Binational San Luis Transportation Study

Final Report

San Luis, Arizona

Prepared For:

ADOT

Prepared By:

JACOBS®

and

TIS Consulting

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ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

PURPOSE OF THE STUDY

The Binational San Luis Transportation Study is a joint effort by the City of San Luis, Ciudad de San Luis Rio Colorado and the Arizona Department of Transportation (ADOT). The primary purpose of this study is to prepare a long-range multimodal transportation plan that will address the most critical current and future transportation issues for the cities of San Luis, Arizona and San Luis Rio Colorado, Sonora, Mexico. The study is being funded by the Federal Highway Administration's (FHWA) Coordinated Border Infrastructure (CBI) Program and administered through ADOT's Office of International Affairs. The final product will consist of two reports - one for each of the two cities. This report will focus on San Luis, Arizona.

Located 20 miles from the City of Yuma in southern Arizona, the Binational study area encompasses 28.8 square miles and includes portions of the incorporated limits of San Luis in Arizona, U.S. and San Luis Rio Colorado in Sonora, Mexico. In the City of San Luis, AZ the study area is bounded by County 22nd Street/County 23th Street to the north, Avenue E to the east, and Merrill Avenue to the west. In Ciudad de San Luis Rio Colorado the study area is bounded by Avenida Nuevo León to the south, Libramiento to the east, Calzada Monterrey to west. Regional access to the study area in San Luis is provided by US-95 and SR-195. US-95, a major north-south thoroughfare, connects San Luis I Land Port of Entry (LPOE) and downtown San Luis with I-8 in the City of Yuma through the City of Somerton. SR-195 provides a direct route from I-8 in the City of Yuma to San Luis II LPOE via Avenue E. Figure 1.1 displays the study area boundary, which represents the limits of the transportation plan. Also, shown is the influence area which extends beyond the study area but has some impact on the study area transportation system by either daily use of the facilities or by proximity to the study area.

As part of the Long Range Transportation Plan identified in the *2009 City of San Luis Small Area Transportation Study (SATS)*, it was recommended that a Binational Study be conducted to address the future travel exchange between the two Cities and the increased traffic using the San Luis I LPOE.

STUDY OBJECTIVES

The principal focus of this study was to update the Transportation Plan identified in the *San Luis SATS*. An integrated transportation plan that specifically address the travel demands for all modes of transportation was needed because of the increasing population and economic interdependency of the two Cities, the resurgence of the maquiladora industry, the opening of the second LPOE and changes to land use in the updated General Plan.. With guidance from the *San Luis SATS*, *San Luis 2020 General Plan*, *YMPO 2010-2033 Regional Transportation Plan* and interviews with members of the Technical Advisory Committee (TAC) the following objectives for the study were identified:

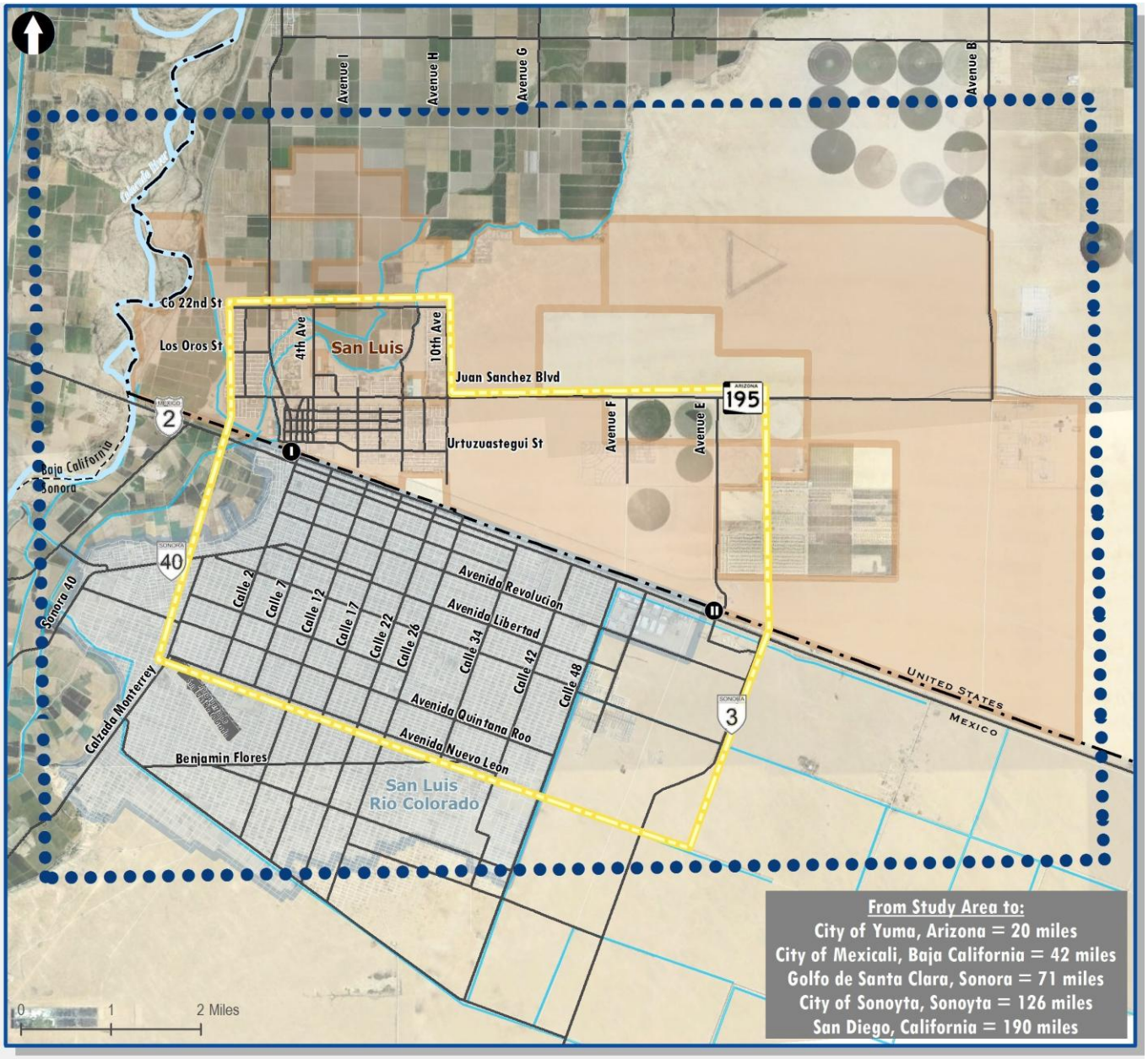


FIGURE 1.1: STUDY AND INFLUENCE AREA

- Study Area
- Influence Area
- Study Roadway
- Land Port of Entry
- Canal
- International Boundary
- San Luis
- San Luis Rio Colorado

Source: ALRIS, SLRC, ADEQ, INEGI, USGS, Google

- Enhance the mobility and connectivity of the transportation system at an international, regional, and local level.
- Address pedestrian and bicycle needs.
- Determine validity of current and planned infrastructure.
- Enhance connectivity between modes - vehicles, transit, and pedestrians.
- Identify funding sources and strategies.
- Communicate with the TAC and public.

STUDY PROCESS

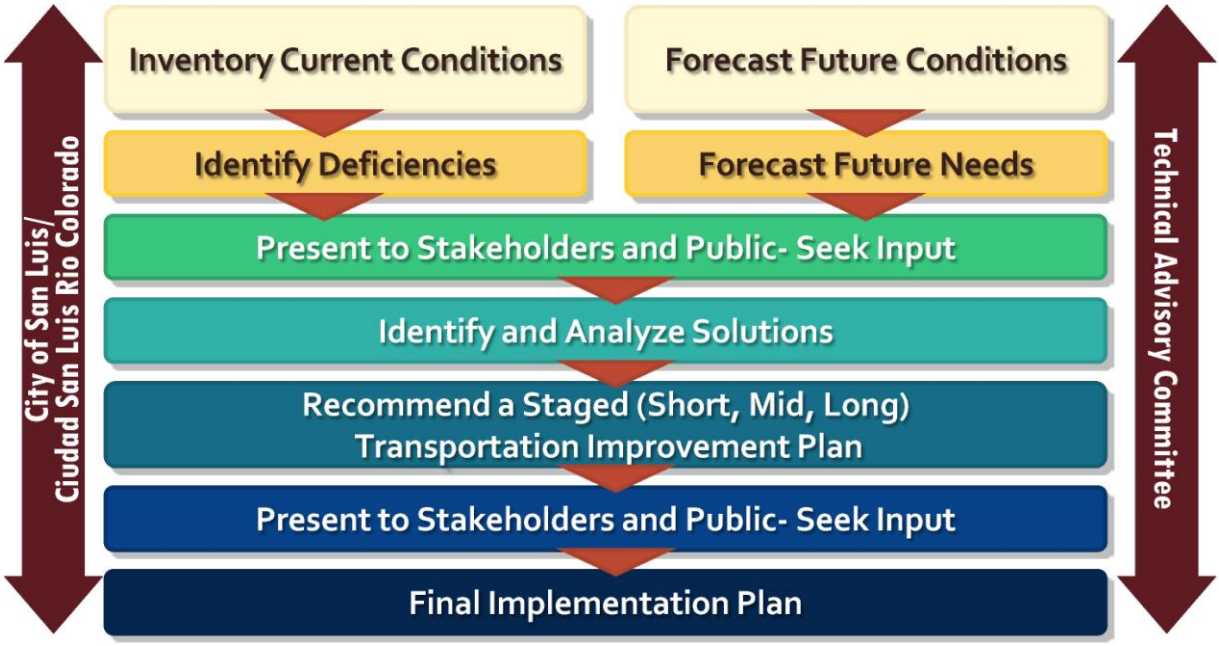
The study was guided by a TAC that included the following agencies:

- City of San Luis
- Ciudad de San Luis Río Colorado
- ADOT – Office of International Affairs
- ADOT – Yuma District
- ADOT – Communication and Community Partnerships (CCP)
- ADOT - Enforcement and Compliance Division
- Federal Highway Administration (FHWA)
- Secretaría de Infraestructura y Desarrollo Urbano (SIDUR)
- Secretaría de Comunicaciones y Transportes (SCT)
- Yuma Metropolitan Planning Organization (YMPO)
- Greater Yuma Economic Development Corporation (GYEDC)
- General Services Administration (GSA)
- U.S. Customs and Border Protection (CBP)
- Greater Yuma Port Authority (GYPA)
- Yuma County Intergovernmental Public Transportation Authority (YCIPTA)

The role of the TAC was to provide technical guidance, support, advice, suggestions, and recommendations, and to perform document reviews throughout the study process. Figure 1.2 illustrates the process utilized to complete this study.

Working Paper 1: Existing and Future Conditions inventoried and analyzed the existing and future conditions in the study area, including existing transportation system deficiencies, constraints, and needs. The first Public Open House was conducted in October 2012 to present existing and projected transportation conditions and issues. *Working Paper 2: Draft Transportation Plan* validated and prioritized accordingly the recommended improvements from the *San Luis SATS* and other pertinent regional studies in order to address the needs and deficiencies identified in *Working Paper 1,* as well as identify additional improvements if needed. The second open house was held in May 2013 to present the proposed multimodal transportation improvements for the San Luis portion of the Binational study area.

FIGURE 1.2: STUDY PROCESS



2.0 EXISTING AND FUTURE CONDITIONS

EXISTING LAND USE AND SOCIOECONOMIC CONDITIONS

This section summarizes current land use, socioeconomic conditions, characteristics of the physical and natural environments, environmental justice population review (Title VI), and cultural resources inventory for the study area.

Land Ownership Status

Figure 2.1 provides an overview of the land ownership within the study area. As illustrated in the figure, privately owned land accounts for 48 percent of all the land coverage while Bureau of Land Management (BLM) covers approximately 24 percent of the remaining land in the study area.

Socioeconomic Conditions

Creating an inventory of the study area's socioeconomic characteristics and understanding this data is a critical element for any transportation planning study. Socioeconomic data is one of the primary inputs to the travel demand modeling process that is used to forecast traffic demand in the study area.

SOCIOECONOMIC CONDITIONS

- Land Area: 28.8 square miles
- Population (Year 2013): 28,072
- Total Housing Units (Year 2013): 6,829
- Occupied Housing Units (Year 2013): 6,227
- Average Household Size: 4.51
- Principal Economic Activities: Retail, Agriculture, and Manufacturing

Source: 2010 U.S. Census Bureau

Population and Housing Unit Growth Trends

According to the 2010 U.S. Census, 98 percent of the total 25,505 residents of the City of San Luis reside in the Binational study area. From 2000 to 2010, the study area experienced a significant amount of growth; population increased from 13,036 to 25,080 while the housing units nearly doubled from 3,327 to 6,378. The growth rate for the study area is nearly three times higher than both the County and State for the same time period. In addition, the average household size in 2010 for the San Luis portion of the study area was 4.5. By 2013, the total population and housing units in the study area is estimated to be 28,072 and 6,829 (11% and 7 % increase respectively). Table 2.1 lists the population and housing growth trends from 2000 to 2013.

TABLE 2.1: POPULATION AND HOUSING UNIT GROWTH TRENDS

	Study Area		Yuma County		Arizona	
	Total Population	Total Housing Units	Total Population	Total Housing Units	Total Population	Total Housing Units
2000	13,036	3,327	160,026	74,140	5,130,632	2,189,189
2010	25,080	6,378	195,751	87,850	6,392,017	2,844,526
2013*	28,072	6,829	235,559	105,715	7,554,429	3,361,814
Average Annual Population Growth Rate						
2000 -2010	9.24%	9.17%	2.23%	1.85%	2.46%	2.99%
2010 -2013*	3.98%	2.36%	6.78%	6.78%	6.06%	6.06%

*Source: 2000 U.S. Census Bureau, 2010 U.S. Census Bureau, *Population estimates from the Arizona Department of Administration (AZDoA)*

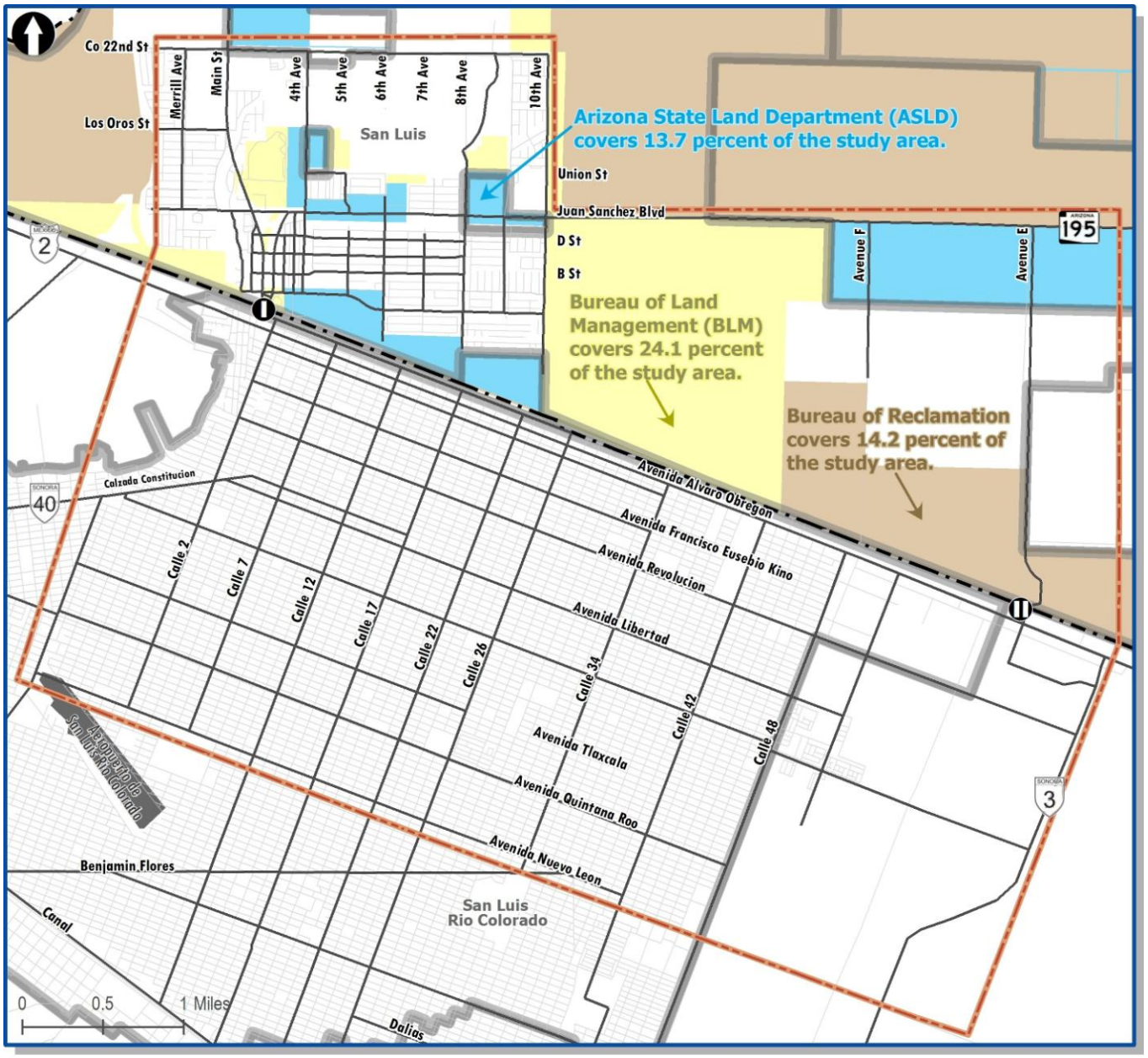


FIGURE 2.1: LAND OWNERSHIP

- Private Land
- State Trust Land
- Bureau of Land Management
- Bureau of Reclamation
- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: ALRIS, SLRC, ADEQ; INEGI; USGS

Figure 2.2 illustrates the population density in the study area for the year 2013. As shown in the figure, the higher population densities occur in two locations: west of the US-95 in the northwest corner of the study area and south of Juan Sanchez Boulevard east of the downtown area.

Employment Overview

Retail, agricultural, and manufacturing are the primary drivers of the economy in the study area. The largest employment center in the area, ACT Call Center, is located west of the downtown along San Luis Plaza Drive. However, many of the residents travel to Yuma or other surrounding communities for employment. Figure 2.3 presents a visual depiction of the locations of the major activity centers in the study area. The commercial area encompasses nearly all of the downtown area from Juan Sanchez Boulevard to Urtuzuastegui Street along Main Street. In addition, there are eleven schools within the study area; five elementary schools, two middle schools, one high school, two charter schools, and a distant learning center associated with Arizona Western College. Table 2.2 lists the schools and the October 2011 student enrollment within the study area.

EMPLOYMENT OVERVIEW

Major Employers (*total employees*):

- ACT Call Center (700)
- Corrections Department (755)
- Gadsden Elementary District (315)
- San Luis High School (200)
- Wal-Mart Supercenter (270)
- City of San Luis (193)
- San Luis Detention Facility (120)
- Paranepics Technology (70)

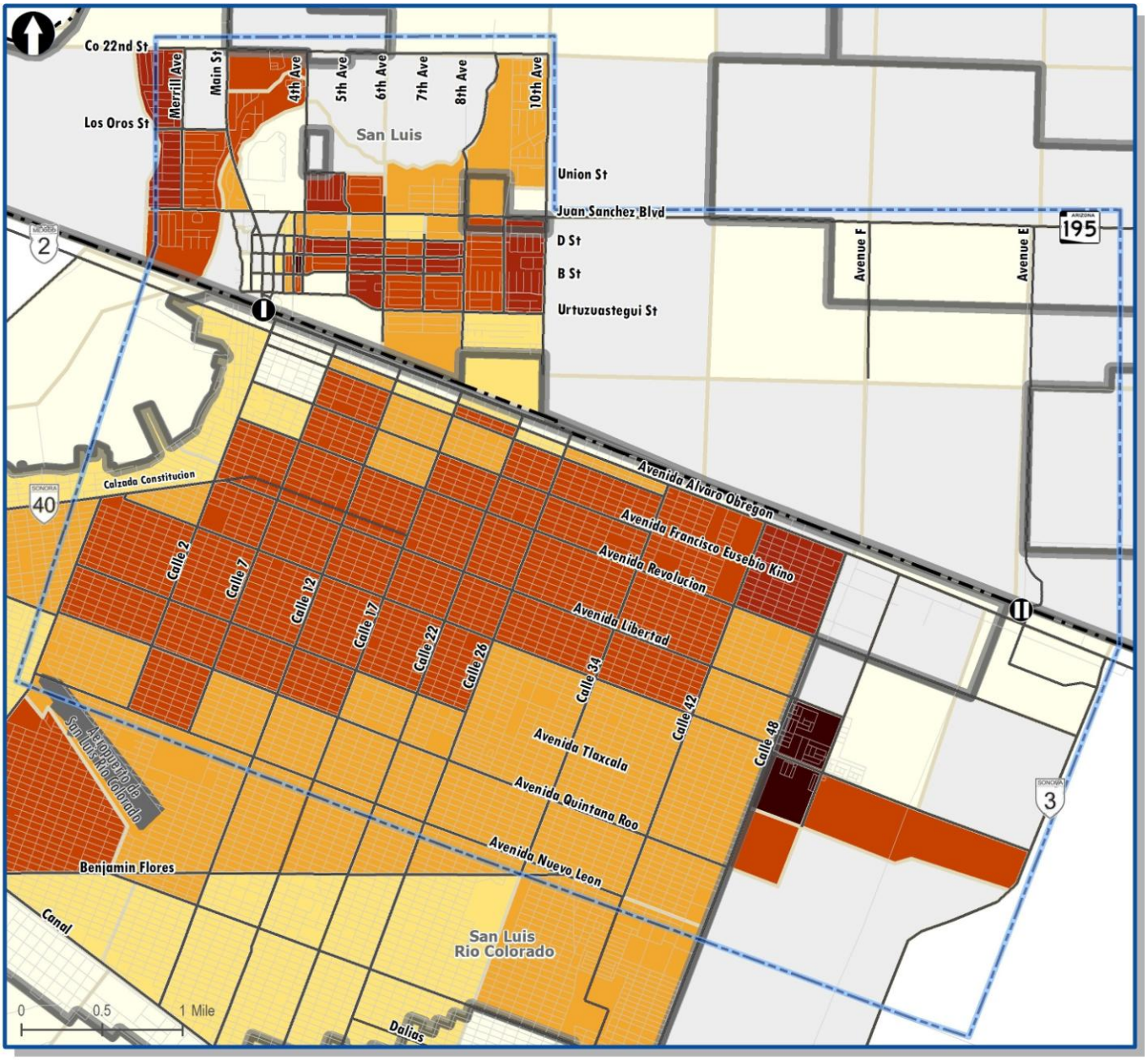
* *Source: InfoUSA database*

TABLE 2.2: STUDY AREA SCHOOLS AND COLLEGES

School	Students
Gadsden Elementary District	**4,603**
- Arizona Desert Elementary	703
- Cesar Chavez Elementary School	741
- Desert View Elementary School	728
- Ed Pastor Elementary	314
- Rio Colorado Elementary School	802
- San Luis Middle School	620
- Southwest Jr. High School	695
Yuma Union High School District	
- San Luis High School	2,593
Harvest Preparatory Academy	223
PPEP TEC - Cesar Chavez Learning Center	120
Arizona Western College-San Luis Learning Center	N/A*

*Overall enrollment at Arizona Western College, including the distance learning centers, is 8,500.

Source: Arizona Department of Education, InfoUSA database



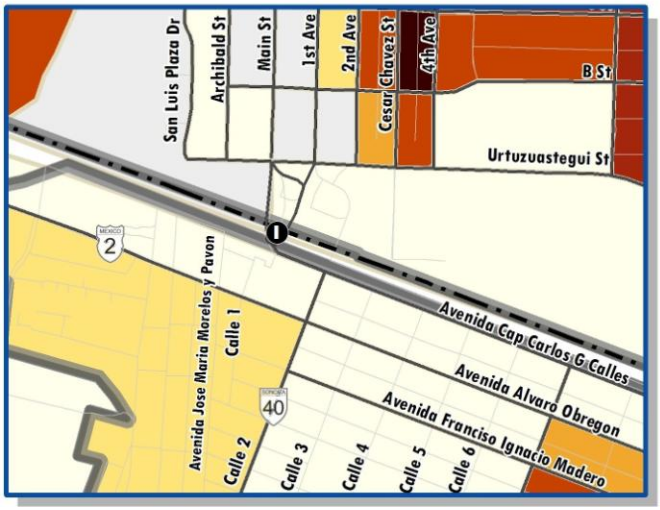


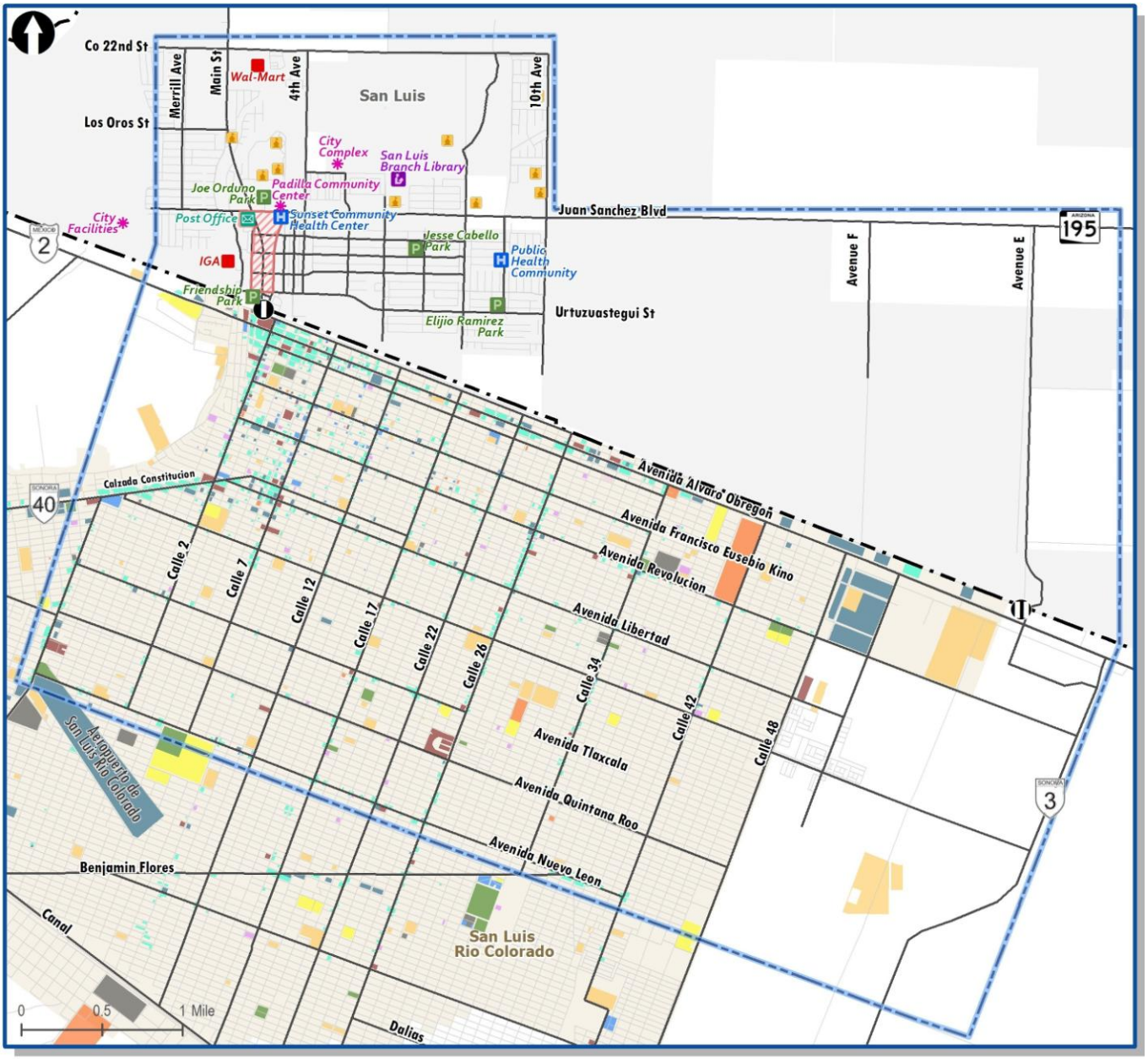
FIGURE 2.2: YEAR 2013 POPULATION DENSITY

Population per Square Mile

- 0
- 1 - 3,000
- 3,001 - 6,000
- 6,001 - 9,000
- 9,001 - 13,000
- 13,001 - 18,000
- 18,001 and above

- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Arizona Dept. of Administration Office of Employment and Population Statistics



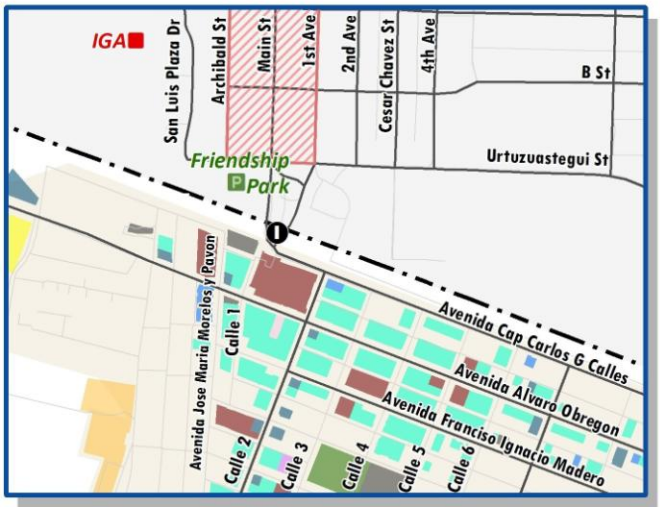


FIGURE 2.3: MAJOR ACTIVITY CENTERS

San Luis
- City Facility
- Library
- Market
- Park
- Post Office
- School
- Hospitals/Health Center
- Commercial Activity Area

San Luis Rio Colorado
- Shopping Center
- Commerical Corridor
- Economics
- Educational
- Public Areas
- Management Offices
- Parks
- Religion
- Health
- Culture
- Sports Areas

- Land Port of Entry
- Study Roadway
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ALRIS, SLRC, ADEQ, USGS, InfoUSA

Traffic Analysis Zones

Population, housing units, and various types of employment categories were inventoried for each Traffic Analysis Zone (TAZ) in the study area. TAZs are geographic subdivisions of the study area bounded by roads, political boundaries, natural and man-made geographical constraints (such as rivers, washes, etc.). For this study, the Yuma Metropolitan Planning Organization travel demand model was used; sixty-eight TAZs from the YMPO model are within the study area boundary. . Table 2.3 summarizes the year 2013 socioeconomic data utilized in the travel demand model. Figure 2.4 displays employment densities for the study area in year 2013

TABLE 2.3: STUDY AREA SOCIOECONOMIC DATA SUMMARY

Socioeconomic Data Variable	Units	Study Area Total
Population	Persons	28,072
Occupied Dwelling Units	Dwelling Units	6,227
Retail	Employees	2,691
Office	Employees	337
Service	Employees	561
Industrial	Employees	196
Public	Employees	408
Manufacturing	Employees	205
Elementary/Junior High School	Employees	335
High School	Employees	238
Community College	Employees	12

Source: Jacobs Engineering, YMPO RTP 2009 - 2033 Travel Demand Model, InfoUSA database, 2010 U.S. Census, Arizona Department of Administration,

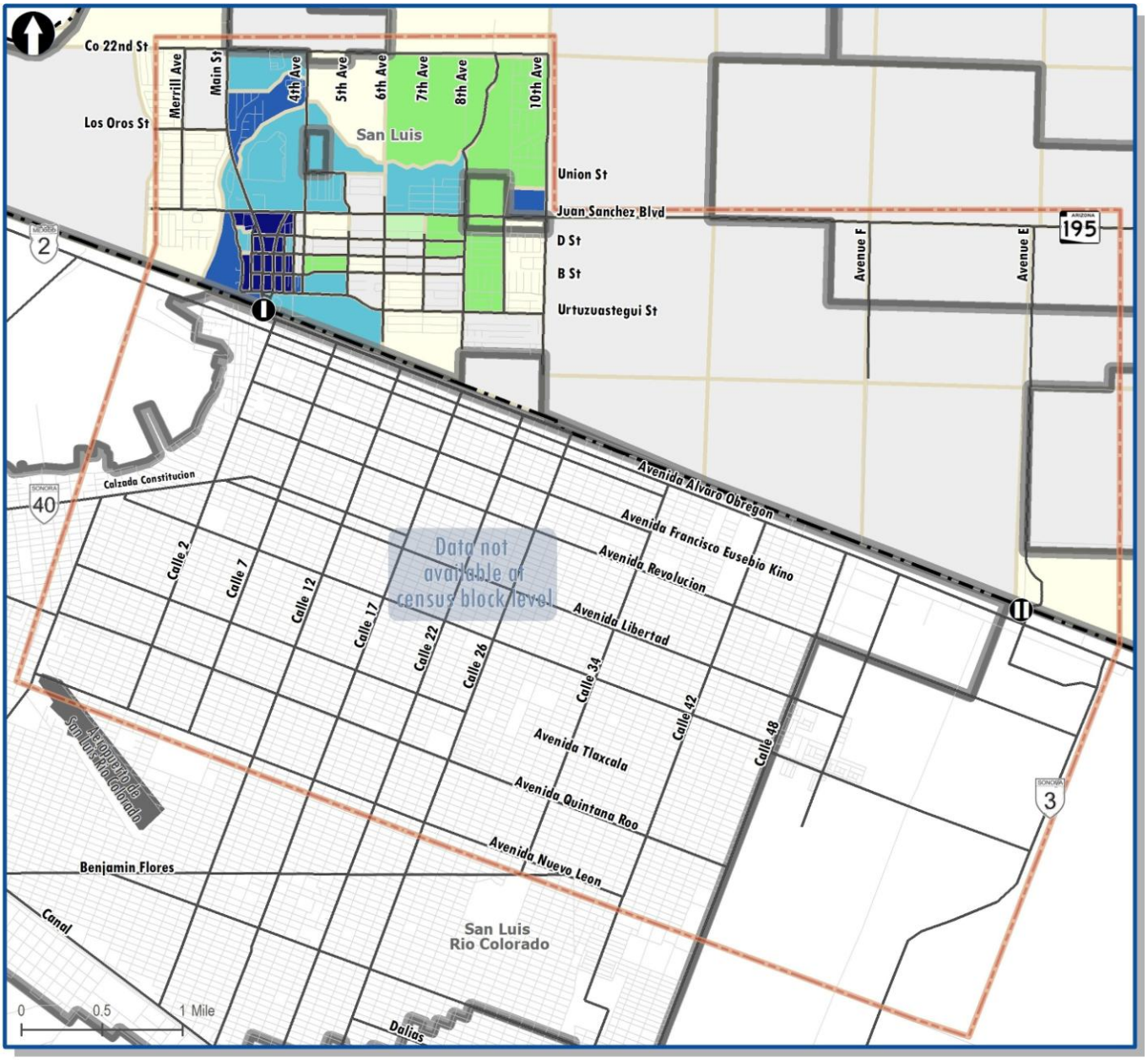


FIGURE 2.4: YEAR 2013 EMPLOYMENT DENSITY

Employees per Square Mile

- No Employees
- 0 - 250
- 251 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 5,000
- 5,001 and above

- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Arizona Dept. of Administration Office of Employment and Population Statistics

Environmental Justice Review (Title VI)

Title VI of the Civil Rights Act of 1964 and related statutes require individuals not be discriminated against based on race, color, national origin, age, sex, or disability. Executive Order 12898 on Environmental Justice dictates that any programs, policies, or activities to be implemented are not to have disproportionately high adverse human health and environmental effects on minority populations. Environmental justice principles and procedures are followed to assure that transportation improvements do not adversely impact different socioeconomic groups. To assure that these policies are adhered to, a variety of possible alternatives should be developed and considered in order to make sure all groups are fairly represented in the amount and type of transportation services provided.

ENVIRONMENTAL JUSTICE (TITLE VI) OVERVIEW

Percentage of Study Area Population:

Minority Population: 99.01%▲

Age 65 and Older Population: 5.9%▲

Percentage of City of San Luis Population:

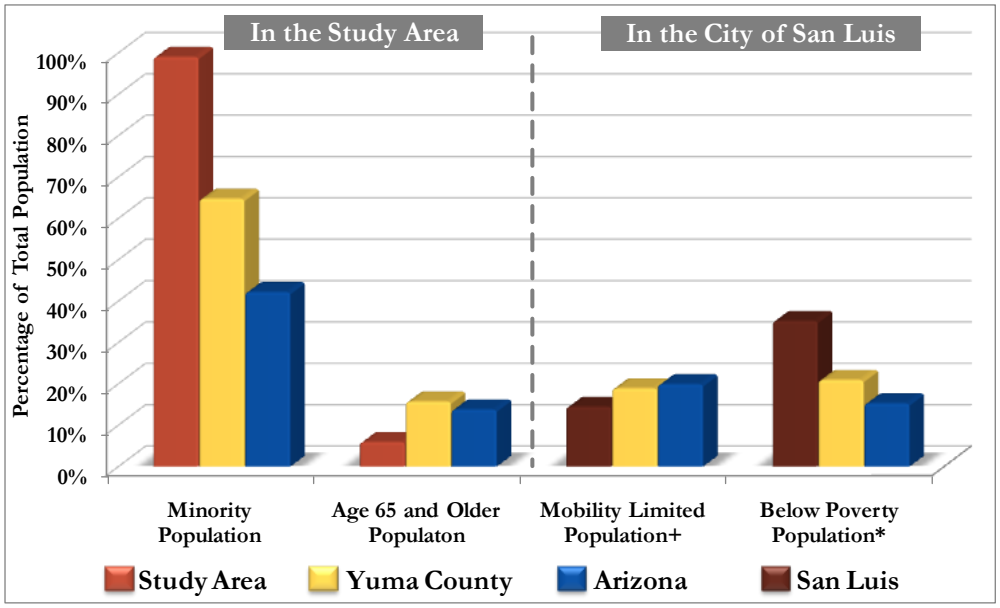
Mobility Limited: 10.1%*

Below Poverty: 35.4%+

Source: ▲2010 U.S. Census Bureau
**2000 U.S. Census Bureau*
+2006 - 2010 American Community Survey

Protected populations considered in this analysis include minority, elderly, low-income, and disabled populations. Figure 2.5 shows a graphical comparison of these protected populations relative to the study area. Table 2.4 summarizes the percentage of minority and elderly populations within the study area, Yuma County, and Arizona based on the 2010 U.S. Census. Updated 2010 U.S. Census data was unavailable for selected protected population; therefore 2000 U.S. Census data and five-year American Community Survey (2006 - 2010) estimates for the City of San Luis were used to identify mobility limited and below poverty level populations. Table 2.5 summarizes the percentage of mobility limited and below poverty level populations within the study area, Yuma County, and Arizona.

FIGURE 2.5: TITLE VI POPULATION GROUPS COMPARISON



*Source: 2010 U.S. Census, +2006 - 2010 American Community Survey (ACS), *2000 U.S. Census*

TABLE 2.4: MINORITY AND AGE 65 AND OLDER POPULATION PERCENTAGES

	Study Area		Yuma County		State of Arizona	
	Total Population	% of Total Population	Total Population	% of Total Population	Total Population	% of Total Population
Total Population *(Year 2010)*	**25,080**		**195,751**		**6,392,017**	
Minority Population	24,840	*99.0*	126,729	*64.7*	2,696,370	*42.2*
Age 65 and Older Population	1,485	*5.9*	30,646	*15.7*	881,831	*13.8*

Source: 2010 U.S. Census

TABLE 2.5: MOBILITY LIMITED AND BELOW POVERTY LEVEL POPULATION PERCENTAGES

	% of Total Population		
	City of San Luis	Yuma County	Arizona
Mobility Limited[+] (Age 16 - 64)	*14.5*	*18.8*	*19.9*
Below Poverty Level[**]	*35.2*	*20.9*	*15.3*

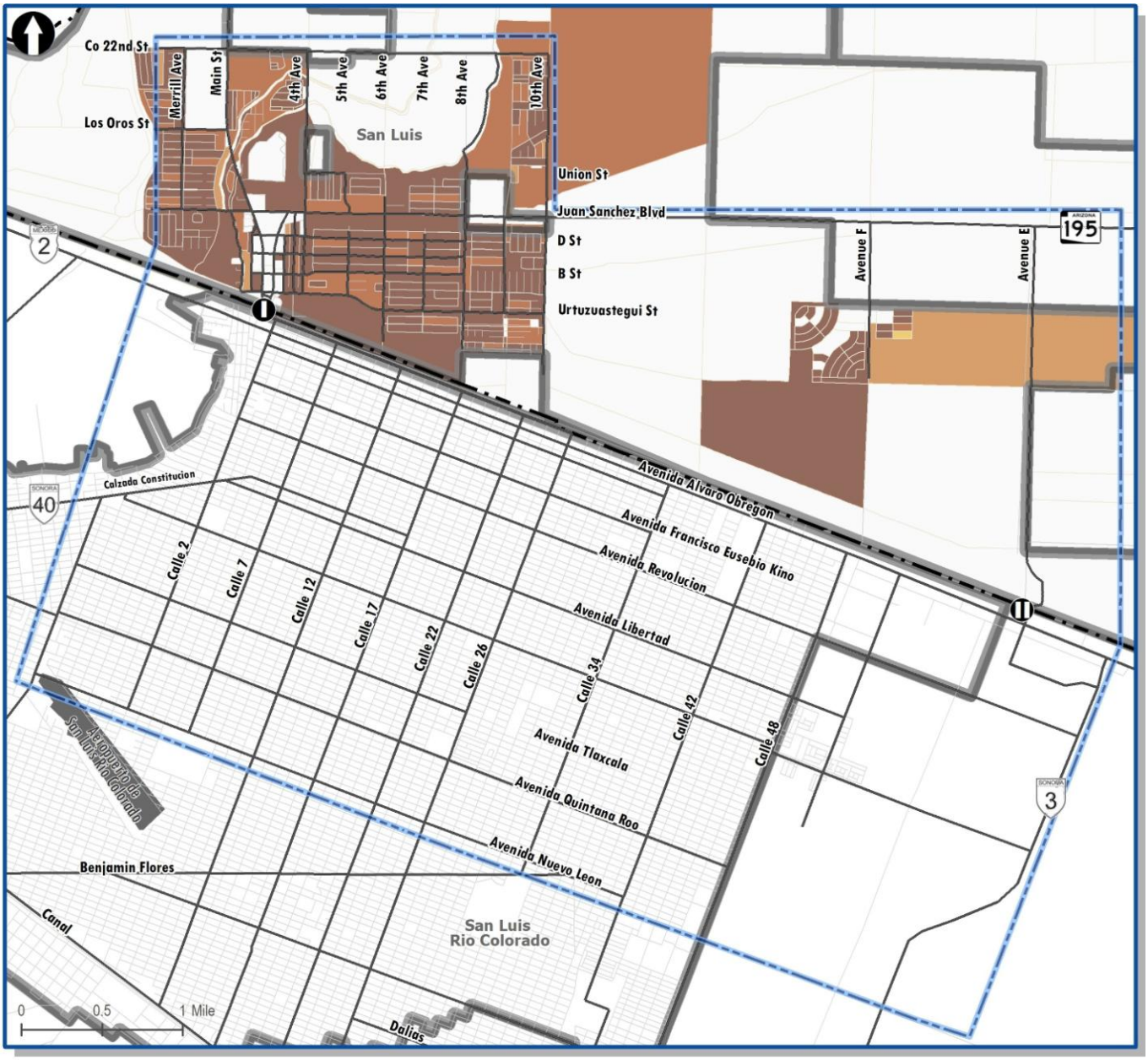
*Source: [+]2006 - 2010 American Community Survey (ACS), **2000 U.S. Census*

Minority Population: Minority population consists of individuals who are members of the following population groups: Native American or Alaskan Native, Asian or Pacific Islander, Black, Hispanic, other race, or two or more races. The 2010 U.S. Census estimated that the minority population accounted for 99.0 percent of the study area population, with Hispanics as the largest minority group. Figure 2.6 illustrates the concentration of minority populations in the study area.

