in a reduction in the number of pedestrians crossing the border through that region of only 0.07 percent. In other words, a marginal increase in wait time has a very small impact on the number of border-crossing trips, suggesting that crossers have high tolerance to wait times throughout the area.

Comparatively, the estimated elasticities show that pedestrians are less sensitive to additional wait times than occupants of vehicles, which could be a reflection that pedestrians are more likely to commit to a border crossing trip once they start it. People crossing for work are less sensitive to additional wait times than those crossing for non-work purposes, likely because they have a greater motivation for and less flexibility in their crossborder trip. Similarly, the estimates show that vehicle crossers in San Diego County are slightly less sensitive to additional border crossing wait times than vehicle crossers in Imperial County, but the opposite is true for pedestrian crossers (pedestrian crossers in San Diego County are slightly more sensitive to wait times than in Imperial County).[27]

OTHER RELEVANT VARIABLES

The survey captured information on other variables that are relevant to understanding behavioral patterns of border crossers. These include trip purpose, origin-destination of crossborder trips and productivity loss due to delays at the border.[28] Summaries of these variables can be found in Appendix C to Volume 1.

CROSS BORDER XPRESS VARIABLES

The surveys collected at CBX as part of the SANDAG Border Survey shed light on the recent change in behavior of border crossers traveling to and from the Tijuana airport during their trip due to the opening of this facility. The short survey conducted at the facility was geared toward capturing responses on trip purpose, expenditure per trip, and crossing behavior before the

[27] Since border crossers travel in both directions during any particular border crossing trip, the elasticity is assumed to be equal for crossers living in the U.S. and Mexico.
[28] Information on origins and destinations used in this study was sourced primarily from the SR11 Binational Travel Demand Model (Version 2.0, February 12, 2018) during an earlier phase of the current study. The information from the SANDAG Border Survey was used for validation purposes.

existence of CBX. The summary statistics for these key variables are presented in Appendix C to Volume 1.[29]

Personal Trips: Base Year Conditions for Other Key Variables

In addition to the key inputs whose values were collected through the SANDAG Border Survey, the study collected data on the base year conditions of border-crossing volumes and delays. In the case of volumes, the information for year 2016 was collected from the Bureau of Transportation Statistics (BTS) by POE and in the case of delays, the information was estimated from measurements collected in the field as part of this study. The most-likely values for these key inputs are presented in Volume 1.

Personal Trips: Incorporating Uncertainty to Base Year Condition Values for Key Variables

The Project Team used a risk analysis approach to address the issue of uncertainty in the value of the key inputs generated by the margin of error of the SANDAG Border Survey and the measurements performed in the field. To accomplish this, probability ranges were created around the most-likely values found earlier in this section using a statistical analysis of the data collected as part of this study. The probability ranges are entered in the model to create a distribution for the variables. The distributions are defined such that 80 percent of the values are contained within the probability range presented.

Excess wait time at the border is defined as a symmetrical distribution. Most likely values for excess border wait time variables are presented in Volume 1, in the Development of Future Conceptual Scenarios section, by mode, scenario, and POE. Most likely values are represented by a measure of delay based on border-crossing times for POVs that were measured at the border for this study (see section Development of Future Conceptual Scenarios in Volume 1 for a description of data collection). Here we present the range defined around most likely values of excess border wait time for the Baseline Scenario in the Base Year (2016). High and low values of the range are computed as plus and minus 20 percent of the most likely value, respectively.[30] Table 9 presents the ranges for excess border wait time in minutes for the Baseline Scenario in the Base Year.

[29] The CBX surveys were used primarily to understand the border-crossing behavior of airport users in the region, but the results were not included in the estimation of economic impacts of delays.
[30] This range is commonly used to account for uncertainty in variables with a symmetrical distribution.

Table 9. Ranges for Excess Border Wait Time (minutes) in the Baseline Scenario

Average Excess Wait Time, minutes	Imperial County			San Diego County		
	Low	Most Likely	High	Low	Most Likely	High
Pedestrians						
Crossers Living in Mexico	21.5	26.6	32.2	30.8	38.0	46.0
Crossers Living in the U.S.	14.0	17.3	21.0	22.6	27.9	33.7
Vehicles						
Crossers Living in Mexico	34.7	42.8	51.8	32.0	39.5	47.8
Crossers Living in the U.S.	2.5	3.1	3.7	4.1	5.0	6.1

The expenditure variables (spending per crossborder trip and spending per foregone trip) are defined with an asymmetrical distribution, because the survey data on this variable was particularly skewed right. The ranges for each subsample were derived from statistical analysis of the expenditure survey data. The most likely values still represent the most likely value (50th percentile) and 80 percent of values in each distribution still fall within these ranges. Every distribution is defined such that the minimum expenditure is zero dollars. Further, these spending behaviors are assumed constant for the analysis period (2016 to 2025).

Average crossborder expenditure ranges are presented in Table 10 for each mode, country of residence and county. In San Diego County, spending is largely similar across country of residence, and pedestrians have a higher upper range of spending than vehicle passengers. In Imperial County, the high end of spending by crossers living in the U.S. is much larger than crossers living in Mexico. Interestingly, for southbound crossers, vehicle passengers have a higher average spending level, but pedestrians have a higher upper range (almost twice as much). This essentially represents a general population average around the most likely value of spending, with a handful of very large spenders.

Table 10. Ranges for Average Spending per Border Crossing Trip

Average Spending per Border Crossing Trip, Dollars	Imperial County			San Diego County		
	Low	Most Likely	High	Low	Most Likely	High
Pedestrians						
Crossers Living in Mexico	$26	$112	$357	$31	$182	$1,458
Crossers Living in the U.S.	$22	$142	$2,093	$38	$220	$1,142
Vehicles						
Crossers Living in Mexico	$32	$147	$683	$36	$166	$864
Crossers Living in the U.S.	$31	$165	$1,103	$39	$165	$874

Ranges for average expenditure in home country per foregone trip are presented in Table 11 for each mode, country of residence and county. In most cases, the ranges for home spending are lower than their corresponding crossborder spending ranges. The exceptions are the upper ends of the spending ranges for crossers living in Mexico through Imperial County. This may be because there are greater spending opportunities in some crossers' home towns than in Andrade.

Table 11. Ranges for Average Spending at Home if a Border Trip is Not Taken

Range in Average Spending per Foregone Trip, Dollars	Imperial County			San Diego County		
	Low	Most Likely	High	Low	Most Likely	High
Pedestrians						
Crossers Living in Mexico	$31	$99	$431	$26	$128	$1,218
Crossers Living in the U.S.	$19	$111	$1,803	$27	$79	$838
Vehicles						
Crossers Living in Mexico	$36	$167	$775	$32	$130	$760
Crossers Living in the U.S.	$24	$102	$855	$22	$95	$494

Ranges of elasticities were calculated for risk analysis purposes in the analysis based on the SANDAG Border Survey responses, and the low and high elasticity estimates are presented in Table 12.[31] Upon statistical analysis of the survey responses, it was determined that an asymmetrical distribution would be appropriate for border crossing elasticity. The high ends of the ranges show that travelers' sensitivity to wait times can be significant, though the most likely elasticity value is closer to the lower end than the upper end of the range. In other words, the elasticity distribution is skewed right, but on average the sensitivity of travelers to delays at the California-Baja California border is still fairly small. Further, the Project Team assumes that these sensitivities will not change over the analysis time period.

Table 12. Range for Elasticities of Travel Demand With Respect to Border Delays

Elasticity of Travel Demand With Respect to Border Delays	Imperial County			San Diego County		
	Low	Most Likely	High	Low	Most Likely	High
Pedestrians						
Crossing for work or business	-0.02	-0.03	-0.09	-0.05	-0.07	-0.15
Crossing for a non-work purpose	-0.03	-0.05	-0.08	-0.03	-0.09	-0.08
Vehicles						
Crossing for work or business	-0.05	-0.09	-0.23	-0.04	-0.08	-0.11
Crossing for a non-work purpose	-0.08	-0.12	-0.26	-0.04	-0.11	-0.15

[31] The basis for these estimates is the responses provided by border-crossers as part of the SANDAG Border Survey. The responses were provided in ranges of time (or bins), and those bins were used to estimate the high and low ranges of the elasticities.

No risk analysis was conducted for 2016 volumes because they came from an official source with reliable measurement procedures.

Freight Trips: Base Year Conditions for Key Variables

This section summarizes the data collected from published secondary sources used to identify the base year (i.e., 2016) values of the following key variables: share of border-crossing loaded trucks, value per border-crossing loaded truck, and the elasticity of border-crossing freight trips to delays.[32]

The share of border-crossing loaded (and empty) trucks was sourced from the BTS by POE for northbound flows, and the share of loaded trucks for southbound flows was extrapolated from data provided by Mexican Aduanas. Shares are presented in Table 13. These values are used in the calculation for the value per loaded truck and are assumed constant for the analysis period.

Table 13. Share of Empty Border-Crossing Trucks

Share of Empty Trucks	Imperial County	San Diego County
Northbound	35%	24%
Southbound	46%	46%

The value per border-crossing loaded truck was calculated from the BTS by POE. Annual import and export trade value, together with annual northbound and southbound loaded truck traffic, formed the northbound and southbound average values per loaded truck, respectively. Per truck values are assumed to remain constant in future years (growth in demand for crossborder trade is represented in growth of truck crossings). Economic and trade conditions that might otherwise change the per truck value are assumed to remain largely the same. Table 14 presents the value per *loaded* truck by county (weighted averages by truck volumes), which enters in the model for impacts of delay on freight. For comparison, the value per truck crossing (including empty trucks) is also presented.

Table 14. Average Value per Truck Crossing

	Imperial County	San Diego County
Value per Loaded Truck Crossing		
Northbound	$41,451	$37,794
Southbound	$33,538	$29,250
Value per Truck Crossing		
Northbound	$26,943	$28,657
Southbound	$18,111	$15,795

[32] These variables were discussed during the Risk Analysis Session of the Economic Peer-Review.

The elasticity of border-crossing trips to delays for freight was gathered from relevant literature and are presented in Table 15. Understandably, the product group most sensitive to border delay is agricultural and food products. Again, these sensitivities are assumed constant for the study period.

Table 15. Elasticity of Freight Demand With Respect to Border Delays

Elasticity of freight demand by type of good	Imperial County and San Diego County
Agricultural and Food Products	-0.69
Mining and Mineral Products	-0.21
Machinery and Equipment	-0.15
Manufactured Goods	-0.15

The sources for border-crossing volumes and delays are the same for freight and personal trips. The study collected data on the base year conditions of border-crossing volumes for year 2016 from the BTS by POE, data on delays and excess wait time was estimated from measurements collected in the field as part of this study. The most-likely values for these key inputs are presented in Volume 1.

Freight Trips: Incorporating Uncertainty to Base Year Condition Values for Key Variables
The Project Team used a risk analysis approach to address the issue of uncertainty in the value of the key inputs generated by missing and unknown information inherent in the data gathered from the published secondary sources. To accomplish this, probability ranges were created around the most-likely values found earlier in this section using a statistical analysis of the data collected as part of this study.

The probability ranges are entered in the model to create a distribution for the variables. The distributions are defined such that 80 percent of the values are contained within the probability range presented.

Ranges for the share of empty border-crossing trucks were based on a statistical analysis of BTS data and the Peer Review Process. The Project Team derived wider ranges on freight flows through San Diego County compared to Imperial County based on Peer Review feedback. Across directions and counties, the defined distributions are slightly skewed left, so the distributions slightly favor values left of the most likely value (less empty and more loaded trucks crossing the border) compared to the higher values in the distributions.[33] Ranges are presented in Table 16.

[33] Note that each distribution is still assumed independent of the others.

Table 16. Ranges for Share of Empty Border-Crossing Trucks

Share of Empty Trucks	Imperial County			San Diego County		
	Low	Most Likely	High	Low	Most Likely	High
Northbound	30%	35%	38%	16%	24%	29%
Southbound	39%	46%	50%	30%	46%	54%

Ranges for average value per loaded truck crossing are presented in Table 17, calculated as plus and minus 20 percent of the most likely value. The distributions defined by these ranges are symmetrical.

Table 17. Ranges for Average Value per Loaded Truck Crossing

Value per Loaded Truck	Imperial County			San Diego County		
	Low	Most Likely	High	Low	Most Likely	High
Northbound	$33,161	$41,451	$49,741	$30,236	$37,794	$45,353
Southbound	$26,831	$33,538	$40,246	$23,400	$29,250	$35,100

Ranges for the elasticity of freight demand are presented in Table 18, calculated as plus and minus 20 percent of the most likely value. The distributions defined by these ranges are symmetrical.

Table 18. Ranges for Elasticity of Freight Demand With Respect to Border Delays

Elasticity of freight by type of good	Imperial County and San Diego County		
	Low	Most Likely	High
Agricultural and Food Products	-0.83	-0.69	-0.55
Mining and Mineral Products	-0.25	-0.21	-0.17
Machinery and Equipment	-0.18	-0.15	-0.12
Manufactured Goods	-0.18	-0.15	-0.12

Identification of Future Conditions under Uncertainty

The Economic Impacts of Delays component of this study quantifies the annual economic impacts of delays between the year 2016 (base year) and the year 2025. The estimation of future impacts is primarily dependent on what the future of border-crossing will look like in the region.

Volume 1 describes the future forecasts of two key inputs into the analysis of future economic impacts of delays, namely growth in border-crossing volumes and growth in border-crossing delays. In particular, Volume 1 characterized the most-likely values for volumes and delays under each Conceptual Scenario. However, given the uncertainty surrounding the characteristics of border crossing trips between now and year 2025, the Project Team incorporated risk analysis in the forecast of key inputs under each Conceptual Scenario.[34]

Overview of Conceptual Scenarios

The conceptual scenarios analyzed as part of this study are defined for each border sub-region (i.e., San Diego County-Tijuana/Tecate and Imperial County-Mexicali), POE, and year of analysis. The scenario for 2016 represents existing conditions. Scenarios for future years and both subregions can be summarized based on the following characteristics[35]:

- **Baseline Scenario** includes certain planned improvements to border-crossing capacity completed by the year 2025, such as Phase 3 improvements at San Ysidro, modernization of the cargo and pedestrian facilities at Otay Mesa, and Phase 1 improvements at Calexico West. This scenario is estimated for all existing POEs in the base year (2016).

- **Baseline Scenario plus Capacity Enhancements and Transit and Active Transportation** considers significant border crossing capacity improvements in year 2025 such as the additional POE at Otay Mesa East, improvements at existing POEs like Calexico East with the expansion of the All-American Canal bridge, and transit and pedestrian access improvements in the vicinity of the POEs in years 2025 and 2035. The assumed first year of operations for these improvements is 2022. The Otay Mesa East POE capacity is planned to be phased; at opening day it will be in a 5x5 configuration and expanded to a 10x10 configuration at a later date. [36] Thus, the results from the SR 11 BTDM with a 5x5 configuration at Otay Mesa East represent the first Baseline Scenario plus Capacity Enhancement for years 2025 and 2035, and the results from the SR 11 BTDM with a 10x10 configuration at Otay Mesa East represent the second Baseline Scenario plus Capacity Enhancement for year 2035.

[34] The uncertainty addressed in this section is related to the potential forecasting errors described earlier in this Volume.
[35] Even though the USMCA trade agreement has entered into force as of July 1, 2020, the scenarios described here assume that future conditions are based on extrapolation of current conditions and that USMCA is not likely to cause significant changes between now and the year 2025.
[36] The 5x5 configuration for OME entails 5 POV and 5 commercial vehicle lanes in *both* directions – so 10 total northbound (NB) lanes and 10 southbound (NB), resulting in 20 bidirectional total. The 10x10 configuration entails 10 POV and 10 Commercial lanes in each direction, resulting in 40 lanes total (20 NB and 20 SB).

- **Sensitivity Scenario** describes changes to future volumes or wait times due to changes in policies, level of economic activity, or other factors, such as changes due to the USMCA trade agreement. This scenario is estimated for all POEs.

The conceptual scenarios used for the Economic Impact Analysis are also defined in Volume 1, in the Development of Future Conceptual Scenarios section, by POE, analysis type, and forecast year. Key inputs that are specific to the Conceptual Scenarios comprise the future border crossing volumes (or, similarly, their growth rates compared to the volumes in 2016) and the future delays (or, similarly, their growth rates compared to the delays in 2016). The most-likely future volumes and future delays used for both the Economic and Air Quality/Emissions Impact Analyses are presented in Volume 1, under the Summary of Border Crossing Volumes for Conceptual Scenarios subsection. The methodology used in the development of these most-likely values of future growth rates for volumes and delays is described in Volume 1, in the Summary of Methodologies Used to Forecast Future Conditions subsection. The full description of this methodology can be found in Volume 1, in the Forecasting Future Volumes of Border-Crossing Traffic subsection.

Future Values and Uncertainty Ranges for Border-Crossing Volumes in Conceptual Scenarios

Risk is incorporated in the analysis of the Conceptual Scenarios through ranges around the growth rates for both the volume and delay variables. Ranges around the crossing volume growth rates account for the one source of uncertainty, due to forecasting error, in key crossing volume inputs. When applied to base volumes, this creates a range of realized future border crossing volumes in the analysis of the Conceptual Scenarios for volume variables.[37] This section presents the most likely growth rates of crossing volumes for each conceptual scenario.

The most likely growth rates are indirectly derived in the transfer of sensitivities methodology described in Volume 1. Briefly, the transfer of sensitivities methodology principally estimates crossing volumes (in levels), for future years and for each scenario, based on BTS data, results from the SR-11 Binational Travel Demand Model (Tier II Traffic and Revenue, April 2020), and other off-model adjustments. These volumes are presented in Volume 1, in the Development of Future Conceptual Scenarios section. Growth rates (most likely values) are derived from these crossing volumes for each scenario solely for the purpose of accounting for uncertainty in the analysis. For crossing volumes, the ranges around the growth rates are calculated as plus/minus 50 percent of the most likely value.

[37] Since the results of this study are presented in terms of dollars of 2016, the key variables related to border-crossing expenditures are kept constant across the future years. Similarly, the elasticities with respect to delays are assumed to be constant across time so there is no risk analysis applied to them across future years.

Table 19 through Table 21 display the low, most likely, and high values for compound annual growth rates (CAGRs) for crossing volumes of passenger vehicles, commercial vehicles, and pedestrians. Note that pedestrian border crossing volumes are the same in 2035, regardless of the Otay Mesa East POE configuration.

Table 19. Growth Rates on Passenger Vehicle Border Crossing Volumes, by Conceptual Scenario

Scenario		Baseline	Baseline plus capacity enhancements*		
			OME at 5x5	OME at 5x5	OME at 10x10
CAGR Year		2016 to 2025	2016 to 2025	2025 to 2035	2025 to 2035
San Diego County	Low	1.08%	1.21%	0.66%	0.84%
	Most Likely	2.17%	2.42%	1.31%	1.68%
	High	3.25%	3.63%	1.97%	2.52%
Imperial County	Low	0.70%	0.87%	-0.42%	-0.42%
	Most Likely	1.40%	1.74%	-0.83%	-0.83%
	High	2.10%	2.61%	-1.25%	-1.25%

*Includes transit and active transportation improvements.