Population Age 65 and Over Elderly populations, or persons who are over the age of 65, in 2010 constituted 5.9 percent of the total population, which is less than the State (13.8%) and County (15.7%) estimates. Figure 2.7 displays the age 65 and over population concentrations.

Mobility Limited Population: Mobility-limited population is comprised of individuals who have a physical or mental disability that prohibits them from operating an automobile and may require them to access public transportation. Based on the 2006 - 2010 American Community Survey, the percentage of mobility-limited population in the study area is 14.5 percent, less the County (18.8%) and State (19.9%) estimates.

Below Poverty Population Below poverty populations are individuals living in households that lie within a set of income thresholds, which vary by family size and composition, established by the U.S. Census Bureau. According to the 2000 U.S. Census, 35.2 percent of the study area population is below poverty; this is more than both State (15.3%) and County (20.9%) estimates.



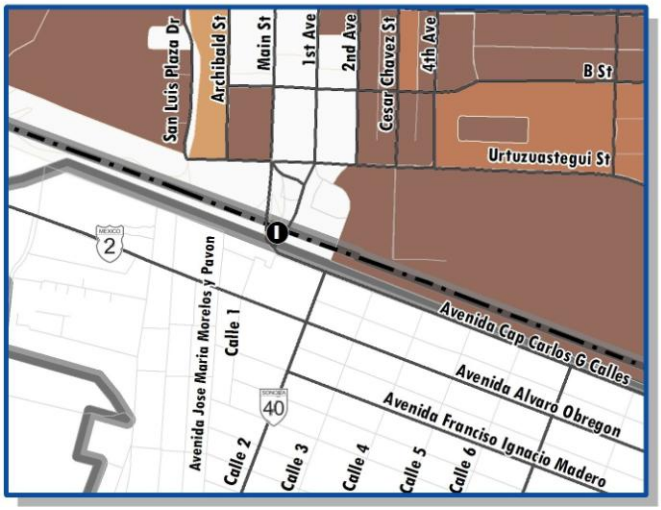


FIGURE 2.6: MINORITY POPULATION

Above Study Area Average

- 0.0%
- 0.1% - 25.0%
- 25.1% - 50.0%
- 50.1% - 75.0%
- 75.1% - 95.0%
- 95.1% - 99.0%

Below Study Area Average

- 99.1% - 100.0%

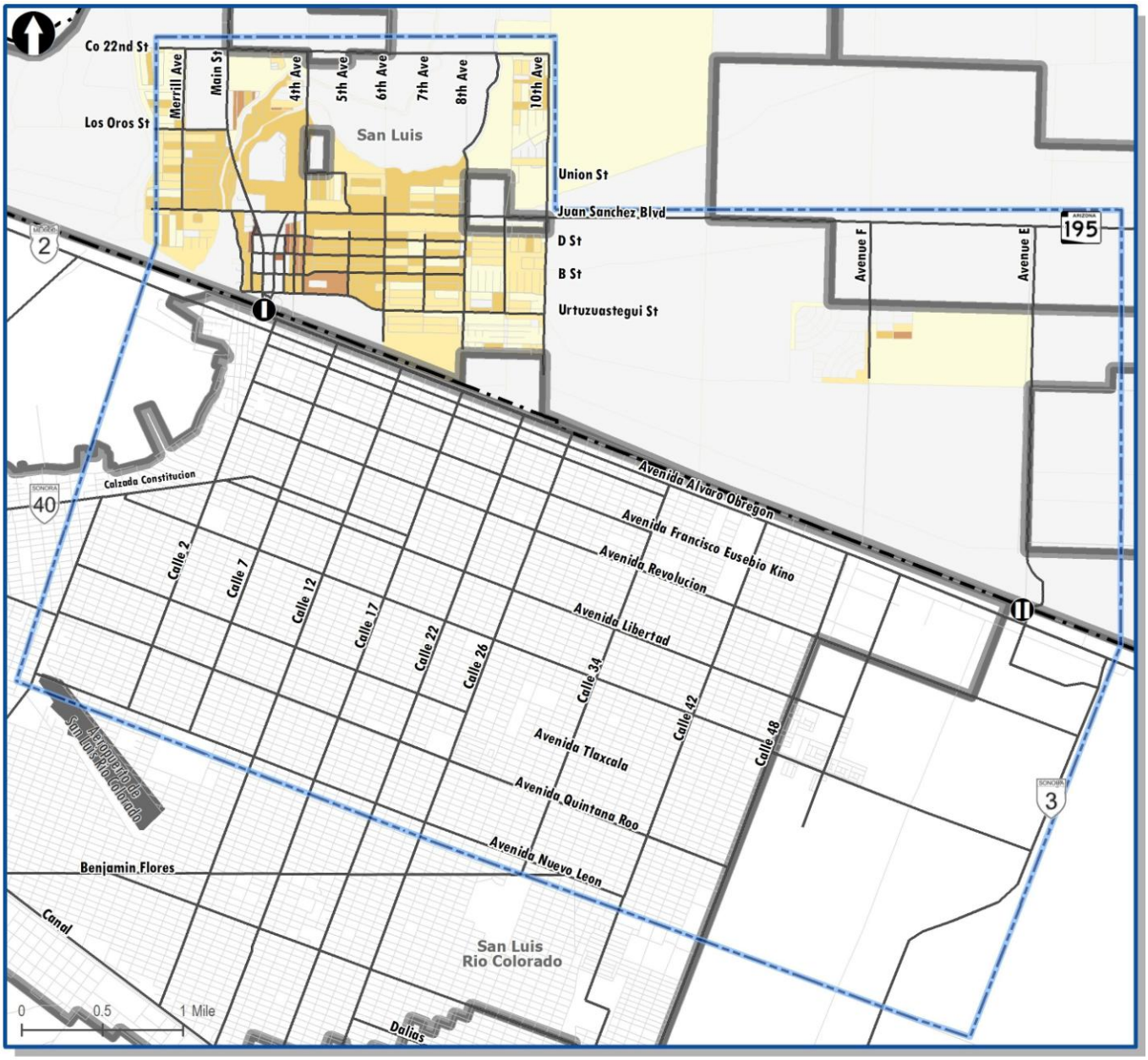
Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS

Percentage of Minority Population in:
Study Area: 99.0%
Yuma County: 64.7%
State of Arizona: 42.2%

Minority population consists of individuals who are members of the following population groups: Native American or Alaskan Native, Asian or Pacific Islander, Black, and Hispanic.

A high percentage of minority population does not necessarily mean that there is a large minority population in the area. The map shows what percentage of people living in the census block are minority.

For example if the census block has a:
Total population = 1 and
the minority population = 1 then the % of minority living in the census block = 100%



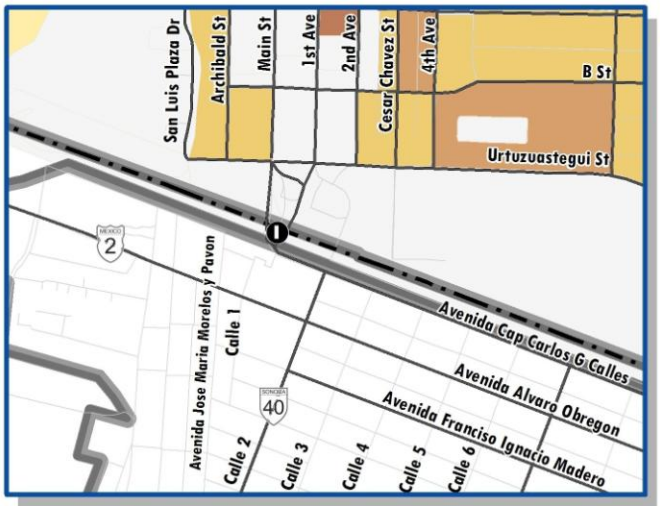


FIGURE 2.7: ELDERLY POPULATION

Above Study Area Average

- 0.0%
- 0.1% - 3.0%
- 3.1% - 6.0%

Below Study Area Average

- 6.1% - 20.0%
- 20.1% - 35.0%
- 35.1% - 50.0%
- 50.1% - 100.0%

Percentage of Elderly Population in:
Study Area: 5.9%
Yuma County: 15.7%
State of Arizona: 13.8%

Elderly population consists of individuals who are age 65 years and older.

A high percentage of elderly population does not necessarily mean that there is a large elderly population in the area. The map shows what percentage of people living in the census block are elderly.

For example if the census block has a:
Total population = 1 and the
elderly population = 1 then the % of
elderly living in the census block = 100%

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS

Environmental Overview

Inventory of the physical, natural, and cultural environment is an important component of the corridor planning process. When environmental conditions and historic and cultural concerns are reviewed in the early stages of the planning process, transportation solutions can be developed to lessen the negative impacts to the environment and cultural treasures.

Natural Environment

Figure 2.8 presents the natural environmental overview of the study area

Vegetation: One type of vegetation, the Sonoran Desertscrub from the Lower Colorado River Subdivision, exists within the study area.

Water Features: There are three canals: Main Drain Canal, East Main Canal, and West Main Canal; all drain into one canal that leads into Mexico west of the San Luis I LPOE.

Wildlife: The Arizona Wildlife Linkages Workgroup (AWLW) is a collaborative effort between ADOT and nine public and nonprofit organizations to identify large blocks of protected habitat, potential wildlife movement corridors, and factors that may disrupt these linkage zones. The AWLW developed the Arizona Wildlife Linkages Assessment, which identified wildlife habitat blocks and linkage zones that allow land managers and transportation planners to integrate wildlife needs into developments and land use plans. Wildlife habitat blocks are defined as large, contiguous areas of natural woodland with little or no human disturbance and are essential for maintaining a diverse and healthy population of wildlife. Wildlife linkage zones are areas of wildlife movement between habitat blocks. The eastern portion of the study area in San Luis, beginning east of the 10th Avenue, is located within the habitat block. In addition, the wildlife linkage zone in the study area extends roughly one-mile on either side of Juan Sanchez Boulevard. It should be noted that portions of the linkage zone extend into Mexico.

Environmental Concerns

Figure 2.9 displays the environmental issues in the study area.

Leaking Underground Storage Tanks: Environmental Protection Agency (EPA) defines underground storage tanks as any tank and any underground piping connected to the tank that stores petroleum or hazardous substances. The Arizona Department of Environmental Quality (ADEQ) has identified six leaking underground storage tanks in the study area.

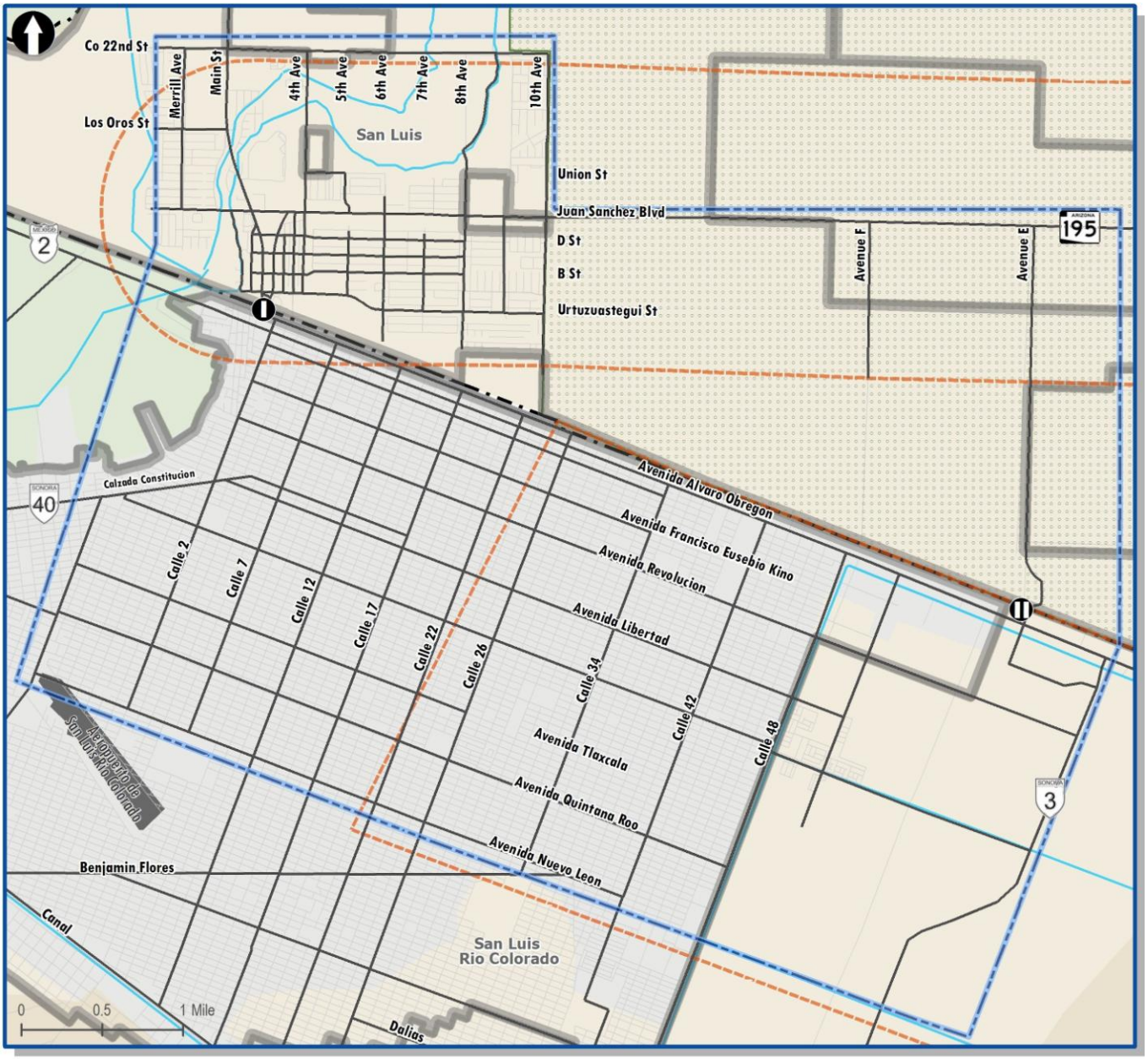
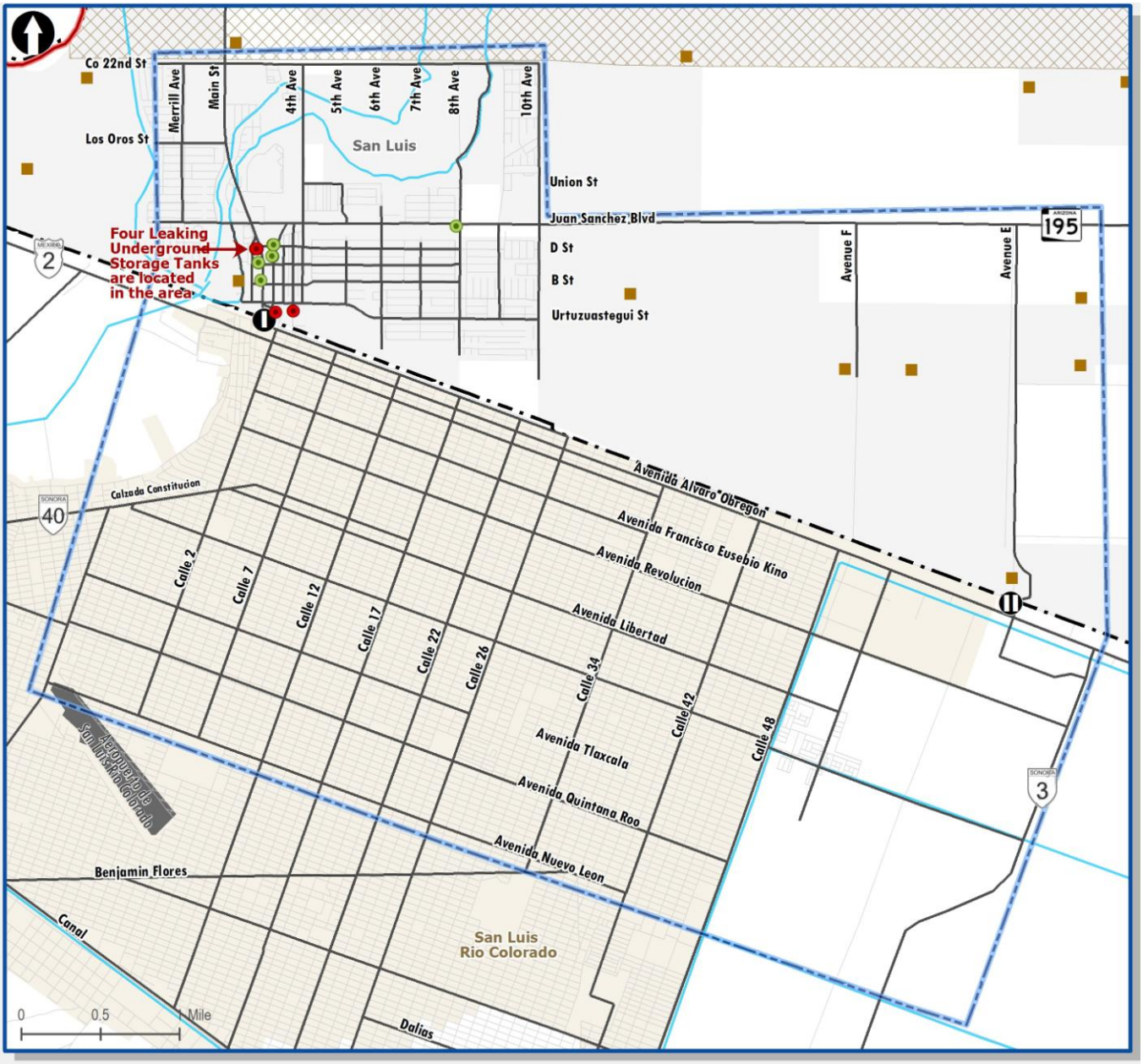


FIGURE 2.8: NATURAL ENVIRONMENT

- Wildlife Habitat Block
- Wildlife Linkage Zone
- Irrigated Agriculture
- Urban Area
- Sonoran Desertscrub
- Sandy Desert Vegetation
- Land Port of Entry
- Study Roadway
- Canal
- International Boundary
- Cities
- Study Area

Source: ADOT; ALRIS, SLRC, ADEQ, INEGI, USGS



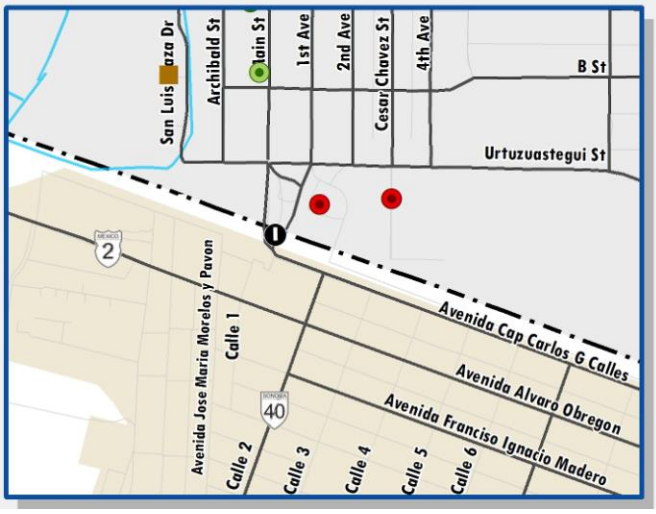


FIGURE 2.9: ENVIRONMENTAL CONCERNS

- Leaking Underground Storage Tanks
- Underground Storage Tanks
- Geothermal Well
- Impaired Streams
- PM10 Nonattainment Area
- Land Port of Entry
- Study Roadway
- Canal
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT; ALRIS, SLRC, ADEQ; INEGI; USGS

Mines: Seven geothermal wells are located in the study area mainly in the rural portion of the study area. To extend the growing season, farmers and ranchers use geothermal water for irrigation to produce citrus and table grapes.

Air Quality: Less than one percent of the northern portion of the study area is in the Yuma Particle Matter (PM10) Nonattainment area

Endangered Species: The Arizona Game and Fish Department (AZGFD) identified several endangered species within the proximity of the study area. Endangered and threatened species within the study area include the Southwestern Willow Flycatcher and Yuma Clapper Rail. A full listing of endangered species within the study area is listed in Table 2.6.

TABLE 2.6: ARIZONA GAME AND FISH ENDANGERED AND THREATENED SPECIES

AZ Game & Fish Identified Species and Habitats within the Study Area	
Flat-tailed Horned Lizard (SC)	Yellow-billed Cuckoo(PS)
Sand Food (SC)	Yuma Clapper Rail (E)
Southwestern Willow Flycatcher (E)	Yuma Hispid Cotton Rat (SC)

E = Endangered under the Endangered Species Act
PS = Partial Status under the Endangered Species Act
SC= Species of Concern to the US Fish and Wildlife Service

Source: Arizona Game and Fish Department

EXISTING TRANSPORTATION CONDITIONS

This section inventories major elements of the transportation system and documents the status/condition of each element. Major elements inventoried include bridges, pavement condition, crashes, traffic conditions, roadway performance, and other modes of transportation in the study area.

Roadway System

Within the next year, US-95 and the downtown area of San Luis are expected to undergo major roadway circulation improvements culminating in the turn back of US-95 to the City of San Luis. To ensure consistency with the new roadways configurations, the downtown improvements were included in the 2013 transportation system which was used as the base year scenario for this study.

Major Roadways

The study area is comprised of a network of major arterials, collectors, and local roadways. The following is a summary of characteristics of the major roadways that transverse the study area:

US-95/ Main Street

- ADOT owned north-south highway that serves as the connection between the U.S.-Mexico border at San Luis I LPOE in San Luis and other Yuma County jurisdictions to the north.
- In the downtown area of San Luis, Main Street will be converted to a two-lane roadway with street parking with a cul-de-sac at the intersection of Main Street and Urtuzuastegui Street. Archibald Street and 1st Avenue are to be converted to one-way streets that will provide access to and from San Luis I LPOE.
- The number of lanes transition from two-lanes (one-lane in each direction) in the vicinity of the downtown area to four-lanes (two-lanes in each direction) north of Juan Sanchez Boulevard.
- Speeds range from 25 mph to 55 mph.
- Traffic control along the corridor includes traffic signals at Juan Sanchez Boulevard and at County 22nd Street, and a roundabout at D Street.

SR-195:

- ADOT owned north-south highway (with limited access) that provides a regional connection for commercial trucks from San Luis II LPOE via Avenue E to I-8 in Yuma. Also, provides an alternative route from San Luis to I-8 via Juan Sanchez Boulevard.
- Four-lane (two-lanes in each direction) divided highway.
- Speeds range from 55 mph to 65 mph.

Juan Sanchez Boulevard:

- East-west arterial that provides local access to businesses and residences as well as regional access to SR-195 just west of Avenue E.
- Two-lane (one-lane in each direction) roadway with the exception between 8th Avenue and 10th Avenue where the road widens to four-lanes (two-lanes in each direction.
- One of two traffic signals in the study area is located at the intersection of US-95/Main Street and Juan Sanchez Boulevard.
- Speeds range from 25 mph to 50 mph.

Roadway Functional Classification

Functional Classification is the grouping of streets and highways by the character of service they intend to provide. Defining a street's functional classification, serves as a basis for establishing speed limits, design standards, and access controls. The roadways functional classification for the study area is presented in Figure 2.10.

Number of Lanes and Posted Speed Limits

A visual review was conducted to inventory the number of lanes and posted speed limits for major roadways in the study area. In addition, traffic control type (signals, roundabouts, stop signs, etc.) at major intersections were also inventoried. Figure 2.11 displays the number of lanes for each roadway, Figure 2.12 displays posted speed limits, and Figure 2.13 identifies traffic signal locations. The following are key observations noted during the review:

Number of Lanes:

- US-95/Main Street: the northern study limits to Archibald Street (four-lanes)
- 8th Avenue: Urtuzuastegui Street to San Luis High School (four-lanes)
- 6th Avenue: B Street to north of D Street (four-lanes)
- Juan Sanchez Boulevard: 8th Avenue to 10th Avenue (four-lanes)
- SR-195: west of Avenue E to eastern study limits (four-lanes)

Downtown improvements include but not limited to:

- US-95/Main Street: Archibald Street to D Street (three-lanes)
- Archibald Street: US-95/Main Street to D Street (two-lanes, one-way)
- Archibald Street: D Street to Urtuzuastegui Street (three-lanes, one-way)
- Urtuzuastegui Street: Archibald Street to San Luis I LPOE (two-lanes, one-way)
- Urtuzuastegui Street: San Luis I LPOE to 1st Avenue (two-lanes, one-way)
- 1st Avenue: D Street to Urtuzuastegui Street (two-lanes, one-way)
- D Street: US-95/Main Street to 1st Avenue (two-lanes, one-way)

Speed Limits:

- US-95/Main Street ranges from 25 to 55 mph
- Juan Sanchez Boulevard ranges from 25 to 55 mph
- SR-195 is 55 mph
- Avenue E is 40 mph
- County 22nd Street is 35 mph
- Majority of streets in the study area are 25 mph or less

Traffic Signals:

- Five traffic signals are located within the study area: US-95/Main Street at County 22nd Street, and US-95/Main Street at Juan Sanchez Boulevard
- A roundabout will replace the signal at the intersection of US-95/Main Street and D Street as part of the downtown improvements.

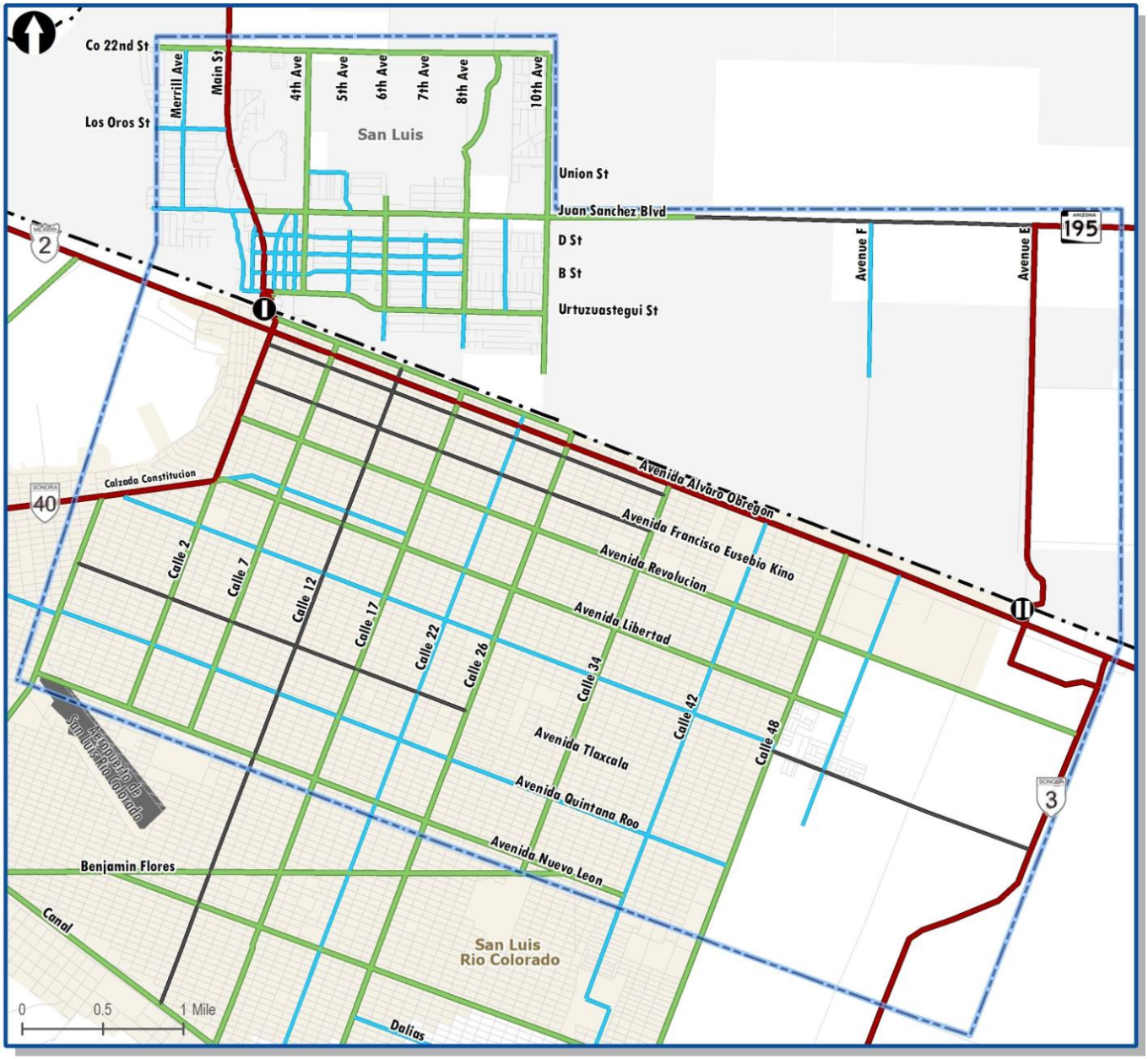
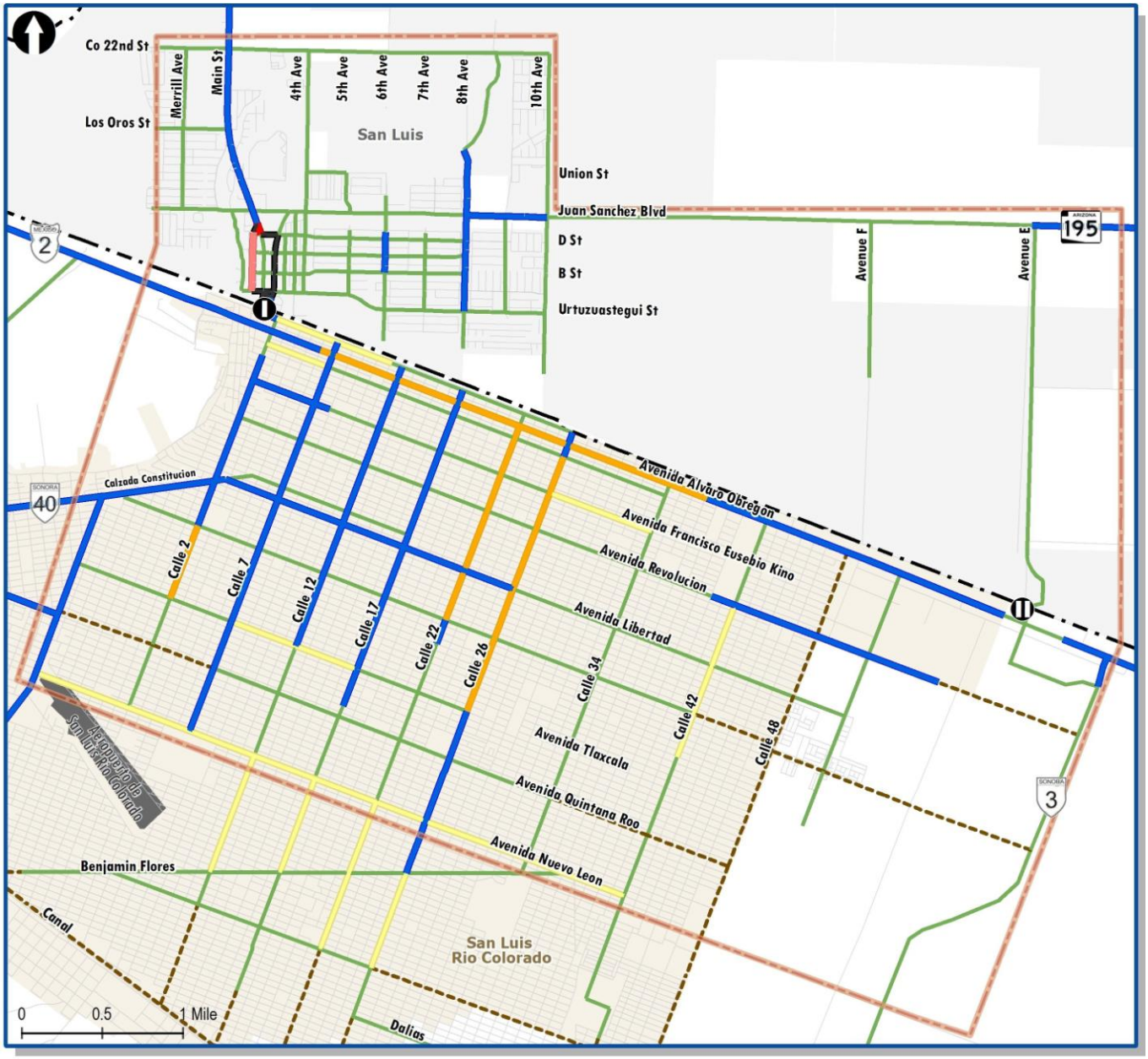


FIGURE 2.10: FUNCTIONAL CLASSIFICATION

- Principal Arterial
- Minor Arterial
- Collector
- Minor Collector
- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SI, YMPO



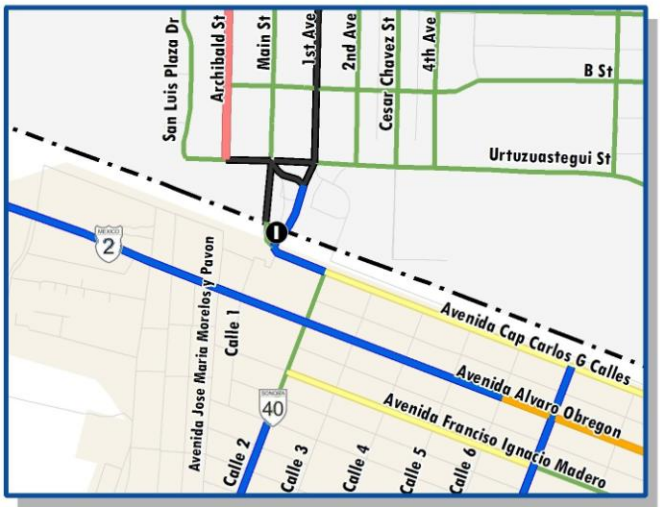
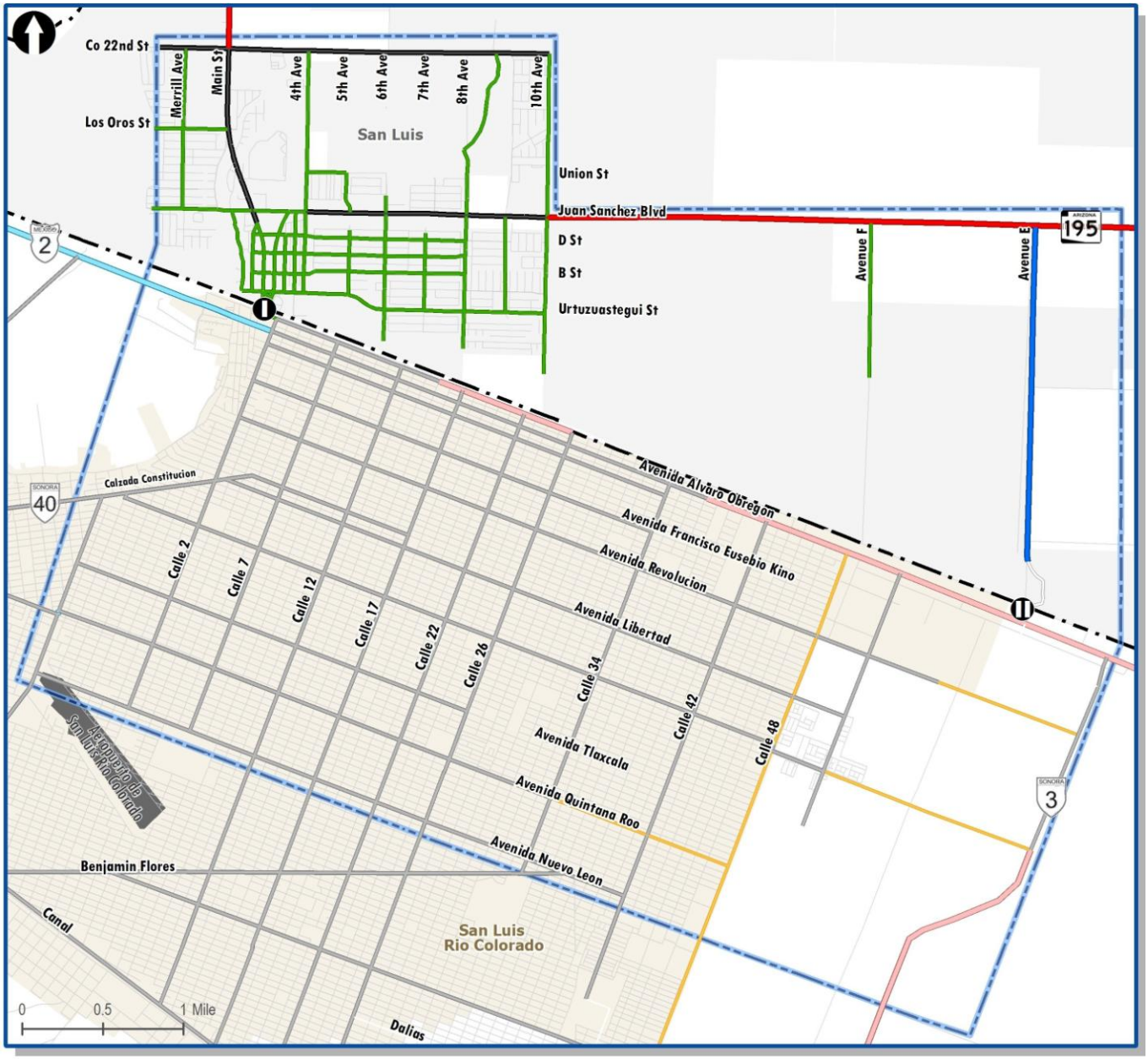


FIGURE 2.11: NUMBER OF LANES

- 4 Lanes with Center Turn Lane Paved
- 4 Lanes Paved
- 3 Lanes Paved
- 3 Lanes Paved (one-way)
- 2 Lanes with Center Turn Lane Paved
- 2 Lanes Paved
- 2 Lanes Paved (one-way)
- 2 Lanes Unpaved

- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ALRIS, SLRC, ADEQ, INEGI, USGS, SL,YMPO



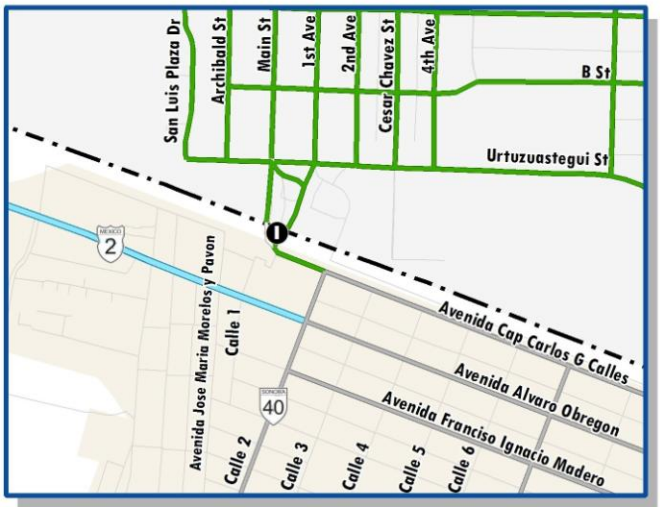


FIGURE 2.12: SPEED LIMITS

San Luis	San Luis Rio Colorado
50 - 55 MPH	50 KPH
40 - 45 MPH	40 - 45 KPH
30 - 35 MPH	30 - 35 KPH
20 - 25 MPH	20 - 25 KPH
15 MPH	15 KPH
0 MPH	0 KPH

Land Port of Entry
International Boundary
San Luis
San Luis Rio Colorado
Study Area

Source: ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO

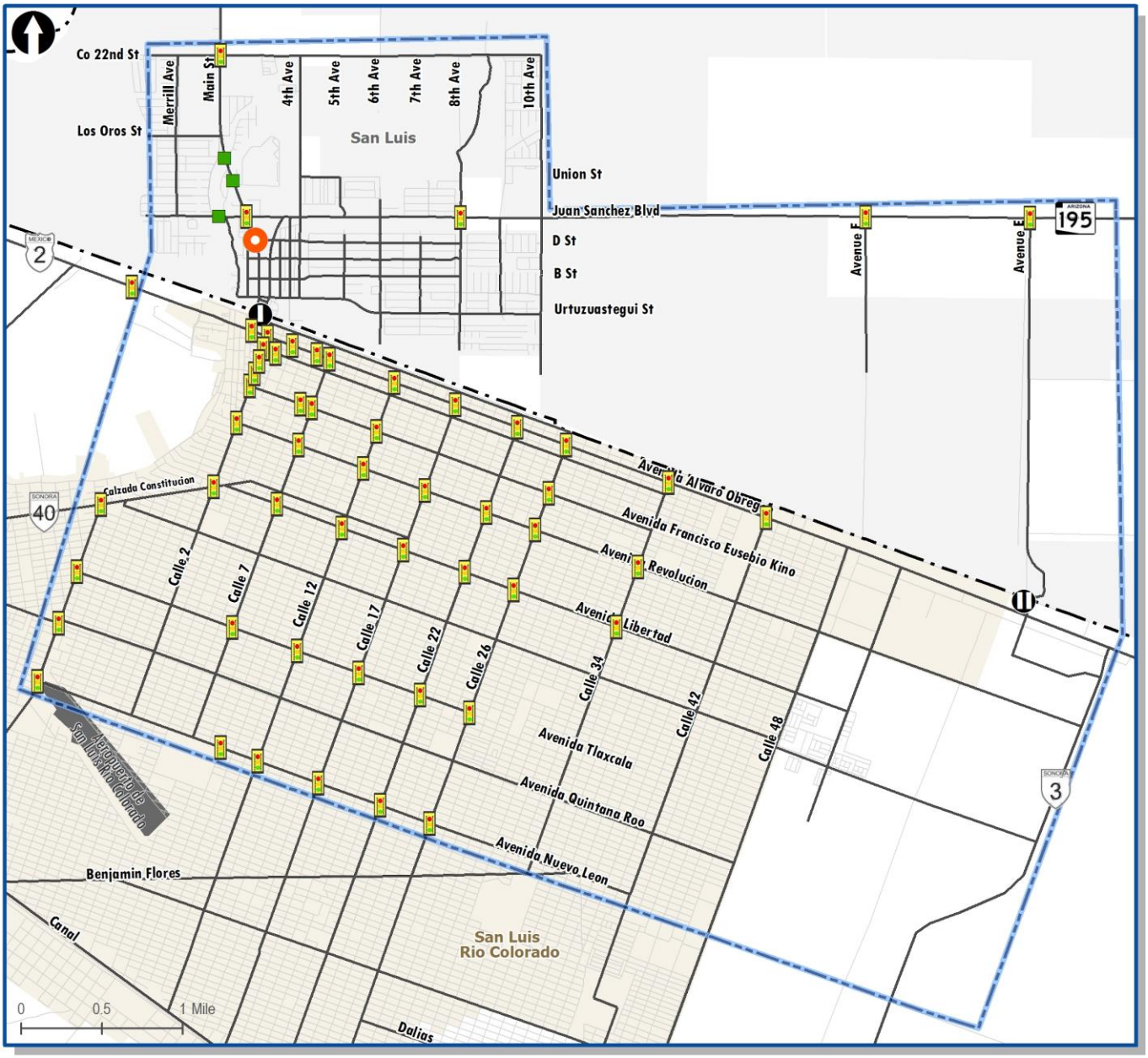


FIGURE 2.13: TRAFFIC CONTROL AND BRIDGES

- Roundabout
- Traffic Signal
- Bridges
- Land Port of Entry
- Study Roadway
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ALRIS, SLRC, ADEQ; INEGI; USGS

Pavement Condition

Pavement condition information for ADOT owned facilities was obtained from the ADOT Pavement Management System. The two ADOT facilities, US-95 and SR-195, located in the study area are in good condition. The remaining study roadway pavement conditions were determined through visual inspection during the field review and exhibited ratings of acceptable for their functional classification.

Bridge Condition

FHWA's National Bridge Inventory database was used to identify the location of all bridges in the study area. A total of three bridges were identified within the study area and all have a sufficiency rating of good. Figure 2.13 displays the location of bridges in the study area.

Crash Data Analysis

Binational - San Luis Crash Analysis

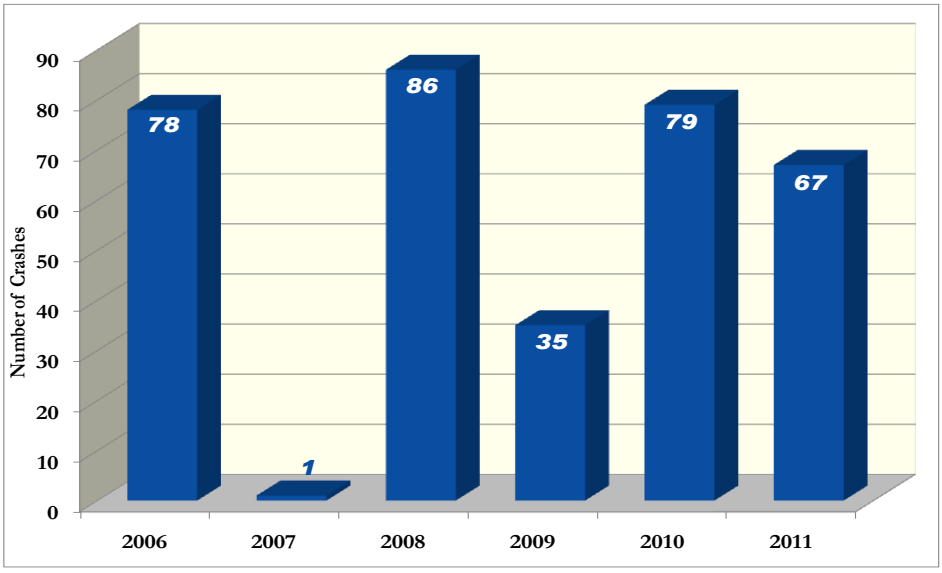
Total Crashes (6 year period): 346

Percentage of Crashes

- Rear End Collisions: 27.2%
- Fatal Crashes: 0.74%
- Pedestrian/Bicyclist: 5.2%
- Intersection Related: 37.0%

Crash analysis was conducted for major roadways in the study area to identify trends, patterns, predominant crash reasons, and high crash rate intersections and corridors. The purpose of the crash analysis is to identify safety hazard locations that need to be addressed to improve area safety. Data for crashes occurring between January 2006 and December 2011 was obtained from ADOT's Accident Location Identification Surveillance System (ALISS) database. It should be noted that the year 2007 presents an anomaly in the crash data with only one crash occurring in the study area. An assessment of the spatial location of the year 2007 crashes revealed that nearly all of the crashes occurred outside the study limits. As shown in Figure 2.14, the total number of crashes within the study area peaked in 2008 and has since steadily declined.

FIGURE 2.14: CRASH TRENDS FROM JAN. 2006 - DEC. 2011



Source: ADOT Accident Location Identification Surveillance System database (January 2006 to December 2011)

Figure 2.15 depicts the location and number of collisions at each site during the analysis period, while Figure 2.16 displays the overall density of crashes as well as the location of collisions with bicyclists/pedestrians and fatal crashes. A review of the two figures identifies the following issues:

- Higher instances of collisions occurred in the downtown area, with the highest concentrations along US-95/Main Street from B Street to Juan Sanchez Boulevard. Crashes were predominantly rear-ending collisions at intersections as result of inattention or distraction.
- Although the intersections of US-95/Main Street at Juan Sanchez Boulevard and C Street yield higher intersection crash densities, the intersection at B Street has more collisions with pedestrians or bicyclists than either of the latter two. Of the 11 crashes at B Street, four were collisions with pedestrians and one collision with a bicyclist; the crashes were cited as inattention, other, unsafe passing, unknown, and no improper driving. No improper driving typically means the driver was not cited for any violations pertaining to the crash.
- The intersection of Juan Sanchez Boulevard and 8th Avenue also experienced high occurrences of rear-end collisions; crashes were cited as other and following too closely.
- Pedestrians and bicyclist crashes, of which one crash was a fatality, accounted for five percent of all the crashes. Half of all the crashes in the downtown area, specifically along US-95/Main Street, are results of driver inattention or distraction.
- One fatal crash occurred within the study area and was cited as a pedestrian collision.

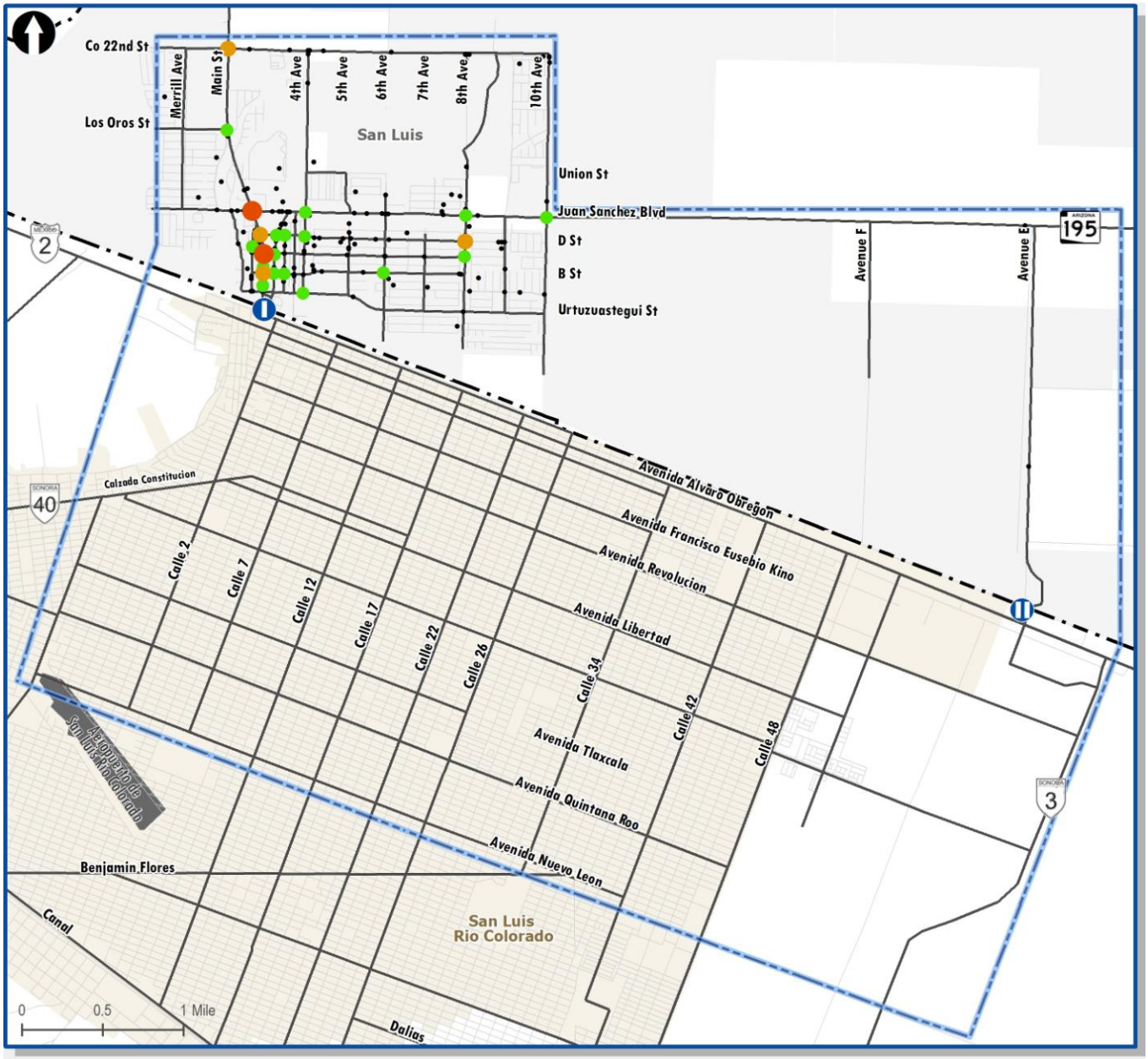
Table 2.7 lists the location of fatal, pedestrian, and bicyclist crashes in the study area while Table 2.8 presents the top seven predominant violation types. Figure 2.17 summarizes the study area crashes by intersection type, collision type, collision manner, and injury severity.

Note the crash data and information is not reflective of the roadway changes to US-95/Main Street in the downtown area, which could potentially impact the number and frequency of crashes along the roadway.

TABLE 2.7: FATAL, PEDESTRIAN, AND BICYCLIST CRASHES

Fatal Crashes	
B Street at 4th Drive	
Pedestrian and Bicyclist Crashes	
US-95/Main Street north of C Street	Juan Sanchez Boulevard east of 6th Avenue
US-95/Main Street at C Street (3 separate crashes)	D Street west of 1st Avenue
US-95/Main Street north of B Street	D Street at 2nd Avenue
US-95/Main Street south of B Street	C Street east of 1st Avenue
1st Avenue north of B Street	B Street at US-95/Main Street (3 separate crashes)
4th Drive north of B Street	B Street at 2nd Avenue
Juan Sanchez Boulevard west of US-95/Main Street	B Street at 4th Drive

Source: ADOT Accident Location Identification Surveillance System database (January 2006 to December 2011)



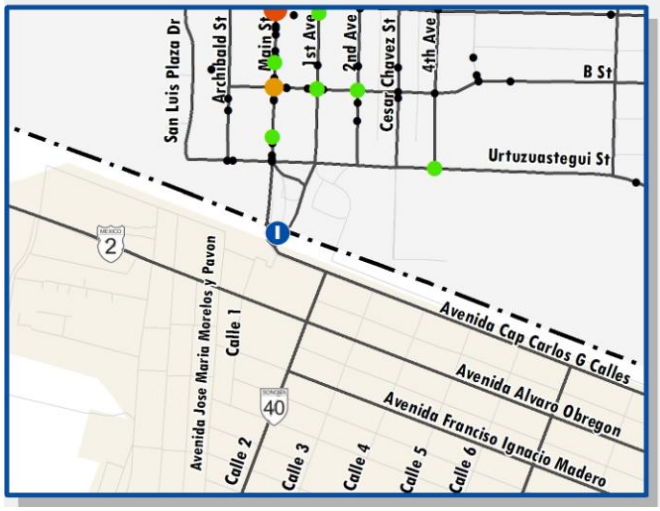
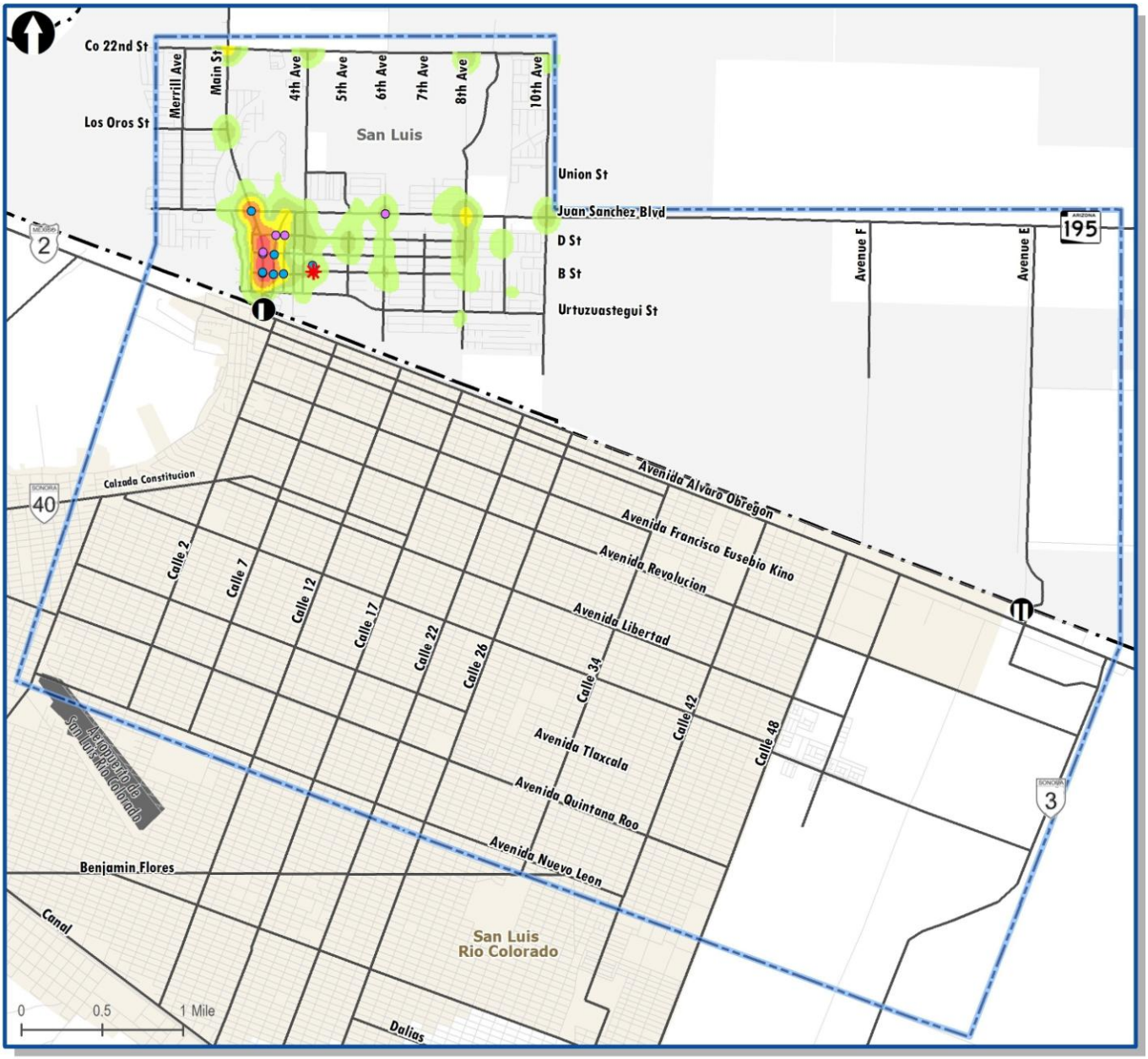


FIGURE 2.15: CRASH LOCATIONS

- 1 crash
- 2 - 3 crashes
- 4 - 6 crashes
- 7 or more crashes

- Land Port of Entry
- Study Roadway
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Accident Location Identification Surveillance System Database (January 2006 - December 2012)



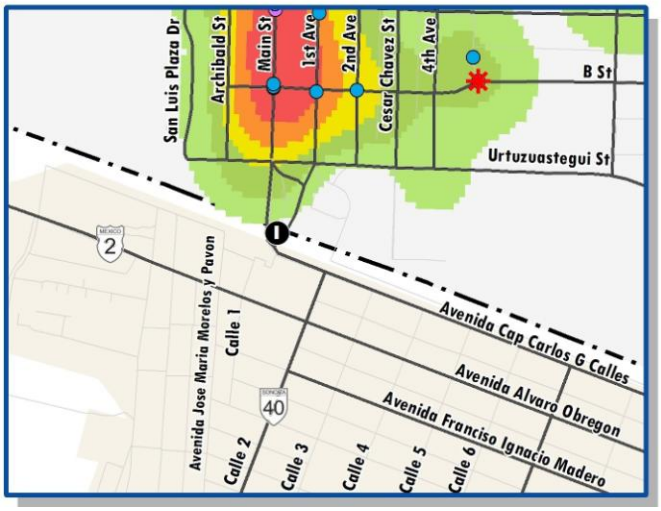


FIGURE 2.16: CRASH DENSITY

Crash Density
Low
High

Fatal Crash
Pedalcycle Crash
Pedestrian Crash

Land Port of Entry
Study Roadway
International Boundary
San Luis
San Luis Rio Colorado
Study Area

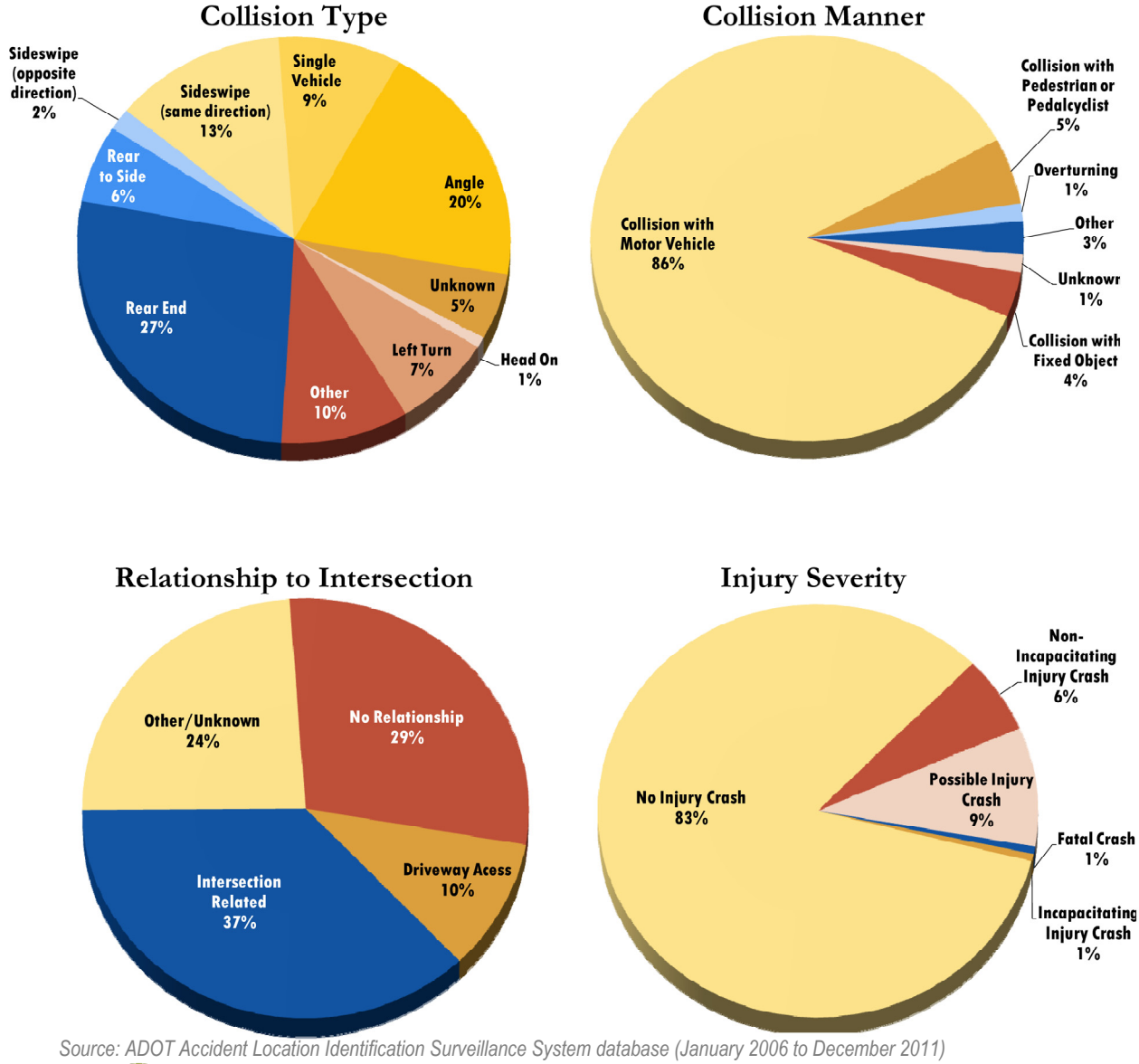
Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Accident Location Identification Surveillance System Database (January 2006 - December 2012)

TABLE 2.8: CRASHES - TOP SEVEN PREDOMINANT VIOLATION TYPES

Violation Type	Percentage
Inattention/Distraction	21.39%
Unknown	16.18%
Other	15.61%
Failed to Yield Right of Way	15.32%
Speed too Fast for Conditions	5.20%
Followed too Closely	3.47%
Unsafe Lane Change	3.18%

Source: ADOT Accident Location Identification Surveillance System Database (January 2006 to December 2011)

FIGURE 2.17: CRASH SUMMARY



Source: ADOT Accident Location Identification Surveillance System database (January 2006 to December 2011)

Traffic Conditions

Daily traffic count data was obtained from the YMPO and ADOT, and was used to validate the YMPO travel demand model with the base year 2013 roadway configuration. Although the traffic dynamics changed in the downtown area, the travel pattern remains the same in other portions of the study area. Figure 2.18 displays the 2013 daily traffic volumes and key observations noted include:

- US-95/Main Street north of Archibald Street has the highest amount of traffic through the study area
- Juan Sanchez Boulevard has significant amount of traffic as it serves local and regional traffic.
- Juan Sanchez Boulevard west of US-95/Main Street to Mesa Street is heavily traveled; since there is no postal delivery for the city and residents must travel to the Post Office to check their mail.

Level of Congestion

Traffic congestion levels of major roadways within the study area were estimated using existing traffic count data. The degree of traffic congestion is commonly expressed in terms of Level of Service (LOS). LOS is a measurement of traffic congestion conditions defined by the Transportation Research Board's (TRB) Highway Capacity Manual (HCM). For a planning level analysis, the roadway LOS is determined based on the ratio of traffic volume on the road to the capacity of the road. Capacity of the road is a function of the number of lanes, functional classification, speed, and roadway geometrics and provides thresholds for the maximum number of cars allowed to travel on a lane for the peak or daily conditions. Each level of service is given a letter grade based on its level of congestion, ranging from "A" through "F", with LOS A representing free flowing traffic conditions where vehicles experience minimal delays, and LOS F represents failure conditions where vehicles experience long delays. Road segment LOS is characterize by the HCM as follows:

LOS A: Best, free flow operations (on uninterrupted flow facilities) and very low delay (on interrupted flow facilities). Freedom to select desired speeds and to maneuver within traffic is extremely high.

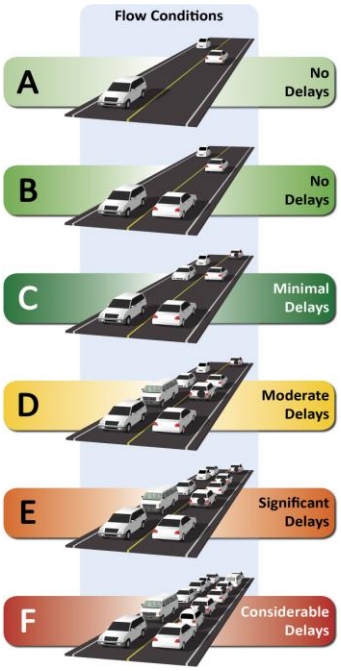
LOS B: Flow is stable, but presence of other users is noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within traffic.

LOS C: Flow is stable, but the operation of users is becoming affected by the presence of other users. Maneuvering within traffic requires substantial vigilance on the part of the user.

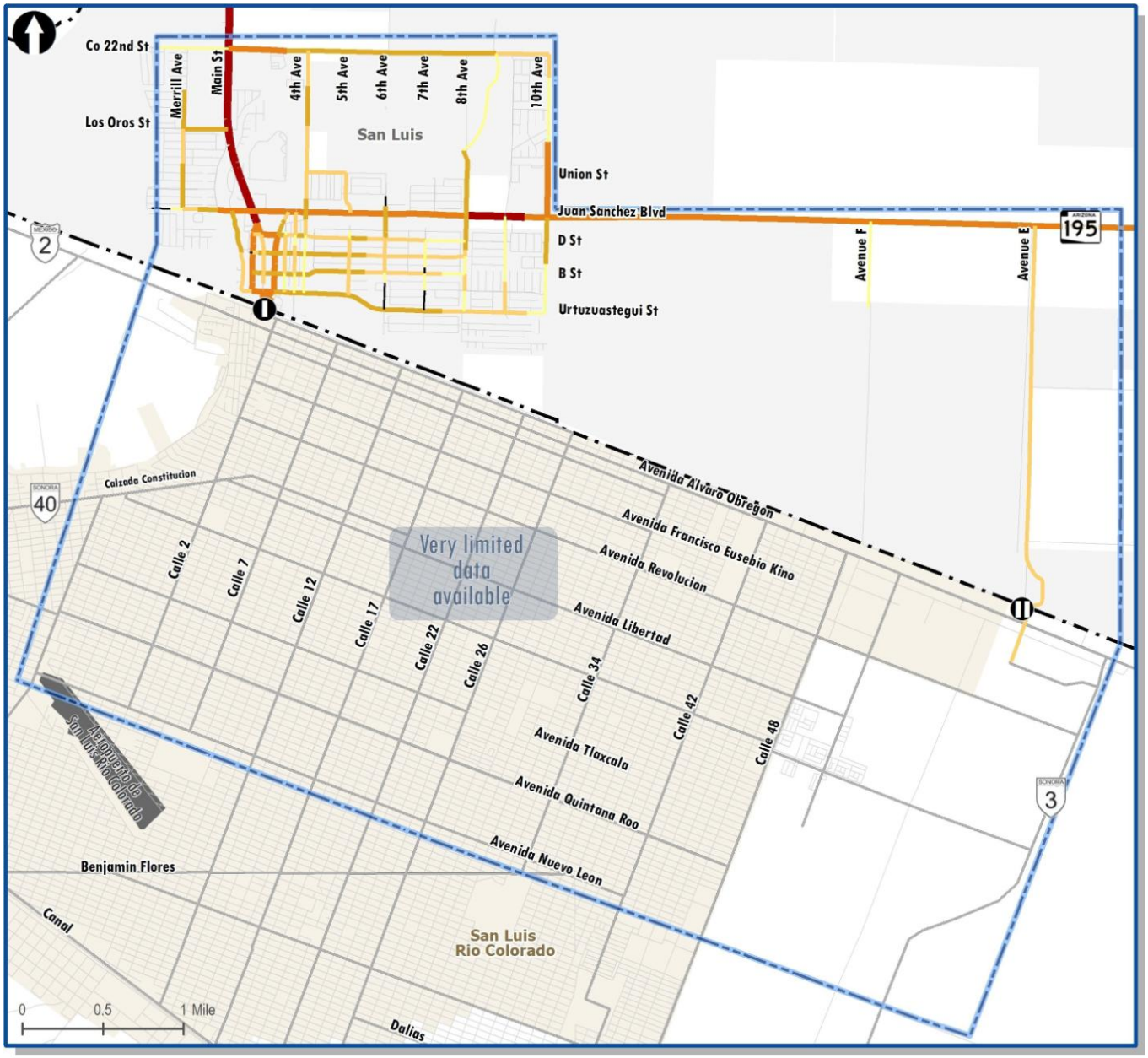
LOS D: High density but stable flow. Speed and freedom to maneuver are severely restricted. The driver is experiencing a generally poor level of comfort and convenience.

LOS E: Flow is at or near capacity. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within traffic is extremely difficult. Comfort and convenience levels are extremely poor.

LOS F: Worse, facility has failed, or a breakdown has occurred.



Source: Jacobs Engineering



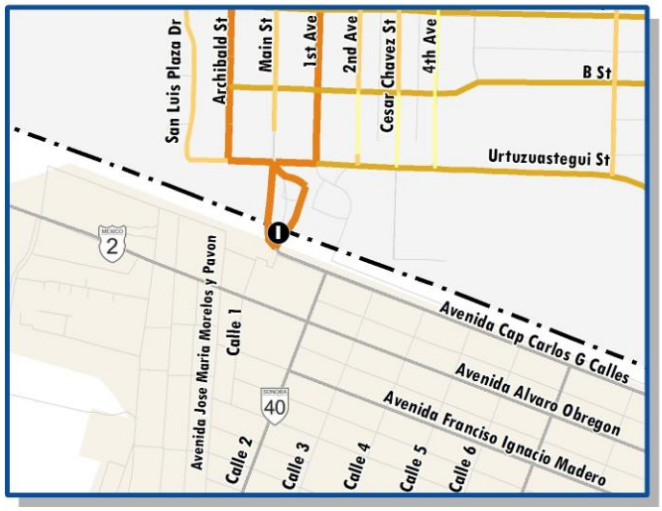


FIGURE 2.18: YEAR 2013 DAILY TRAFFIC VOLUMES

VOLUME
- 1 - 500
- 501 - 1,500
- 1,501 - 3,500
- 3,501 - 7,000
- 7,001 - 14,000
- 14,001 - 24,000
- 24,001 and above

- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO

The six levels of service (LOS A - F) were combined into three congestion levels: Low (LOS A and B), Moderate (LOS C and D), and High (LOS E and F). Figure 2.19 displays the base year 2013 level of congestion for the study roadways. Currently, all roads located within the study area operate at low levels of congestion (LOS A and B), except for the following:

High Congestion (LOS E and F)

- Juan Sanchez Boulevard: Mesa Street to US-95/Main Street

Moderate Congestion (LOS C and D)

- Juan Sanchez Boulevard: east of Merrill Avenue to Mesa Street
- Juan Sanchez Boulevard: US-95/Main Street to 8th Avenue
- Juan Sanchez Boulevard: east of 10th Avenue to SR-195 west of Avenue E
- US-95/Main Street: C Street to D Street
- B Street: Archibald Street to Main Street
- B Street: west of 1st Avenue
- Urtuzuastegui Street: 4th Avenue to 5th Avenue

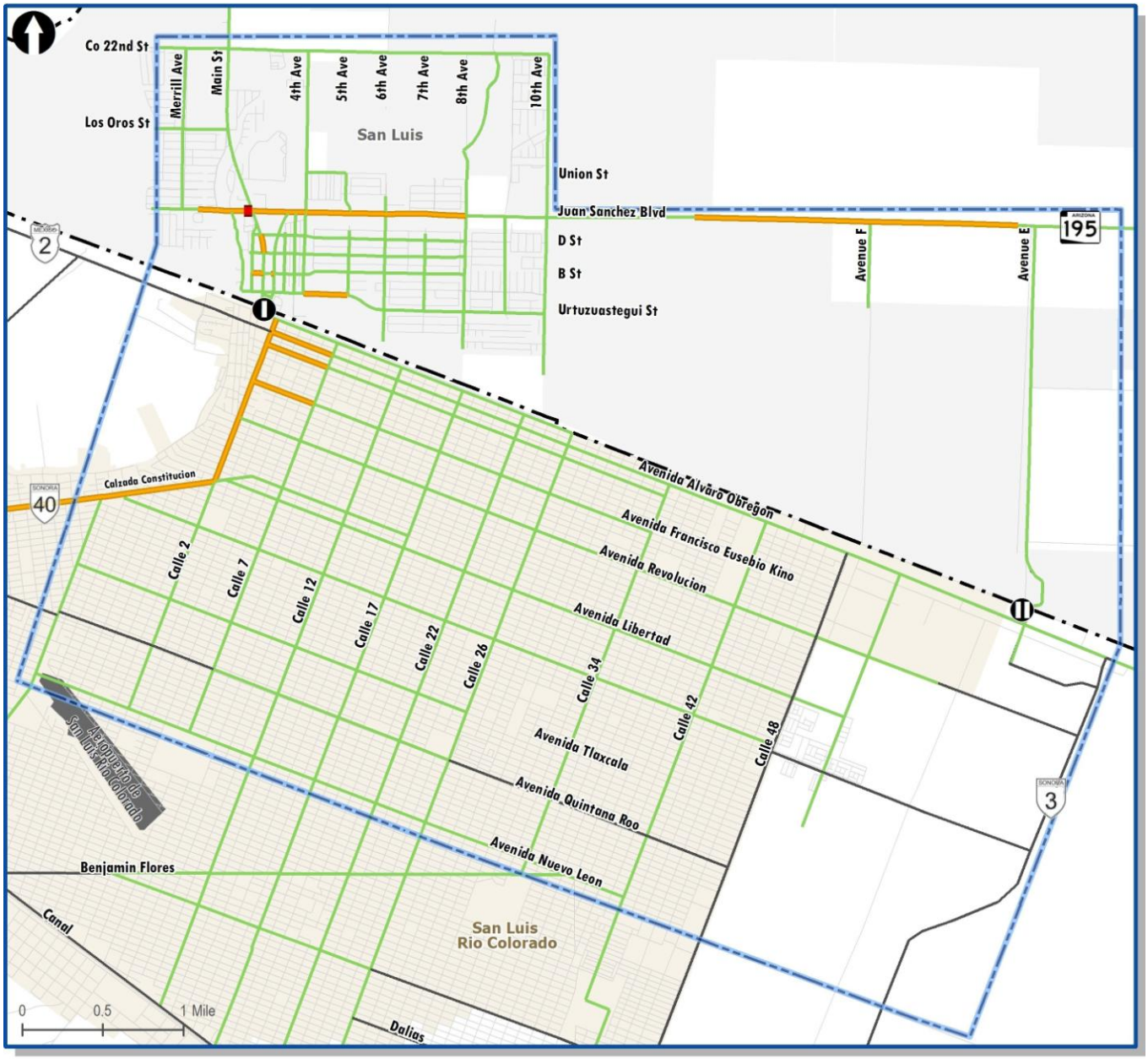
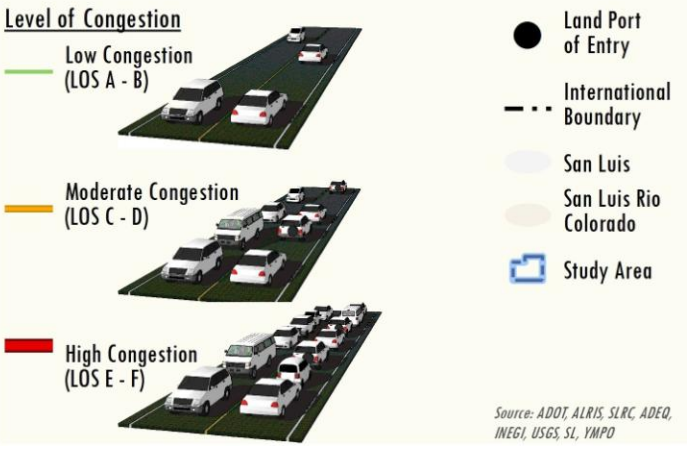


FIGURE 2.19: YEAR 2013 LEVEL OF CONGESTION



Other Modes of Transportation

Alternative modes of transportation are an important aspect of the multimodal transportation network as they provide mobility for those not able to operate or without access to a vehicle.

Pedestrian and Bicycle Facilities

Large number of the pedestrians and bicyclists cross through San Luis I LPOE daily for shopping, work, and school. In close proximity to the LPOE, the downtown area of San Luis experiences intense pedestrian activity on a daily basis. Figure 2.20 illustrates the pedestrian facilities in the study area and key observations noted include:

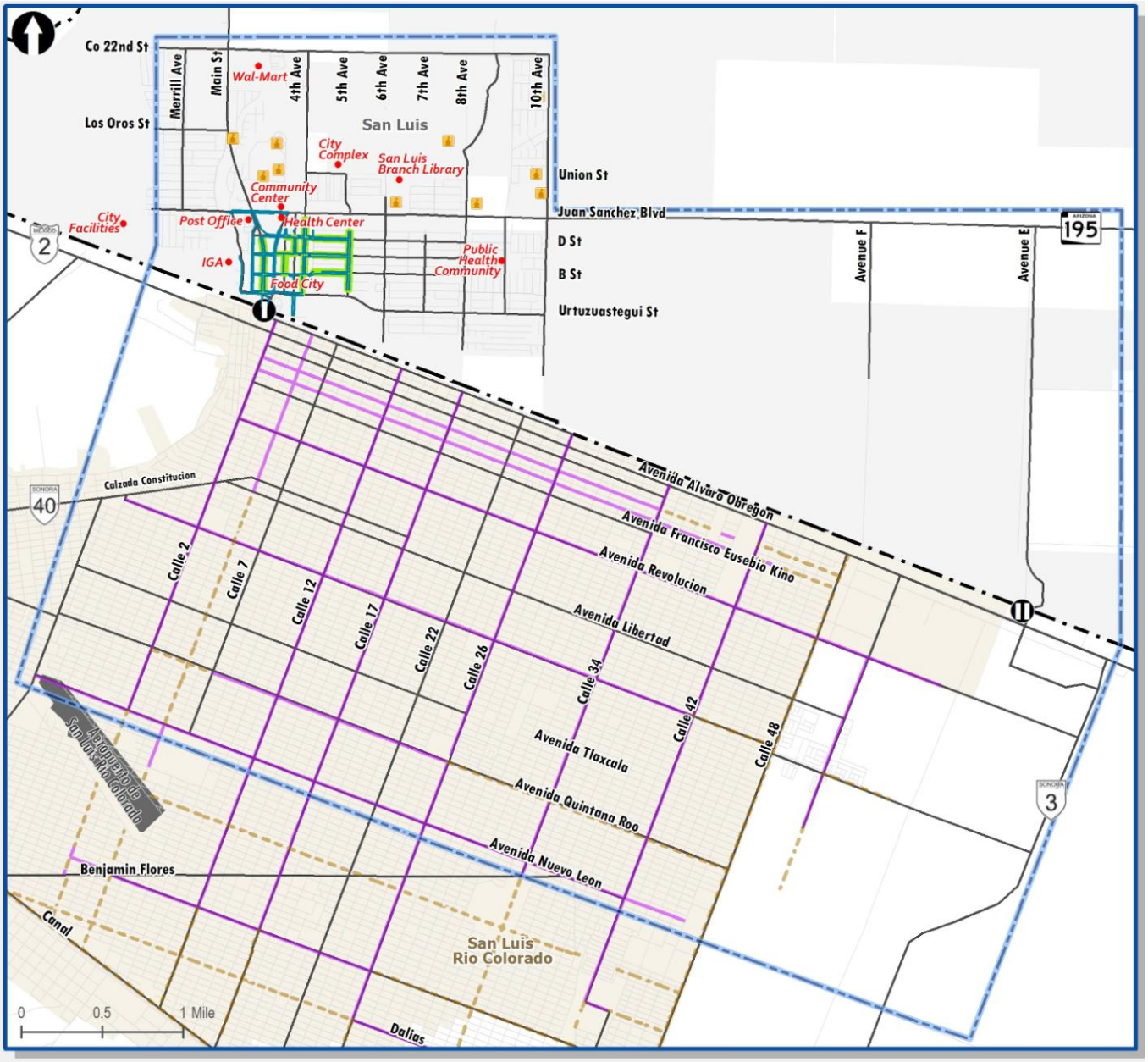
- As US-95/Main Street undergoes improvement in the next year or two, the new two-lane roadway will include new sidewalks, pedestrian refugee islands, and improved curb cuts at crosswalks.
- Majority of the sidewalks are located throughout the downtown area, with some extending eastward to the residential area.
- Sidewalk connectivity is limited with other major activity centers in the study area, such as schools and shopping centers like Wal-Mart Supercenter, which are not in close proximity to the downtown area.
- There are no designated bike lanes or routes in the study area. In addition, bicycles are left at various locations throughout the city and are retrieved sometime later usually at the end of the day.

Transit Service

The Yuma County Intergovernmental Public Transit Authority (YCIPTA) administers, plans, operates, and maintains the public transit services, including YCAT and YCAT OnCall, throughout Yuma County. YCAT is a fixed-route public transit service that provides bus service to the region, including the City of San Luis. Since completion of *Working Paper 2*, transit service for the area changed and the Final Report reflects the most current conditions. The Yellow Route 95, formerly the Yellow Route, connects Yuma with Somerton and San Luis Monday through Saturday from 6:30 AM to 7:22 PM every 45-60 minutes. The new Silver Route 9 connects San Luis and Arizona Western College (AWC)/Northern Arizona University (NAU)/ University of Arizona (UA) via SR-195, Monday through Thursday. As shown in Figure 2.21, the Yellow Route 95 follows US-95/Main Street and loops around 4th Avenue via County 22nd Street and Urtuzuastegui Street with stops at Wal-Mart Supercenter (San Luis) and the downtown area. The Silver Route 9 follows Juan Sanchez Boulevard and 8th Avenue while in the downtown area the route loops around C Street via 4th Avenue and US-95/Main Street. Stops for the route include AWC San Luis Center/San Luis High School and the downtown area. In addition, there are several taxi-cab companies within and near San Luis that provide additional transportation services.

Freight

Located about five miles from downtown, San Luis II LPOE is the commercial port of entry that processes large freight trucks since its opening in November 2010. As the only Port of Entry constructed in the last several years, San Luis II LPOE was built in an effort to lessen the congestion at San Luis I LPOE. Upon opening, the San Luis II LPOE was expected to process an estimated 150 trucks per day and potentially increase to 650 trucks per day by 2030. At the end of the 2011 Fiscal Year, October 2010 to September 2011, the port of entry processed an average of 95 trucks per day.