Table 20. Growth Rates on Commercial Vehicle Border Crossing Volumes, by Conceptual Scenario

Scenario		Baseline	Baseline plus capacity enhancements		
			OME at 5x5	OME at 5x5	OME at 10x10
CAGR Year		2016 to 2025	2016 to 2025	2025 to 2035	2025 to 2035
San Diego County	Low	1.26%	1.27%	1.08%	1.08%
	Most Likely	2.53%	2.55%	2.15%	2.16%
	High	3.79%	3.82%	3.23%	3.24%
Imperial County	Low	0.72%	0.82%	0.66%	0.66%
	Most Likely	1.44%	1.64%	1.33%	1.33%
	High	2.15%	2.46%	1.99%	1.99%

Note: Transit improvements have no bearing on commercial vehicle crossings.

Table 21. Growth Rates on Pedestrian Border Crossing Volumes, by Conceptual Scenario

Scenario		Baseline	Baseline plus capacity enhancements*	Baseline plus capacity enhancements*
CAGR Year		2016 to 2025	2016 to 2025	2025 to 2035
San Diego County	Low	0.08%	0.28%	0.32%
	Most Likely	0.16%	0.56%	0.63%
	High	0.24%	0.84%	0.95%
Imperial County	Low	0.11%	0.12%	0.11%
	Most Likely	0.21%	0.24%	0.21%
	High	0.32%	0.36%	0.32%

*Includes transit and active transportation improvements.

Future Values and Uncertainty Ranges for Border-Crossing Delays in Conceptual Scenarios

There are two sources of risk accounted for in the analysis of the Conceptual Scenarios for delay variables. The first is measurement error in the field measurements of this study that represent base year conditions, the ranges for which are presented in the section in this Volume on Base Year Conditions (Personal Trips: Incorporating Uncertainty to Base Year Condition Values for Key Variables). The second is uncertainty due to forecasting error, accounted in ranges around the growth rates for delay. When applied to base wait times, this creates a range of realized future border crossing wait times and delay.

Growth rates of wait times are derived from wait times in levels at specific years within the study period for the purpose of accounting for uncertainty in the analysis. In particular, individual growth rates in wait times were estimated for each individual conceptual scenario and were assumed to be constant across all years of analysis to simplify the risk analysis computations. Further, due to the limited information available on pedestrian wait times and processing speeds, wait time growth for pedestrians is assumed equal to wait time growth for passenger vehicles at the county level.

This section presents the most likely growth rates of wait times for each time period for all conceptual scenarios. The growth rates reported for 2025 to 2035 wait times (estimated within the emissions analysis) are representative of both Baseline plus Capacity Enhancement Scenarios, the first of which OME is in a 5x5 configuration, and the second of which OME is in a 10x10 configuration. The ranges around the wait time growth rates are assumed to be plus/minus 20 percent of the most likely value, though ranges are not calculated for the 2025 to 2035 growth rates, as the ranges are not used in the emissions analysis. Table 22 and Table 23 display the low, most likely, and high values for compound annual growth rates (CAGRs) for passenger vehicles, commercial vehicles, and pedestrians.

Table 22. Growth Rates on Border Wait Times for Passenger Vehicles and Pedestrians by Time Period

Scenario		Baseline		Baseline plus capacity enhancements		Baseline plus capacity enhancements	
CAGR Year		2016 to 2025		2016 to 2025		2025 to 2035*	
Direction		Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
San Diego County	Low	-6.4%	28.5%	-5.4%	30.9%	n/a	n/a
	Most Likely	-8.0%	35.7%	-6.8%	38.6%	29.3%	26.1%
	High	-9.5%	42.8%	-8.2%	46.4%	n/a	n/a
Imperial County	Low	3.1%	-8.1%	3.1%	-8.1%	n/a	n/a
	Most Likely	3.9%	-10.1%	3.9%	-10.1%	8.4%	-15.3%
	High	4.7%	-12.1%	4.7%	-12.1%	n/a	n/a

Note: The Baseline Scenario plus Capacity Enhancements includes transit and active transportation improvements.
*County-wide growth in wait times from 2025 to 2035 are estimated for each POE within the emissions analysis.

Table 23. Growth Rates on Border Wait Times for Commercial Vehicles by Conceptual Scenario

Scenario		**Baseline**		**Baseline plus capacity enhancements**		**Baseline plus capacity enhancements**	
CAGR Year		**2016 to 2025**		**2016 to 2025**		**2025 to 2035***	
Direction		**Northbound**	**Southbound**	**Northbound**	**Southbound**	**Northbound**	**Southbound**
San Diego County	Low	-3.7%	11.7%	1.2%	12.6%	n/a	n/a
	Most Likely	-4.6%	14.7%	1.5%	15.7%	45.0%	70.4%
	High	-5.5%	17.6%	1.7%	18.9%	n/a	n/a
Imperial County	Low	1.2%	0.1%	1.2%	0.1%	n/a	n/a
	Most Likely	1.5%	0.2%	1.5%	0.2%	28.7%	261.3%**
	High	1.8%	0.2%	1.8%	0.2%	n/a	n/a

Note: Transit improvements have no bearing on commercial vehicle crossings.
*County-wide growth in wait times from 2025 to 2035 are estimated for each POE within the emissions analysis.
**Southbound wait times at Calexico East are anticipated grow from 12 minutes in 2025 to 42 minutes in 2035 because demand exceeds the capacity of the single southbound primary booth.

Economic Impact Analysis Results

The assessment of economic impacts of delays in the California-Baja California region was done using two different approaches. The first approach comprised an outreach to businesses in the California-Baja California region to obtain opinions and anecdotal evidence to support a qualitative impact assessment of prolonged or increased delay at the border. The second approach consisted of developing an economic model (based on the IO models described in the methodology of the study) that reflects the interactions between the different variables described in the methodology section to conduct a quantitative assessment of the impacts of delays. The results of both approaches are presented in this section of the report.

Results from Business Interviews Approach

This section summarizes the efforts for and results of the economic business outreach. The Project Team, together with SANDAG and ICTC, chose 20 businesses with ties to the border to interview, focusing on questions relating to the supply chain, logistics, employment, and customer service. The companies chosen span nine different industries and include businesses both on the U.S. side and the Mexican side of the border. A handful of trends were expressed in the interviews and were common among businesses across the California-Baja California border region[38]:

- Local adaptability to border delay;
- Importance of accessibility;
- Desire to reduce border delays; and
- Desire for improved processing measures.

The main points for each are briefly summarized in the following four sections.

BORDER DELAY ADAPTABILITY

The interview responses indicate that many workers and customers traveling across the border are relatively tolerant to small changes in border delay, especially when border wait times are as expected, albeit long. Because people are accustomed to the border delay, it is normal to incorporate the extra time in their travel or commute plans, and their decision to cross the border is unlikely to change with border wait times. For example, if the standard wait times are long (1 to 1.5 hours), an extra 10 to 15 minutes is a relatively small increase, and may not be significant enough to change their behavior.

Several human-capital-dependent companies do not perceive a significant impact from border delays on their employment or operations, stating that people simply incorporate extra travel time for their crossborder commute, at times purposefully living and working on opposite sides of the border. However, unpredictable changes in the border wait times, due to construction or long-term lane closures, are perceived to negatively impact customers, employees, and sales more than expected border delay.

[38] In the border wait time data collection efforts, it is clear that northbound delays are longer than southbound delays. However, the responses in these interviews imply that both northbound and southbound delays affect multiple aspects of business operations (logistics, supply chain management, customer service and accessibility, and employment or human capital), for companies on the north and south side of the border.

A few employers perceive that the long border wait times negatively impact the quality of life of their employees. Others acknowledge that the decision is made deliberately by employees to extend their U.S. income across a lower cost of living in Mexico. It appears that some crossborder workers are able to incorporate the trade-off in quality of life between the long commute and the higher compensation and adapt when necessary, and that these compensated and adaptable individuals are more likely to be high-skilled workers.

Based on the interviews, one group of workers is potentially more sensitive to border delay, consisting of the low-skilled, entry-level portion of the labor force, mainly employed in agriculture, hospitality, or retail. In this region there are more low-skilled workers than low-skilled jobs, so workers must compete for employment and the market favors the employer. Thus, these employees bear a majority of the costs of border delay and their border delay adaptability is borne out of a necessity to stay employed. Interviewees (the employers) listed additional stress, high turnover, absences, and lateness due to unpredictable or increased border delay, impacting job retention and productivity, particularly for part-time and seasonal workers.

One interview revealed that there is a growing supply of skilled labor in Mexico fostered by local universities and vocational schools (specifically mechanical and bio-medical engineers and software developers). Companies with operations on the Mexico side of the border increasingly rely on this labor force instead of crossborder employees and thus avoid the impacts of border delay on their employees. The availability of skilled labor remains an important factor in locational decisions for operations on both sides of the border.

According to the interviews, companies that see employees commuting across the border include bio-medical, hoteling, freight, agriculture, retail, food service, and health care businesses. It is expected that hospitals and manufacturing companies also employ labor from across the border, though none of the interviews with companies from these industries revealed that their employee base comprised crossborder commuters.[39] It is clear that health care facilities in Mexico and retail centers in the U.S. serve crossborder clientele, some specifically catering to clients across the border.

ACCESSIBILITY AND MISSED OPPORTUNITIES

Many companies express border delay concerns not only in terms of the monetary costs from border delay increases, but also in the missed opportunities and potential benefits from improvements in crossing times and efficient processing, which can be summarized generally as the importance of accessibility in the Cali-Baja border region. Representatives from interviewed companies discuss missed opportunities in employment and business development in the region, and limitations to economic expansion on both sides of the border. They also discuss cost savings in labor, productivity, inventory, and warehousing. One interviewee mentioned that “a reduction in border friction” would likely increase company functions in Tijuana. Another interviewee stated that long border delays cancel out the strategic advantage of proximity to the border.

[39] However, it appears that some workers living in Mexico and working in the U.S. maintain a U.S. address for personal reasons, and provide this address to their employer. Thus for large corporations, and from a human resources point of view, employee residence is difficult to confirm.

Manufacturing and logistics companies discuss accessibility and opportunities in terms of goods movement, reliable travel times in both directions, border processing efficiency, and relative proximity to suppliers and markets. Representatives from advanced manufacturing operations and freight service companies particularly expressed a desire for better access to ports, better roadway infrastructure in Tijuana, more efficient and expedited processing measures at the border, and more predictability (or less uncertainty) around crossborder trips.

In particular, one construction company representative asserted that reducing border delays would increase Tijuana's competitiveness as an industrial location, and a hotel representative discussed the potential to attract international tourism to the Cali-Baja border region. Several companies expressed that accessibility and the "agility" of goods movement were main factors in their locational decision of the Baja-Cali region.[40] A recurring issue for companies that move goods across the border is holiday closures across the U.S. and Mexico, which create significant barriers to freight flows and can take several days for businesses to recover.

Companies that rely on human capital and labor, such as medical centers, bio-medical engineering and research sites, retail centers, and hospitality operations, want increased access to the labor force and business locations across the border. Some also stated that employee productivity is directly affected by delays at the border. Businesses based north of the border desire access to recruitment opportunities from a workforce available only in Mexico. As one interviewee said, "talent is only as good as the access to it." With increasingly perceived barriers to the sites and talent across the border, some companies with higher sensitivity to border delays may consider relocating their business if border delays worsen.

BORDER DELAY REDUCTION MEASURES

Several of the companies expressed that they are currently implementing measures to alleviate the effects of border delays. The current strategies largely comprise a reallocation of resources and working around the current extreme border wait time peaks, based on interview information. Companies that rely on or serve the flow of inputs (goods and products), logistics operations, delivery services, and manufacturing companies, are able to schedule truck shipments during off-peak hours, incorporate expected border delay into truck delivery and inventory schedules, and alter warehousing and inventory decisions to avoid more costly consequences of border delay. As one interviewee said, "we have become very good planners, but there's a cost associated with that."

Many businesses that move goods north across the border utilize expedited processing programs for truck movements, though there is a general awareness of diminished benefits from such programs due to their popularity.[41] Companies have also explored changing the sea ports used for inputs and outputs (e.g. using the sea port on the same side of the border, rather than crossing the border for the larger sea port) and increasing the use of Mexico-based suppliers instead of importing inputs. A small subset of companies has the margin to take comparatively

[40] The need for accessibility is especially prevalent for manufacturing companies in Tijuana whose production lines rely on the timely arrival of southbound supplies.
[41] Examples of expedited processing programs include the Customs Trade Partnership Against Terrorism (CTPAT) and Free and Secure Trade (FAST). Such programs are only available for northbound truck movements.

extreme measures to alleviate border delay because of the time sensitivity of their product input and the high value of their final product.

In contrast, some companies are 'maxed out' in their ability to lessen border delay impacts, according to the interviews. Day-to-day business operations do not always allow the opportunity to be flexible with schedules, routes, and providers. Scheduling limitations and demand of freight movements can override attempts at efficiency and expediency. Border delays impact multiple aspects of the logistics supply chain, as both actual product deliveries and empty units on a return trip (drivers and trailers) are affected, further limiting shipment options and companies' efforts to alleviate border delay impacts. Impacts are prevalent when the border delay is unpredictable or when large, unique, or time-sensitive (just-in-time) orders and shipments are involved. In these instances, impacts of border delay can be cumbersome.

Companies that rely on skilled labor force movements across the border attempt to alleviate labor productivity losses by lessening border delay inconveniences for their employees. Strategies implemented by businesses include flexible work schedules, designated shuttles to transport workers across the border from one office or factory location to another, and reimbursement for Secure Electronic Network for Travelers Rapid Inspection (SENTRI) passes. Interview information implies that companies employing low-skilled labor simply deal with the high turnover and extra operating costs and do not attempt to lessen the effects of border delay on their crossborder workers.

In some cases employees will take measures to lessen the impact of border delay on their commute.[42] Representatives from a food service business and an agricultural operation stated that some employees respond to border delay by immigrating and relocating to the U.S. when possible, and others leave for work earlier or use a different POE to commute. They also stated that significant increases in border delay motivate some people to leave their jobs in the U.S. for employment in Mexico, which indicates that given the right opportunity, some workers opt to avoid a crossborder commute altogether.

NEED FOR MORE IMPROVEMENTS AT THE BORDER

The unpredictability of wait times was listed as the most impactful aspect of border delay, even more than the wait times themselves. Unpredictable wait times make it difficult for businesses to plan logistics accordingly. Inefficient processing at the border is cited as another factor that increases border delay. Both issues are costly in inventory, production, and overtime costs, in addition to the logistical problems due to reduction in available trailers and drivers for crossborder trips.

The companies heavily involved with goods movement applaud programs like the Unified Cargo Processing (UCP), FAST, and joint inspection facilities. Others look to the SENTRI program and Cross Border Xpress (CBX) as good examples of expedited border crossing for individuals. Several interviewees expressed a desire for additional expedited processing programs for low-

[42] Note that this information comes from what the employer perceives that the employee does to lessen crossborder commuting delays, as no individual employees were interviewed.

risk and frequent goods shipments and commuters, so there is some strategic advantage to be regained at the border.

Regarding the standard border crossing procedure, one freight services company representative suggested that an emphasis should be placed on efficiency (via more lanes, more staff, better electronic systems support, and more federal support) and not on expansion of schedules, so that processing time is improved. On the contrary, an agriculture company representative suggested opening the POEs earlier to cater to the early-morning commute times of field workers, and some businesses wish for an extra hour designated for preapproved business freight movements.

There is also a desire, expressed in several interviews, for improved infrastructure near the POEs on the Mexican side of the border. As some stated, “Infrastructure in Tijuana impacts [the] flow of goods.”, noting the limited directional signage, poor condition of local streets, and congestion to access the POEs in Baja California. In addition to the economic ramifications to local and regional businesses, the condition of the infrastructure also impacts the impression of Tijuana as a potential business and production site. Improvements in local road surfaces, roadway connectivity, and signage at all the POEs would increase the number of useful access points and provide more options for crossing the border. Well-designed directional signage for SENTRI, ReadyLane, and Regular lanes would decrease confusion and congestion. Further, lane closures and significant changes to POE operations should be communicated clearly and often, so people and businesses can plan for the extra delay.

Finally, several interviewees are anticipating a new POE to decrease border delay times at existing POEs. Many businesses support opening another POE and are eager to take advantage of the general reduction in delays and more specifically the shorter wait times at the new POE. They also expect that the new POE will foster greater economic development in the region.

Results from Quantitative Analysis Approach

The Economic Impact Analysis results are presented by mode (pedestrians, privately-owned vehicles, and commercial vehicles) and by border crossing region (San Diego County, Imperial County). Impacts for passenger vehicles and pedestrians are estimated for spending categories (retail, recreation and entertainment, hotels, and miscellaneous), while impacts for commercial vehicles are estimated for generalized sectors (agricultural and food products, mining and mineral products, machinery and equipment, and manufactured goods).

Economic impacts on output and labor income are quantified in millions of 2016 U.S. dollars, and impacts on employment are quantified in number of jobs. Results are presented for each of the conceptual scenarios analyzed, and for corresponding years, summarized as:

- Baseline Scenario, Base Year (2016);
- Baseline Scenario, 2025; and
- Baseline Scenario plus Capacity Enhancements, including transit and active transportation improvements, 2025.

In addition to the quantitative results presented for the scenarios above, there is a qualitative discussion on the impacts of delays under the Sensitivity Scenario defined in this study.

Economic impacts of delay in the Base Year (2016) are presented by spending category and generalized industry sector, by mode and county. For all other scenarios, results are aggregated across spending categories and generalized sectors by border crossing region.[43] Comparable result summaries for Base Year (2016) results are presented in Volume 1, in the Summary of Findings and Recommendations section. The results presented in this section reflect the 50th percentile results from the risk analysis. [44] Appendix E contains aggregated economic impacts for 2016 and 2025 and all scenarios, for delays in Imperial County and for delays in San Diego County, broken down by geography in which the impacts are incurred.

ECONOMIC IMPACTS OF BORDER DELAYS IN BASE YEAR, 2016

The base year border-crossing conditions identified as part of this study can be used to estimate the economic impacts of delays at the border for the base year (in this case, 2016). The impacts represent the starting point of the analysis and are meant to reflect the impacts that observed delays have on the regional economies in both countries. Results are presented by expenditure category for passenger vehicles and pedestrians and by generalized sector for commercial vehicles.

[43] The reason for not disaggregating the impacts by either spending categories or generalized sectors in year 2025 is that the economic multipliers at the industry-level may change between 2016 and 2025 due to the natural evolution of the economy and therefore reporting the breakdown at that level could potentially be misleading.

[44] It is not recommended to apportion the economic impacts presented in this study to the direction of border-crossing delays (i.e., northbound and southbound). The reason is that delays on northbound trips generate reduced expenditure in the U.S. side of the border (that is, negative economic impacts) but delays on southbound trips generate additional expenditure in the U.S. side of the border due to substitution of spending (i.e., positive economic impacts). The net outcome of these two effects is what is presented in this section's tables as the economic impacts of delays.