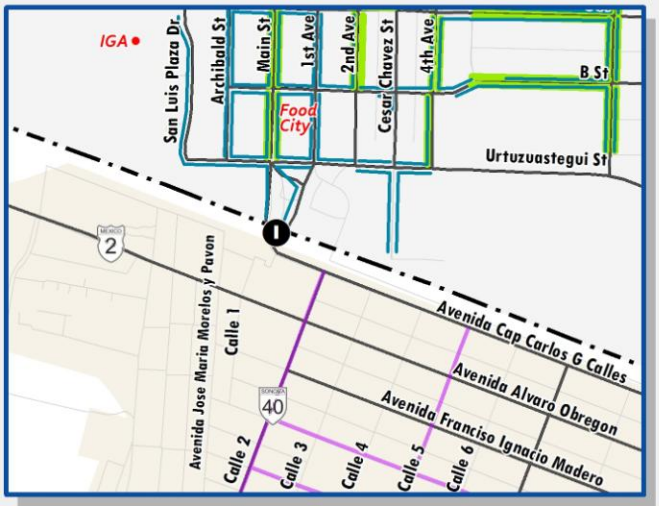
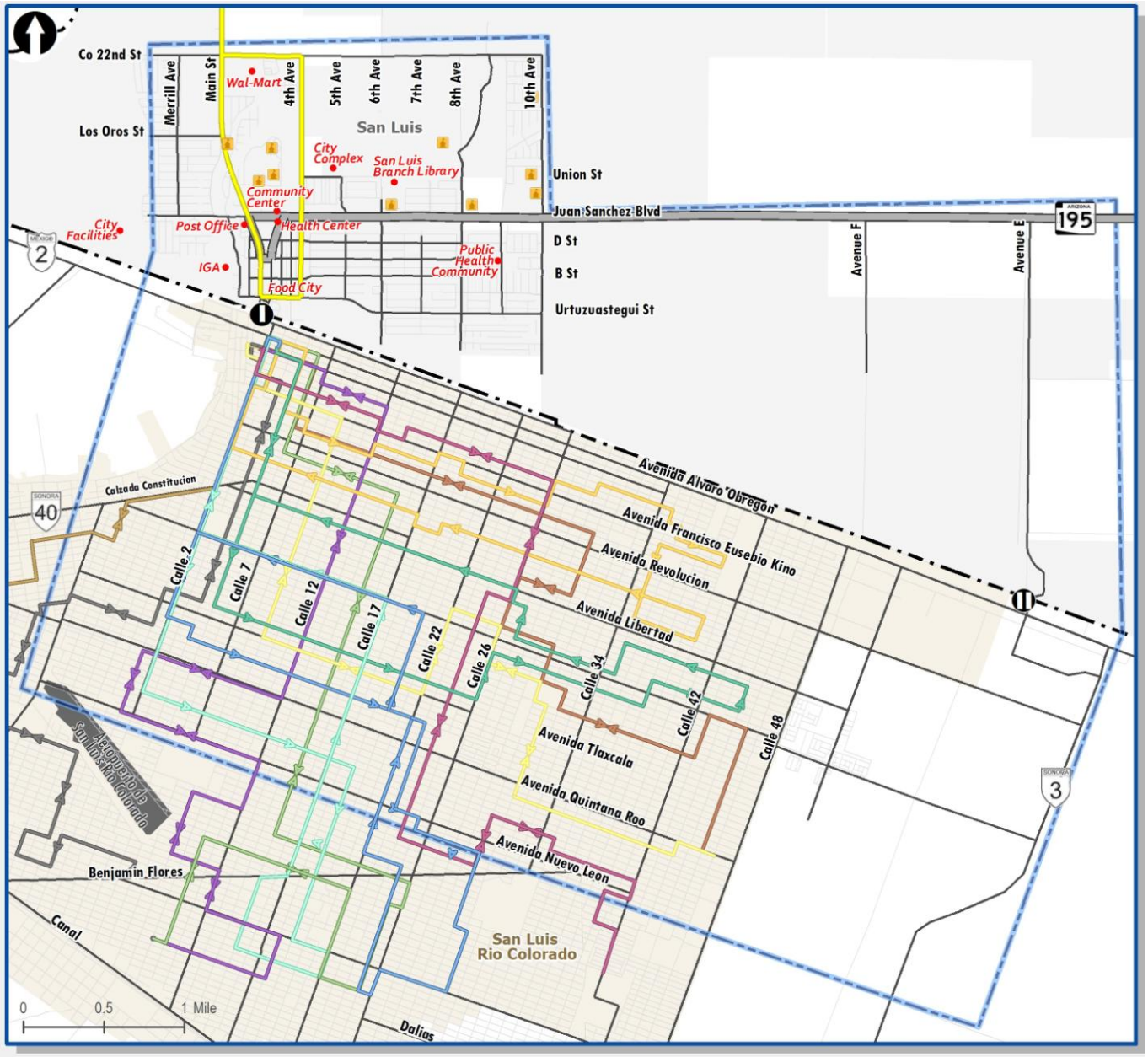


FIGURE 2.20: SIDEWALK AND BICYCLE FACILITIES

- Major Activity Center in San Luis
- Schools in San Luis
- Sidewalk
- On-Street Parking
- Current Bike Lane (Paved)
- Current Bike Lane (Unpaved)
- Land Port of Entry
- Study Roadway
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO



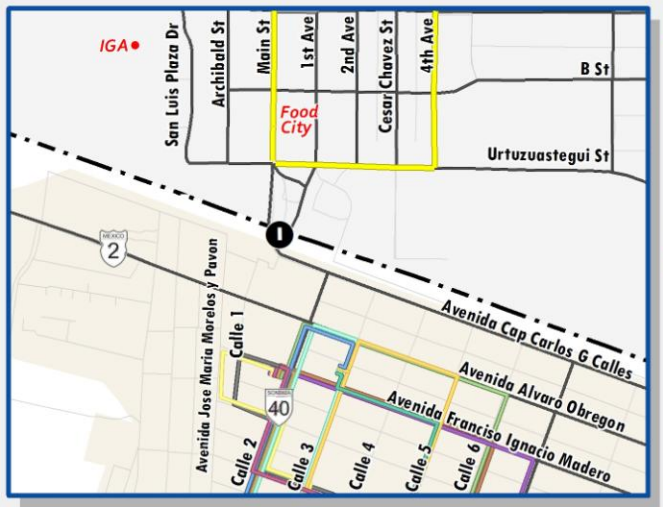


FIGURE 2.21: TRANSIT FACILITIES

- Major Activity Center in San Luis
- Schools in San Luis
- YCAT Yellow Route 95
- YCAT Silver Route 9
- San Luis Rio Colorado Transit Routes
- Land Port of Entry
- Study Roadway
- San Luis
- San Luis Rio Colorado
- Study Area

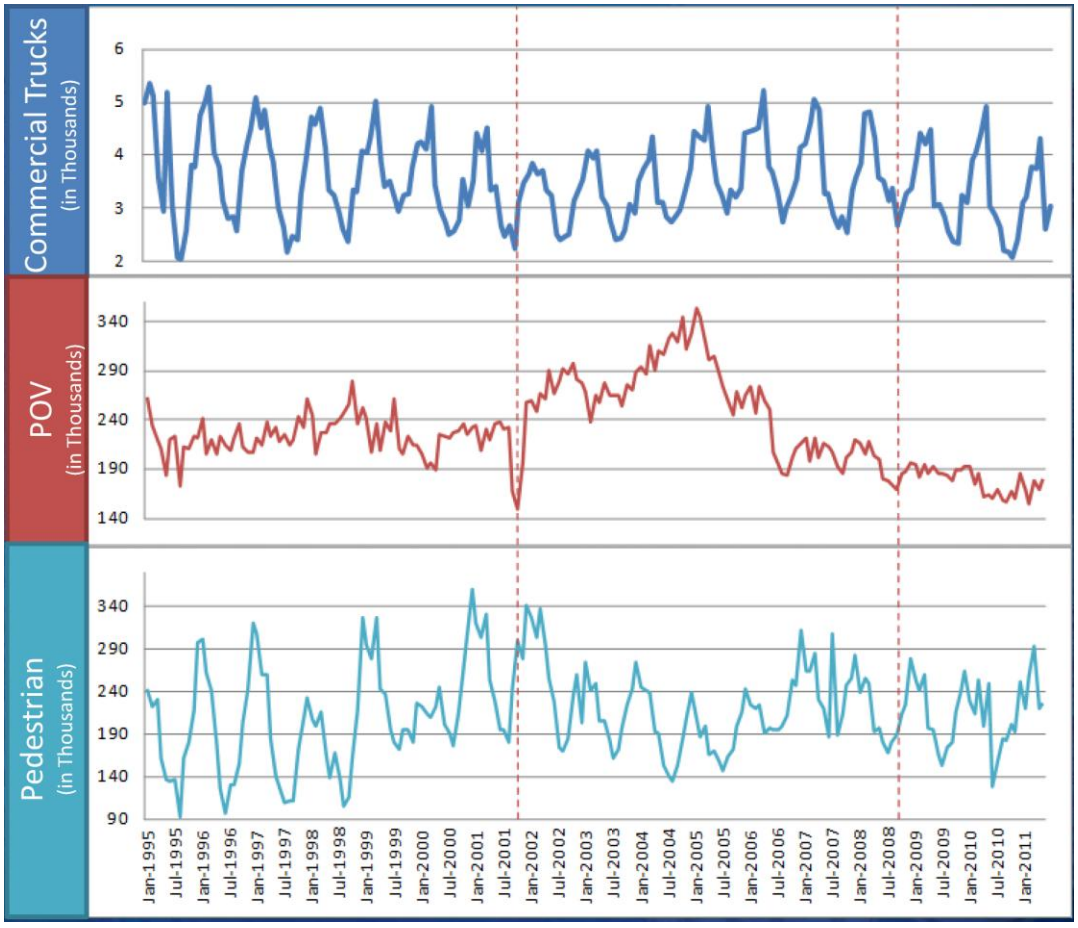
Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO

San Luis I LPOE Existing Conditions

Operational activities at the port strongly impacts the surrounding transportation facilities in San Luis and San Luis Rio Colorado as it is the only processing location for non-commercial vehicles, pedestrians, and bicyclists. Below is a summary of the findings; a more detailed report of the operational condition of San Luis I LPOE is located in Appendix A.

Data received from U.S. Customs and Border Protection for San Luis I LPOE was reviewed and analyzed to identify trends and deficiencies at the port. Figure 2.22 displays the traffic volume by the different modes at San Luis I LPOE over a 16 year period. Commercial trucks prior to the opening of San Luis II LPOE in November 2010 were processed at San Luis I LPOE. As illustrated in the figure, commercial truck and pedestrian activity are influenced by the season; higher in the winter months during the harvesting and lower in the summer months. Major events in history impacted LPOE activity as well, as denoted by the dash red line, the first represents the effects of 9/11 events while the latter represents the economic recession of 2008. The commercial and pedestrian activity have remained relatively steady over the last 16 years, however privately owned vehicle (POV) activity is still declining from its peak in January 2005.

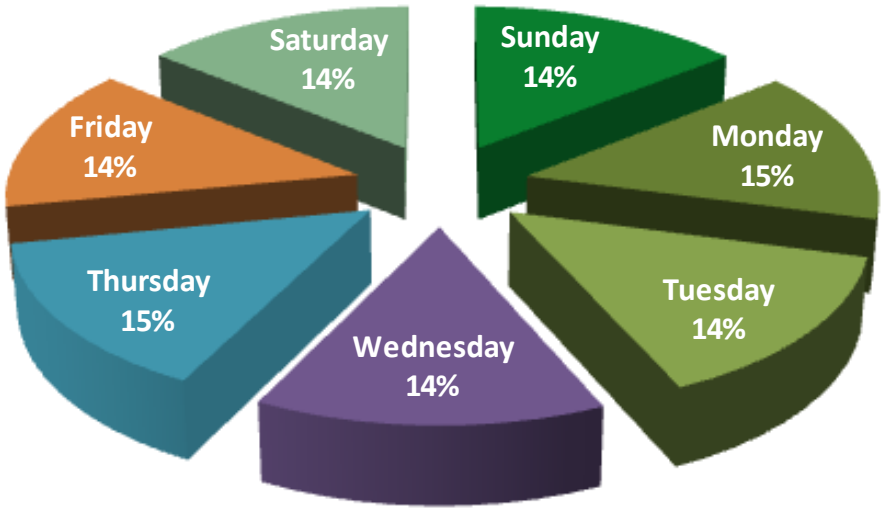
FIGURE 2.22: TRAFFIC VOLUMES AT SAN LUIS I LPOE FROM JANUARY 1995 TO JANUARY 2011



Source: TIS Consulting Group, U.S. Customs and Border Protection

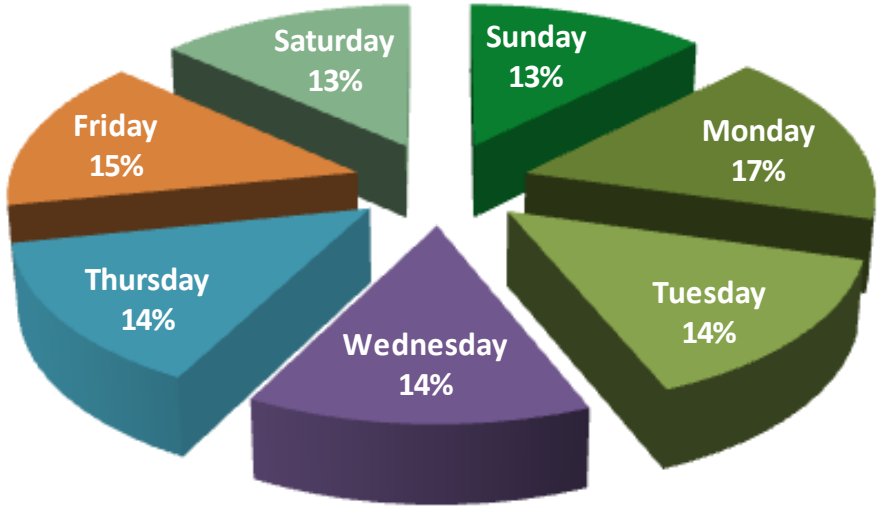
Figures 2.23 and 2.24 display the percentage of POV and pedestrian traffic entering San Luis I LPOE by day of the week for FY 2010 respectively. As illustrated in both figures, traffic is nearly equally distributed throughout out the week for each of the two modes thus indicating a consistent daily use of the LPOE by the local residents.

FIGURE 2.23: DAILY DISTRIBUTION OF POV CROSSINGS IN FY 2010



Source: TIS Consulting Group, U.S. Customs and Border Protection (October 2009 to September 2010)

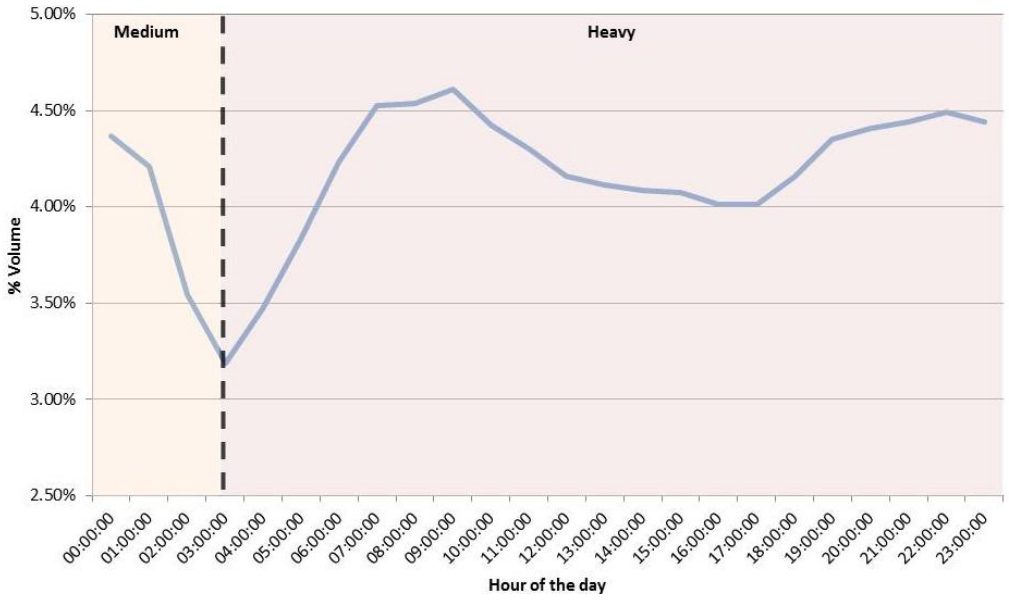
FIGURE 2.24: DAILY DISTRIBUTION OF PEDESTRIAN CROSSINGS IN FY 2010



Source: TIS Consulting Group, U.S. Customs and Border Protection (October 2009 to September 2010)

Figure 2.25 displays the POV volumes by the hour of the day at San Luis I LPOE. Congestion at the northbound lanes of the LPOE is nearly continuous throughout an average day, with the exception of the period between 1 AM and 3 AM where there is a significant drop in vehicles.

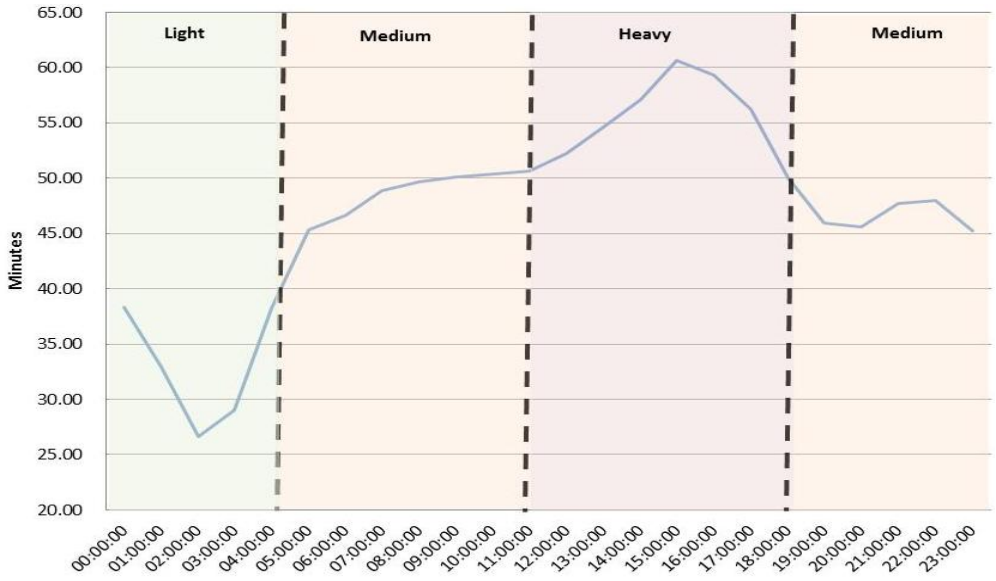
FIGURE 2.25: POV VOLUME BY DAY HOUR IN FY 2010



Source: TIS Consulting Group, U.S. Customs and Border Protection (October 2009 to September 2010)

Figure 2.26 depicts the POV wait times by hour of the day at San Luis I LPOE. Wait times also follow the same daily distribution pattern as the traffic volumes with the longest wait time occurring between 11 AM to 6 PM.

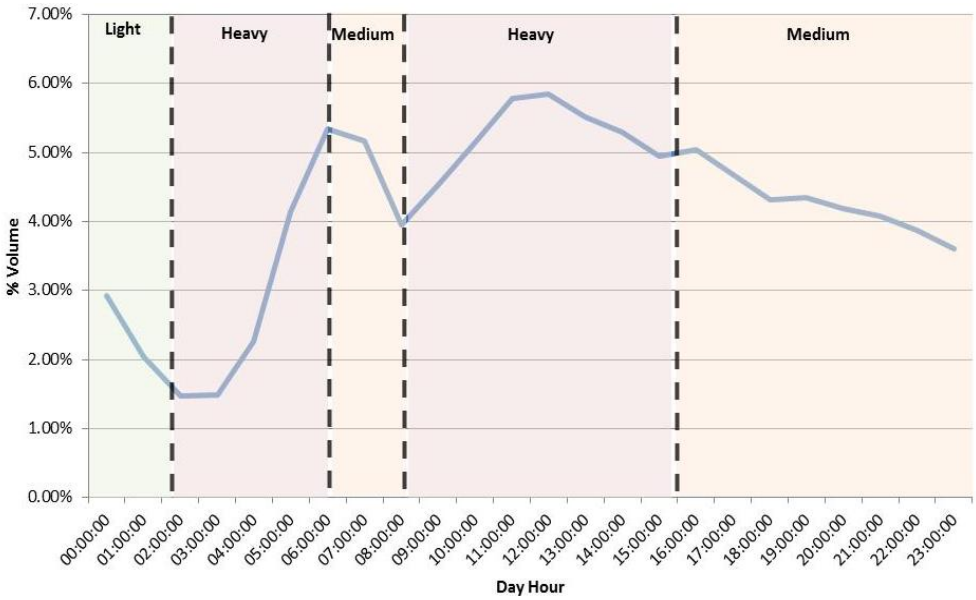
FIGURE 2.26: POV WAITING TIME BY DAY HOUR IN FY 2010



Source: TIS Consulting Group, U.S. Customs and Border Protection (October 2009 to September 2010)

Figure 2.27 displays the pedestrian volumes by the hour of the day at San Luis I LPOE. During the early morning hours (3 AM to 6 AM), pedestrian volume at the LPOE quickly increases due to the agricultural activities in the region.

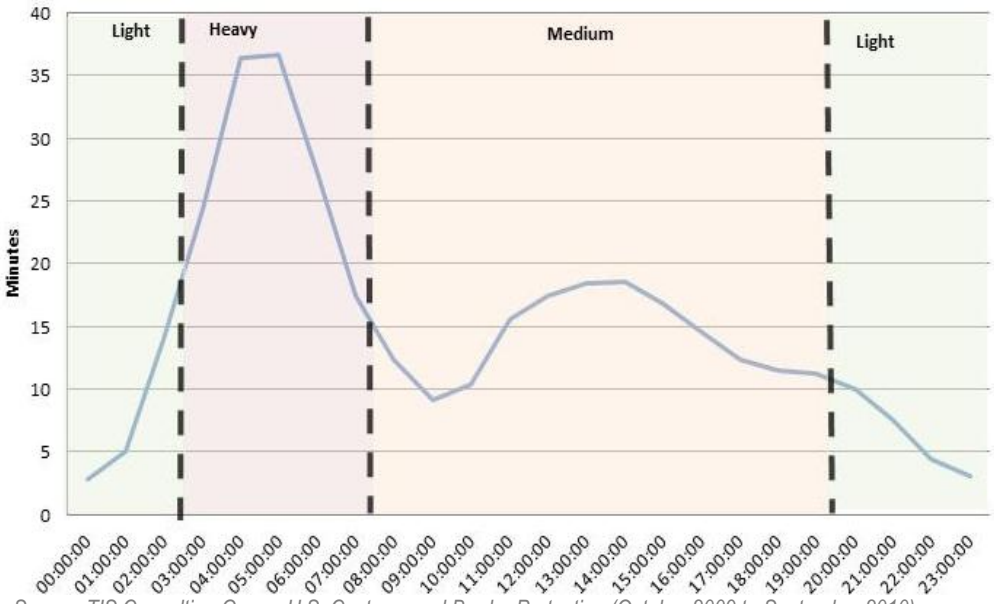
FIGURE 2.27: PEDESTRIAN VOLUME BY DAY HOUR IN FY 2010



Source: TIS Consulting Group, U.S. Customs and Border Protection (October 2009 to September 2010)

Figure 2.28 depicts the pedestrian wait times by hour of the day at San Luis I LPOE. With a heavy influx of pedestrians from 3 AM to 6 AM, wait times significantly increase creating severe congestion at the port.

FIGURE 2.28: PEDESTRIAN WAITING TIME BY DAY HOUR IN FY 2010



Source: TIS Consulting Group, U.S. Customs and Border Protection (October 2009 to September 2010)

Origin-Destination Survey

To better understand the travel characteristics in the San Luis Binational area, an Origin-Destination Survey was conducted on the U.S. side entry and exit terminals of San Luis I LPOE. POV, motorcycles, pedestrians, and bicyclists were surveyed one day in March 2012 for three periods:

- Morning (6:00 AM - 10:00 AM)
- Mid-day (11:00 AM - 1:00 PM)
- Evening (4:00 PM - 7:00 PM

In total, 1,605 drivers and 448 pedestrians were surveyed. Of those surveyed at the northbound terminals, 719 were drivers and 249 were pedestrians while at the southbound terminals, 886 were drivers and 199 were pedestrians.

Overall, the majority of POV trips are between the two cities, San Luis and San Luis Rio Colorado, for shopping, family visits, work or medical appointments. Trips occur daily typically in the morning hours (6 AM to 10 AM) and do not last for more than a few hours.

Similarly to the POVs, pedestrian trips are mainly between the two cities for the purposes of shopping, work, and personal. Pedestrians access San Luis I LPOE on a daily basis or at the very least once a week, typically in the morning hours. In addition, trips last only a few hours for shoppers or family visitors while trips last all day long for the farm workers. It was also observed that farm workers constituted a large portion of the pedestrian traffic at the LPOE, the majority of which crossed the border during the early hours of the morning and late afternoon.

More detailed results of the survey are located in Appendix B.

FUTURE SOCIOECONOMIC CONDITIONS

Forecasting future socioeconomic conditions allows us to anticipate changes in future travel demand and travel patterns and to help identify future transportation and mobility needs. Development of rational projections for population, housing units, and employment is vital to the process of forecasting realistic future travel demand.

Population, Housing Units, and Employment Forecasts

Future population, housing units, and employment were forecasted for the horizon years 2018, 2030, and 2040. For the 2018 horizon year, the population estimates were calculated using the 2013 population and applying a yearly growth factor of 3.4 percent per year which was observed between 2010 and 2012. For the 2030 and 2040 horizon years, future population estimates for the City of San Luis were based on the projections from Arizona Department of Administration, Office of Employment and Population Statistics. There is no forecasted data for housing units; it is assumed that the current population to occupied housing unit ratio will continue for future horizon years.

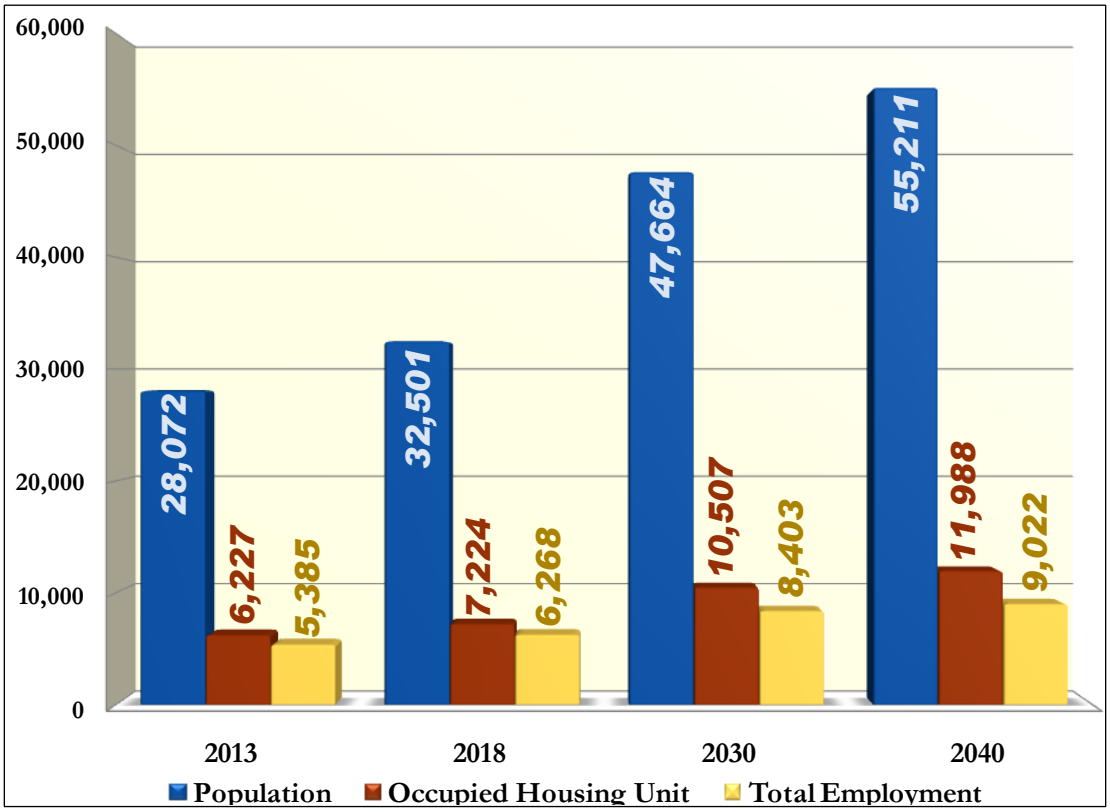
Similar to the housing units, there is no known source for employment projections however through coordination with City Staff and utilizing the *City of San Luis 2020 General Plan* employment estimates were developed. In addition, it was assumed that the current employment to population ratio will remain relatively constant for all future horizon years. Table 2.9 shows a tabular summary of the base year and projected population along with the number of housing units in the study area. Figure 2.29 is a graphical depiction of the population and occupied housing units in the study area.

TABLE 2.9: PROJECTED POPULATION, HOUSING UNITS, AND EMPLOYMENT

		2013	2018	2030	2040
Study Area	**Population**	**28,072**	**32,501**	**47,664**	**55,211**
	Occupied Housing Unit	6,227	7,224	10,507	11,988
	Total Employment	5,385	6,268	8,403	9,022
City of San Luis	**Population**	**28,413**	**33,355**	**55,651**	**64,728**
	Occupied Housing Unit	6,317	7,412	12,376	14,384
	Total Employment	6,141	7,142	10,038	12,574
YMPO Region	**Population**	**195,683**	**222,455**	**295,892**	**330,161**
	Occupied Housing Unit	76,011	80,497	101,208	113,018
	Total Employment	71,208	86,739	111,353	124,271

Source: Jacobs Engineering, YMPO RTP 2009 - 2033 Travel Demand Model, and Arizona Department of Administration Office of Employment and Population Statics.

FIGURE 2.29: STUDY AREA POPULATION, HOUSING UNITS, AND EMPLOYMENT PROJECTIONS



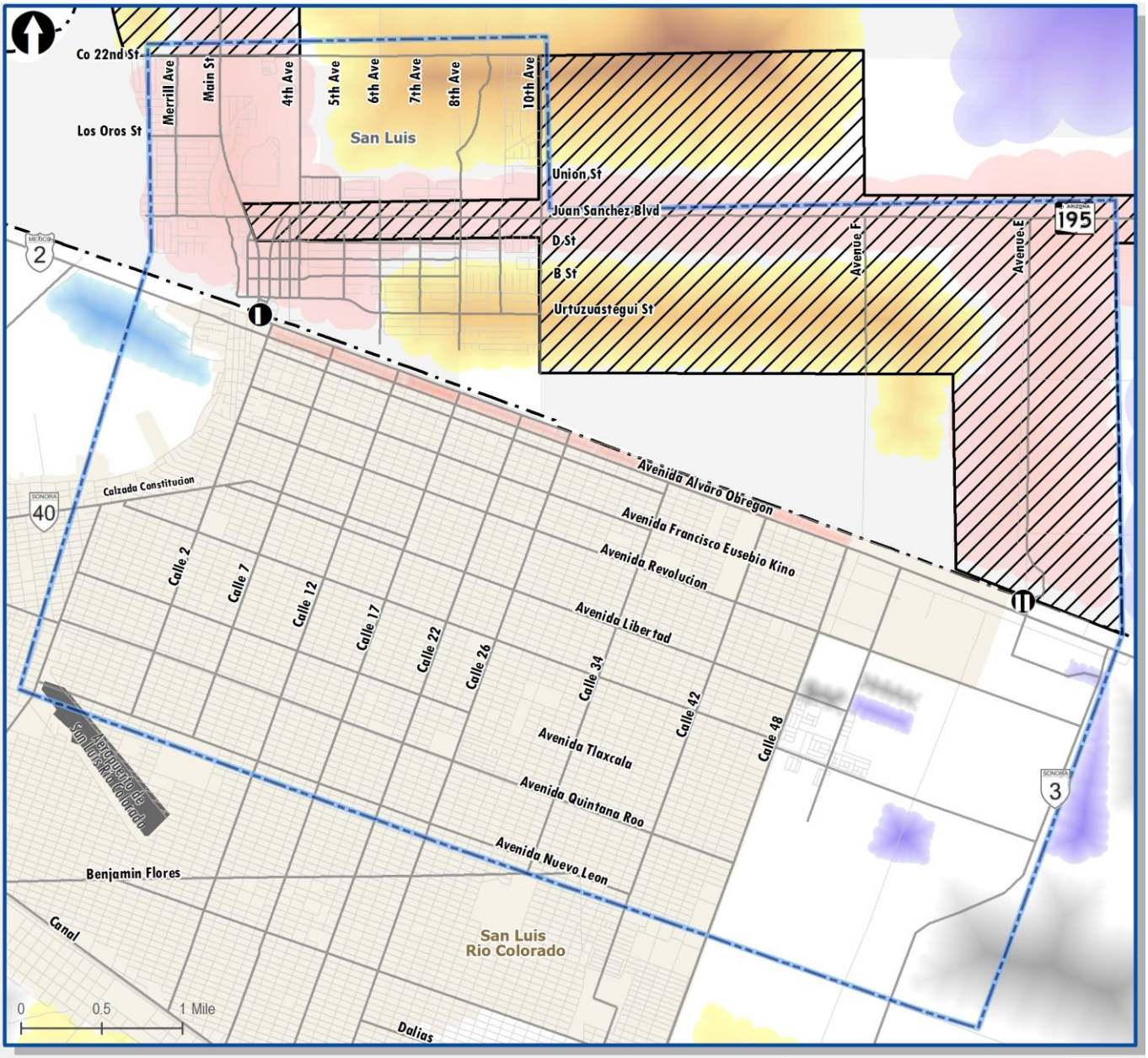
Source: Jacobs Engineering, YMPO RTP 2009 - 2033 Travel Demand Model, and Arizona Department of Administration Office of Employment and Population Statics.

Socioeconomic Data for Travel Demand Model

The 2009 YMPO travel demand model was used to estimate the 2013 traffic volumes and to forecast future traffic volumes for horizon years 2018, 2030, and 2040. Future socioeconomic data (population, housing units, and employment), as previously discussed, was disaggregated into the travel model's TAZs. Housing units and employment data were allocated to the TAZs using the Land Use and identified growth areas from *San Luis 2020 General Plan* as a guide. As shown in Figure 2.30, growth areas identified in the *General Plan* include:

- Juan Sanchez Boulevard from US-95/Main Street to 10th Avenue
- Avenue E from SR-195 to U.S.-Mexico Border
- Area east of 10th Avenue between County 22nd Street and County 24th Street
- US-95/Main Street from County 22nd Street to south of County 19th Street

Figures 2.31 to 2.33 display the population densities for each of the future horizon years and provide a visual representation of the area growth trends. Figures 2.34 to 2.36 present the employment densities for each of the horizon years, respectively.



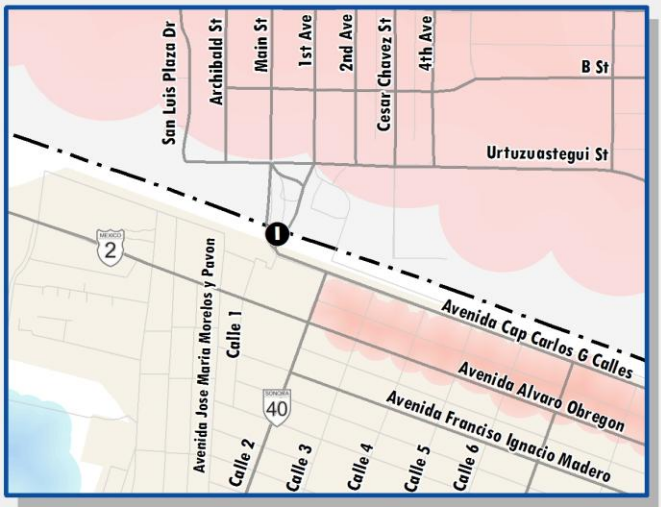
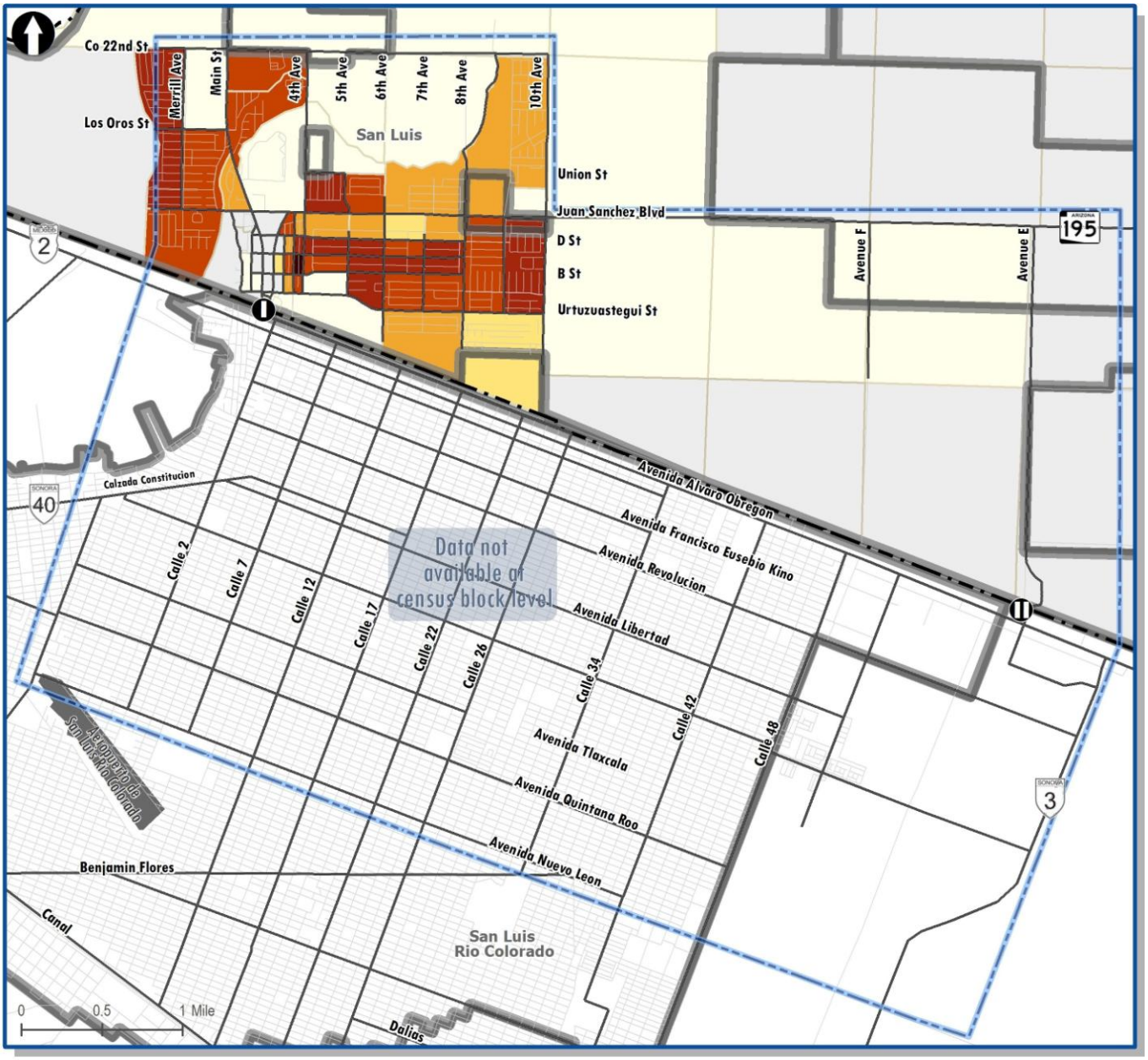


FIGURE 2.30: GROWTH AREAS

- Identified Growth Area
- Residential
- Commerical/Office
- Medical
- Mixed Use
- Airport
- Industrial/Manufacturing
- Land Port of Entry
- Study Roadway
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO



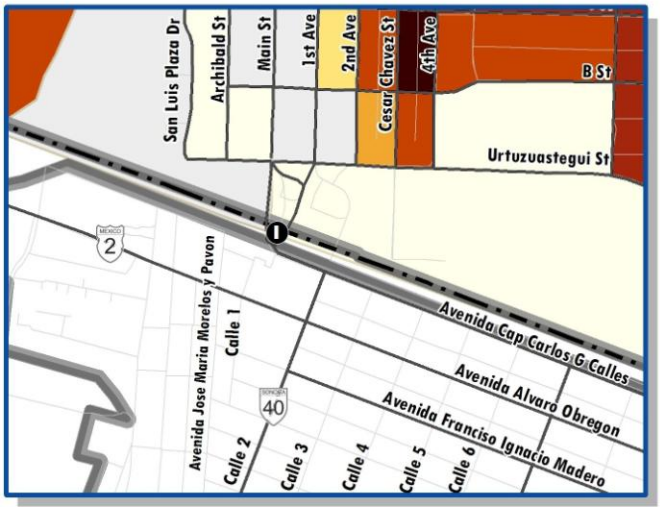


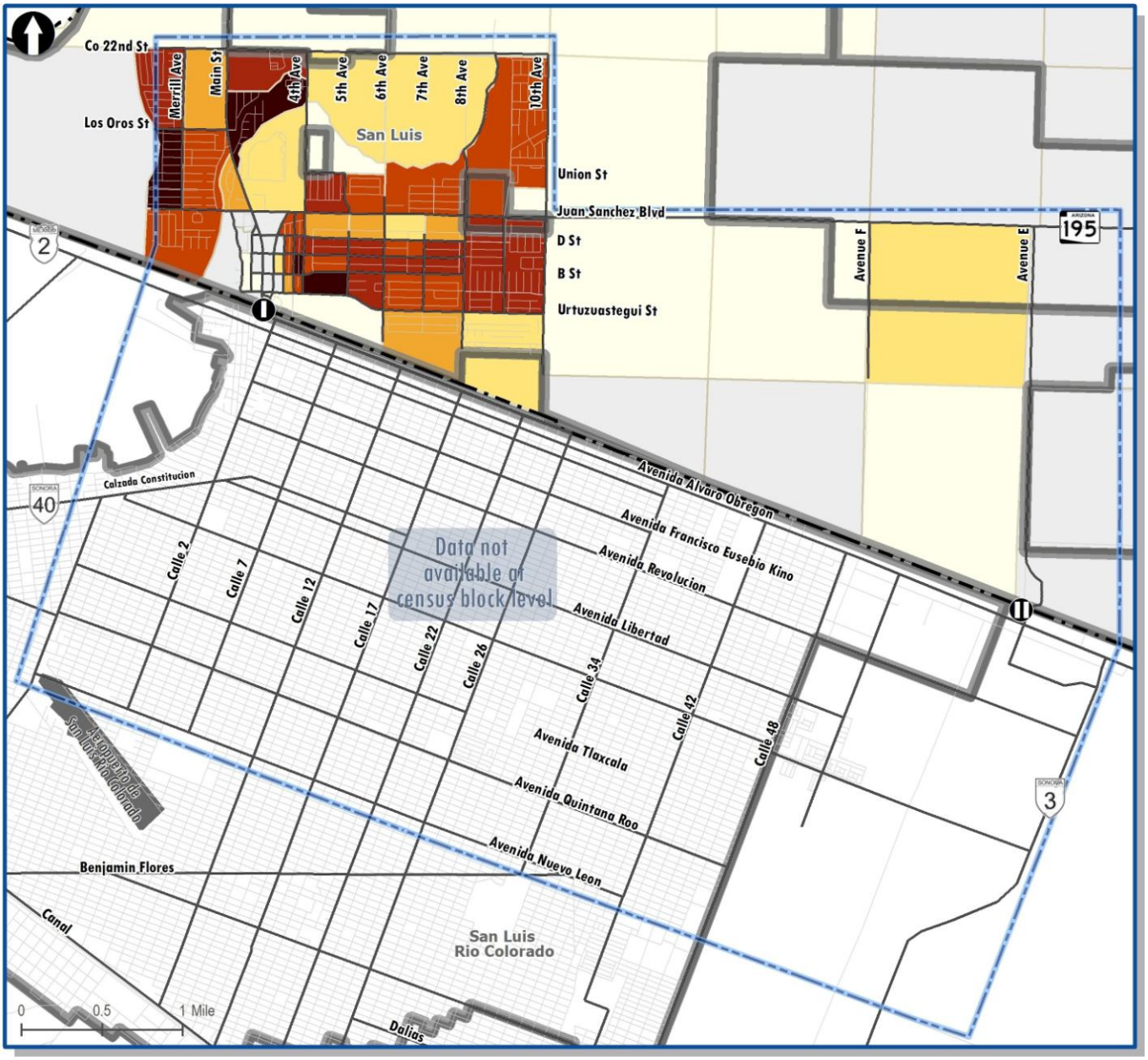
FIGURE 2.31: YEAR 2018 POPULATION DENSITY

Population per Square Mile

- No Population
- 1 - 3,000
- 3,001 - 6,000
- 6,001 - 9,000
- 9,001 - 13,000
- 13,001 - 18,000
- 18,001 and above

- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Arizona Dept. of Administration Office of Employment and Population Statistics