For the county of San Diego, the economic impacts of delays at the border for passenger vehicles represent almost $600 million in output losses, $240 million in labor income losses, and about 5,650 job losses.[45] Similarly, impacts for pedestrian trips amount to about $600 million in output losses, $240 million in labor income losses, and about 5,850 job losses. Impacts from both pedestrian and passenger vehicle trips are dominated by reduced spending in the retail industry.[46]

Table 24. Economic Impacts from Delays in San Diego County, Personal Trips, Base Year (2016)

Impact Category	From Reduced Spending in...	Impacts from Passenger Vehicle Trips	Impacts from Pedestrian Trips	Total Impacts from Personal Trips
Output (millions of U.S. dollars)	Retail	-$511	-$445	-$956
	Recreation & Entertainment	-$58	-$75	-$133
	Hotels	-$12	-$27	-$39
	Miscellaneous	-$13	-$57	-$70
	Total	**-$593**	**-$604**	**-$1,198**
Labor Income (millions of U.S. dollars)	Retail	-$208	-$174	-$382
	Recreation & Entertainment	-$22	-$29	-$51
	Hotels	-$4	-$10	-$14
	Miscellaneous	-$6	-$29	-$36
	Total	**-$240**	**-$243**	**-$483**
Employment	Retail	-4,840	-4,276	-9,117
	Recreation & Entertainment	-617	-838	-1,455
	Hotels	-98	-228	-326
	Miscellaneous	-93	-513	-607
	Total	**-5,649**	**-5,855**	**-11,505**

Note: Impacts by category may not sum to the total due to rounding.

[45] See Appendix D to this Volume for economic impact tables similar to the ones presented in this section for each one of the 7 San Diego County Major Statistical Areas (MSAs) analyzed in this study.
[46] Previous studies did not explicitly report the economic impacts of delays for pedestrians. This study found that impacts from delays to pedestrian are as important as impacts to delays to passenger vehicles. The reason is that the distribution of pedestrian expenditures for border-crossing trips is similar to the expenditures of passenger vehicle occupants, but the industries where pedestrians spend their money (such as recreation and entertainment) have strong ties to the regional economy.

For commercial vehicles the impacts in San Diego County of base year (2016) delays at the border amount to $96 million in output, $28 million in labor income, and about 550 jobs.[47] In terms of output, more than half of the losses are felt in Agricultural and Food Products and Machinery and Equipment. However, employment impacts are largely comprised by jobs lost in Agricultural and Food Products.

Table 25. Economic Impacts from Delays in San Diego County, Commercial Vehicle Trips, Base Year (2016)

Impact Category	From Reduced Spending in...	Total Impact from Commercial Trips
Output (millions of U.S. dollars)	Agricultural and Food Products	-$27
	Mining and Mineral Products	-$14
	Machinery and Equipment	-$34
	Manufactured Goods	-$20
	Total	**-$96**
Labor Income (millions of U.S. dollars)	Agricultural and Food Products	-$11
	Mining and Mineral Products	-$3
	Machinery and Equipment	-$10
	Manufactured Goods	-$5
	Total	**-$28**
Employment	Agricultural and Food Products	-264
	Mining and Mineral Products	-92
	Machinery and Equipment	-125
	Manufactured Goods	-67
	Total	**-548**

Note: Impacts by category may not sum to the total due to rounding.

[47] See Appendix D to this Volume for economic impact tables similar to the ones presented in this section for each one of the 7 San Diego County's Major Statistical Areas (MSAs) analyzed in this study.

For Imperial County, the economic impacts of delays at the border for passenger vehicles represent about $260 million in output, $90 million in labor income, and about 3,100 jobs. With a similar distribution of impacts across spending categories, the impacts from delays for pedestrian crossings represent $17 million in output, $6 million in labor income, and about 210 jobs. The majority of the impacts from personal trips are due to reduced spending in the retail industry.

Table 26. Economic Impacts from Delays in Imperial County, Personal Trips, Base Year (2016)

Impact Category	From Reduced Spending in...	Impacts from Passenger Vehicle Trips	Impacts from Pedestrian Trips	Total Impacts from Personal Trips
Output (millions of U.S. dollars)	Retail	-$219	-$15	-$234
	Recreation & Entertainment	-$38	-$3	-$41
	Hotels	-$1	$0	-$1
	Miscellaneous	-$2	$1	-$1
	Total	**-$261**	**-$17**	**-$278**
Labor Income (millions of U.S. dollars)	Retail	-$81	-$5	-$86
	Recreation & Entertainment	-$11	-$1	-$11
	Hotels	$0	$0	$0
	Miscellaneous	-$1	$1	$0
	Total	**-$93**	**-$6**	**-$99**
Employment	Retail	-2,571	-181	-2,752
	Recreation & Entertainment	-498	-39	-537
	Hotels	-17	0	-17
	Miscellaneous	-20	11	-9
	Total	**-3,105**	**-209**	**-3,315**

Note: Impacts by category may not sum to the total due to rounding.

And, finally, delays associated to commercial vehicle trips represent $34 million in output, $8 million in labor income, and almost 140 jobs. Impacts in Imperial County are distributed similarly to impacts from foregone commercial vehicle trips in San Diego County (mostly in Agricultural and Food Products and Machinery and Equipment).

Table 27. Economic Impacts from Delays in Imperial County, Commercial Vehicle Trips, Base Year (2016)

Impact Category	From Reduced Spending in...	Total Impact from Commercial Trips
Output (millions of U.S. dollars)	Agricultural and Food Products	-$10
	Mining and Mineral Products	-$5
	Machinery and Equipment	-$11
	Manufactured Goods	-$8
	Total	**-$34**
Labor Income (millions of U.S. dollars)	Agricultural and Food Products	-$4
	Mining and Mineral Products	-$1
	Machinery and Equipment	-$2
	Manufactured Goods	-$1
	Total	**-$8**
Employment	Agricultural and Food Products	-57
	Mining and Mineral Products	-24
	Machinery and Equipment	-33
	Manufactured Goods	-22
	Total	**-136**

Note: Impacts by category may not sum to the total due to rounding.

Table 28 displays economic impacts for base year 2016 from delays and foregone trips through San Diego County, at the county and state-wide level, by mode.

Table 28. Economic Impacts from Delays for Trips through San Diego County, 2016

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	San Diego County	-$593	-$240	-5,649
	California	-$662	-$265	-5,547
	Baja California	-$222	-$36	-11,010
	California & Baja California	-$884	-$301	-16,557
Pedestrian Trips	San Diego County	-$604	-$243	-5,855
	California	-$719	-$286	-6,233
	Baja California	$13	$2	474
	California & Baja California	-$706	-$284	-5,759
Freight Movements	San Diego County	-$96	-$28	-548
	California	-$192	-$61	-857
	Baja California	-$461	-$80	-25,994
	California & Baja California	-$654	-$141	-26,851
Combined Personal Trips and Freight Movements	San Diego County	-$1,294	-$512	-12,053
	California	-$1,573	-$612	-12,638
	Baja California	-$670	-$115	-36,530
	California & Baja California	-$2,243	-$726	-49,167

When all types of border-crossing trips are considered, delays at the border in San Diego County in base year 2016 represented economic impacts of almost $1.3 billion in terms of output losses, about $500 million in labor income losses, and represented more than 12,000 jobs lost. For the State of California, the delays in base year 2016 at San Diego County POEs represented nearly $1.6 billion in output losses, about $600 million in labor income losses and more than 12,500 jobs lost. Similarly, for the State of Baja California in Mexico the delays totaled more than $650 million in output losses, more than $100 million in labor income losses and more than 36,500 jobs lost.

Table 29 shows economic impacts from delays and foregone trips through Imperial County, at the county and state-wide level, by mode.

Table 29. Economic Impacts from Delays for Trips through Imperial County, 2016

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	Imperial County	-$261	-$93	-3,105
	California	-$407	-$162	-3,426
	Baja California	-$123	-$20	-6,030
	California & Baja California	-$531	-$183	-9,456
Pedestrian Trips	Imperial County	-$17	-$6	-209
	California	-$18	-$6	-164
	Baja California	-$32	-$5	-1,600
	California & Baja California	-$50	-$11	-1,765
Freight Movements	Imperial County	-$34	-$8	-136
	California	-$92	-$29	-394
	Baja California	-$147	-$26	-8,265
	California & Baja California	-$239	-$54	-8,659
Combined Personal Trips and Freight Movements	Imperial County	-$312	-$106	-3,451
	California	-$518	-$197	-3,984
	Baja California	-$302	-$51	-15,896
	California & Baja California	-$820	-$248	-19,880

With all types of border-crossing trips considered, delays at the border in Imperial County in base year 2016 represented $300 million in terms of output losses, more than $100 million in labor income losses and represented more than 3,400 jobs lost. For the State of California, the delays in base year 2016 of POEs located in Imperial County represented more than $500 million in output losses, almost $200 million in labor income losses and almost 4,000 jobs lost. Similarly, for the State of Baja California in Mexico the delays totaled more than $300 million in output losses, more than $50 million in labor income losses and almost 16,000 jobs lost.[48]

[48] The large difference in the ratio of labor income losses to employment losses between California and Baja California can be explained by the differences in wages between the two regions as well as the specific industries impacted by the delays in each side of the border.

Table 30 shows aggregated economic impacts from delays and foregone trips through both San Diego County and Imperial County, at the state-wide and national level, by mode.[49]

Table 30. Economic Impacts from Delays at the California-Baja California Border, 2016

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	California	-$1,069	-$427	-8,973
	Baja California	-$345	-$57	-17,040
	California & Baja California	-$1,414	-$484	-26,014
	United States	-$1,069	-$427	-8,973
	Mexico	-$342	-$56	-17,092
	United States & Mexico	-$1,411	-$483	-26,065
Pedestrian Trips	California	-$737	-$292	-6,398
	Baja California	-$19	-$3	-1,126
	California & Baja California	-$756	-$295	-7,524
	United States	-$737	-$292	-6,398
	Mexico	-$11	-$1	-697
	United States & Mexico	-$747	-$294	-7,095
Freight Movements	California	-$285	-$89	-1,251
	Baja California	-$608	-$106	-34,259
	California & Baja California	-$893	-$196	-35,510
	United States	-$285	-$89	-1,251
	Mexico	-$956	-$167	-53,843
	United States & Mexico	-$1,240	-$256	-55,094
Combined Personal Trips and Freight Movements	California	-$2,091	-$809	-16,622
	Baja California	-$973	-$165	-52,426
	California & Baja California	-$3,063	-$975	-69,048
	United States	-$2,091	-$809	-16,622
	Mexico	-$1,308	-$224	-71,632
	United States & Mexico	-$3,399	-$1,033	-88,254

When all passenger vehicle, pedestrian and commercial border-crossing trips are considered, delays at the border along the California-Baja California POEs in base year 2016 generated almost $3.4 billion in terms of output losses, more than $1.0 billion in labor income losses and represented more than 88,000 jobs lost for both the United States and Mexico combined.