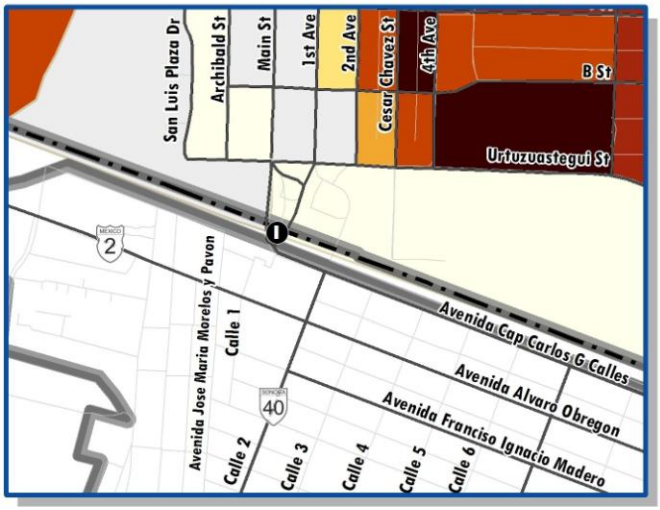


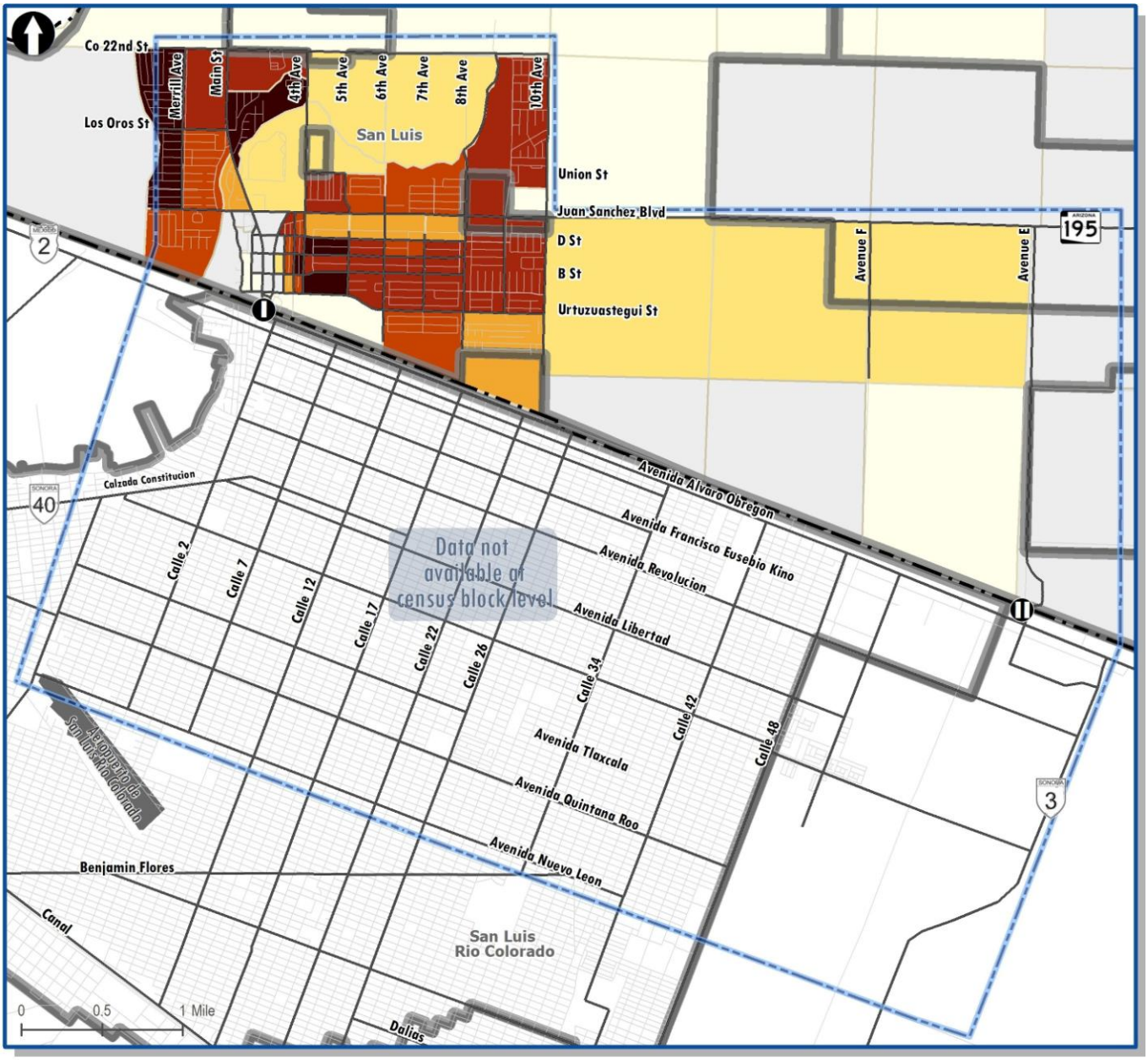
FIGURE 2.32: YEAR 2030 POPULATION DENSITY

Population per Square Mile

- No Population
- 1 - 3,000
- 3,001 - 6,000
- 6,001 - 9,000
- 9,001 - 13,000
- 13,001 - 18,000
- 18,001 and above

- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Arizona Dept. of Administration Office of Employment and Population Statistics



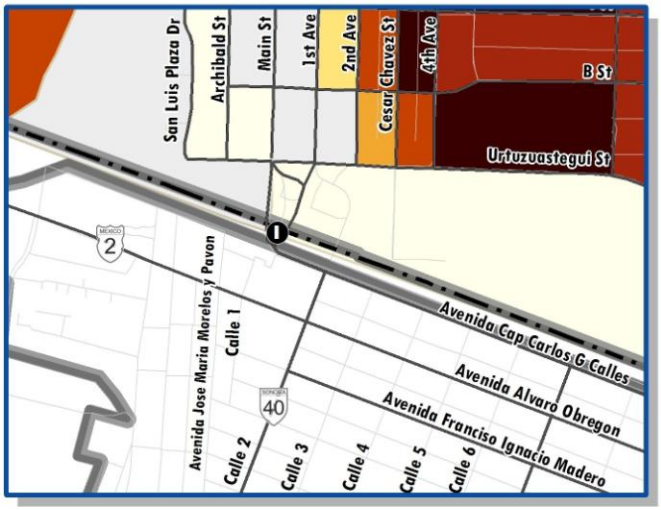


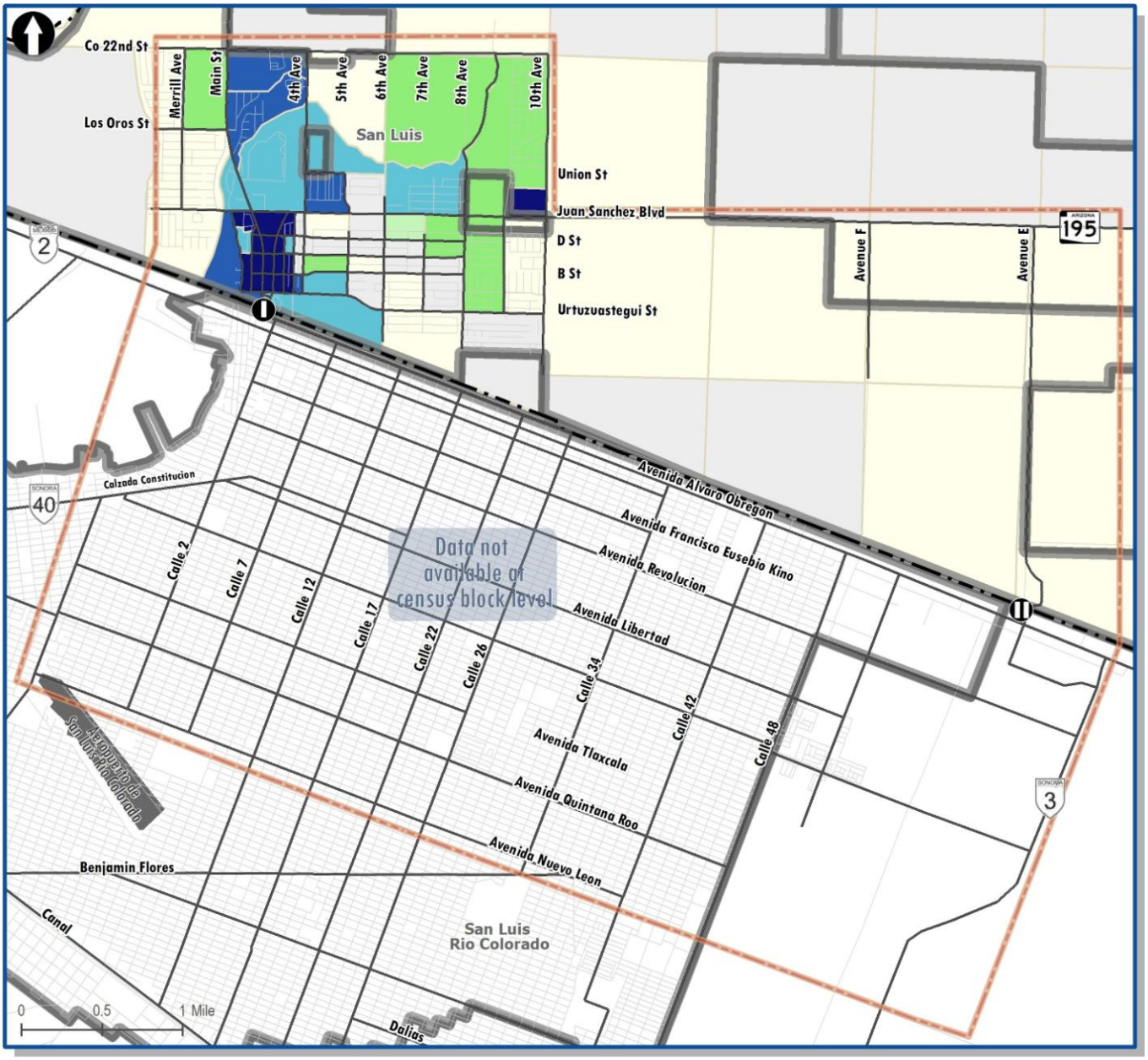
FIGURE 2.33: YEAR 2040 POPULATION DENSITY

Population per Square Mile

- No Population
- 1 - 3,000
- 3,001 - 6,000
- 6,001 - 9,000
- 9,001 - 13,000
- 13,001 - 18,000
- 18,001 and above

- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Arizona Dept. of Administration Office of Employment and Population Statistics



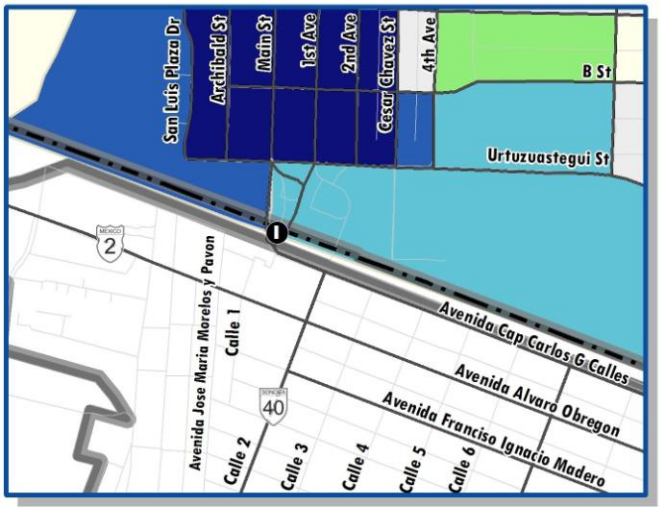


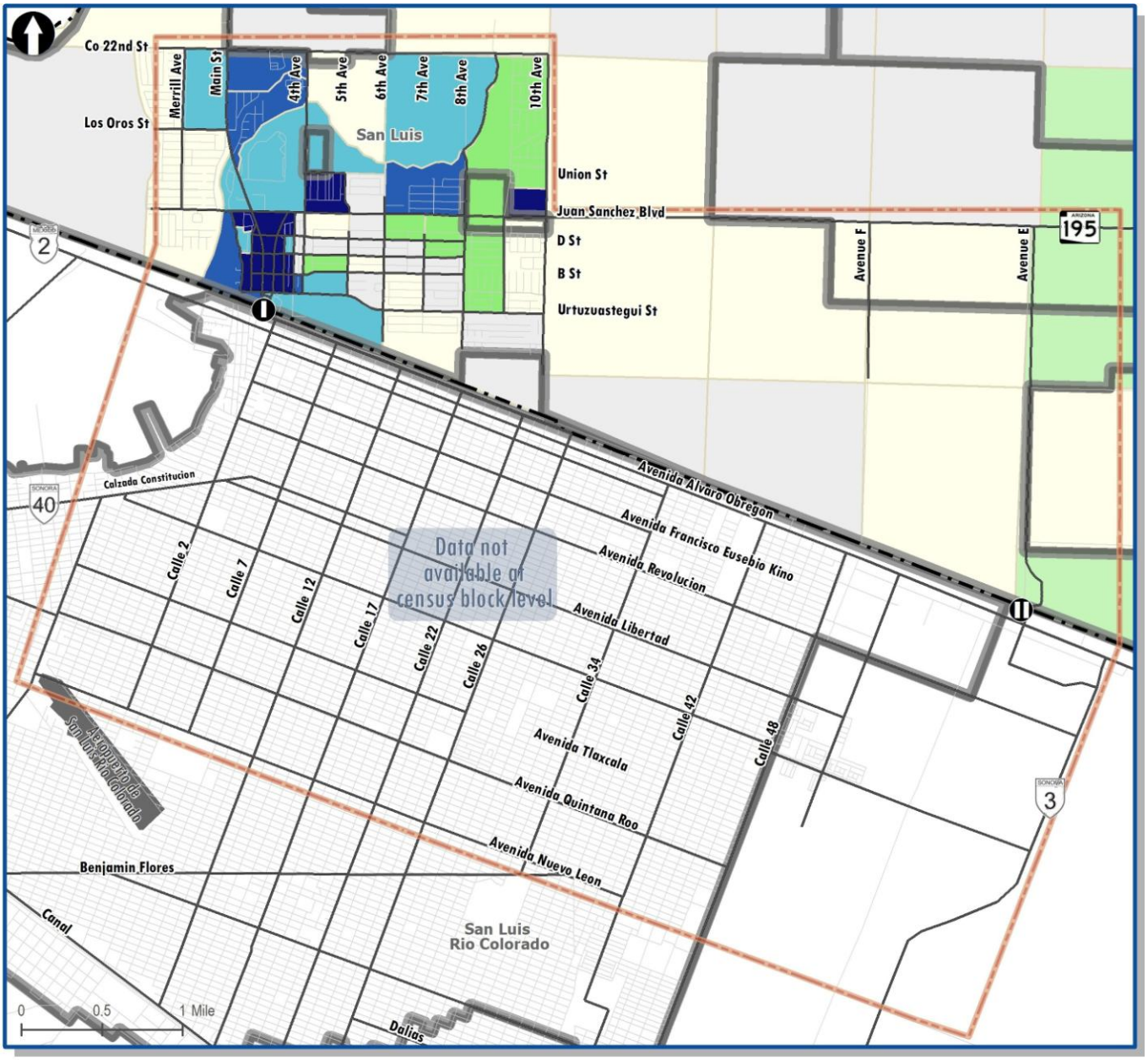
FIGURE 2.34: YEAR 2018 EMPLOYMENT DENSITY

Employees per Square Mile

- No Employees
- 1 - 250
- 251 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 5,000
- 5,001 and above

- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Arizona Dept. of Administration Office of Employment and Population Statistics



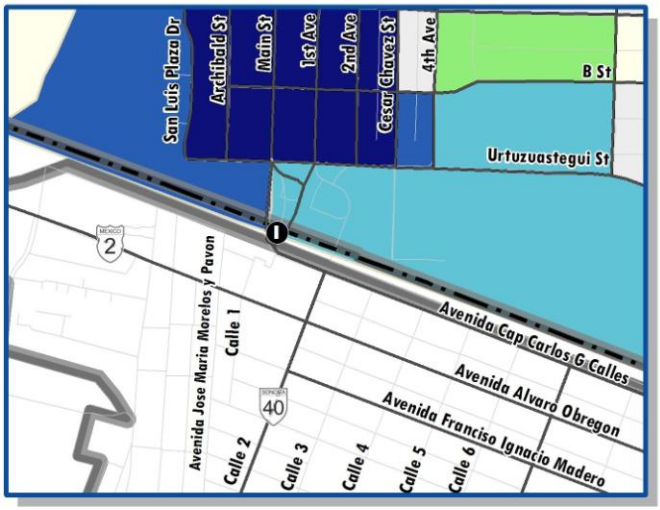


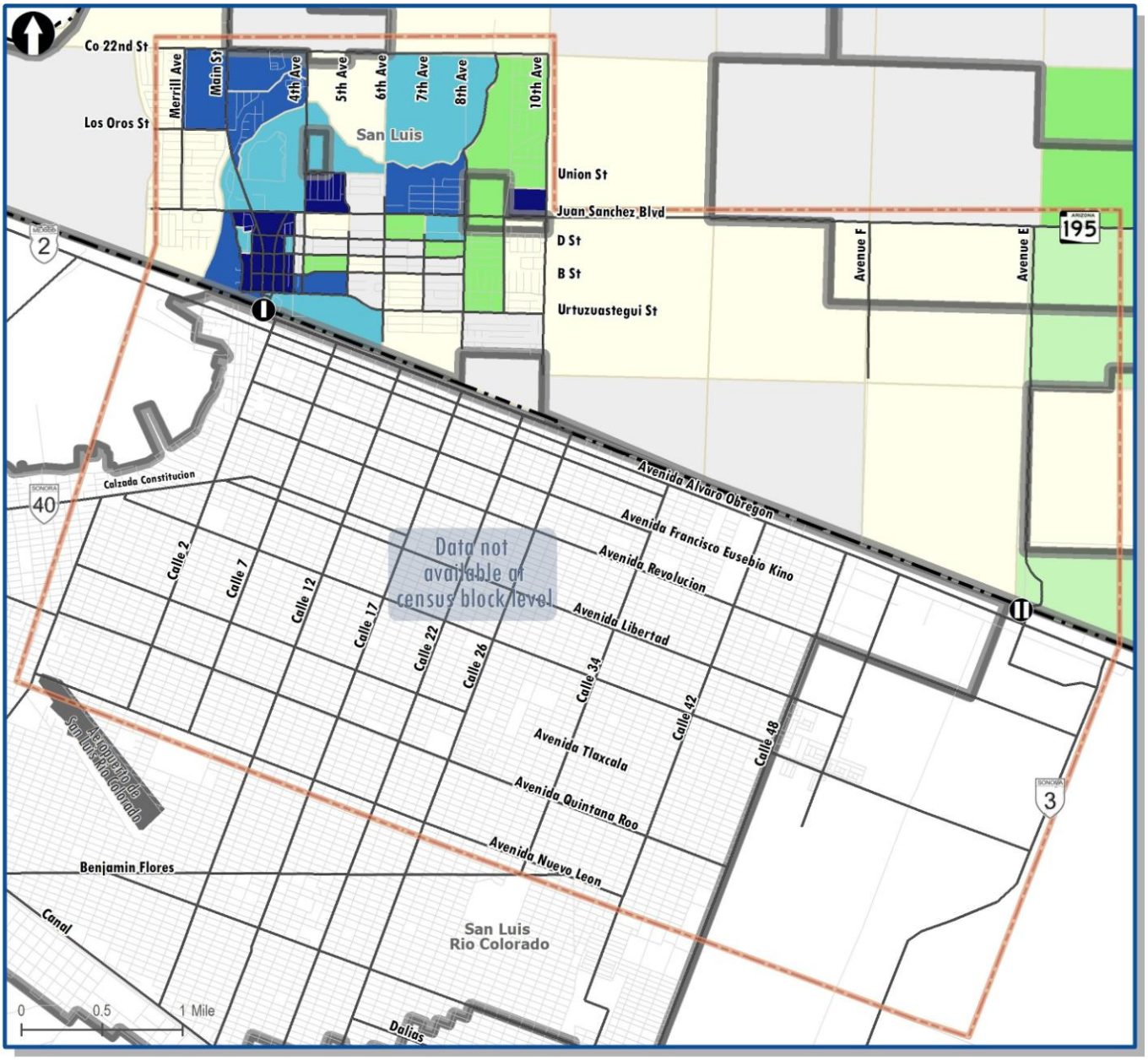
FIGURE 2.35: YEAR 2030 EMPLOYMENT DENSITY

Employees per Square Mile

- No Employees
- 1 - 250
- 251 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 5,000
- 5,001 and above

- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Arizona Dept. of Administration Office of Employment and Population Statistics



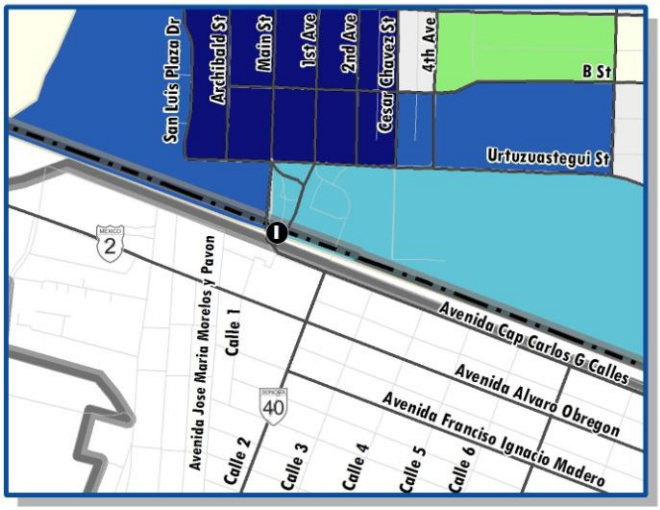


FIGURE 2.36: YEAR 2040 EMPLOYMENT DENSITY

Employees per Square Miles

- No Employees
- 0 - 250
- 251 - 500
- 501 - 1,000
- 1,001 -2,000
- 2,001 - 5,000
- 5,000 and above

- Land Port of Entry
- Study Roadway
- International Boundary
- Cities
- Study Area

Source: U.S. Census 2010, ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, Arizona Dept. of Administration Office of Employment and Population Statistics

FUTURE TRANSPORTATION CONDITIONS

The primary purpose of forecasting future traffic volumes is to estimate the additional travel demand added to base year roadways and to forecast congestion levels due to projected population and employment growth. In addition, this analysis provides valuable insight into potential transportation solutions. As previously discussed, the YMPO Regional Travel Demand Model was used to forecast traffic volumes for 2018, 2030, and 2040 using the socioeconomic data developed in the preceding sections.

Projected 2018 Traffic Conditions

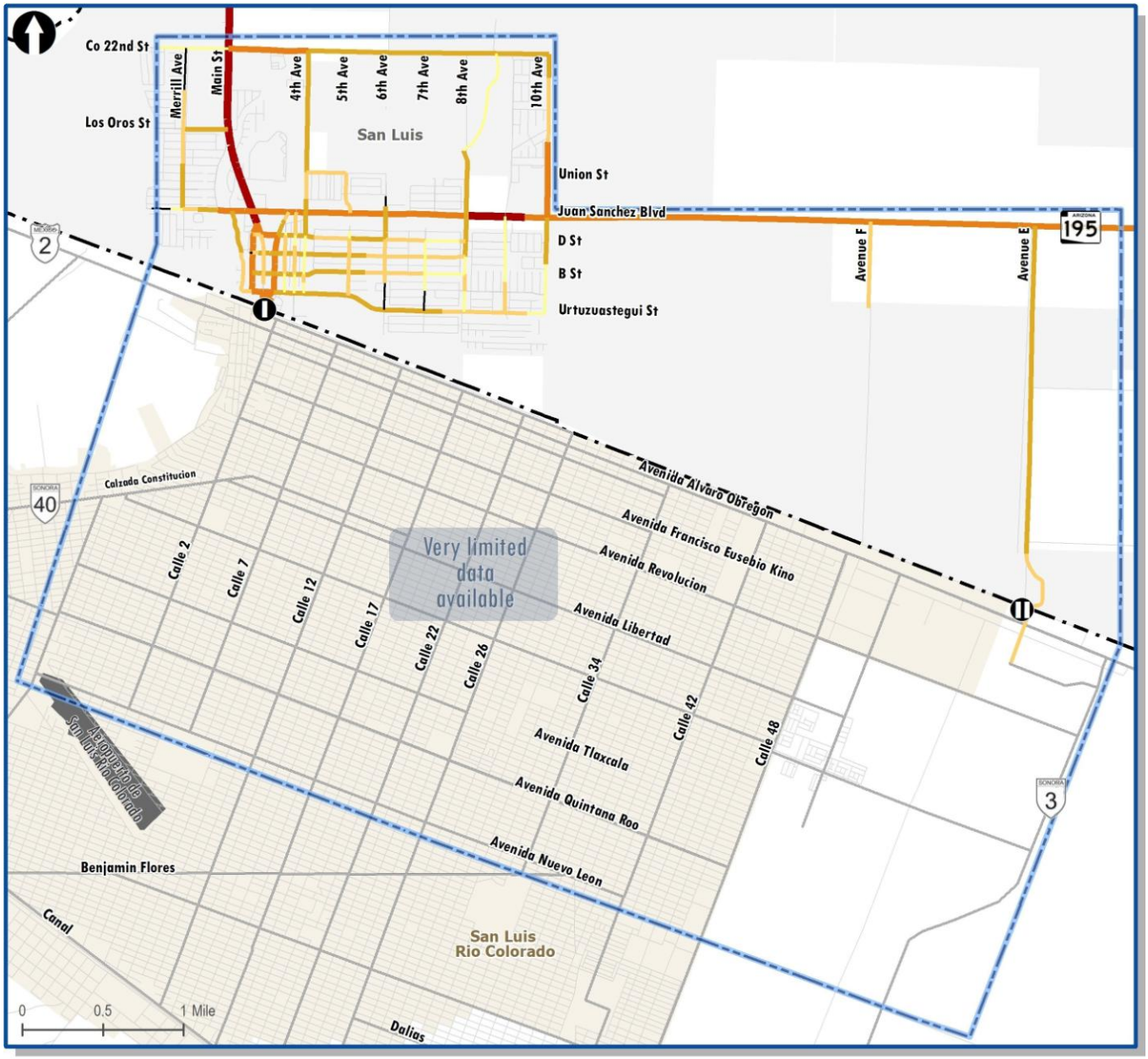
Figure 2.37 displays the projected 2018 traffic volumes and Figure 2.38 depicts the level of congestion for the base year 2013 roadway network with projected 2018 socioeconomic conditions *if no roadway improvements are made (No-Build)*. Traffic volumes and congestion results in this section represent average annual daily traffic conditions. All roads located within the study area operate at low levels of congestion (LOS A and B), except for the following:

High Congestion (LOS E and F)

- Juan Sanchez Boulevard: Mesa Street to US-95/Main Street

Moderate Congestion (LOS C and D)

- County 22nd Street: US-95/Main Street to west of 4th Avenue
- Juan Sanchez Boulevard: east of Merrill Avenue to Mesa Street
- Juan Sanchez Boulevard: US-95/Main Street to 8th Avenue
- Juan Sanchez Boulevard: 10th Avenue to SR-195 east of Avenue E
- D Street: US-95/Main Street to 1st Avenue
- B Street west of Main Street
- Urtuzuastegui Street: Archibald Street to US-95/Main Street
- Urtuzuastegui Street: 4th Avenue to 5th Avenue
- Archibald Street: US-95/Main Street to D Street
- US-95/Main Street: D Street to C Street
- 1st Avenue: D Street to Urtuzuastegui Street



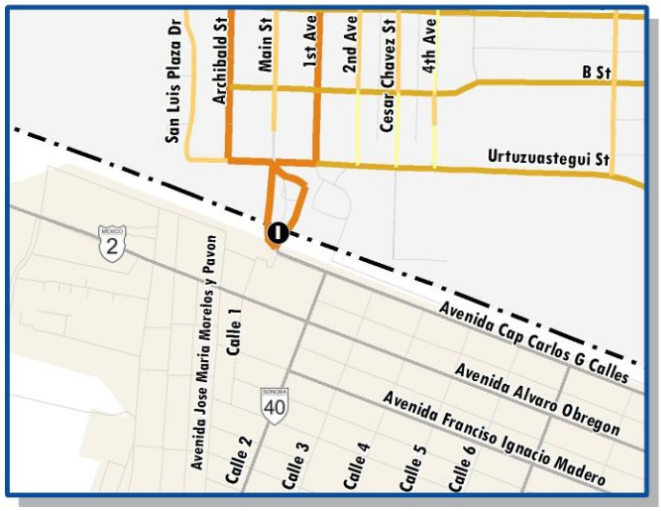


FIGURE 2.37: YEAR 2018 NO-BUILD DAILY TRAFFIC VOLUMES

VOLUME
- 1 - 500
- 501 - 1,500
- 1,501 - 3,500
- 3,501 - 7,000
- 7,001 - 14,000
- 14,001 - 24,000
- 24,001 and above

- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO

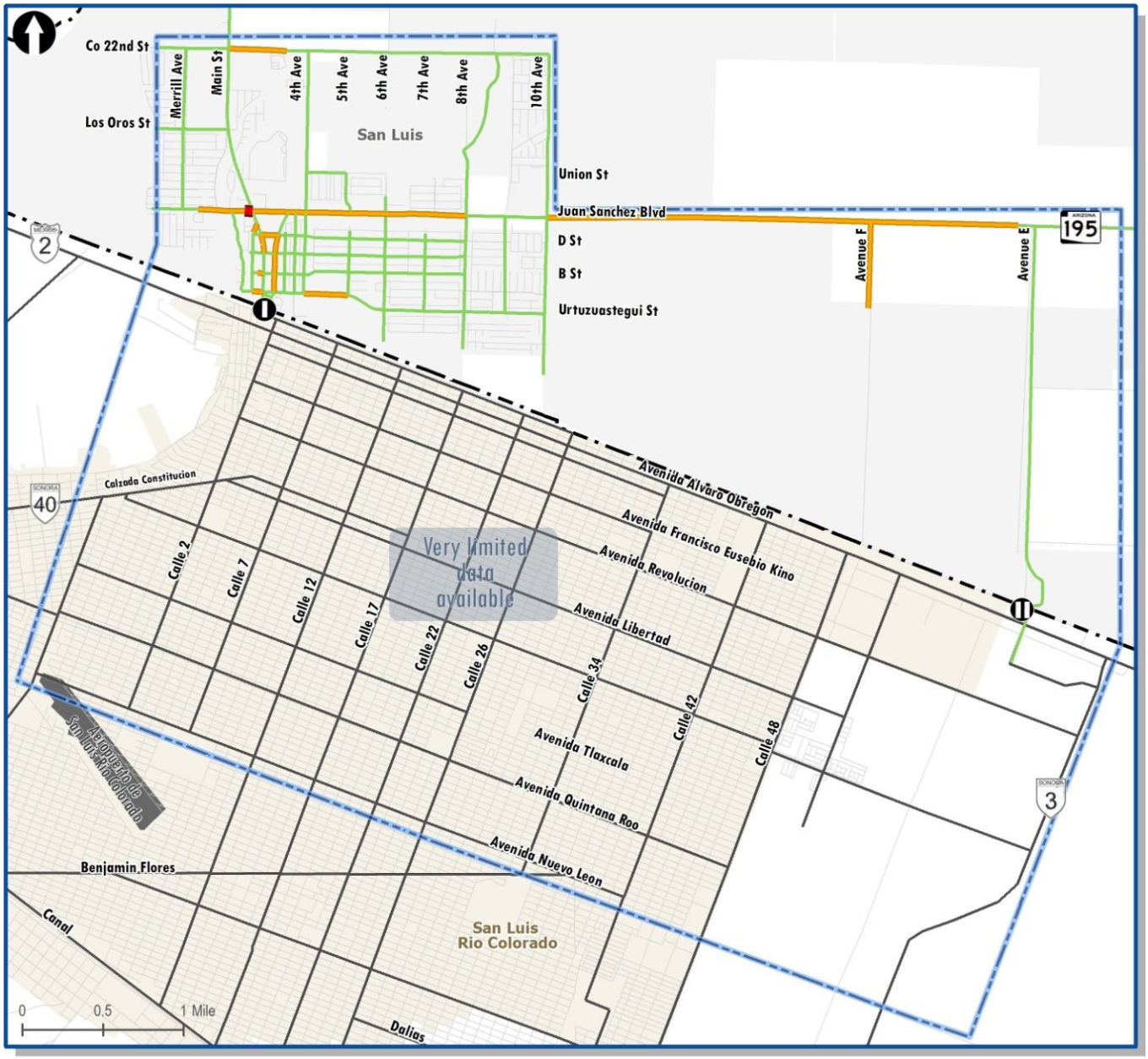
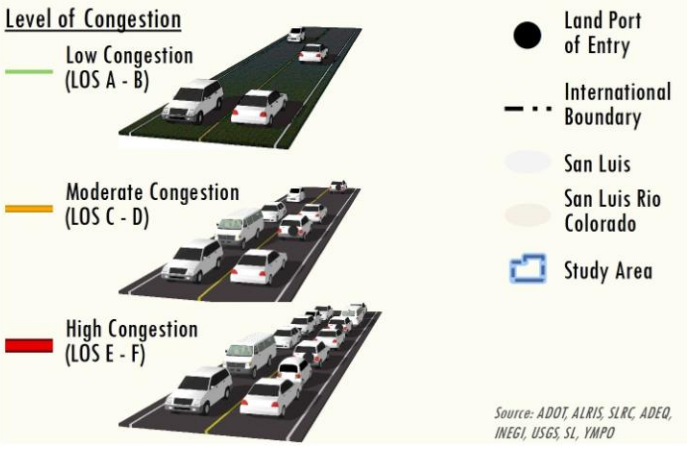


FIGURE 2.38: YEAR 2018 NO-BUILD LEVEL OF CONGESTION



Projected 2030 Traffic Conditions

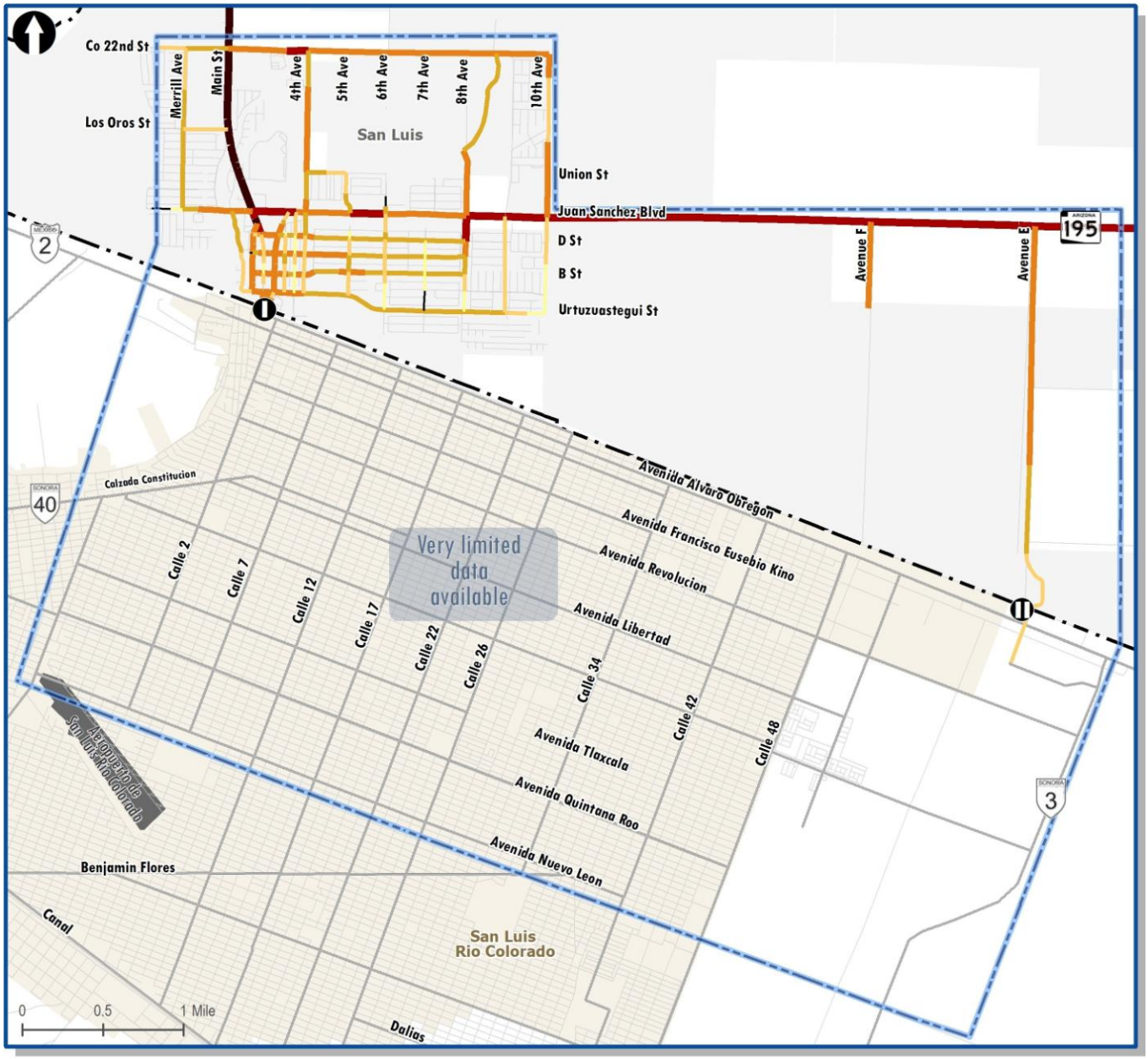
Figure 2.39 displays the projected 2030 traffic volumes and Figure 2.40 depicts the level of congestion for the base year 2013 roadway network with projected 2030 socioeconomic conditions *if no roadway improvements are made (No-Build)*. Traffic volumes and congestion results in this section represent average annual daily traffic conditions. All roads located within the study area operate at low levels of congestion (LOS A and B), except for the following:

High Congestion (LOS E and F)

- County 22nd Street: west of 4th Avenue
- Juan Sanchez Boulevard: Mesa Street to Cesar Chavez Street
- Juan Sanchez Boulevard: 10th Avenue to SR-195 west of Avenue E
- D Street: US-95/Main Street to 1st Avenue
- Urtuzuastegui Street: Archibald Street to US-95/Main Street
- US-95/Main Street: northern study limits to County 22nd Street
- Avenue F: south of Juan Sanchez Boulevard

Moderate Congestion (LOS C and D)

- County 22nd Street: US-95/Main Street to west of 4th Avenue
- County 22nd Street: 4th Avenue to 10th Avenue
- Juan Sanchez Boulevard: east of Merrill Avenue to Mesa Street
- Juan Sanchez Boulevard: Cesar Chavez Street to 10th Avenue
- SR-195: west of Avenue E to eastern study limits
- D Street: Cesar Chavez Street to 5th Avenue
- C Street: west of US-95/Main Street to east of 5th Avenue
- B Street: Archibald Street to east of 2nd Street
- B Street: Cesar Chavez Street to 4th Drive
- B Street west of 5th Avenue to west of 6th Avenue
- Urtuzuastegui Street: 2nd Avenue to 6th Avenue
- Archibald Street: US-95/Main Street to Urtuzuastegui Street
- US-95/Main Street: County 22nd Street to Juan Sanchez Boulevard
- US-95/Main Street: D Street to C Street
- US-95/Main Street: Urtuzuastegui Street to San Luis I LPOE
- 1st Avenue: E Street to Urtuzuastegui Street
- 4th Avenue: 0.28 mile north of Union Street to Las Brisas Boulevard
- 10th Avenue: County 22nd Street to Krystal Street
- 10th Avenue: Black Street to Juan Sanchez Boulevard
- Avenue E: Juan Sanchez Boulevard to 0.48 mile north of County 24th Street



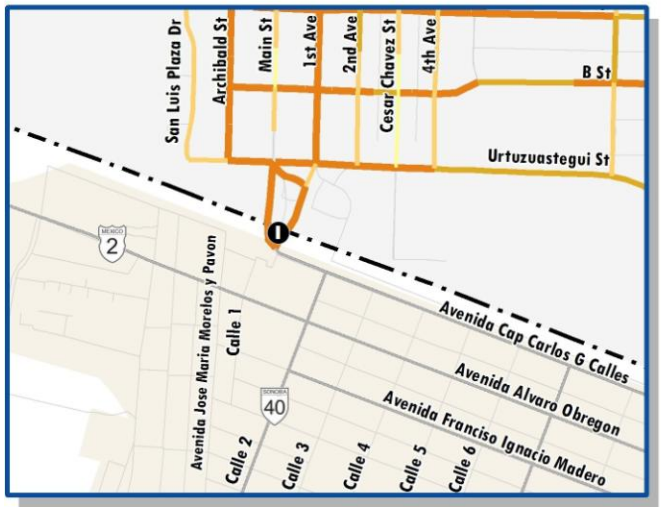


FIGURE 2.39: YEAR 2030 NO-BUILD DAILY TRAFFIC VOLUMES

VOLUME
- 1 - 500
- 501 - 1,500
- 1,501 - 3,500
- 3,501 - 7,000
- 7,001 - 14,000
- 14,001 - 24,000
- 24,001 and above

- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO

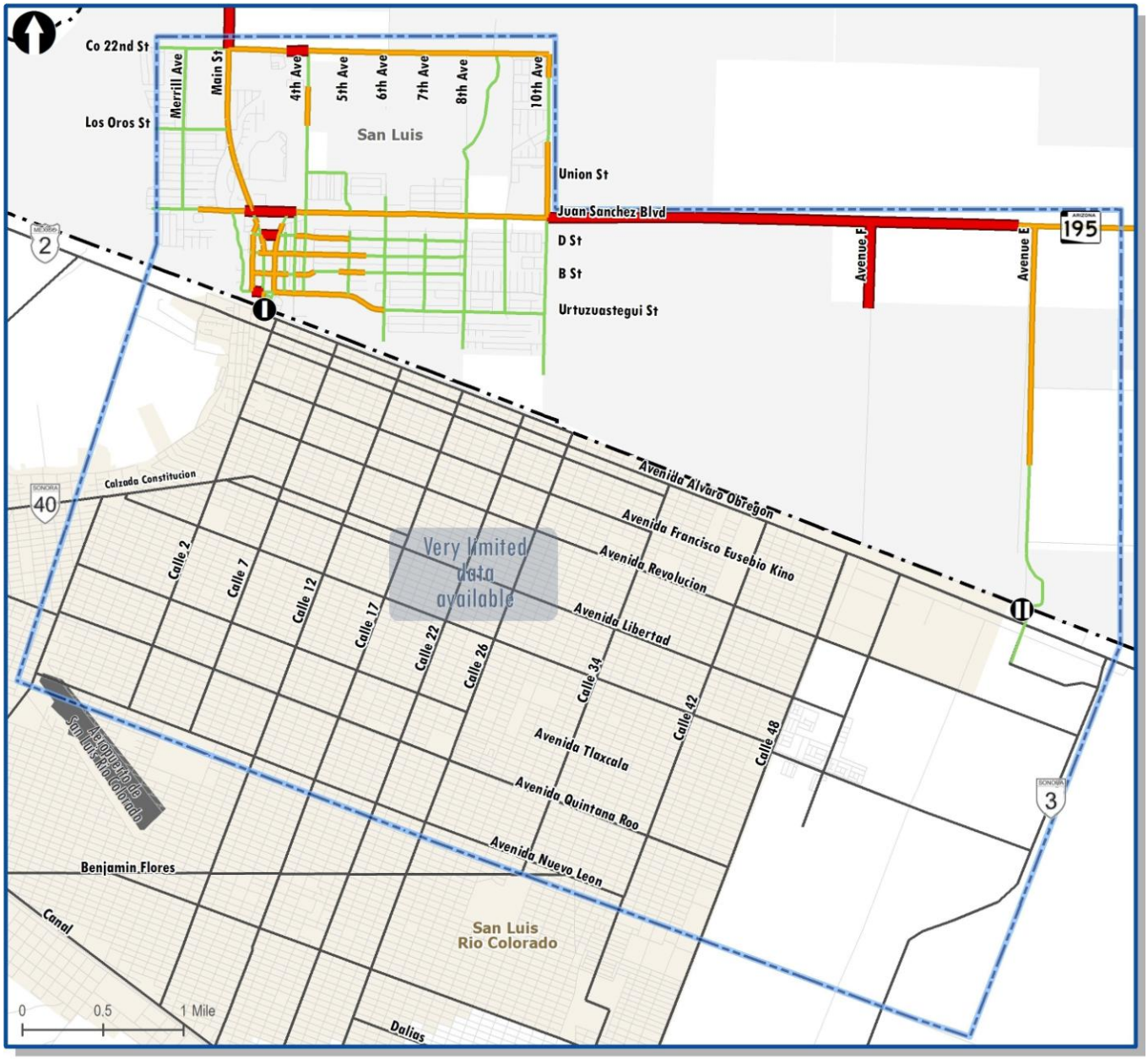
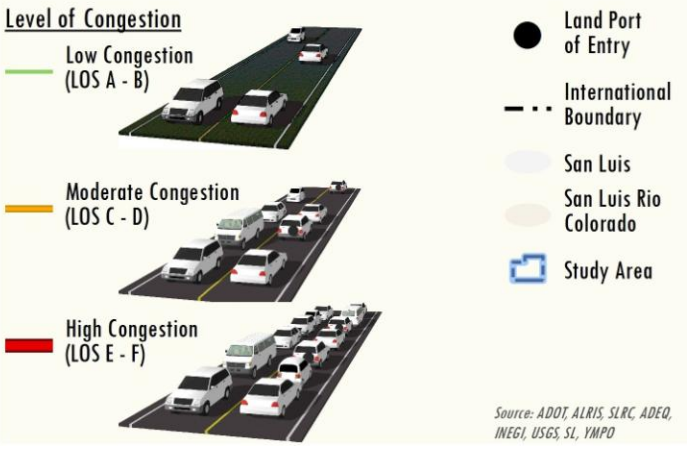