ECONOMIC IMPACTS OF BORDER DELAYS IN BASELINE SCENARIO, YEAR 2025

The economic impacts of delays at the border for 2025 can be estimated in the Baseline Scenario using border conditions identified as part of this study. The impacts represent the last year of the economic analysis performed as part of this study and are meant to reflect the impacts that anticipated delays would have on the regional economies and provide a basis for comparison against other scenarios in the same year. Personal trips represent the sum of

[49] A breakdown of these impacts by county is presented in Appendix D of this Volume.

impacts from passenger vehicle trips and pedestrian trips, and freight trips represent border-crossing trips of commercial vehicles. The results are presented in total impacts by border crossing region, aggregated across expenditure category (for personal trips) or generalized sector (for freight movements). Comparable tables for the baseline scenario in year 2025 are presented in Volume 1, in the in the Summary of Findings and Recommendations section. **Error! Reference source not found.** provides more detail of economic impacts incurred in each geography (including the national level) from delays in Imperial County and from delays in San Diego County in this scenario.

Table 31 presents economic impacts from anticipated delays at the San Diego County POEs for personal trips and freight movements for San Diego County, California, and Baja California. In general, more monetary (output and labor income loss) impacts are felt in California, and more employment impacts are observed in Baja California. In terms of losses from combined personal and commercial trips, total output losses in California are about $2.2 billion and in Baja California are more than $750 million. The total labor income losses are more than $800 million in California and just under $150 million in Baja California. For employment, California is estimated to lose more than 15,000 jobs, whereas Baja California's estimate is over 40,000 jobs.

Table 31. Economic Impacts from Delays in Trips through San Diego County, Baseline Scenario, 2025

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	San Diego County	-$626	-$254	-5,960
	California	-$678	-$271	-5,685
	Baja California	-$380	-$63	-18,878
	California & Baja California	-$1,059	-$334	-24,563
Pedestrian Trips	San Diego County	-$548	-$220	-5,309
	California	-$647	-$258	-5,610
	Baja California	-$11	-$2	-418
	California & Baja California	-$658	-$260	-6,028
Freight Movements	San Diego County	-$437	-$129	-2,485
	California	-$871	-$276	-3,884
	Baja California	-$374	-$65	-21,050
	California & Baja California	-$1,245	-$341	-24,934
Combined Personal Trips and Freight Movements	San Diego County	-$1,611	-$603	-13,762
	California	-$2,197	-$805	-15,199
	Baja California	-$769	-$130	-40,987
	California & Baja California	-$2,966	-$934	-56,187

Table 32 presents economic impacts from personal trips and freight movements due to estimated delays through Imperial County POEs, for Imperial County, California, and Baja California. Overall, impacts are lower in absolute value compared to San Diego (largely due to lower overall volumes and differences in expenditure behavior). There is still a large margin in

employment impacts between California and Baja California. In terms of losses from combined personal and commercial trips, total output losses in California are more than $650 million and in Baja California are more than $250 million. The total labor income losses are about $250 million in California and about $45 million in Baja California. Employment losses in Baja California amount to over 14,000 jobs, and California's losses amount to just over 5,000 jobs.

Table 32. Economic Impacts from Delays in Trips through Imperial County, Baseline Scenario, 2025

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	Imperial County	-$319	-$114	-3,792
	California	-$509	-$203	-4,284
	Baja California	-$53	-$9	-2,603
	California & Baja California	-$563	-$212	-6,887
Pedestrian Trips	Imperial County	-$21	-$7	-263
	California	-$28	-$10	-258
	Baja California	-$16	-$3	-779
	California & Baja California	-$44	-$12	-1,037
Freight Movements	Imperial County	-$45	-$10	-179
	California	-$122	-$38	-519
	Baja California	-$191	-$33	-10,740
	California & Baja California	-$312	-$71	-11,259
Combined Personal Trips and Freight Movements	Imperial County	-$385	-$131	-4,233
	California	-$659	-$251	-5,059
	Baja California	-$260	-$45	-14,122
	California & Baja California	-$919	-$296	-19,180

Table 33 presents economic impacts from personal trips and freight movements due to anticipated delays at POEs across the entire California-Baja California border, for both states and countries. The large difference in employment impacts north and south of the border can be seen at the national level, with employment losses estimated at about 24,000 jobs in the U.S. and more than 73,000 jobs in Mexico. It appears that delays on freight movements result in more monetary impacts and employment losses across the entire region compared to personal trips.

Table 33. Economic Impacts from Delays at the California-Baja California Border, Baseline Scenario, 2025

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	California	-$1,188	-$475	-9,969
	Baja California	-$434	-$71	-21,481
	California & Baja California	-$1,621	-$546	-31,450
	United States	-$1,188	-$475	-9,969
	Mexico	-$430	-$71	-21,665
	United States & Mexico	-$1,618	-$546	-31,634
Pedestrian Trips	California	-$675	-$267	-5,869
	Baja California	-$27	-$5	-1,197
	California & Baja California	-$702	-$272	-7,066
	United States	-$675	-$267	-5,869
	Mexico	-$21	-$3	-943
	United States & Mexico	-$696	-$271	-6,812
Freight Movements	California	-$993	-$313	-4,404
	Baja California	-$564	-$99	-31,790
	California & Baja California	-$1,557	-$412	-36,193
	United States	-$1,862	-$507	-8,146
	Mexico	-$887	-$155	-49,962
	United States & Mexico	-$2,749	-$662	-58,108
Combined Personal Trips and Freight Movements	California	-$2,857	-$1,056	-20,258
	Baja California	-$1,029	-$174	-55,109
	California & Baja California	-$3,885	-$1,230	-75,367
	United States	-$3,726	-$1,249	-24,000
	Mexico	-$1,340	-$230	-73,159
	United States & Mexico	-$5,065	-$1,479	-$97,159

Note: The model assumes that economic impact of delay in personal trips across the Cali – Baja Cali border that is incurred outside California in the remaining United States is negligible. Therefore, economic impacts from personal trips in California are the same as those estimated for the United States. Additionally, results displayed for countries are inclusive of their corresponding states.

ECONOMIC IMPACTS OF BORDER DELAYS IN BASELINE PLUS CAPACITY ENHANCEMENTS SCENARIO

The economic impacts of delays at the border for 2025 can be estimated in the Baseline plus Capacity Enhancements Scenario, which includes transit and active transportation improvements, using border conditions identified as part of this study. All the results for year 2025 in this scenario correspond to Otay Mesa East in the 5x5 configuration. The impacts represent the final year of the economic analysis performed as part of this study and are meant to reflect the impacts that forecasted delays will have on the regional economies in light of planned additional capacity, transit, and active transportation improvements.

Additionally, the anticipated modal switch generated by transit and active transportation improvements means that some crossers will move away from using the passenger vehicle crossings and will use pedestrian crossings instead. As a result, wait times improve slightly for

passenger vehicle traffic and deteriorate slightly for pedestrians. Thus, economic losses for pedestrian flows are slightly increased compared to the Baseline Scenario.

Personal trips represent the sum of impacts from passenger vehicle trips and pedestrian trips, and freight trips represent border-crossing trips of commercial vehicles. The results are presented in total impacts by border crossing region, aggregated across expenditure category (for personal trips) or generalized sector (for freight movements). Again, **Error! Reference source not found.** provides more detail of economic impacts incurred in each geography (including the national level) from delays in Imperial County and from delays in San Diego County in this scenario.

Table 34 presents economic impacts from personal trips and freight movements resulting from forecasted delays at POEs in San Diego County, for San Diego County, California, and Baja California. The spread of impacts across impact categories is similar compared to the previous scenario. However, there is a significant reduction on the output losses, labor income losses and jobs lost compared to the year 2025 results under the Baseline Scenario, due to the change in delay from capacity enhancements. The reduction is particularly noticeable in commercial vehicle trips, since the Otay Mesa East POE (in a 5x5 configuration) is anticipated to significantly reduce wait times for this type of traffic. Overall, the results for San Diego County in year 2025 under the Baseline Scenario plus Capacity Enhancements are of similar magnitude to those reported for this county in the base year 2016.

Table 34. Economic Impacts from Delays in Trips through San Diego County, Baseline plus Capacity Enhancements Scenario, 2025*

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	San Diego County	-$482	-$194	-4,545
	California	-$512	-$203	-4,270
	Baja California	-$393	-$66	-19,979
	California & Baja California	-$905	-$269	-24,249
Pedestrian Trips	San Diego County	-$608	-$244	-5,855
	California	-$754	-$301	-6,491
	Baja California	$2	$0	42
	California & Baja California	-$752	-$301	-6,449
Freight Movements	San Diego County	-$112	-$33	-628
	California	-$223	-$71	-992
	Baja California	-$267	-$47	-15,106
	California & Baja California	-$490	-$118	-16,098
Combined Personal Trips and Freight Movements	San Diego County	-$1,201	-$471	-11,028
	California	-$1,489	-$575	-11,739
	Baja California	-$659	-$113	-35,317
	California & Baja California	-$2,148	-$688	-47,056

*Includes transit and active transportation improvements.

Table 35 presents economic impacts from personal trips and freight movements due to forecasted delays through Imperial County POEs, for Imperial County, California, and Baja California. As in the case of San Diego County, there is a reduction on the output losses, labor income losses and jobs lost compared to the year 2025 results under the Baseline Scenario. The reduction is particularly noticeable in commercial vehicle trips, and for impacts in California. Overall, the results for Imperial County of year 2025 under the Baseline Scenario plus Capacity Enhancements are of smaller magnitude for California impacts and similar magnitude for impacts in Baja California, compared to those reported for this county in the base year 2016.