FIGURE 2.40: YEAR 2030 NO-BUILD LEVEL OF CONGESTION



Projected 2040 Traffic Conditions

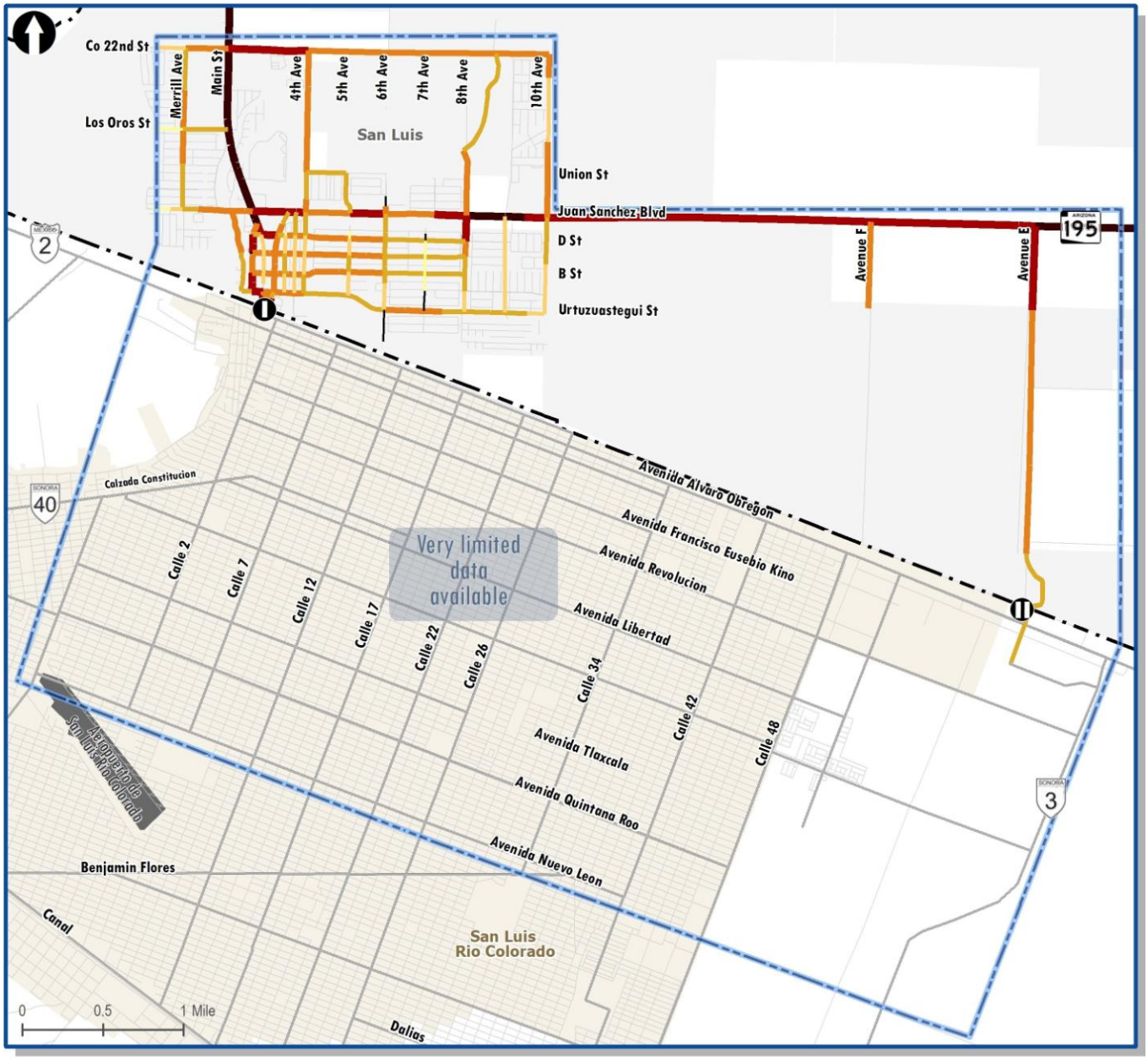
Figure 2.41 displays the projected 2040 traffic volumes and Figure 2.42 depicts the level of congestion for the base year 2013 roadway network with projected 2040 socioeconomic conditions *if no roadway improvements are made (No-Build)*. Traffic volumes and congestion results in this section represent average annual daily traffic conditions. All roads located within the study area operate at low levels of congestion (LOS A and B), except for the following:

High Congestion (LOS E and F)

- County 22nd Street: US-95/ Main Street to 4th Avenue
- Juan Sanchez Boulevard: Avenue J to San Luis Plaza Drive
- Juan Sanchez Boulevard: Mesa Street to Cesar Chavez Street
- Juan Sanchez Boulevard: 5th Avenue to 6th Avenue
- Juan Sanchez Boulevard: 7th Avenue to 8th Avenue
- Juan Sanchez Boulevard: 10th Avenue to SR-195 west of Avenue E
- D Street: US-95/Main Street to 1st Avenue
- Urtuzuastegui Street: Archibald Street to US-95/Main Street
- US-95/Main Street: northern study limits to County 22nd Street
- 1st Avenue: D Street to C Street
- 1st Avenue: north of Urtuzuastegui Street
- Avenue F: south of Juan Sanchez Boulevard

Moderate Congestion (LOS C and D)

- County 22nd Street: 4th Avenue to 10th Avenue
- Juan Sanchez Boulevard: east of Merrill Avenue to Avenue J
- Juan Sanchez Boulevard: San Luis Plaza Drive to Mesa Street
- Juan Sanchez Boulevard: Cesar Chavez Street to 5th Avenue
- Juan Sanchez Boulevard: 6th Avenue to 7th Avenue
- Juan Sanchez Boulevard: 8th Avenue to 10th Avenue
- SR-195: west of Avenue E to eastern study limits
- D Street: 2nd Avenue to 6th Avenue
- C Street: Archibald Street to 6th Avenue
- B Street: Archibald Street to 6th Avenue
- Urtuzuastegui Street: 4th Avenue to east of 7th Avenue
- Merrill Avenue: Los Valles Street to Aquila Street
- San Luis Plaza Drive: south of Juan Sanchez Boulevard
- Archibald Street: US-95/Main Street to Urtuzuastegui Street
- US-95/Main Street: County 22nd Street to C Street
- US-95/Main Street: Urtuzuastegui Street to San Luis I LPOE
- 1st Avenue: E Street to D Street
- 1st Avenue: C Street to Urtuzuastegui Street
- 4th Avenue: Las Brisas Boulevard to Union Street
- 4th Avenue: Arizona Street to Juan Sanchez Boulevard
- 8th Avenue: south of Juan Sanchez Boulevard
- 10th Avenue: County 22nd Street to Krystal Street
- 10th Avenue: Black Street to Juan Sanchez Boulevard
- Avenue E: Juan Sanchez Boulevard to 0.48 mile north of County 24th Street



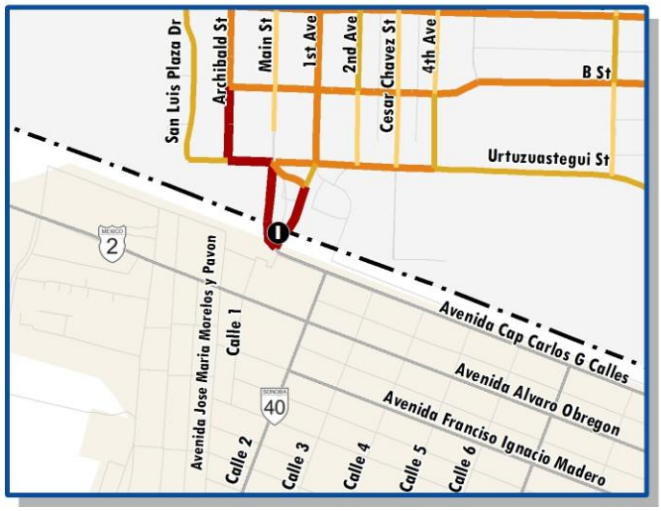


FIGURE 2.41: YEAR 2040 NO-BUILD DAILY TRAFFIC VOLUMES

VOLUME
- 1 - 500
- 501 - 1,500
- 1,501 - 3,500
- 3,501 - 7,000
- 7,001 - 14,000
- 14,001 - 24,000
- 24,001 and above

- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO

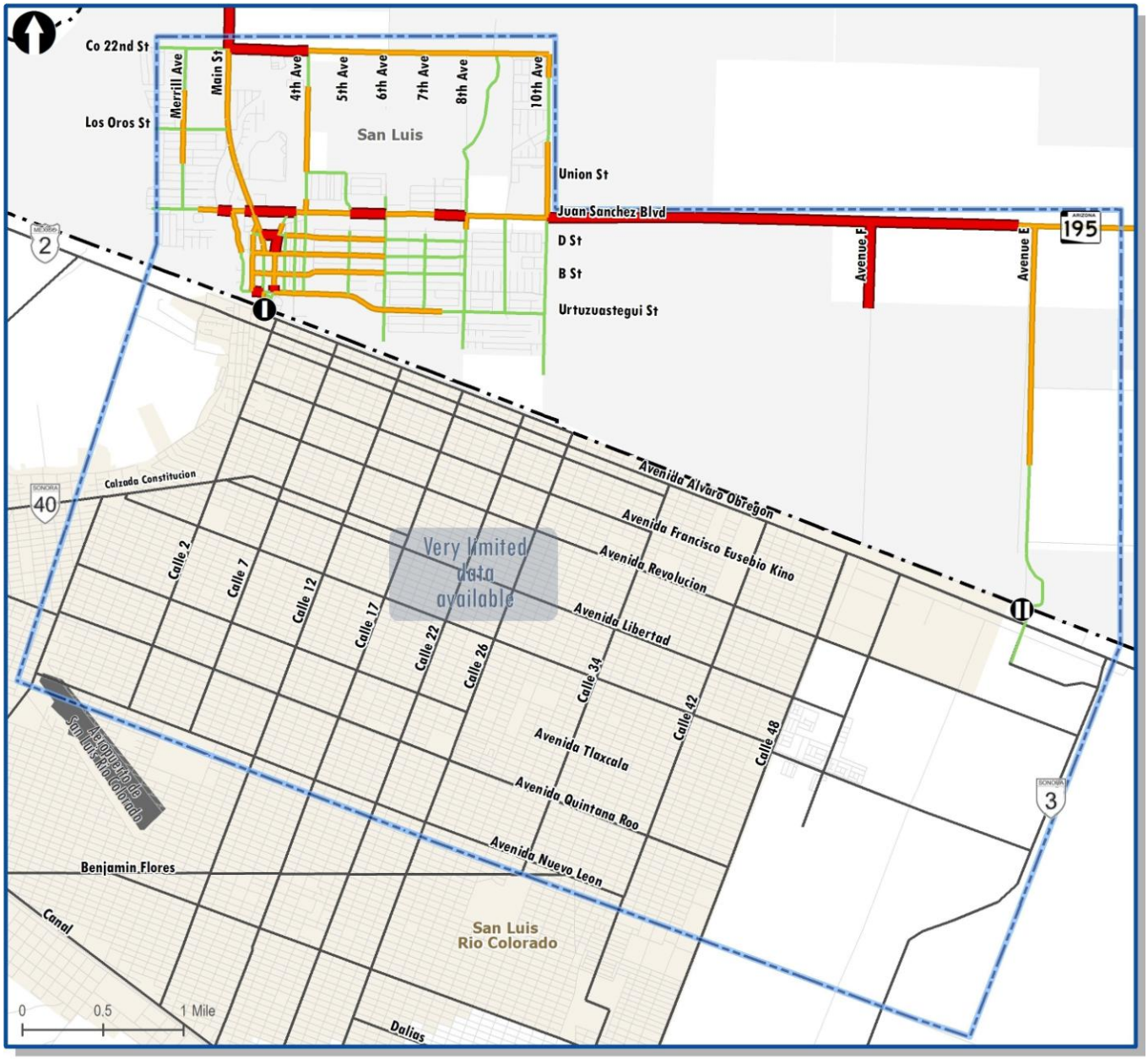
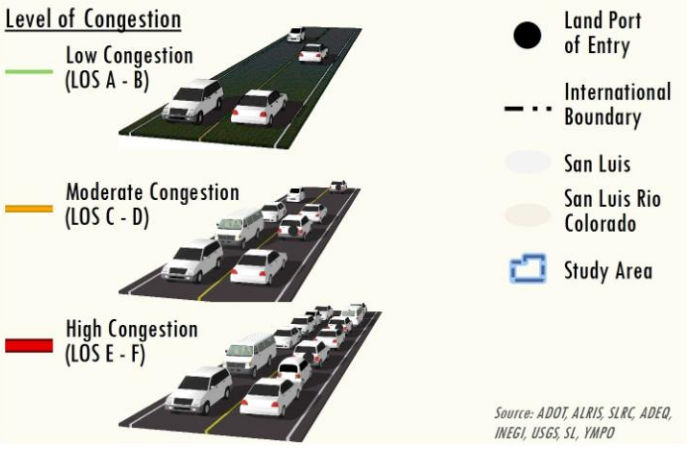


FIGURE 2.42: YEAR 2040 NO-BUILD LEVEL OF CONGESTION



Summary of Future Conditions*

**If no roadway improvements are made (No-Build)*

The following is a summary of findings from the future conditions analysis.

- Population and employment growth between 2013 and 2018 is relatively small, resulting in little change in traffic volumes and patterns.
- Similar to the base year 2013 traffic conditions, Juan Sanchez Boulevard is highly congested near US-95/Main Street in each of the future horizon years as a result of the people trying to access the U.S. Post Office.
- By 2030, Juan Sanchez Boulevard east of 10th Avenue is highly congested in areas where future growth is expected to occur.
- County 22nd Street from US-95/Main Street to 4th Avenue is congested by 2040; it serves as an alternative route to the congested Main Street and Juan Sanchez Boulevard.
- By 2030, a majority of the east-west streets in the downtown area are moderately congested as they carry traffic between the one-way couplets (Archibald Street and 1st Avenue) and Main Street.
- In addition, the same east-west streets experience moderate congestions as the roads transition from the downtown area to the residential area to the east.

San Luis I LPOE Future Conditions

Statistical models that correlated border crossing volumes with the relative change of certain economic variables over time were used to forecast traffic volumes at the LPOEs. Detail methodologies and analyses for future crossing volumes are located in Appendix A. Crossing volumes for POVs, pedestrians, and commercial vehicles were estimated for three time frames: 5-years, 10-years, and 20-years. Using the identified time frames, the economic variables associated with each of the three modes were projected to determine the demand. The primary economic drivers identified for each of the modes at the San Luis ports of entry are listed in Table 2.10.

TABLE 2.10: MAIN IDENTIFIED DRIVERS OF BORDER CROSSINGS BY MODE

Mode	External Factors with High Correlation to Border Crossings
Pedestrian	Index of Industrial Production in the United States (nine-month lag) Main Agricultural Production in Yuma County, AZ (no lag)
POV	Index of Industrial Production in the United States (seven-month lag) Main Agricultural Production in Yuma County, AZ (no lag)
Truck	MXN/USD Exchange Rate (twelve-month lag) Main Agricultural Production in Yuma County, AZ (no lag)

Source: TIS Consulting Group

Since it is very difficult to ascertain a single value for each of the primary drivers, three levels of predictions were established:

- Optimistic, represents the high 85% confidence interval of the predictions
- Expected, represents the mean of the predictions. ***For planning purposes the expected scenario is used for forecasting activities.***
- Pessimistic, represents the lower 85% confidence interval of the predictions.

The optimistic and pessimistic scenarios define the upper and lower growth boundaries for each driver. The forecasted values for the primary drivers by horizon year are shown in Tables 2.11 and 2.12 for POVs and commercial vehicles crossing respectively.

TABLE 2.11: PROJECTED VALUES FOR DRIVERS OF PEDESTRIAN AND POV CROSSINGS

United States Index of Industrial Production (IIPU)						
Level	+5 years		+10 years		+20 years	
	Jan 2017	% Increment	Jan 2022	% Increment	Jan 2032	% Increment
Hi 85	101.53	12%	107.02	18%	117.88	30%
Expected	**95.22**	**5%**	**98.64**	**8%**	**105.80**	**16%**
Lo 85	87.45	-4%	88.22	-3%	90.57	0%

Source: TIS Consulting Group

Main Agricultural Production Levels in Yuma County (AGRI)						
Level	+5 years		+10 years		+20 years	
	2016-17	% Increment	2021-22	% Increment	2030-31	% Increment
Hi 85	721,241	25%	735,552	28%	745,047	29%
Expected	**600,310**	**4%**	**578,649**	**0%**	**540,114**	**-6%**
Lo 85	483,429	-16%	434,698	-25%	363,483	-37%

Source: TIS Consulting Group

TABLE 2.12: PROJECTED VALUES FOR DRIVERS OF COMMERCIAL VEHICLES CROSSINGS

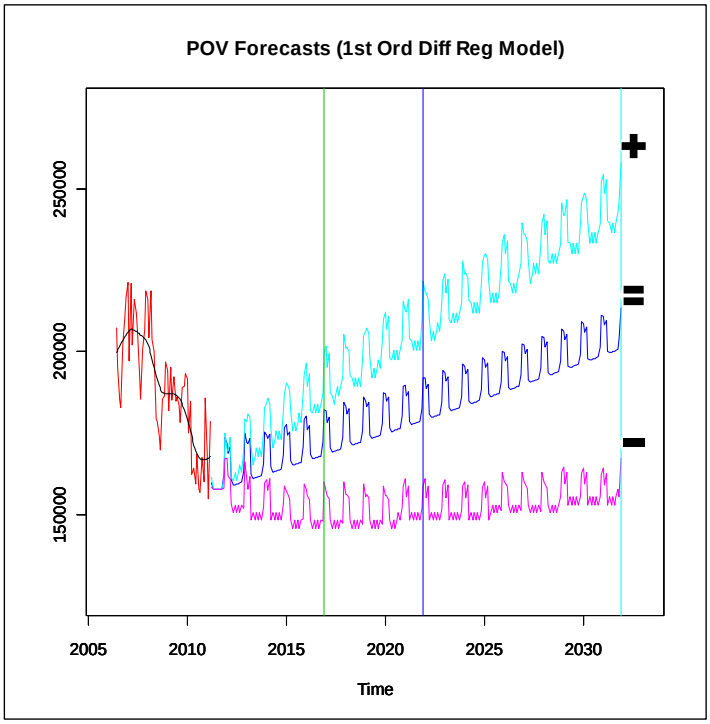
MXN/USD Exchange Rate (EXCH)						
Level	+5 years		+10 years		+20 years	
	Jan 2017	% Increment	Jan 2022	% Increment	Jan 2032	% Increment
Hi 85	17.46	46%	22.08	84%	34.47	187%
Expected	**15.07**	**26%**	**18.33**	**53%**	**27.02**	**125%**
Lo 85	12.00	0%	13.18	10%	17.06	42%

Source: TIS Consulting Group

Privately Owned Vehicles (POVs)

Even with the decline in the overall monthly volume over the last few years at San Luis I LPOE, POV traffic constitutes the largest crossing demand at the port. POV traffic at San Luis I LPOE is dependent on the level of agriculture and industrial production in the U.S (see Table 2.11), however data showed that seasonal changes did not strongly affect the level of POV traffic at the port. Displayed in Figure 2.43 are the upper and lower bounds, as well as expected values of the projected POV traffic. These bounds are defined from the combination of the three scenarios: the ***optimistic*** scenario (shown with a "+" sign); the ***expected*** scenario (shown with a "=" sign); and the ***pessimistic*** scenario (shown in a "–"sign).

FIGURE 2.43: SHORT-, MID- AND LONG-TERM PROJECTIONS FOR POV TRAFFIC



Source: TIS Consulting Group

Table 2.13 displays the yearly average of the projected POVs crossing by each time frame.

TABLE 2.13: PROJECTED VALUES FOR POV BORDER CROSSINGS

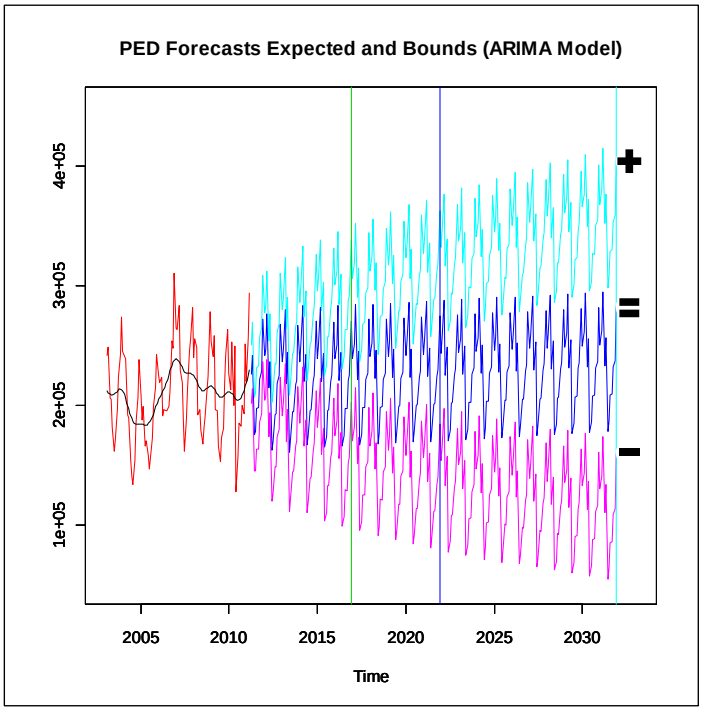
POV Border Crossing - Monthly						
Level	+5 years		+10 years		+20 years	
	2017	% Increment	2022	% Increment	2032	% Increment
Hi 85	191,909	15%	211,153	27%	244,639	47%
Expected	**173,862**	**4%**	**184,248**	**10%**	**203,936**	**22%**
Lo 85	150,340	-10%	152,417	-9%	157,598	-6%

Source: TIS Consulting Group

Pedestrians

As one of the modes with the largest demand at the port, the San Luis I LPOE pedestrian traffic accounts for nearly 30 percent of the total pedestrian border crossing volume in Arizona. Ranked #2 among Arizona's LPOE's and #11 among the entire Mexican-U.S. ports of entry for pedestrian border crossing volumes in 2010, the San Luis I LPOE pedestrian traffic is largely dependent on the level of agriculture and industrial production in the U.S (see Table 2.11). Exhibited in Figure 2.44 are the upper and lower bounds, as well as expected values of the projected pedestrian traffic. These bounds are defined from the combination of the three scenarios: the ***optimistic*** scenario (shown with a "+" sign); the ***expected*** scenario (shown with a "=" sign); and the ***pessimistic*** scenario (shown in a "–"sign).

FIGURE 2.44: SHORT-, MID- AND LONG-TERM PROJECTIONS FOR PEDESTRIAN TRAFFIC



Source: TIS Consulting Group

Table 2.14 displays the yearly average of the projected pedestrian crossing for each time frame.

TABLE 2.14: PROJECTED VALUES FOR PEDESTRIAN CROSSINGS

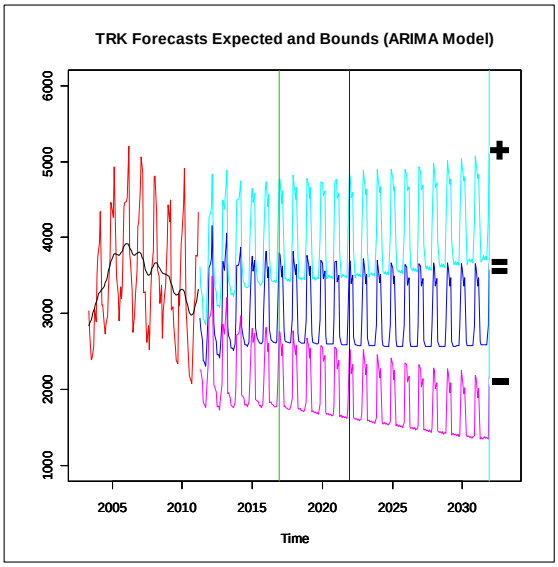
Pedestrian Border Crossing (PED) - Monthly						
Level	+5 years		+10 years		+20 years	
	2017	% Increment	2022	% Increment	2032	% Increment
Hi 85	294,944	38%	319,711	50%	356,321	67%
Expected	**224,981**	**6%**	**228,724**	**7%**	**235,969**	**11%**
Lo 85	153,078	-28%	136,117	-36%	113,409	-47%

Source: TIS Consulting Group

Commercial Vehicles

Only in operation for two years, commercial truck crossing data from San Luis II LPOE was insufficient to conduct a thorough analysis so additional data from San Luis I LPOE, prior to 2011, was utilized in the projection of commercial trucks. Ranked #2 among Arizona's LPOE and #13 among the entire Mexican-U.S. commercial ports of entry, commercial truck traffic at San Luis I LPOE accounted for 12 percent of the total commercial truck entering the State in 2010. The commercial truck traffic in the San Luis Binational area is highly dependent on the level of agricultural production as well as the exchange rate of the Mexican Peso to U.S. Dollar (see Tables 2.11 and 2.12). Similar to the pedestrian mode, the commercial truck traffic is reflective of the season. Illustrated in Figure 2.45 are the upper and lower bounds, as well as expected values of the projected commercial truck traffic. These bounds are defined from the combination of the three factors: the ***optimistic*** scenario (shown with a "+" sign); the ***expected*** scenario (shown with a "=" sign); and the ***pessimistic*** scenario (shown in a "–"sign).

FIGURE 2.45: SHORT-, MID- AND LONG-TERM PROJECTIONS FOR COMMERCIAL VEHICLE TRAFFIC



Source: TIS Consulting Group

Table 2.15 displays the yearly average of the projected commercial trucks crossing for each time frame.

TABLE 2.15: PROJECTED VALUES FOR TRUCK CROSSINGS AT SAN LUIS II LPOE

Commercial Trucks Border Crossing (TRK) - Monthly						
Level	+5 years		+10 years		+20 years	
	2017	% Increment	2022	% Increment	2032	% Increment
Hi 85	3,919	26%	3,969	27%	4,196	35%
Expected	**3,013**	**-3%**	**2,948**	**-5%**	**2,925**	**-6%**
Lo 85	2,067	-34%	1,880	-40%	1,594	-49%

Source: TIS Consulting Group

3.0 EVALUATION OF TRANSPORTATION IMPROVEMENTS

Based on an inventory and analysis of base year conditions, transportation deficiencies and issues were identified. These issues and deficiencies form the basis for the next phase of the study, which is the development of the long-range transportation plan.

TRANSPORTATION ISSUES SUMMARY

Figure 3.1 displays the major transportation issues in the study area for the base year. Study area issues have been grouped into five categories and the key issues in each category are listed below.

Safety issues:

- Majority of the crashes occur in the downtown area, specifically along two corridors: US-95/Main Street and 1st Avenue.
- US-95/Main Street and Juan Sanchez Boulevard intersection.
- US-95/Main Street and C Street intersection.
- Juan Sanchez Boulevard and 8th Avenue intersection.
- High number of pedestrian collisions at the intersection of US-95/Main Street and B Street.
- High number of intersection related crashes.

Mobility issues:

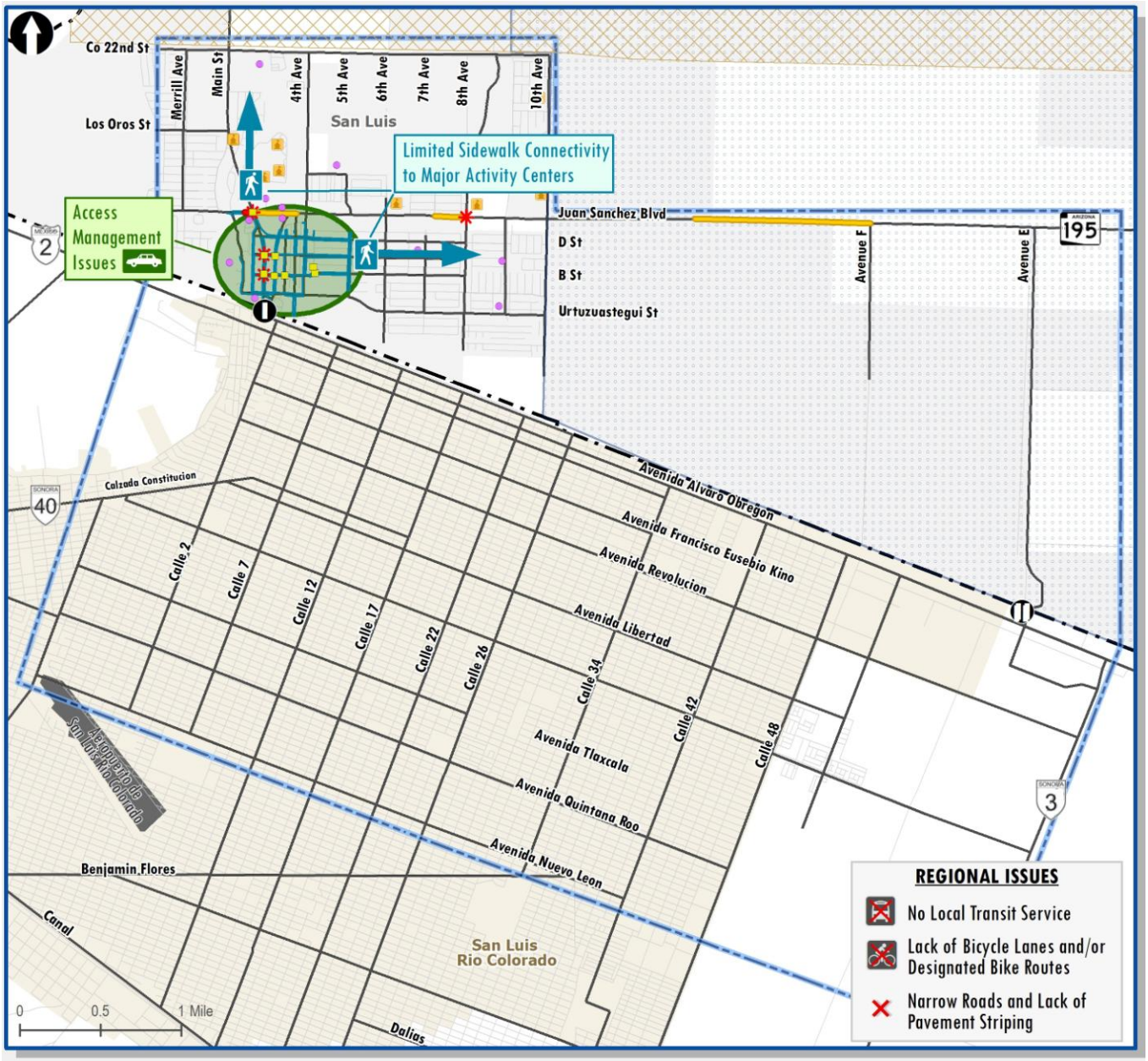
- Congestion on Juan Sanchez Boulevard from US-95/Main Street to Mesa Street.
- Moderate congestion along portions of Juan Sanchez Boulevard from US-95/Main Street to Avenue F.
- Narrow roadways and lack of pavement striping.
- Access management issues in the downtown area.
- No local transit service.

Pedestrian, and bicycle issues:

- Lack of sidewalk connectivity.
- Limited sidewalk connection to other major activity centers.
- Lack of bicycle lanes and designated bike routes.

Environmental issues:

- More than half of the study area is located in the wildlife habitat block.
- The area east of 10th Avenue is in the wildlife linkage zone.
- Six leaking underground storage tanks are located within the study area.



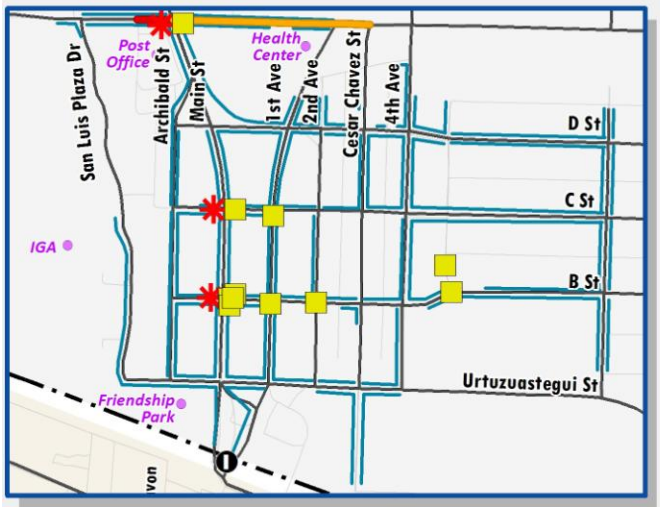


FIGURE 3.1: TRANSPORTATION ISSUES

- Schools
- Major Activity Center
- Pedestrian Crash
- High Crash Intersections
- Sidewalk Connectivity

Level of Congestion
- Moderate Congestion
- High Congestion

- Potential Linkage Zone
- Wildlife Habitat Block
- PM10 Non Attainment

- Land Port of Entry
- Study Roadway
- International Boundary
- Study Area

Source: ADOT; ALRIS, SLRC, INEGI, USGS

STATUS UPDATE OF PROJECTS IDENTIFIED IN THE PREVIOUS PLAN

The *San Luis Small Area Transportation Study (SATS)* identified improvement projects for the short-, mid-, and long-range time frames for the Transportation Plan. Table 3.1 displays the status of the projects for each of the three time frames. As previously discussed, the downtown circulation improvements are anticipated to be completed by the 2013 base year. The Transportation Plan from the *SATS* was included in the adopted *2010-2033 YMPO RTP*. It should be noted that two construction projects, 9th Avenue and Avenue E have since been modified per the *YMPO RTP*. The construction of 10th Avenue has replaced 9th Avenue improvements from County 19th Street to SR-195 while the northern terminus for the Avenue E improvement will now align to Avenue D at County 19th Street.

TABLE 3.1: SAN LUIS SATS TRANSPORTATION PLAN PROJECT STATUS

Short-Term (Y2008 - Y2014)		Status
Roadway	County 22nd Street: construct 2-lanes from 9th Avenue to 10th Avenue	✔
	Conduct downtown circulation study	✔
	Conduct bi-national study for southbound traffic on US-95	●
	Conduct a parking structure location feasibility study	✘
Transit	Organize a transit advisory committee	✔
	Designate a city transportation coordinator	✔
	Implement transit oriented development policies	✘
Bicycle & Pedestrian	Improve sidewalks	✘
	Review and research bicycle users travel patterns	✘
Mid-Term (Y2015 - Y2019)		
Roadway	Juan Sanchez Boulevard: widen to 5-lanes from US-95 to 10th Avenue	●
	New Roadway: construct 2-lanes from 8th Avenue to Avenue F	✘
	6th Avenue: construct 2 lanes from Union Street to County 22nd Street	✘
Transit	Develop a transportation demand management program	✘
	Review ridership on YCAT and request increase in service frequency	✔
Bicycle & Pedestrian	Study the feasibility to install bicycle lane on Main Street	✔
	Study feasibility of pedestrian signal crossing locations and devices	✘
	Study feasibility for bicycle and pedestrian amenities	✘
Long-Term (2020-2030)		
Roadway	Juan Sanchez Boulevard: widen to 5-lanes from 10th Avenue to Avenue E	●
	9th Avenue: construct 2-lanes from County 19th Street to SR-195	✘
	New Roadway: construct 2-lanes from 6th Avenue to Avenue E	✘
	Avenue E: widen to a 4-lanes parkway	✘
	Avenue E: construct 2-lanes from SR-195 to County 19th Street	✘
	County 22nd Street: construct 2-lanes from 10th Avenue to Avenue E½	✘
	Archibald Street & 1st Avenue: convert Archibald Street and 1st Avenue to one-way couplet from C Street to Urtuzuastegui Street	✔
Transit	Develop a transit center	✘
Bicycle & Pedestrian	Implement studies' findings	✘

✔ Completed ✘ Not Started ● Study in Progress

Source: Jacobs Engineering, San Luis Small Area Transportation Study

ROADWAY IMPROVEMENT OPTIONS

Using the uncompleted projects from Table 3.1, the Binational roadway improvement options for the short-, mid-, and long-term phases were identified. Roadway improvement projects were classified into two different categories: capacity related improvement projects and non-capacity roadway improvement projects. Capacity related improvement projects include widening existing roadways and constructing new roadways. Non-capacity related improvements address safety concerns, intersection improvements, and the need to conduct additional planning studies In addition, funding is available through Moving Ahead for Progress in the 21st Century (MAP-21) for non-capacity related improvements. Capacity-related projects were evaluated using the TransCAD travel demand model developed for this study.

Potential Roadway Improvements for Short-Term Phase

ADOT State Transportation Improvement Program (STIP) was reviewed to identify transportation projects scheduled for implementation. Using Table 3.1, potential improvement projects that meet the traffic demand for the year 2018 were identified. Below is a list of potential capacity roadway improvements that were evaluated for the short-term phase. Figure 3.2 displays the roadway number of lanes for the short-term phase.

Capacity Related Roadway Improvements

New Roadway:
- County 24th Street: 10th Avenue to Avenue F

Widening to four-lanes:
- Juan Sanchez Boulevard: US-95/Main Street to 9th Avenue
- Avenue E: SR-195 to U.S./Mexico Border

Non-Capacity Related Roadway Improvements

Additional Planning Studies
- Conduct a parking structure location feasibility study

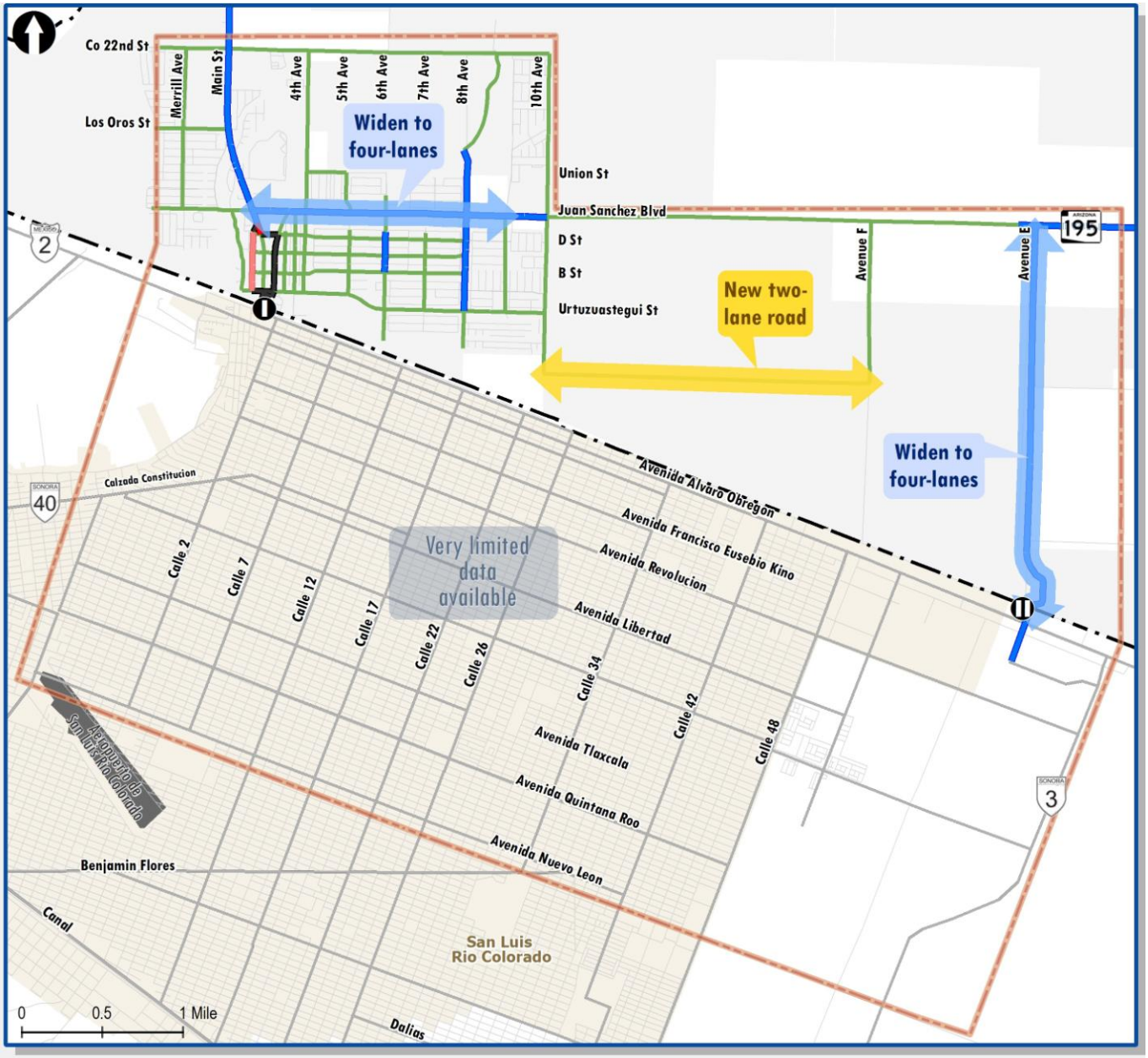


FIGURE 3.2: NUMBER OF LANES FOR SHORT-TERM PHASE

- Four-lanes
- Three-lanes
- Three-Lanes (one-way)
- Two-Lanes
- Two-Lanes (one-way)
- New Road
- Roadway Widening
- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ALRIS, SLRC, ADEQ, INEGI, USGS, SL,YMPO

Roadway Level of Congestion

Figure 3.3 displays the projected 2018 traffic volumes with the incorporated roadway improvements and Figure 3.4 depicts the corresponding level of congestion for the 2018 roadway network in the study area for the short-term phase. Traffic volumes and congestion results in this section represent average annual daily traffic conditions. All roads located within the study area operate at a low level of congestion (LOS A and B), except for the following:

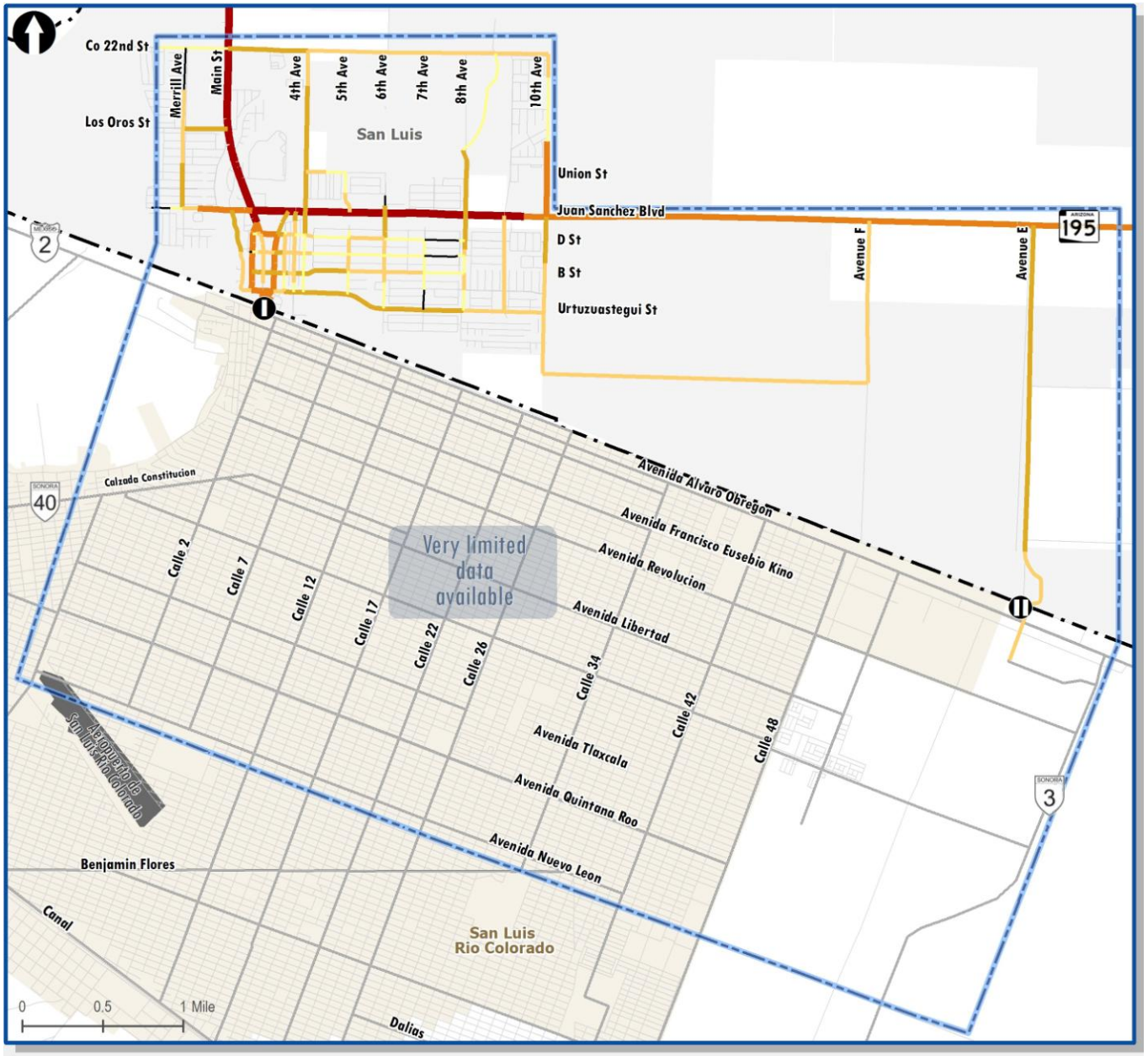
High Congestion (LOS E and F)

- Juan Sanchez Boulevard: Merrill Avenue to US-95*

**This portion of roadway is the primary access to the San Luis Post Office. For all future horizon years, it was assumed that the postal service will not change from the base year status.*

Moderate Congestion (LOS C and D)

- Archibald Street: US-95/Main Street to north of D Street
- 1st Avenue: D Street to Urtuzuastegui Street
- Juan Sanchez Boulevard: east of Merrill Avenue
- Juan Sanchez Boulevard: US-95/Main Street to 6th Avenue
- Juan Sanchez Boulevard: 7th Avenue to 8th Avenue
- Juan Sanchez Boulevard: 10th Avenue to Avenue E
- D Street: US-95/Main Street to 1st Avenue
- Urtuzuastegui Street: Archibald Street to US-95/Main Street



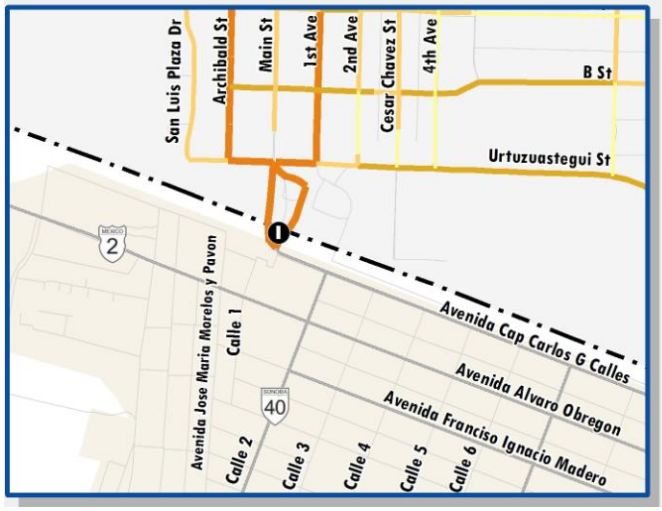
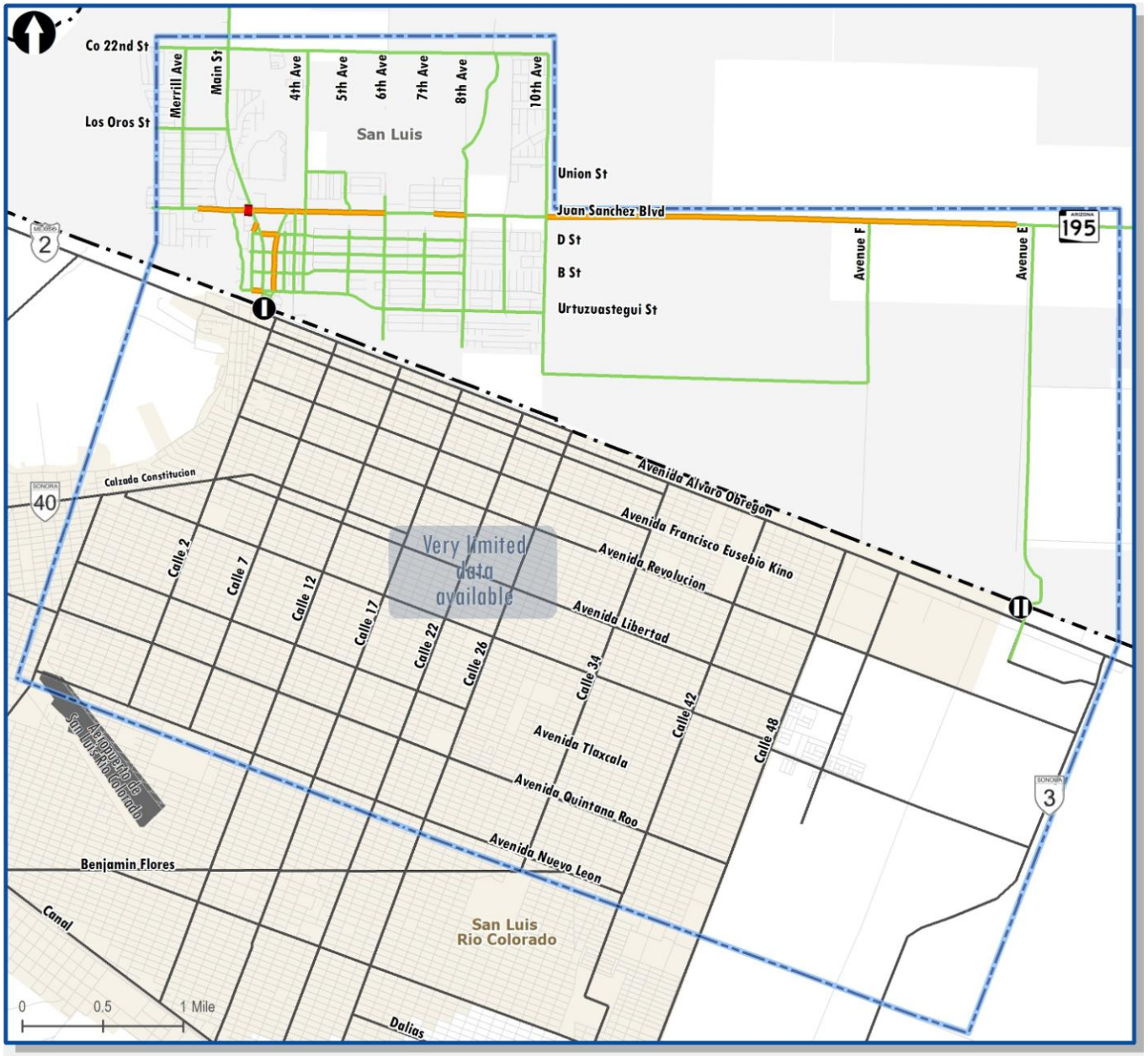


FIGURE 3.3: DAILY TRAFFIC VOLUMES FOR SHORT-TERM PHASE

VOLUME
- 1 - 500
- 501 - 1,500
- 1,501 - 3,500
- 3,501 - 7,000
- 7,001 - 14,000
- 14,001 - 24,000
- 24,001 and above

- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO



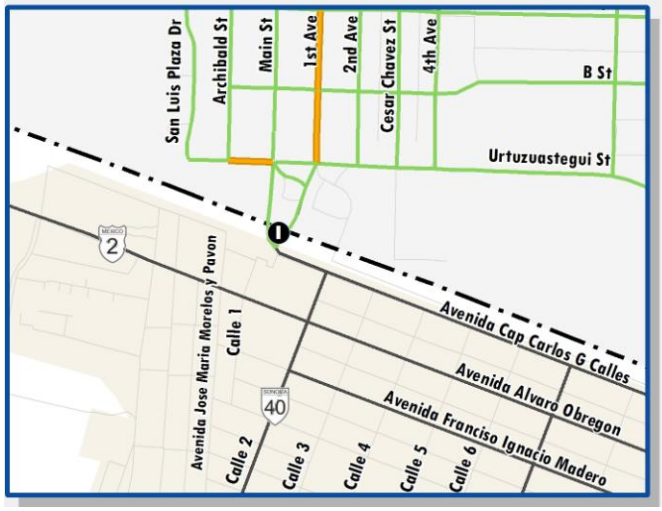
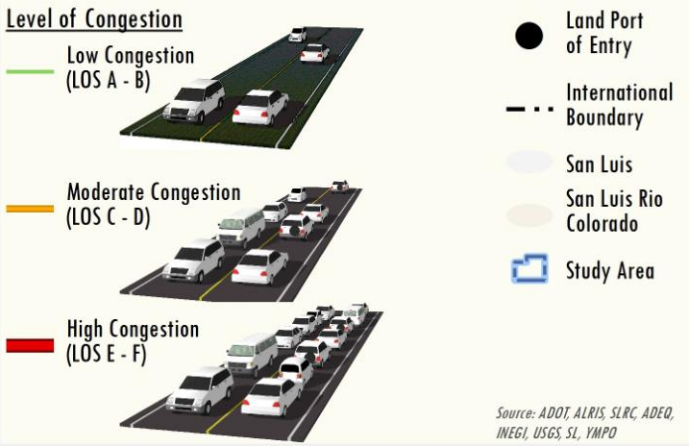


FIGURE 3.4: LEVEL OF CONGESTION FOR SHORT-TERM PHASE



Potential Roadway Improvements for Mid-Term Phase

As the study area reaches the mid-term phase, additional transportation improvements are required to meet the higher traffic demand resulting from the increase in population and employment. Below is a list of potential capacity roadway improvements that were evaluated for the mid-term phase, these transportation improvements are in addition to those identified in the short-term phase. Figure 3.5 displays the roadway number of lanes for the mid-term phase.

Capacity Related Roadway Improvements

New Roadway:
- 6th Avenue: County 22nd Street to California Street
- Avenue H: County 19th Street to County 22nd Street

Widening to four-lanes:
- Juan Sanchez Boulevard: 10th Avenue to SR-195 (just west of Avenue E)

Roadway Level of Congestion

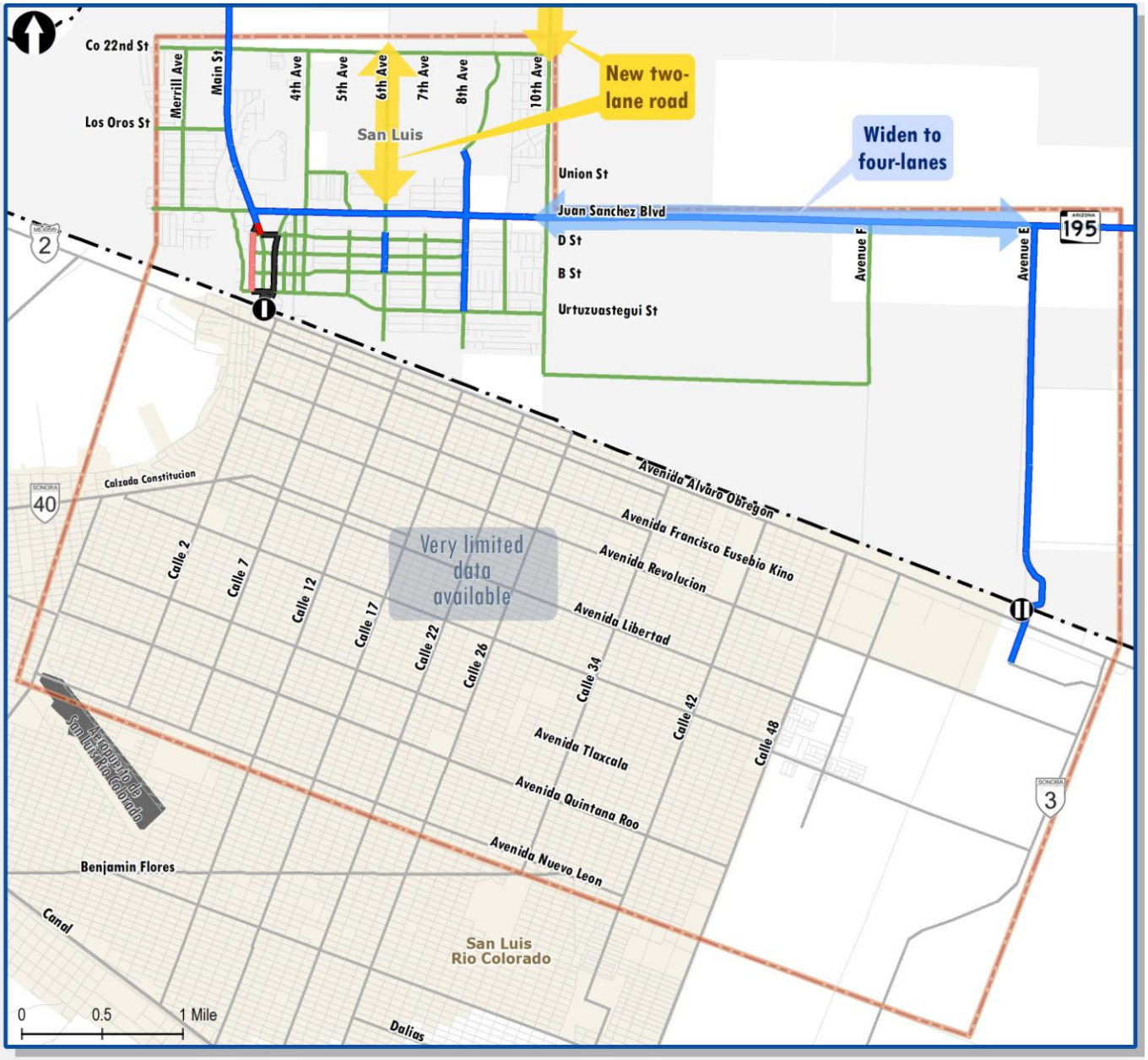
Figure 3.6 displays the projected 2030 traffic volumes with the incorporated roadway improvements while Figure 3.7 depicts the corresponding level of congestion. Traffic volumes and congestion results in this section represent average annual daily traffic conditions. All roads located within the study area operate at low levels of congestion (LOS A and B), except for the following:

High Congestion (LOS E and F)

- Juan Sanchez Boulevard: Merrill Avenue to US-95/Main Street
- Urtuzuastegui Street: Archibald Street to US-95/Main Street

Moderate Congestion (LOS C and D)

- County 22nd Street: US-95/Main Street to 6th Avenue
- Juan Sanchez Boulevard: east of Merrill Avenue to Mesa Street
- Juan Sanchez Boulevard: US-95/Main Street to eastern study limits
- D Street: US-95/Main Street to 1st Avenue
- B Street: Archibald Street to US-95/Main Street
- Urtuzuastegui Street: 4th Avenue to 6th Avenue
- Archibald Street: US-95/Main Street to Urtuzuastegui Street
- US-95/Main Street: northern study limits to County 22nd Street
- US-95/Main Street: south of Beach Street to Juan Sanchez Boulevard
- US-95/Main Street: Urtuzuastegui Street to San Luis I LPOE
- 1st Avenue: D Street to Urtuzuastegui Street
- 6th Avenue: north of Juan Sanchez Boulevard
- 10th Avenue: northern study limits to south of County 22nd Street
- 10th Avenue: south of Black Street to Juan Sanchez Boulevard
- Avenue F: Juan Sanchez Boulevard to County 24th Street



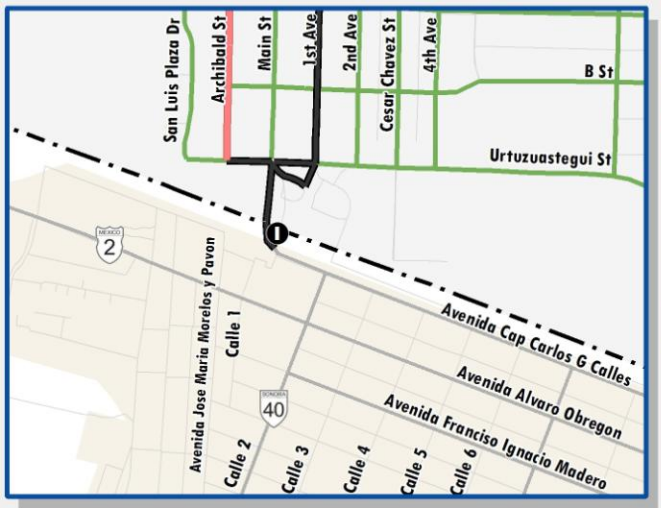
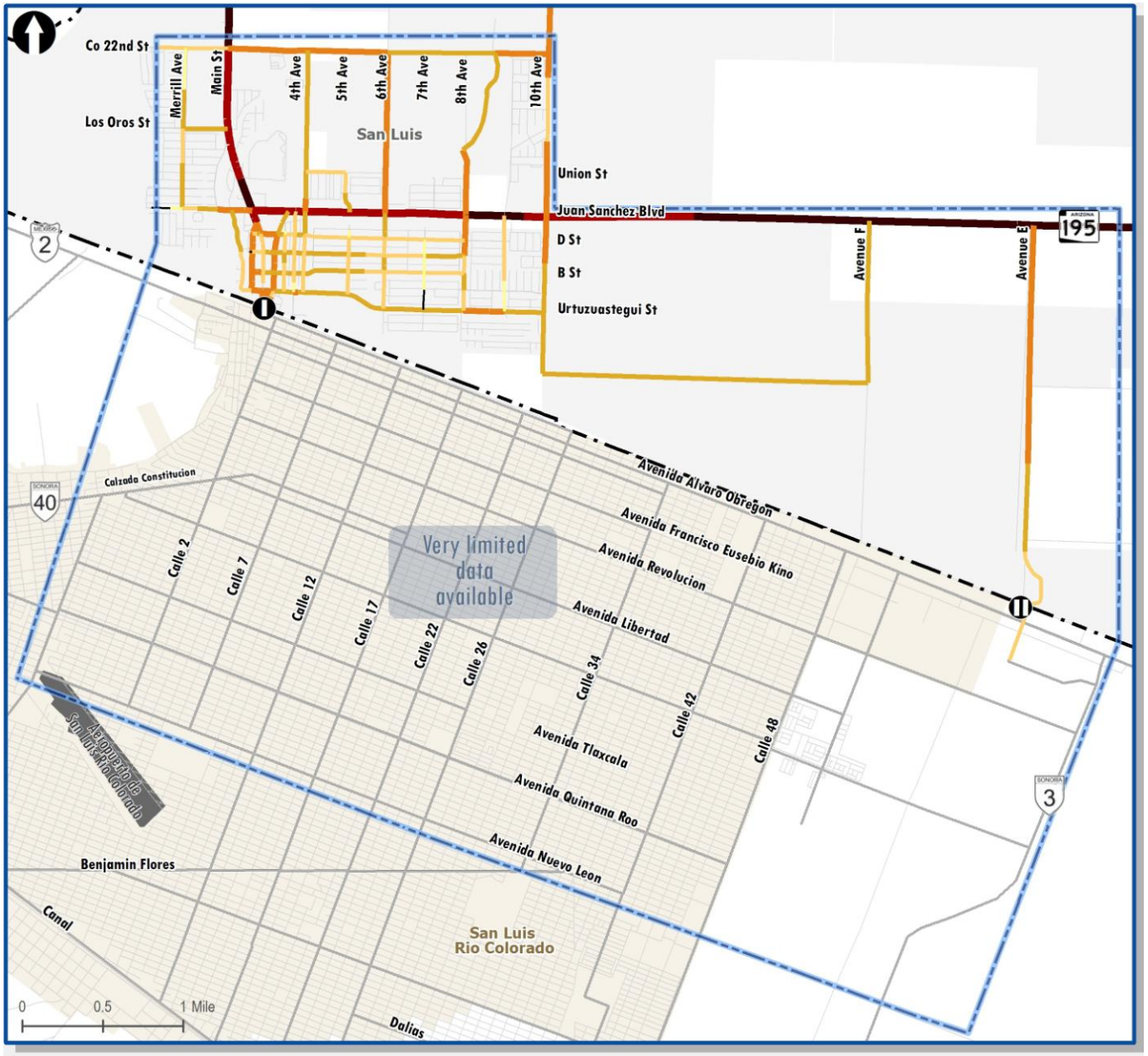


FIGURE 3.5: NUMBER OF LANES FOR MID-TERM PHASE

- Four-lanes
- Three-lanes
- Three-lanes (one-way)
- Two-lanes
- Two-lanes (one-way)
- New Road
- Roadway Widening
- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ALRIS, SLRC, ADEQ, INEGI, USGS, SL,YMPO



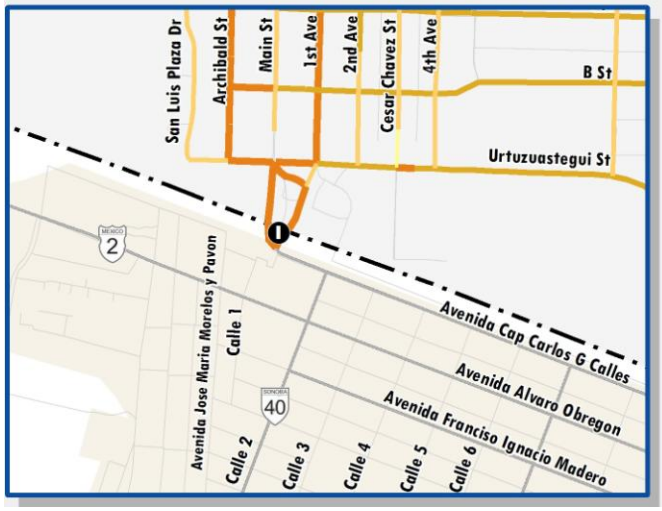


FIGURE 3.6: DAILY TRAFFIC VOLUMES FOR MID-TERM PHASE

VOLUME
- 1 - 500
- 501 - 1,500
- 1,501 - 3,500
- 3,501 - 7,000
- 7,001 - 14,000
- 14,001 - 24,000
- 24,001 and above

- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO

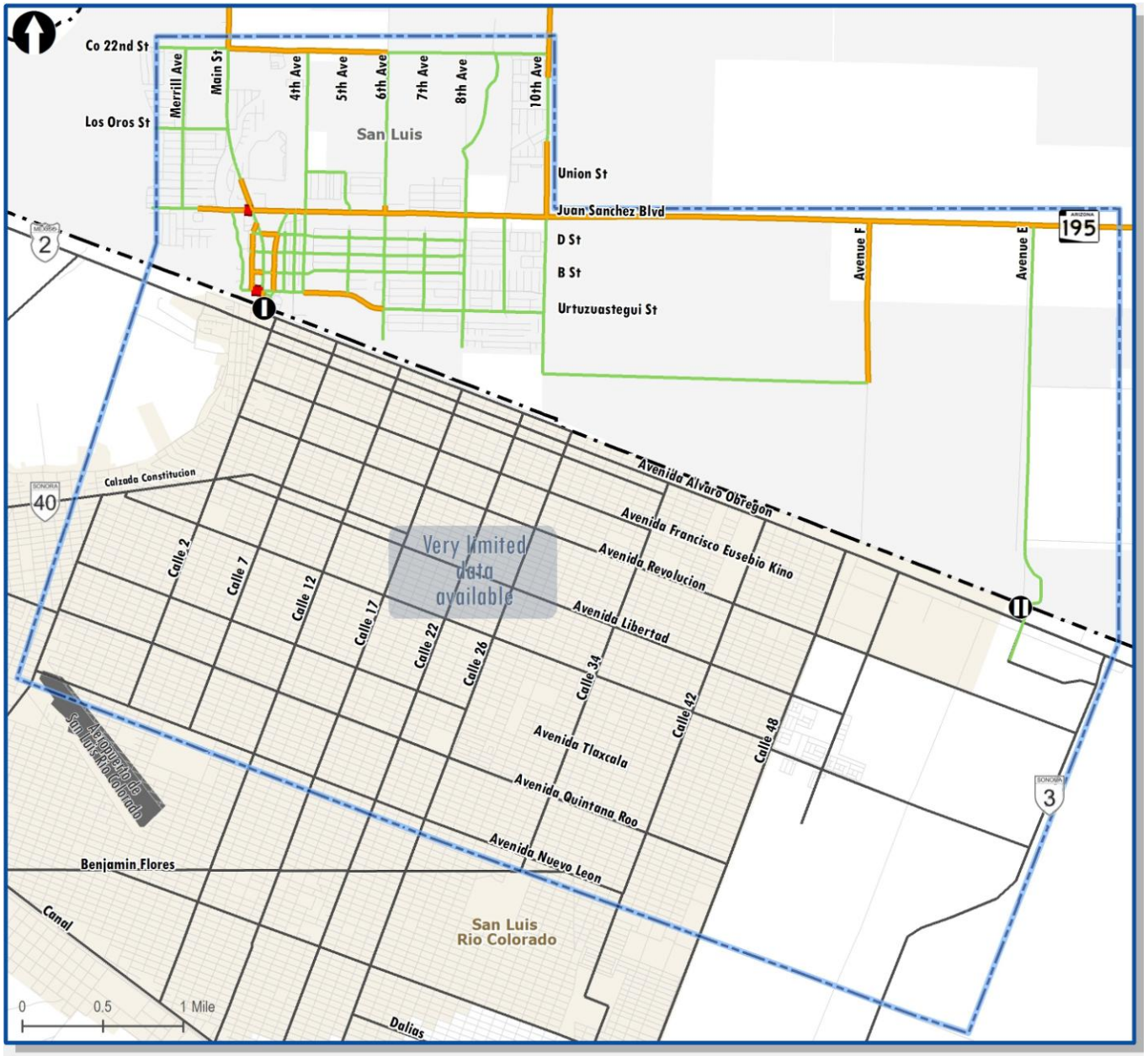
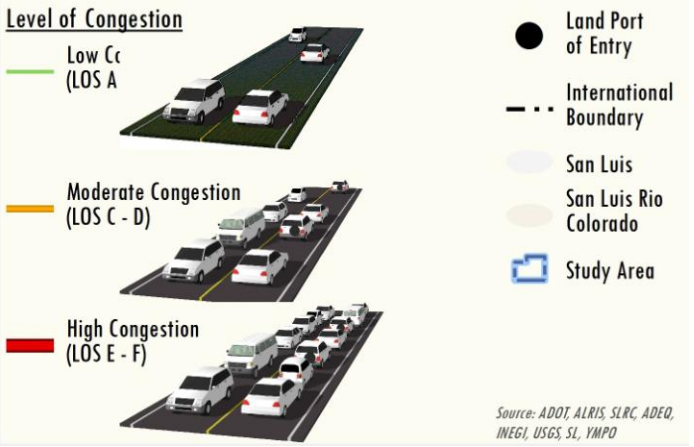


FIGURE 3.7: LEVEL OF CONGESTION FOR MID-TERM PHASE



Potential Roadway Improvements for Long-Term Phase

As the study area reaches the long-term phase, additional transportation improvements in addition to the ones identified in the short- and mid-term phases are required to meet the higher traffic demand resulting from the area projected growth. Below is a list of potential capacity roadway improvements that were evaluated for the long-term phase. Figure 3.8 displays the roadway number of lanes for the long-phase.

Capacity Related Roadway Improvements

New Roadway:

- County 22nd Street: 10th Avenue to Avenue E/Avenue D
- County 24th ½ Street: 6th Avenue to Avenue E
- Avenue E/Avenue D: County 19th Street to SR-195

Roadway Level of Congestion

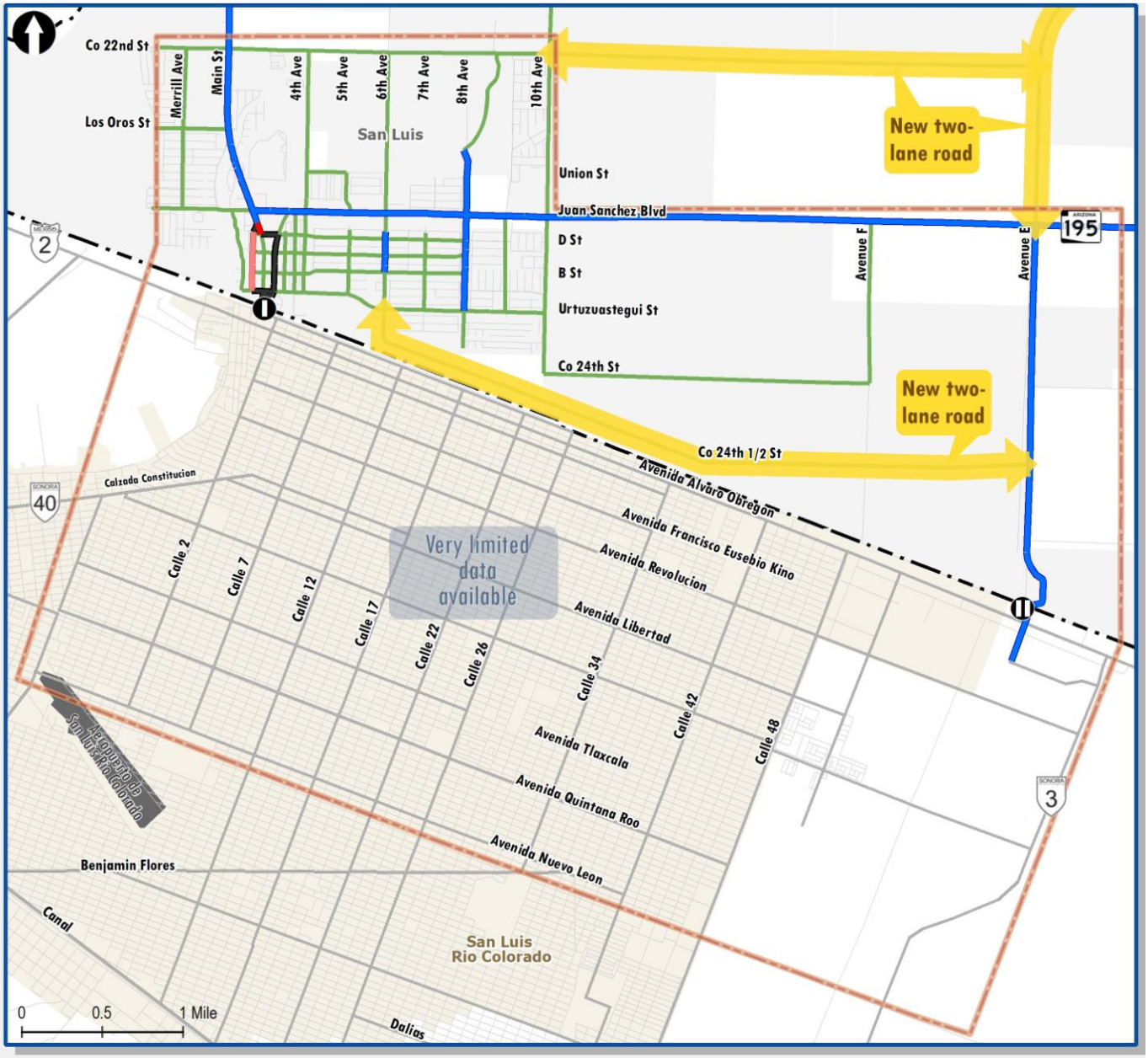
Figure 3.9 displays the projected 2040 traffic volumes with the incorporated roadway improvements and Figure 3.10 depicts the corresponding level of congestion. Traffic volumes and congestion results in this section represent average annual daily traffic conditions. All roads located within the study area operate at low levels of congestion (LOS A and B), except for the following:

High Congestion (LOS E and F)

- Juan Sanchez Boulevard: Merrill Avenue to US-95/Main Street
- Urtuzuastegui Street: Archibald Street to US-95/Main Street

Moderate Congestion (LOS C and D)

- County 22nd Street: US-95/Main Street to west of 6th Avenue
- County 22nd Street: 8th Avenue to 10th Avenue
- County 22nd Street: east of 10th Avenue to Avenue E
- Juan Sanchez Boulevard: east of Merrill Avenue to Mesa Street
- Juan Sanchez Boulevard: US-95/Main Street to eastern study limits
- D Street: US-95/Main Street to 1st Avenue
- B Street: Archibald Street to 2nd Avenue
- B Street: 4th Avenue to 4th Drive
- Archibald Street: B Street to Urtuzuastegui Street
- Urtuzuastegui Street: 4th Avenue to 6thAvenue
- Archibald Street: US-95/Main Street to Urtuzuastegui Street
- US-95/Main Street: northern study limits to County 22nd Street
- US-95/Main Street: north of Los Oros Street to Juan Sanchez Boulevard
- US-95/Main Street: D Street to C Street
- US-95/Main Street: Urtuzuastegui Street to San Luis I LPOE
- 1st Avenue: D Street to Urtuzuastegui Street
- 6th Avenue: north of Juan Sanchez Boulevard
- 10th Avenue: County 22nd Street to south of Krystal Street
- 10th Street: Black Street to north of Fuentes
- Avenue F: Juan Sanchez Boulevard to County 24th Street
- Avenue E/Avenue D: north of SR-195



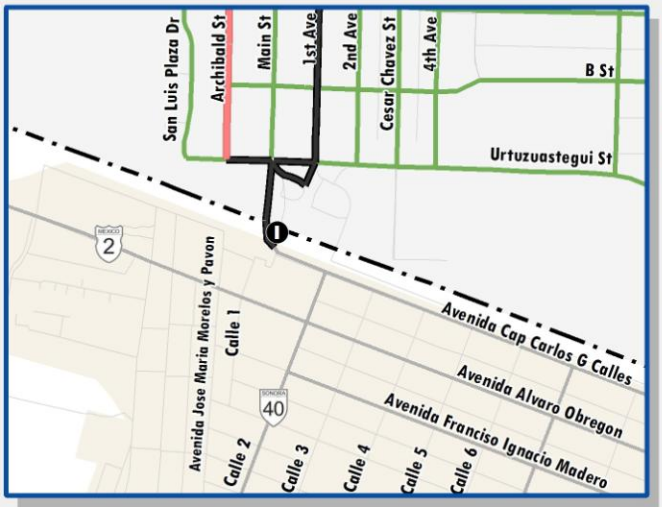


FIGURE 3.8: NUMBER OF LANES FOR LONG-TERM PHASE

- Four-lanes
- Three-lanes
- Three-lanes (one-way)
- Two-lanes
- Two-lanes (one-way)
- New Road
- Land Port of Entry
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ALRIS, SLRC, ADEQ, INEGI, USGS, SI, YMPO

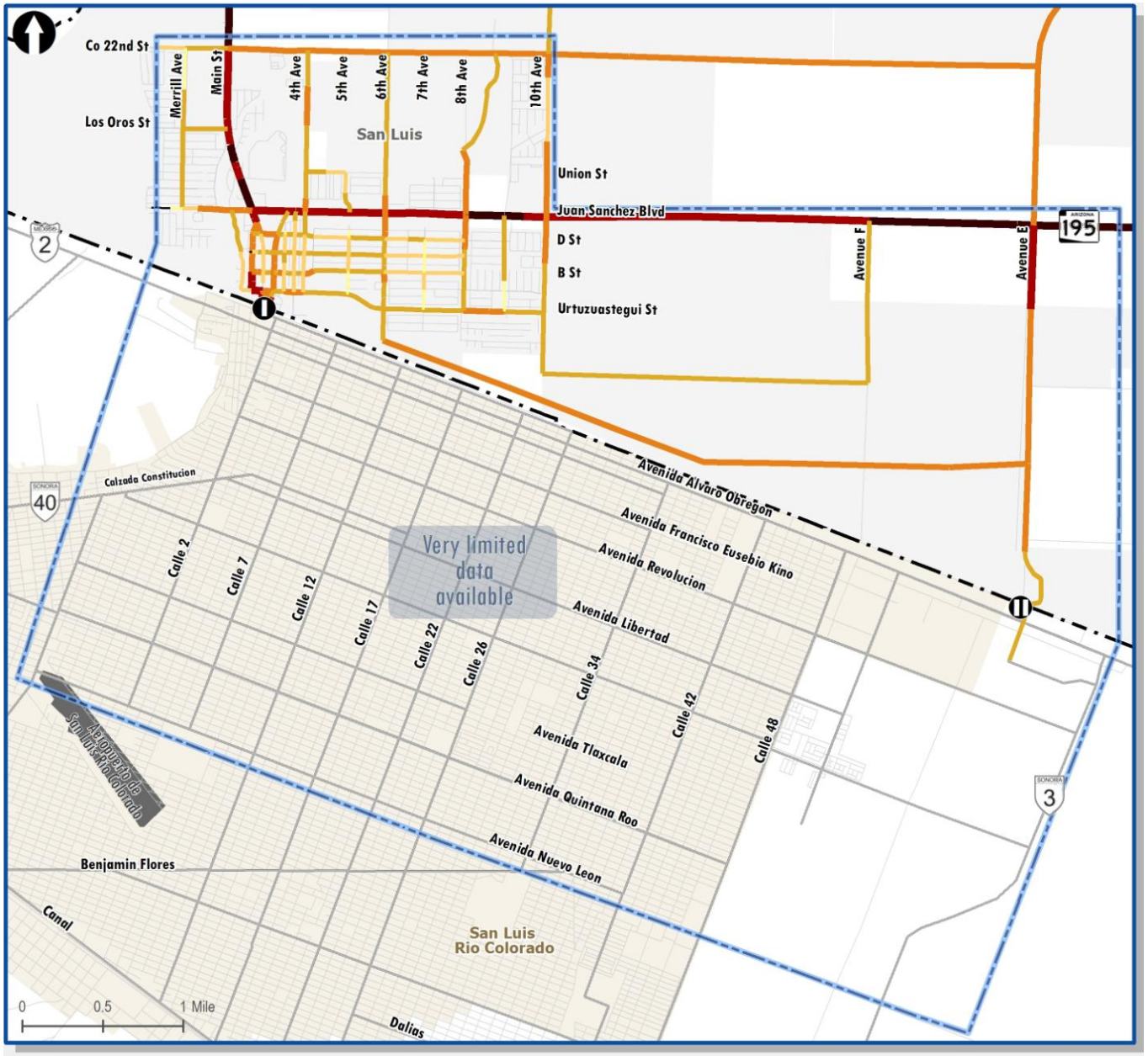
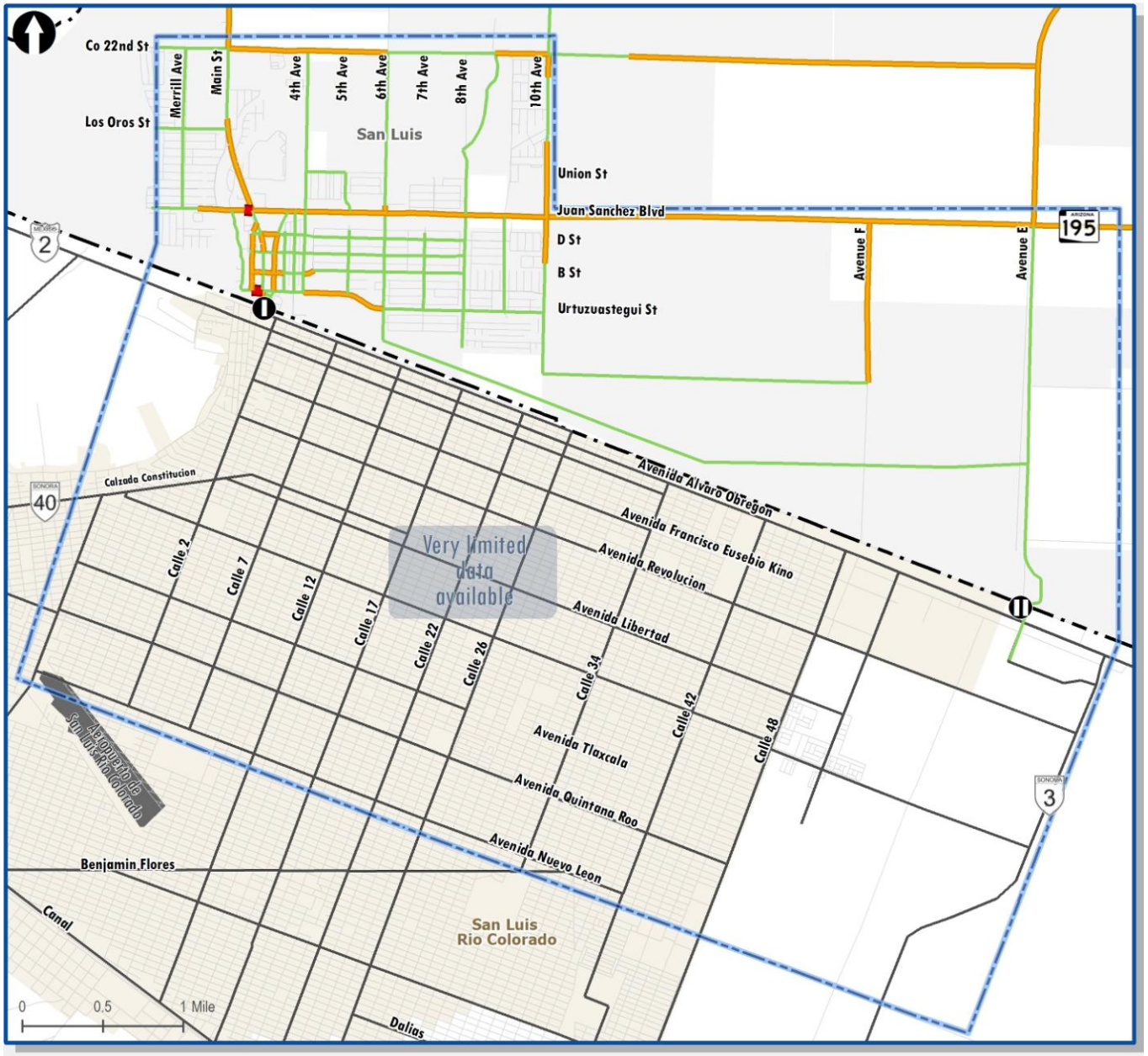


FIGURE 3.9: DAILY TRAFFIC VOLUMES FOR LONG-TERM PHASE



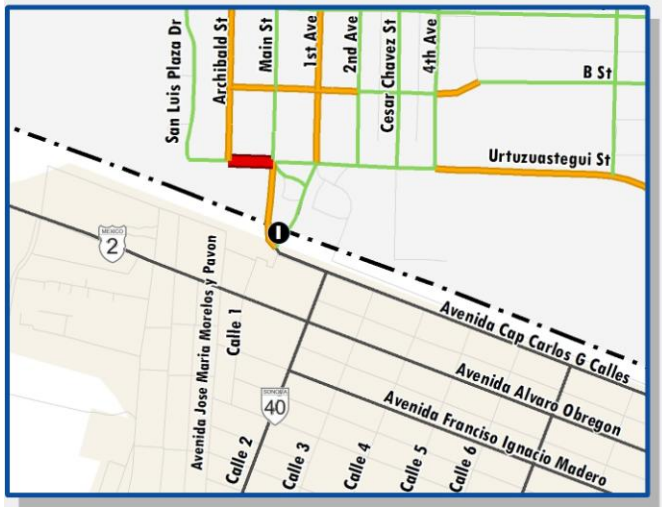
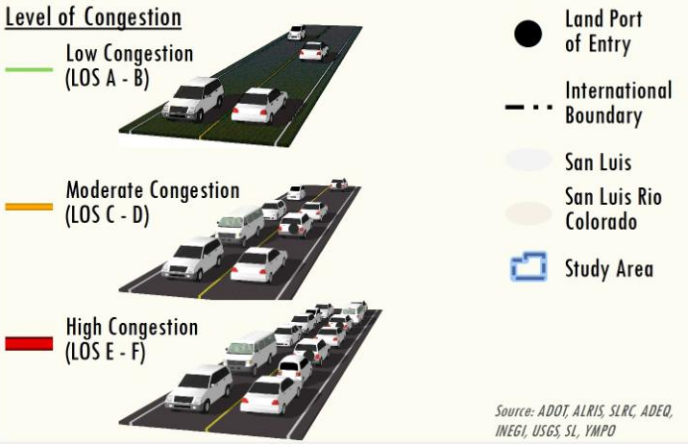


FIGURE 3.10: LEVEL OF CONGESTION FOR LONG-TERM PHASE



EVALUATION OF SAN LUIS LPOE PROJECTS

The recently completed, *Arizona-Sonora Border Master Plan (BMP),* developed a coordinated binational implementation plan to improve traffic at the LPOEs along the Arizona - Sonora Border, as well as enhancing the surrounding multimodal transportation facilities. Listed below are the *BMP* LPOE specific projects for the San Luis area as well as the overall project ranking:

- Rank 1: San Luis I - SENTRI Primary Booth Project
- Rank 2: San Luis I - Pedestrian Pop-out Project #1 (Reconfiguration in place)
- Rank 3: San Luis I - Pedestrian Pop-out Project #2 (Expansion)
- Rank 4: San Luis II - POV/Pedestrian Processing Facility
- Rank 6: San Luis I - Outbound Technology Project
- Rank 8: San Luis I - SENTRI Secondary Inspection Area
- Rank 9: San Luis I - Expansion and Modernization
- Rank 10: San Luis I - Outbound Inspection Infrastructure
- Rank 11: San Luis I - Primary Booth Replacement Project
- Rank 16: San Luis II - New Rail POE

In addition to the LPOE projects identified in the *BMP*, the following is recommended:

- Conduct a study to develop an implementation plan for processing POVs and pedestrians at San Luis II LPOE.