Table 35. Economic Impacts from Delays in Trips through Imperial County, Baseline plus Capacity Enhancements Scenario, 2025

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	Imperial County	-$94	-$32	-1,122
	California	-$107	-$41	-913
	Baja California	-$285	-$47	-14,326
	California & Baja California	-$392	-$88	-15,239
Pedestrian Trips	Imperial County	-$21	-$7	-258
	California	-$27	-$10	-246
	Baja California	-$18	-$3	-897
	California & Baja California	-$45	-$13	-1,142
Freight Movements	Imperial County	-$48	-$11	-187
	California	-$129	-$39	-538
	Baja California	-$57	-$10	-3,206
	California & Baja California	-$186	-$49	-3,745
Combined Personal Trips and Freight Movements	Imperial County	-$163	-$50	-1,567
	California	-$263	-$90	-1,698
	Baja California	-$361	-$60	-18,430
	California & Baja California	-$623	-$150	-20,128

*Includes transit and active transportation improvements.

Table 36 presents economic impacts from personal trips and freight movements through both San Diego County and Imperial County, at the state and national level. As in the case of the individual counties, there is a significant reduction on the impacts of delays under this scenario compared to the Baseline Scenario in 2025. The majority of the reduction comes from commercial vehicle crossings, since their wait times significantly improve due to the capacity enhancements modeled under the Baseline plus Capacity Enhancement Scenario.[50] All in all, the results in terms of output losses, labor income losses and job losses under this scenario are of a similar magnitude compared to those reported under the base year 2016.

[50] Notice that the output losses, labor income losses and job losses related to pedestrian flows under this scenario do not improve compared to the 2025 baseline scenario. The reason is that the vast majority of the improvements modeled under this scenario relate to passenger vehicle and commercial trips.

Table 36. Economic Impacts from Delays at the California-Baja California Border, Baseline plus Capacity Enhancements Scenario, 2025

Type of Traffic	Areas	Output, $M	Labor Income, $M	Employment, jobs
Passenger Vehicle Trips	California	-$619	-$244	-5,183
	Baja California	-$678	-$113	-34,305
	California & Baja California	-$1,297	-$357	-39,488
	United States	-$619	-$244	-5,183
	Mexico	-$726	-$121	-36,609
	United States & Mexico	-$1,345	-$365	-41,792
Pedestrian Trips	California	-$781	-$311	-6,737
	Baja California	-$17	-$3	-855
	California & Baja California	-$798	-$314	-7,592
	United States	-$781	-$311	-6,737
	Mexico	-$9	-$1	-545
	United States & Mexico	-$790	-$312	-7,282
Freight Movements	California	-$352	-$111	-1,531
	Baja California	-$324	-$57	-18,312
	California & Baja California	-$676	-$168	-19,843
	United States	-$663	-$180	-2,905
	Mexico	-$506	-$89	-28,623
	United States & Mexico	-$1,168	-$269	-31,528
Combined Personal Trips and Freight Movements	California	-$1,752	-$665	-13,437
	Baja California	-$1,020	-$173	-53,747
	California & Baja California	-$2,772	-$838	-67,184
	United States	-$2,062	-$735	-14,811
	Mexico	-$1,242	-$211	-66,053
	United States & Mexico	-$3,304	-$946	-80,864

*Includes transit and active transportation improvements.

Table 37 presents a comparison of the Baseline Scenario to the Baseline plus Capacity Enhancement Scenario in year 2025. Labor income impacts are proportional to output losses, so that comparison is not presented. Output impacts are in millions of 2016 dollars, employment impacts in number of jobs.

Table 37. Comparison of Economic Impacts from Delays at the California-Baja California Border in 2025, Baseline to Baseline plus Capacity Enhancements

Personal Trips and Freight Movements	Baseline 2016		Baseline 2025		Baseline plus Capacity Enhancement 2025*		Change due to Capacity Enhancement	
Geography	Output, $M	Employment, jobs	Output, $M	Employment, jobs	Output, $M	Employment, jobs	Output, $M	Employment, jobs
San Diego County	-$1,294	-12,053	-$1,611	-13,762	-$1,201	-11,028	$410	2,734
							-25%	-20%
Imperial County	-$312	-3,451	-$385	-4,233	-$163	-1,567	$222	2,666
							-58%	-63%
California & Baja California	-$3,063	-69,048	-$3,885	-75,367	-$2,772	-67,184	$1,114	8,182
							-29%	-11%
Mexico & United States	-$3,399	-88,254	-$5,065	-97,159	-$3,304	-80,864	$1,761	16,295
							-35%	-17%

*Includes transit and active transportation improvements.

The introduction of large capacity enhancements (i.e., Otay Mesa East POE in San Diego County and All-American Canal Bridge Expansion in Imperial County) is anticipated to generate positive and significant economic impacts in year 2025 when compared to a situation where these improvements do not take place. As a result of the improvements considered in this scenario, delay at San Diego County POEs is anticipated to create more than $410 million in additional output and more than 2,700 additional jobs. Imperial County is forecasted to gain more than $220 million in additional output and generate more than 2,600 additional jobs. At the country level, the U.S. and Mexico would benefit from nearly $1.8 billion in increased output and almost 16,300 additional jobs generated in the binational region.

ECONOMIC IMPACTS OF BORDER DELAYS IN SENSITIVITY SCENARIO

Based on the definition of scenario characteristics developed as part of this study, the economic impacts of delays at the border for year 2025 under the Sensitivity Scenario can be qualitatively assessed using the results from year 2025 under the Baseline plus Capacity Enhancements Scenario. To do this, a qualitative assessment is made based on the characteristics of the methodology used to estimate the economic impacts due to delays at the POEs.

The methodology relies on an estimation of the foregone border-crossing trips for both pedestrian and passenger vehicles that are attributable to delays at the individual POEs. Existing or forecasted wait times are combined with the elasticities of demand for border-crossing trips and the observed border-crossing volumes to determine the number of potential personal trips that did not take place due to long delays. The number of estimated foregone trips is then combined with the degree of expenditure substitution across countries and multiplied by the average border-crossing expenditures anticipated in each expenditure category (or generalized sector) to estimate the total output, labor income and employment losses associated with those foregone trips.

In the case of commercial trips, the methodology uses the total number of trucks crossing the border to estimate a per-truck value of trade. Later, the existing or forecasted wait times are transformed into a measure of foregone trade, which then is combined with elasticities of output at the commodity level and substitutability of revenue in the home country to identify the specific sectors where output, labor income and jobs are lost.

As such, the determination of how changes to volumes and delays under the Sensitivity Scenario affect the amount of output, labor income and job losses it is not straightforward. However, through a series of high-level sensitivity estimations, it was identified that the following qualitative statements can be made for this scenario:

- Changes to border-crossing personal trips volumes have a close to proportional effect on the amount of output losses, while changes to border-crossing commercial trip volumes have a marginal effect. In other words, a decrease of 10 percent in personal trip volumes across the border would reduce the output losses by approximately 10 percent in the region, while the same 10 percent reduction in commercial trips would not change the output losses in the region.
- Changes to border-crossing delays for personal trips have a marginal effect on the amount of output losses in the region, while changes to border-crossing delays for commercial trips have a close to proportional effect. In other words, a decrease of 10 percent in personal trip delays across the border would marginally reduce the output losses in the region, while the same 10 percent reduction in delays for commercial trips would decrease the output losses in the region by approximately 10 percent.

Given that output losses linked to delays of personal trips are larger in absolute magnitude than output losses associated to delays of commercial trips, an observation resulting from the Sensitivity Scenario is that border-crossing volumes have a larger impact on the regional economy than delays. However, since this is the result of a sensitivity analysis in which a single variable is changed at a time, it ignores the feedback mechanism that exists between volumes and delays. Therefore, a generalized statement that volumes (and not delays) play a larger role in the economic impacts in the region should be used with caution.

Summary of Findings and Recommendations

Delays at the POEs along the California-Baja California border experienced by border crossers during 2016 generated combined output losses in the U.S. and Mexico equivalent to almost $3.4 billion. This is almost equivalent to the economic impact generated by 23 Comic-Con conventions.[51] Slightly less than two-thirds of the total output losses in the two countries are generated by delays associated with personal trips (pedestrian and passenger vehicle crossings), with the remaining one-third corresponding to delays related to commercial trips. This could be the result of businesses actively taking steps to manage border crossing delays in the region, as identified by the qualitative findings of the business interviews conducted as part of this study.

Of the total output losses estimated in 2016, about $2.1 billion correspond to the output losses in the U.S. while the remaining $1.3 billion are estimated to be experienced by the Mexican economy. San Diego County bears the largest share of the output losses on the U.S. side, with more than 70 percent of the total U.S. impact. This is not surprising given the large volume of border-crossing trips that occur at the San Diego-Tijuana border region.

The analysis found that economic losses continue to increase between years 2016 and 2025 in real terms despite the moderate increase of physical capacity at several of the POEs in the region. For example, total output losses in year 2025 under the baseline scenario are equivalent to $5.1 billion, representing an increase of almost 50 percent in total output losses between 2016 and 2025. In other words, despite the moderate increase of POE capacity along the border in this period, delays are expected to increase, generating economic losses throughout the binational region.

The introduction of larger infrastructure capacity enhancements, such as the Otay Mesa East POE (in a 5x5 configuration) and the All-American Canal Bridge Expansion, furthered by the transit and active transportation improvements, would generate enough additional capacity to predominately reduce anticipated vehicle delays at key POEs throughout the region. This, in turn, means a reduction in the economic losses associated to delays. In particular, the total output losses on both countries in year 2025 under the Baseline with Capacity Enhancements Scenario revert to levels slightly below those estimated for year 2016. In other words, the construction of the border-infrastructure projects considered under this scenario can potentially, on average, the growth of output losses in the region between 2016 and 2025.

Finally, a sensitivity analysis conducted on the results shows that the economic impacts in the border region react differently to changes in border-crossing volumes and delays based on the crossing modes analyzed (i.e., personal trips or commercial trips). While the economic impacts generated by personal trips seem to be more sensitive to changes in border-crossing volumes, the economic impacts created by commercial trips seem to respond more to changes in delays. A sensitivity analysis, however, ignores the fact that there is a feedback mechanism between volumes and delays and therefore this observation cannot be said to be too robust.

[51] In 2019, Comic-Con had an estimated economic impact of $150 million. (CIC Research, Inc.).

Recommendations: Improvements to Consider

The Project Team developed several recommendations to improve conditions at the border. The recommended strategies may have significant impacts on border crossers and businesses that utilize crossings in the California-Baja California border region. Potential impacts include reductions in delays, changes in modal split, and air quality improvement. Broadly, the types of recommended improvements can be summarized in the following categories:

- Investment in POE Infrastructure and Physical Capacity
- Improved Operations at POEs
- Improved Access to POEs
- Corridor-Wide Improvements
- Support for Coordination on Long-Term Strategies

Specific improvements considered under each category are listed in Table 38 through Table 42, as well as the impact they are anticipated to have in either border-crossing wait times/delay or modal splits between motorized vehicles and pedestrians.

In terms of capacity expansions at POEs, the Project Team recommends that additional lanes and booths be added for motorized vehicles. These improvements are expected to reduce delays for motorized crossers in the binational region, saving time and money of individual crossers (see Table 38).

Table 38. Investment in POE Infrastructure and Physical Capacity

Improvement	Impact on Wait-Times	Impact on Modal Split
Additional lanes and booths for motorized vehicles • Phase 3 Improvements at San Ysidro (complete)[52] • Phase 1 (complete) and Phase 2 Improvements at Calexico West[53] • Bridge Expansion over All-American Canal at Calexico East[54] • Otay Mesa Commercial Modernization[55]	Reduces wait-times for motorized crossers in binational region	Minimal, but may increase share of motorized crossers
Additional lanes and booths for pedestrian crossers • Phase 2 Improvements at Calexico West • Otay Mesa Pedestrian Modernization[56]	Reduces wait-times for pedestrian crossers in binational region	Minimal, but may increase share of pedestrian users
New POE facilities • Otay Mesa East Port of Entry	Reduces wait-times for motorized crossers across the San Diego-Tijuana region	Minimal, but may increase share of motorized crossers

[52] Phase 3 improvements at San Ysidro include the addition of 10 southbound POV lanes with additional southbound primary inspection booths and 8 northbound POV lanes with 15 additional northbound inspection booths. This project was completed in 2019. *Source:* General Services Administration
[53] Phase 1 improvements at Calexico West include the addition of 5 southbound POV lanes and a southbound bridge over the New River as well as 10 northbound POV lanes. This project was completed in 2018. *Source:* General Services Administration. Phase 2 improvements at Calexico West include a new pedestrian processing facility, 5 additional southbound POV lanes and 6 additional northbound POV lanes. This phase is currently unfunded but expected to be constructed by the corresponding analysis year (2025). *Source:* General Services Administration.
[54] "Expanded bridge over the All-American Canal" is part of proposed improvements to increase capacity at the Calexico East POE. Envisioned expansion comprises 2 additional northbound POV lanes and 2 additional northbound commercial lanes. The bridge expansion component is proposed to address the current bottleneck observed over this section of the approach road. These improvements are expected to be constructed before 2025. *Source:* California Transportation Commission.
[55] Otay Mesa Commercial Modernization refers to a General Services Administration (GSA) led effort to renovate and expand commercial facilities at the Otay Mesa POE, including 6 additional commercial processing booths and other related improvements. *Source:* General Services Administration
[56] Otay Mesa Pedestrian Modernization refers to a GSA led effort to renovate and expand pedestrian facilities at the Otay Mesa POE. The construction is expected to include 6 additional pedestrian processing lanes and other related improvements. *Source:* General Services Administration

There are several improvements recommended under the Improved Operations at POEs category, more than half of which are related to truck crossings. In particular, interchangeable lanes, reversible lanes, and other innovative lane management operations are recommended to reduce delays for all POE crossers; however, this may also increase the share of motorized personal trips (see Table 39).

Table 39. Improved Operations at POEs

Improvement	Impact on Wait Times	Impact on Modal Split
Southbound Electronic Commercial Clearance (Aduanas PITA program)	Marginal, but reduces total crossing and idling time for truck crossers at POE	-
Unified Cargo Processing	Marginal, but potentially reduces total crossing and idling time for truck crossers at POE	-
Joint Inspection Facility	Marginal, but reduces total crossing and idling time for truck crossers at POE	-
Interchangeable Lanes	Reduces wait-times for crossers at POE	Minimal, but may increase share of motorized crossers
Reversible Lanes	Reduces wait-times for crossers at POE	Minimal, but may increase share of motorized crossers
Lane Management	Reduces wait-times for crossers at POE	Minimal, but may increase share of motorized crossers
Appointment Time for Truck Crossers	Potential to reduce wait-times for truck crossers at POE	-
Extended Hours of Operations	Potential to reduce wait-times for crossers at POE	-
Variable tolls at OME	Potential to reduce wait-times for truck crossers at Otay Mesa	-

Strategies to improve access to POEs include improved bike and pedestrian access at San Ysidro, Calexico West and Calexico East POEs, enhanced transit services at the border, the deployment of an advanced traffic management and traveler information system and the prioritization of zero / near-zero trucks, with their different impacts listed in Table 40. There are several improvements being advanced by border agencies. For example, Caltrans and SANDAG are pursuing a border wait time measurement system using ITS technologies. The system completed a successful pilot phase for southbound POV wait time measurements at San Ysidro, and the agencies are advancing the system at all ports of entry and in both the northbound and southbound direction. This effort corresponds to the Advanced Traffic Management and Advanced Traveler Information System and Regional Border Management System improvement concepts mentioned in Table 40.

Table 40. Improved Access to POEs

Improvement	Impact on Wait Times	Impact on Modal Split
Bike/pedestrian access improvements (San Ysidro, Calexico West and Calexico East)	-	Potential shift to pedestrian mode from motorized mode
Enhanced transit services (including Tijuana BRT and higher frequency of transit service at San Ysidro and Otay Mesa), completion of Calexico West Intermodal Transit Center, and completion of Transit Center/Cell Phone Lot at Calexico East.	-	Potential shift to pedestrian mode from motorized mode
Advanced Traffic Management and Advanced Traveler Information System, including RFID and Wi-Fi readers on Mexico's northbound lanes to capture commercial and POV vehicle wait-time data	Potential reduction in NB wait times for trucks and POVs due to planning and routing to faster POE	-
Zero/Near-Zero Truck Prioritization at POEs	Potential to reduce wait times for truck crossers at POE (and reduce emissions from using zero/near-zero emission trucks)	-

A recommendation for corridor-wide improvements consisted of the deployment of a Regional Border Management System (RBMS) and subcomponents. The individual components have the potential to reduce northbound and southbound delays for commercial and passenger vehicles due to efficient re-routing with advanced travel information (see Table 41).

Table 41. Corridor-Wide Improvements

Improvement	Impact on Wait Times	Impact on Modal Split
Regional Border Management System (RBMS) and Subcomponents - • Southbound Congestion Management and ITS Infrastructure Improvements • Freight Advanced Traveler Information System (FRATIS), including Information Dissemination Process • Integrated Corridor Management (ICM) and Active Traffic Management (ATM)	Potential reduction in NB and SB wait-times due to improved POE choice and trip routing could be realized for commercial and passenger vehicles with advanced travel information	Minimal, but may increase share of motorized crossers

A final recommendation (see Table 42) is that local planning agencies support binational planning processes and foster collaboration efforts for POE operations and transportation infrastructure. This cooperation is essential for the successful implementation of several of the recommended strategies identified above.

Table 42. Support for Coordination on Long-Term Strategies

Improvement or Strategy	Impact on Wait Times	Impact on Modal Split
Support Binational Planning Process for POEs and Transportation Infrastructure	Potential reductions to NB and SB wait-times	Potential shift to pedestrian mode from motorized mode

These recommendations also align with state of California goals and objectives noted in existing planning documents and efforts currently underway. Key examples of planning efforts that include border improvement strategies, projects and policies include the 2016 California Sustainable Freight Action Plan (CSFAP), which includes a work plan to implement pilot projects for "Advanced Technology Corridors at Border Ports of Entry". The series of pilot projects are currently being implemented and include elements such as deployment of technology to dynamically manage border infrastructure to reduce wait times. Currently, Caltrans is developing the 2020 California Freight Mobility Plan (CFMP) which is anticipated to include many of the same border improvement elements.[57]

Another example of planning work aligned with the study recommendations is the 2021 California-Baja California Border Master Plan (BMP) effort. This ongoing effort involves participation from more than 30 U.S. and Mexican agencies at the local, state and federal levels to coordinate on border infrastructure projects and improvement strategies. As part of the 2021 BMP, a comprehensive list of innovative border improvement strategies documents various approaches to help manage the binational transportation system in the California-Baja California region. The goal of developing innovative strategies is to optimize the use of existing infrastructure and projects under development with a focus on innovative and multimodal strategies and to leverage technology where possible. Some of the objectives in the 2021 BMP innovative strategies that overlap with the improvement categories listed above include;

- Promote a mode shift from single occupant vehicles (SOV) to active transportation and transit
- Provide safe and secure processing at the border and reduce wait times for all modes of border crossings
- Improve the air quality in and around the border region
- Coordinate binational operations and shared data
- Provide accurate and timely information to the traveling public
- Provide high-speed connections to and from the border

[57] https://dot.ca.gov/programs/transportation-planning/freight-planning/strategic-planning