EVALUATION OF TRANSIT AND NON-MOTORIZED MODES OF TRANSPORTATION

Transit

Yuma County Intergovernmental Public Transportation Authority (YCIPTA) administers and operates the YCAT throughout southwestern Yuma County. Completed in January 2012, the Yuma Regional Transit Study developed regional implementation plans for the YCIPTA based on three funding scenarios: current funding sources and two proposed sales tax levies. Option 1 included a 1/10 cent county-wide sales tax, and Option 2 included a 1/5 cent county-wide sales tax. Study recommendations include expanding the Yellow Route to provide local services in the City and if additional funding sources are available, increase bus frequencies. As mentioned, two of the three scenarios are dependent on dedicated sales tax, which will be brought to the Yuma County voters in November 2014 and potential implementation is estimated for the beginning of FY 2014/2015.

The *San Luis SATS* recommended establishing local transit services and policies to meet the needs and demands of the ever-growing transit dependent population within the study area. The transit projects identified in the *San Luis SATS*, listed in Table 3.1, were evaluated for their validity and

prioritized accordingly. Two additional projects that would provide local service within the City were identified:

- Conduct a study to develop a potential circulator route that would coordinate with Yellow Route 95 and provide service to areas in the City core where there is little to no transportation mode choices.
- Conduct a study to determine the feasibility to expand circulator service to the area east of 10th Avenue where residential and employment growth are expected to occur.

Non-Motorized Modes of Transportation

Alternative modes of transportation such as sidewalks, bike paths/routes, and trails are an important aspect of the multimodal transportation network as they provide mobility for those not able to operate or without access to a vehicle and also for recreational purpose. Sidewalks currently exist in the downtown area providing access to the post office and businesses located along Main Street. Beyond the downtown area, sidewalks are needed in the vicinity of schools and other activity centers. In addition, there are little to no bike paths/lanes throughout the study area.

Needs Analysis

The existing sidewalks, bike lanes, and trails in the study area were reviewed in relation to:

- The location of activity centers such as schools, large retail establishments, libraries, hospitals, and recreation activity centers.
- Existing and future roadway alignments.

The pedestrian and bicycle improvements identified from the *San Luis SATS*, listed in Table 3.1, are still needed to provide mobility, connectivity, and safety to the pedestrians and bicyclists in the study area. It is also recommended that pedestrian facilities be implemented along the Juan Sanchez corridor to provide access to the major activity centers in the vicinity.

4.0 MULTIMODAL TRANSPORTATION PLAN

This section presents the Multimodal Transportation Plan for the short-, mid-, and long-term phases. This transportation plan is the result of the deficiency analysis from Working Paper 1, Working Paper 2, Public Open House Input, and Chapters 2 - 3 of this report. It is a multimodal plan that includes roadway, transit, pedestrian, and bicycle improvements. Each project is assigned a unique project number that the City can use to track project progress. Unless otherwise noted, the recommended projects are not yet funded.

SHORT-TERM RECOMMENDATIONS

Short-term phase projects are recommended to be completed as the study area reaches year 2018. Table 4.1 lists the transportation recommendations for this phase, as well as the project number*, location, description, and estimated costs for each project. Figure 4.1 is a graphical illustration of the short-term transportation recommendations.

MID-TERM RECOMMENDATIONS

Mid-term phase projects are recommended to be completed as the study area reaches year 2030. Table 4.2 lists the transportation recommendations for this phase, as well as the project number*, location, description, and estimated costs for each project. Figure 4.2 is a graphical illustration of the mid-term transportation recommendations.

LONG-TERM RECOMMENDATIONS

Long-term phase projects are recommended to be completed as the study area reaches year 2040. Table 4.3 lists the transportation recommendations for this phase, as well as the project number*, location, description, and estimated costs for each project. Figure 4.3 is a graphical illustration of the long-term transportation recommendations.

Estimated costs for each project are expressed in 2012 dollars and are general estimates. Actual costs for projects could vary at the time of implementation; therefore, a detailed analysis should be performed on a case-by-case basis to determine actual costs. The estimated roadway improvement costs reflect the construction of pavement, curb, and cutter, and does not include the cost for sidewalks, traffic control, and/or signage.

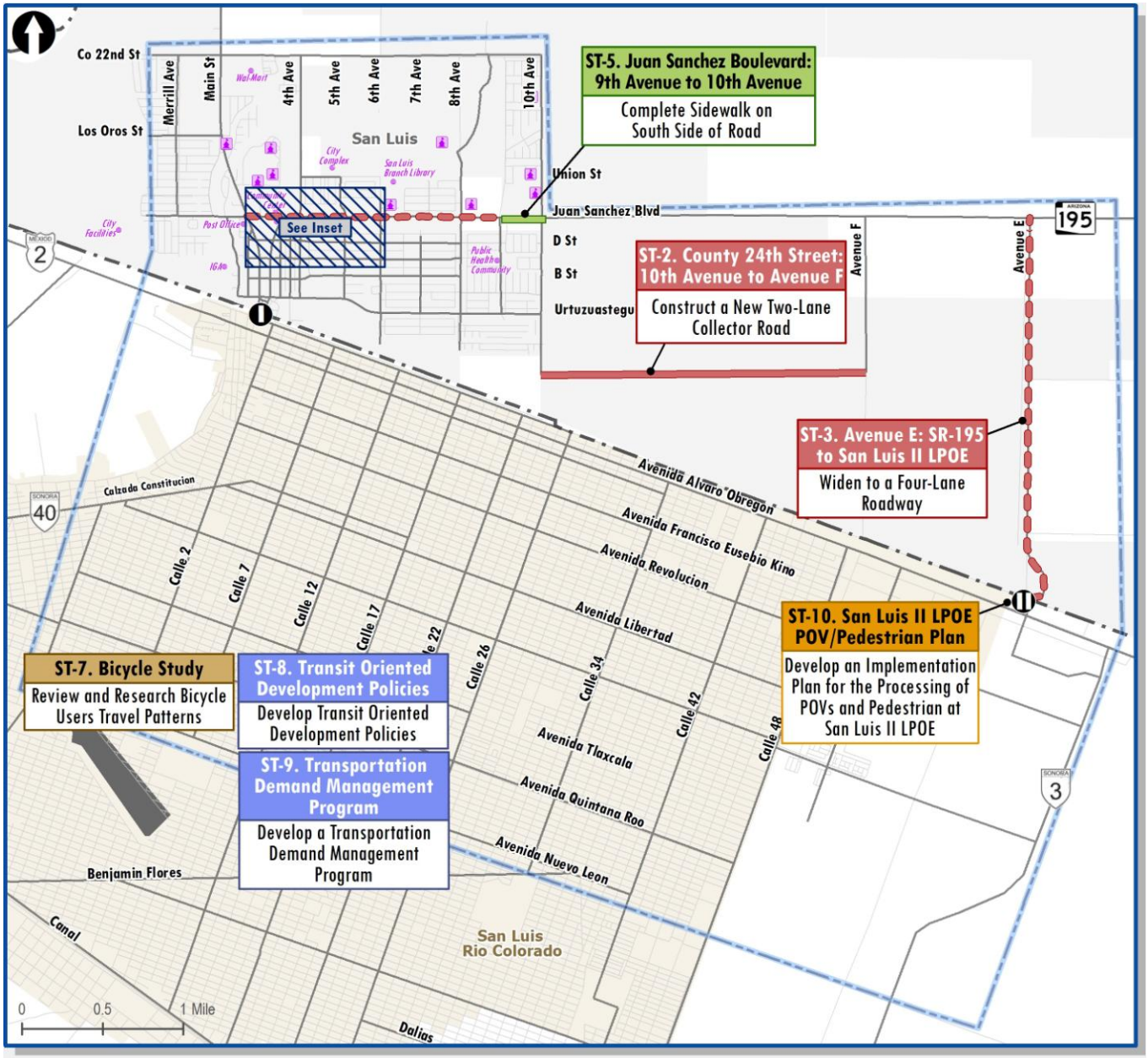
** The Project Identification Number (e.g.: ST -1) does NOT represent the priority of the project; rather it is an identification number to track project progress in the future.*

TABLE 4.1: SHORT-TERM RECOMMENDATIONS

ID*	Project Location and Project Description	Cost	Agency
	Roadway		
ST-1	**Juan Sanchez Boulevard: US-95/Main Street to 9th Avenue** Widen to a four lane roadway (two lanes in each direction) with a center turn lane, and sidewalk on each side	$4,750,000	ADOT
ST-2	**County 24th Street: 10th Avenue to Avenue F** Construct a new two lane (one lane in each direction) collector road	$2,250,000	San Luis/ YMPO
ST-3	**Avenue E: SR-195 to San Luis II LPOE** Widen to a four lane roadway (two lanes in each direction)	$6,850,000	ADOT
ST-4	**Parking Structure Location Feasibility Study** Conduct study to evaluate potential locations in the downtown area for a parking facility	$25,000	TBD
	Pedestrian and Bicycle Facilities		
ST-5	**Juan Sanchez Boulevard: 9th Avenue to 10th Avenue** Complete sidewalk on south side of road	$50,000	ADOT
ST-6	**Main Street at Urtuzuastegui Street** Potential pedestrian crossing improvements	TBD	TBD
ST-7	**Bicycle Study** Conduct study to review and research bicycle users travel patterns	$50,000	San Luis
	Transit		
ST-8	**Transit Oriented Development Policies** Develop transit oriented development policies	$25,000	San Luis
ST-9	**Transportation Demand Management Program** Develop a transportation management program	$45,000	San Luis
	San Luis LPOEs		
ST-10	**San Luis II LPOE POV/Pedestrian Plan** Conduct a study to develop an implementation plan for processing POVs and pedestrians at San Luis II LPOE	TBD	GSA/ CBP

Source: Jacobs Engineering

** The Project Identification Number (e.g.: ST -1) does NOT represent the priority of the project; rather it is an identification number to track project progress in the future.*



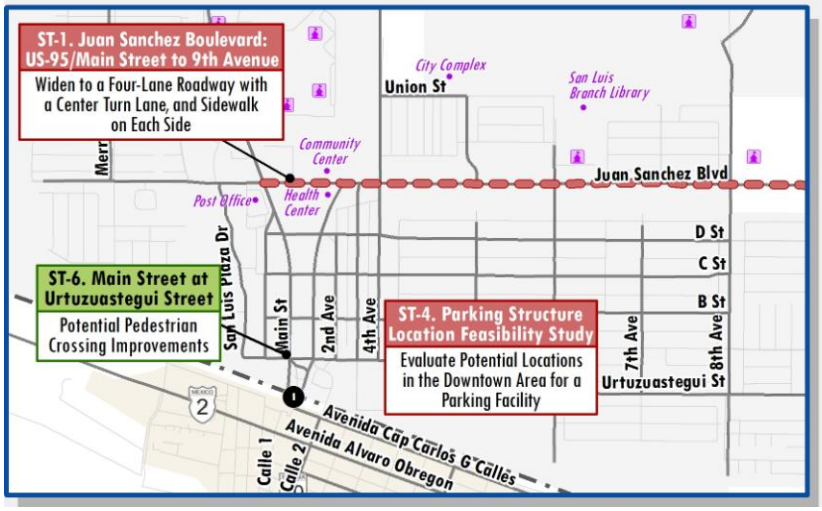


FIGURE 4.1: SHORT-TERM IMPROVMENTS

- New Roadway
- Roadway Widening
- Pedestrian
- Bicyle
- Transit
- San Luis LPOEs
- Land Port of Entry
- Study Roadway
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: Jacobs Engineering, ADOT, ALRIS, SLRC, INEGI, SL, YMPO

TABLE 4.2: MID-TERM RECOMMENDATIONS

ID*	Project Location and Project Description	Cost	Agency
	Roadway		
MT-1	**Juan Sanchez Boulevard: 10th Avenue to Avenue E** Widen to a four lane roadway (two lanes in each direction), with depressed median and sidewalk on each side, if needed	$8,100,000	ADOT
MT-2	**6thAvenue: Union Street to County 22nd Street** Construct a new two lane (one lane in each direction) arterial road	$1,100,000	San Luis/ YMPO
MT-3	**10th Avenue/Avenue H: County 19th Street to County 22nd Street** Construct a new two lane (one lane in each direction) collector road	$3,650,000	YMPO
MT-4	**Implement Findings from Parking Structure Location Study**	TBD	San Luis
	Pedestrian and Bicycle Facilities		
MT-5	**US-95/Main Street: County 22nd Street to Juan Sanchez Boulevard** Construct shared multi-use path	$175,000	San Luis
MT-6	**Juan Sanchez Boulevard: US-95/Main Street to 10th Avenue** Construct shared multi-use path	$325,000	ADOT
MT-7	**Cesar Chavez Street: Juan Sanchez Boulevard to E Street** Complete sidewalk on both sides of road	$10,000	San Luis
MT-8	**4th Avenue: Arizona Street to E Street** Complete sidewalk on both sides of road	$52,000	San Luis
MT-9	**5th Avenue: south of Arizona Street to Juan Sanchez Boulevard** Complete sidewalk on both sides of road	$40,000	San Luis
MT-10	**6th Avenue: Arizona Street to Juan Sanchez Boulevard** Complete sidewalk on west side of road	$20,000	San Luis
MT-11	**Pedestrian Safety Study** Study feasibility of pedestrian signal crossing locations and devices	$50,000	San Luis
MT-12	**Pedestrian and Bicycle Amenities Study** Study feasibility for pedestrian and bicycle amenities such as landscaping for shade	$45,000	San Luis
MT-13	**Implement Findings from Bicycle Study**	TBD	San Luis
	Transit		
MT-14	**Circulator Route Study** Conduct a study to develop a potential circulator route that coordinates with regional YCAT route in downtown San Luis or at Wal-Mart Supercenter. Service should focus on the northern and eastern areas of the City where there is limited or no transportation	TBD	YCIPTA/ San Luis
MT-15	**San Luis Transit Center Study** Conduct a study to identify potential locations for a Transit Center that includes a park-n-ride facility as well as pedestrian and bicycle amenities such as shade or bike lockers	TBD	YCIPTA/ San Luis
	San Luis LPOEs		
MT-16	**Implement findings from the San Luis II LPOE POV/Pedestrian Plan**	TBD	GSA/ CBP

Source: Jacobs Engineering

** The Project Identification Number (e.g.: MT -1) does NOT represent the priority of the project; rather it is an identification number to track project progress in the future.*

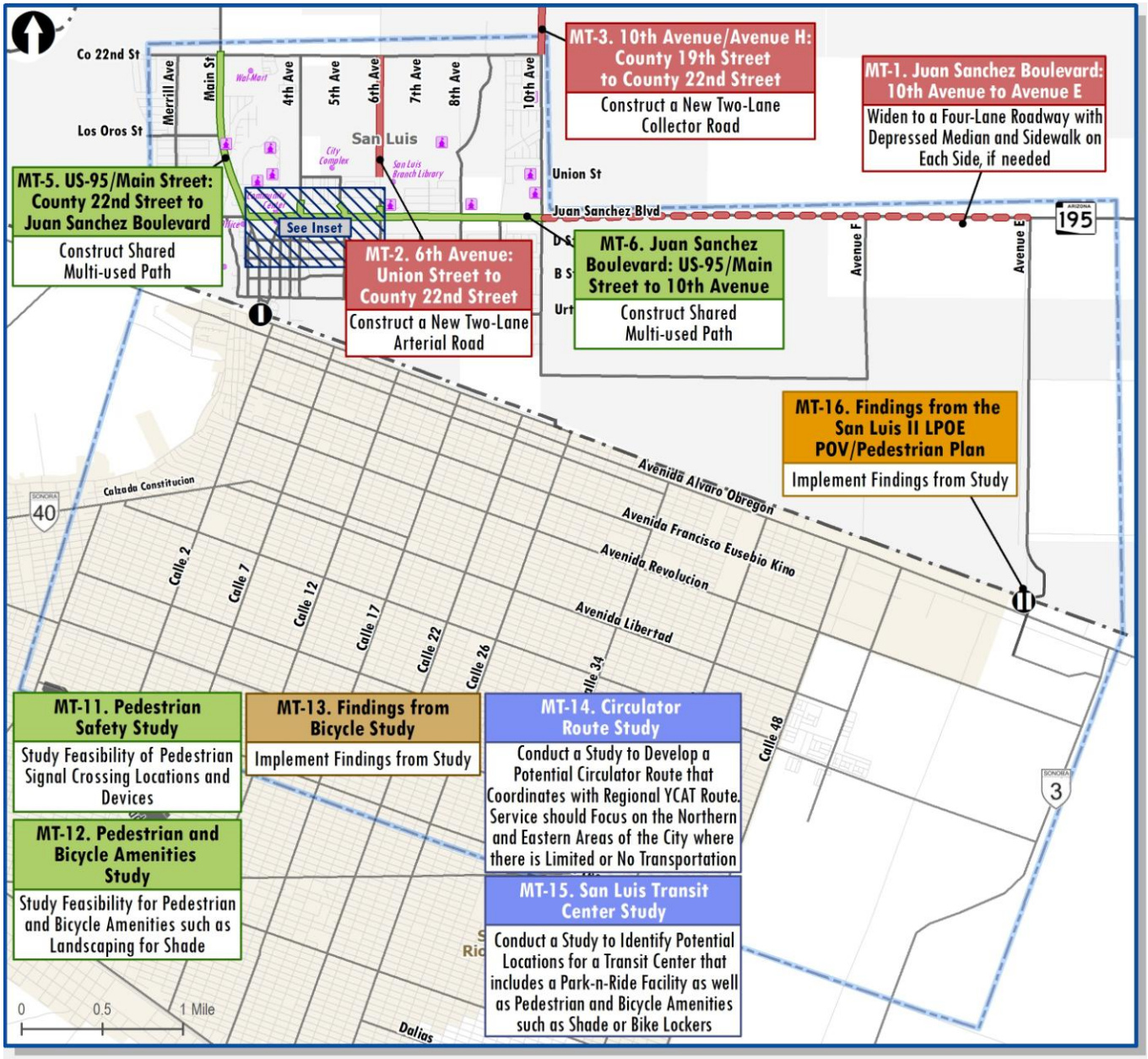


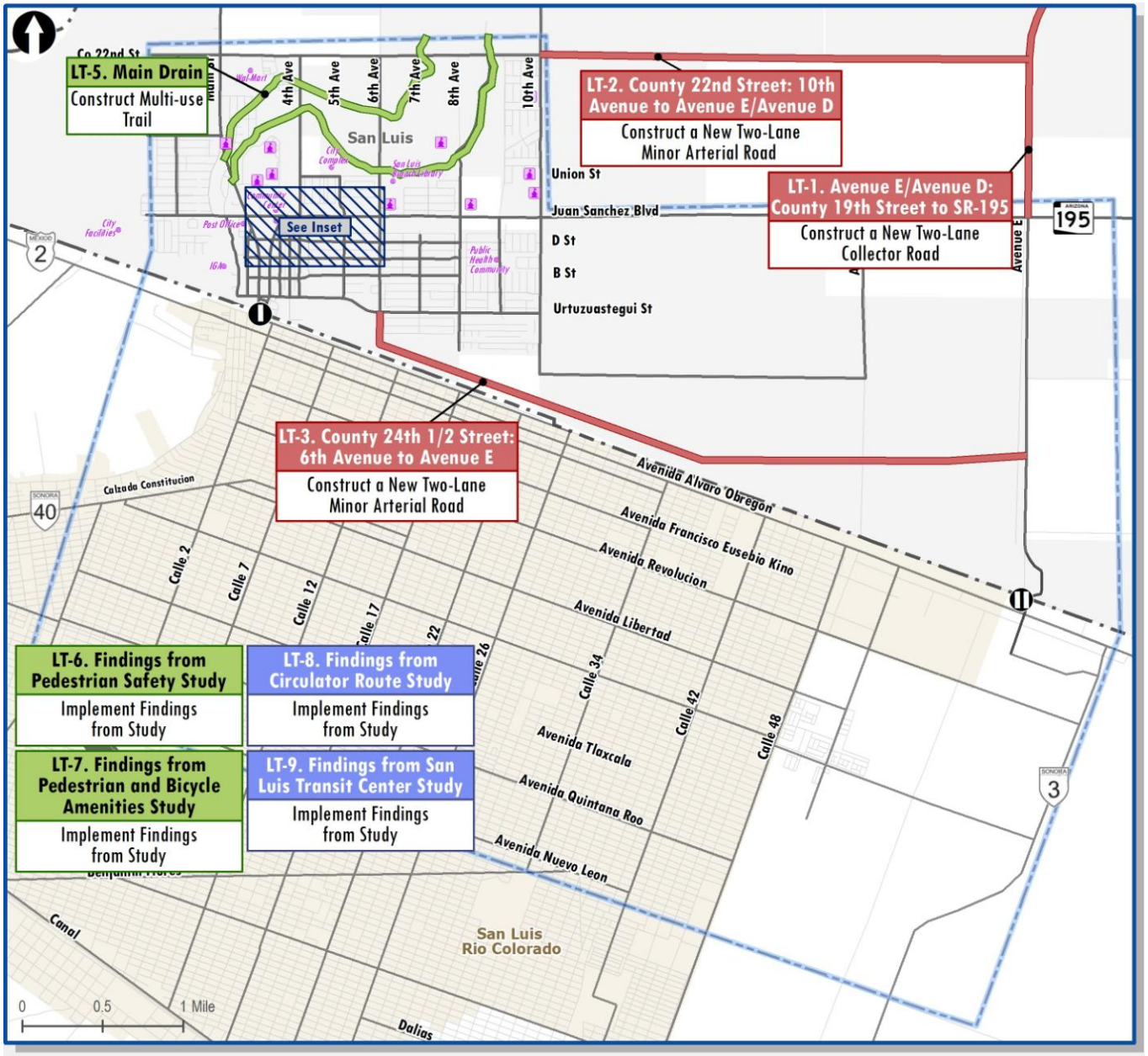
FIGURE 4.2: MID-TERM IMPROVMENTS

TABLE 4.3: LONG-TERM RECOMMENDATIONS

ID*	Project Location and Project Description	Cost	Agency
	Roadway		
LT-1	**Avenue E/Avenue D: County 19th Street to SR-195** Construct a new two lane (one lane in each direction) collector road	$5,550,000	ADOT
LT-2	**County 22nd Street: 10th Avenue to Avenue E/Avenue D** Construct a new two lane (one lane in each direction) minor arterial road	$3,750,000	San Luis/ YMPO
LT-3	**County 24th ½ Street: 6th Avenue to Avenue E** Construct a new two lane (one lane in each direction) minor arterial road	$5,250,000	ADOT
	Pedestrian and Bicycle Facilities		
LT-4	**East Main Canal Multiuse Trail** Construct multi-use trail along canal	$475,000	San Luis
LT-5	**Main Drain Multiuse Trail** Construct multi-use trail along canal	$360,000	San Luis
LT-6	**Implement Findings from Pedestrian Safety Study**	TBD	San Luis
LT-7	**Implement Findings from Pedestrian and Bicycle Amenities Study**	TBD	San Luis
	Transit		
LT-8	**Implement Findings from Circulator Route Study**	TBD	YCIPTA/ San Luis
LT-9	**Implement Findings from San Luis Transit Center Study**	TBD	YCIPTA/ San Luis

Source: Jacobs Engineering

** The Project Identification Number (e.g.: LT -1) does NOT represent the priority of the project; rather it is an identification number to track project progress in the future.*



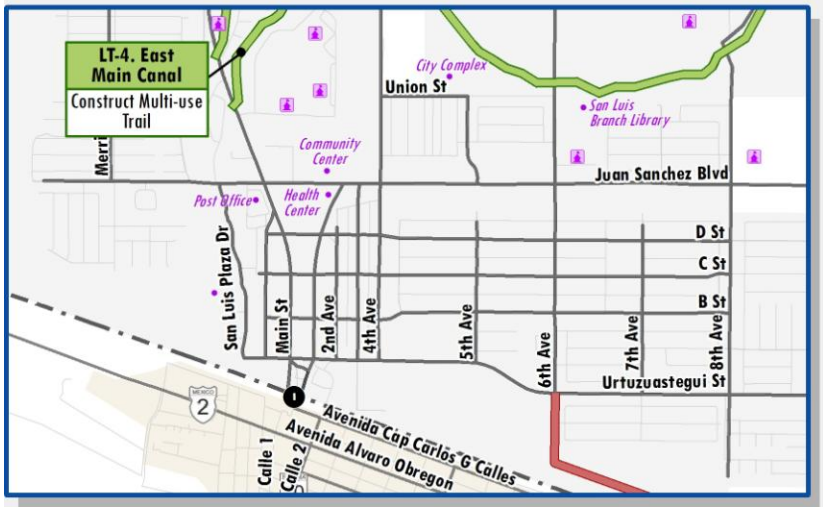


FIGURE 4.3: LONG-TERM IMPROVMENTS

- New Roadway
- Roadway Widening
- Pedestrian
- Bicyle
- Transit
- Land Port of Entry
- Study Roadway
- International Boundary
- San Luis
- San Luis Rio Colorado
- Study Area

Source: ADOT, ALRIS, SLRC, ADEQ, INEGI, USGS, SL, YMPO

TITLE VI AND ENVIRONMENTAL JUSTICE POPULATION IMPLICATIONS

In accordance with federal requirements, this study identified Title VI and Environmental Justice populations within the study area. Proposed transportation improvement projects recommended by this study may impact these populations differently than other residents. A preliminary review of the recommended projects indicates no potentially negative impacts to the Title VI population groups. Title VI review should be revisited during the design phase of each project when actual roadway alignments and design are established.

COMMUNITY OUTREACH

Public involvement is essential to the broad acceptance and successful implementation of any transportation improvement plan. The goal of community outreach is to educate the public about the study, provide opportunities for community input, and to create a process to build consensus in support of the study recommendations. For this study, community outreach was conducted through two public meetings; the first focused on current transportation issues, problem areas, and future needs while the second prioritized recommended improvements for the problem areas and needs identified in the first meeting. Meetings were conducted in English with a Spanish translator available for members of the public who chose to listen via headphones.

The first of two public meetings was conducted in October 2012 and provided an overview of the existing and future conditions, needs and deficiencies of the study area in San Luis, AZ. Approximately 25 people attended the first meeting and no comments were received.

The second public meeting, conducted in May 2013, presented the recommended improvement projects in each phase for the different modes for the San Luis, AZ portion of the study area. A total of 15 people attended the second meeting. One Self-Identification Survey and two comment forms were completed and returned, Table 4.4 presents a summary of the public comments.

TABLE 4.4: SUMMARY OF PUBLIC MEETING #2 COMMENTS

Public Comments
▪ I am so interested in all the recommendations. The parking for the city was one of the ideas I have, so I support that. Also, the walk way and bike lane will be so greatly needed so that the community will have other and safer ways to get around the city. It will also be a way they can use them for increase activity.
▪ The presentation had very good information that better helps the public understand the future issues we are facing if no transportation infrastructure improvements are done. It really helped me understand what are the important issues and concerns ADOT has and will address. The information also helped us understand which phases were in the design phase.

5.0 TRANSPORTATION PLAN IMPLEMENTATION

This section discusses available funding sources, roadway standards and policies, and implementation actions to help implement the Transportation Plan.

FUNDING SOURCES

Successful implementation of the Transportation Plan is contingent upon the availability of funding for the design and construction phases. A variety of funding sources may be applicable as the Plan is multi-modal and includes not only automobiles but also transit, pedestrians and bicycles. Primary funding sources include federal programs, ADOT, and other regional government agencies. Initially established in 1998 under the Transportation Equity Act for the 21st Century (TEA-21) and continued in preceding legislations, the Coordinated Border Infrastructure (CBI) Program funded a variety of projects in the border regions, including the *Binational San Luis Transportation Study*. However, the federal funding structure has since changed. Enacted in 2012, Moving Ahead for Progress in the 21st Century (MAP-21) Act creates a multimodal, streamline, and performance based program which will fund surface transportation programs over the next two years (FY 2013 and FY 2014). Under the new legislation, programs from SAFETEA-LU were either consolidated, restructured, or eliminated to eight core programs:

- National Highway Performance Program (NHPP)
- Surface Transportation Program (STP)
- Congestion Mitigation and Air Quality (CMAQ)
- Highway Safety Improvement Program (HSIP)
- Railroad-Highway Crossing
- Transportation Alternatives (TA)
- Construction of Ferry Boats and Terminal Facilities

It should be noted that most of the eliminated programs were covered in other core programs. Displayed in Figure 5.1, are those programs that could be most commonly used as funding sources. Funding should not be specifically limited to these programs but further researched to identify other potential sources prior to final design and construction of the recommend improvement projects.

Also restructured under MAP-21 were the public transportation programs; programs were either consolidated or eliminated. Displayed in Figure 5.2 are those programs that could be most commonly used as funding sources for public transportation. Similar to roadway funding, sources should not be specifically limited to these programs.

FIGURE 5.1: MAP-21 HIGHWAY PROGRAMS

SAFETEA-LU	MAP-21	Eligible Projects
Interstate Maintenance Program National Highway System (NHS) Highway Bridge Program	**National Highway Performance Program (NHPP)** *Provides funding for construction and maintenance projects located on the expanded National Highway System, it includes the Interstate system and all other highways classified as principal arterials*	▪Construction, reconstruction, rehabilitation and preservation of highways and bridges ▪Bridge and tunnel inspections, evaluation, and training for bridge and tunnel inspectors ▪Construction, rehabilitation, or replacement of ferry boats and facilities ▪Safety projects ▪Environmental restoration and mitigation ▪Bicycle and pedestrian infrastructure ▪ITS ▪With certain conditions: transit projects or federal aid highways
Surface Transportation Program Coordinated Border Infrastructure Program Equity Bonus Highway Bridge Program *(15% for off-system bridges)*	**Surface Transportation Program (STP)** *Provides funding for highways, bridges, transit projects, as well as for pedestrian and bicycle infrastructure. It is the largest and most flexible program*	▪Highway and bridge construction and rehabilitation ▪Federal-aid and off-system bridge repair, including de-icing ▪Congestion pricing and travel demand management ▪Transit projects ▪Development of state asset management plan ▪Carpool projects including fringe and corridor parking ▪Environmental mitigation ▪Bicycle, pedestrian, and trails infrastructure ▪ITS ▪Border infrastructure projects
Safe Routes to Schools Recreational Trails National Scenic Byways Transportation Enhancements (TE) *(10% of STP)*	**Transportation Alternative Program (TAP)** *Provides funding bicycle and pedestrian infrastructure and facilities, enhancement of connectivity between modes for non-drivers, environmental mitigation and transportation enhancement projects*	▪Projects eligible under previous programs still eligible ▪Bicycle and pedestrian facilities ▪Safe routes for non-drives ▪Construction of turnouts and overlooks ▪Vegetation management ▪Historic preservation and rehabilitation of historic transportation facilities ▪Rails to trails ▪Archeological activities related to transportation ▪Environmental mitigation activity including NEPA compliance ▪Design or construction of boulevards ▪Workforce development, training, and education
Congestion Mitigation and Air Quality (CMAQ)	**Congestion Mitigation & Air Quality Program (CMAQ)** *Provides funding for projects that will reduce congestion and pollution levels to help meet federal air quality standards*	▪Establishment or operation of traffic monitoring, management and control facility ▪Traffic flow improvements, i.e. HOV lanes, turning lanes ▪Alternative modes including carpool, and vanpool ▪Diesel retrofits ▪Alternative fuel facilities ▪ITS ▪Transit projects ▪Bicycle and pedestrian facilities ▪Fringe and corridor parking facilities ▪Intermodal freight capital ▪Variable roadway pricing
Highway Safety Improvement Program High Risk Rural Roads Programs (HRRR) Strategic Highway Safety Plan (SHSP) Transportation Safety Planning (TSP)	**Highway Safety Improvement Program (HSIP)** *Provides funding for projects that will reduce injuries or fatalities on public roads, pathways, or trails per the State's Strategic Highway Safety Plan*	▪Projects that would rectify a safety problem or element, or a hazardous location. ▪High risk rural roads improvements ▪Traffic calming ▪Data collection ▪Improvements for bicyclists, pedestrians, and individuals with disabilities ▪Safety education, training and workforce development ▪Older driver improvements ▪Truck parking facilities ▪Safety audits ▪Projects that were eligible under SAFETEA-LU

FIGURE 5.2: MAP-21 TRANSIT PROGRAMS

SAFETEA-LU	MAP-21	Eligible Projects
Urbanized Area & Growing States (5307) Job Access and Reverse Commute (5316)	**Urbanized Areas (5307)** *Provides funding for new bus and rail projects, and maintenance on existing systems for areas with population over 50,000 and may cover operation costs for areas with population than less 200,000*	▪Public transportation capital ▪Planning ▪Job access and reverse commute projects ▪Operating costs in areas were population is less than 200,000 ▪Under certain limits, operating costs for grantees in areas with population more than 200,000 who operate a maximum of 100 buses in fixed-route service during peak hours
Job Access and Reverse Commute (5316) Rural Area Grants (5311)	**Rural Area Grants (5311)** *Provides funding for public transportation projects in rural communities with a population less 50,000*	▪Planning, capital, and operating costs ▪Job access and reverse commute projects ▪Acquisition of public transportation services
Elderly and Disabled (5310) New Freedom Program (5317)	**Elderly and Disable (5310)** *Provides funding for projects that will improve mobility for seniors and individuals with disabilities*	▪55% of funds must be used on capital projects »Public transportation projects (planned, designed, and carried out) that meet the needs of seniors or individuals with disabilities ▪45% of funds may be used for: »Public transportation projects that exceed ADA requirements »Or improve access to fixed-route while decreasing dependency on paratransit »Alternatives to public transportation
Bus and Bus Facilities (5309)	**Bus and Bus Facilities (5339)** *Provides funding for the purchase, rehabilitation, and repair of buses and bus facilities*	▪Replace, rehabilitate, and purchase buses, vans, and/or related equipment ▪Construct bus-related facilities
Fixed Guideway Modernization (5309)	**State of Good Repair (5337)** *Provides funding for maintenance projects to keep existing rail and bus systems in state of good repair*	▪Replacement and/or rehabilitation of: rolling stock, line equipment and structures, signals and communications, power equipment and substations, passenger stations and terminals, security equipment and systems, maintenance facilities and equipment, and operational support equipment ▪Transit asset management plan development and implementation
New Starts (5309)	**New Starts (5309)** *Provides funding for new and expanded streetcar, light rail, bus-rapid transit, ferries, and heavy rail transit projects*	▪Core capacity improvement (expand capacity by 10% in existing guideways*) ▪New fixed-guideways or extension to fixed guideways ▪Bus rapid transit operating in mixed traffic **fixed-guideways include those for rapid rail, commuter rail, light rail, hybrid rail, trolley bus, cable car, passenger ferries, and bus rapid transit.*
Alternative Analysis (5339)	**TOD Planning Grants (20005(b) of MAP-21)** *Provides funding for new fixed guideway and capacity improvement projects that support transit-oriented development (TOD)*	▪Planning activities with emphasis on growth around transit stations, housing near transit facilities, revitalizing downtown centers and neighborhoods, and local development.

Presented below are the federal funding programs that could be used to implement the improvements identified in this study. It is recommend that additional sources be investigated for funding purposes since MAP-21 is limited to the fiscal years 2013 and 2014

National Highway Performance Programs (NHPP) — Source: Federal

Description: Provides funding for construction and maintenance projects located on the expanded National Highway System, it includes the Interstate system and all other highways classified as principal arterials

Requirements: Projects must be located on the Interstate or the National Highway System

Eligible Uses:
- Construction, reconstruction, rehabilitation and preservation of highways and bridges
- Bridge and tunnel inspections, evaluation, and training for bridge and tunnel inspectors
- Construction, rehabilitation, or replacement of ferry boats and facilities
- Safety projects
- Environmental restoration and mitigation
- Bicycle and pedestrian infrastructure
- ITS
- With certain conditions: transit projects or federal aid highways

Surface Transportation Programs (STP) — Source: Federal

Description: Provides funding for highways, bridges, transit, projects as well as for pedestrian and bicycle infrastructure.

Requirements: Project must be located on:
- Federal-aid highway
- Bridge project on any public road
- Transit capital products
- Intracity/intercity bus terminals and facilities
- Facilities for non-motorized transportation

Eligible Uses:
- Highway and bridge construction and rehabilitation
- Federal-aid and off-system bridge repair, including de-icing
- Congestion pricing and travel demand management
- Transit projects
- Development of state asset management plan
- Carpool projects including fringe and corridor parking
- Environmental mitigation
- Bicycle, pedestrian, and trails infrastructure
- ITS
- Border infrastructure projects

Transportation Alternative Program (TAP) — Source: Federal

Description: Provides funding for bicycle and pedestrian infrastructure and facilities, enhancement of connectivity between modes for non-drivers, environmental mitigation and transportation enhancement projects

Requirements:

Eligible Uses:
- Projects eligible under previous programs still eligible
- Bicycle and pedestrian facilities
- Safe routes for non-drives
- Construction of turnouts and overlooks
- Vegetation management
- Historic preservation and rehabilitation of historic transportation facilities
- Rails to trails
- Archeological activities related to transportation
- Environmental mitigation activity
- Design or construction of boulevards
- Workforce development, training, and education

Congestion Mitigation and Air Quality Improvement Program (CMAQ)

Source: Federal

Description: Provides funding for projects that will reduce congestion and pollution levels to help meet federal air quality standards

Requirements: Located in nonattainment or maintenance areas

Eligible Uses:

- Establishment or operation of traffic monitoring, management, and control facility
- Traffic flow improvements, i.e. HOV lanes, turning lanes
- Alternative modes including carpool, and vanpool
- Diesel retrofits
- Alternative fuel facilities
- ITS
- Transit projects
- Bicycle and pedestrian facilities
- Fringe and corridor parking facilities
- Intermodal freight capital
- Variable roadway pricing

Highway Safety Improvement Program (HSIP)

Source: Federal

Description: Provides funding for safety projects that will reduce injuries or fatalities on public roads, pathways, or trails per the State's Strategic Highway Safety Plan

Requirements: Project must be located on public roads, which includes non-state owned roads and roads on tribal lands

Eligible Uses:

- Projects that would rectify a safety problem or element, or a hazardous location
- High risk rural roads improvements
- Traffic calming
- Data collection
- Improvements for bicyclists, pedestrians, and individuals with disabilities
- Safety education, training and workforce development
- Older driver improvements
- Truck parking facilities
- Safety audits
- Projects that were eligible under SAFETEA-LU

Transit Funds Section 5305, 5310, 5311, 5337, and 5339

Source: Federal

Description: Provides funding for local transit

Requirements:

Eligible Uses:

- 5305: State planning and research programs
- 5311: Local transit systems for rural areas
- 5337: Maintenance projects
- 5339: Bus and bus facilities

State and Community Highway Safety Grants

Source: Federal

Description: Provides funding to assist jurisdictions in the development and implementation of highway safety programs designed to reduce traffic crashes, deaths, injuries and property damage

Requirements:

Eligible Uses:

- Alcohol countermeasures
- Occupant protection
- Police traffic services (e.g. enforcement)
- Emergency medical services
- Traffic records
- Motorcycle safety
- Pedestrian and bicycle safety (jointly administered by FHWA and NHTSA)
- Non-construction aspects of roadway safety (administered by FHWA)
- Speed control (jointly administered by NHTSA and FHWA)

Presented below are the state programs that could be used to implement the improvements identified in this study. It is recommended that additional funding sources be investigated prior to the design and construction of the recommended improvement project.

Highway User Revenue Fund (HURF)

Source: State

Description: Funds derived from fuel taxes, vehicle license tax, registration fees and other fees

Requirements:

Eligible Uses:
- Highway construction,
- Highway improvements
- Other related expenses

Safety Enforcement Transportation Infrastructure Fund (SETIF)

Source: State

Description: Funds generated from entry fee of foreign vehicles entering Arizona at international ports of entry

Requirements: Projects must be within 25-miles of the international border

Eligible Uses:
- Vehicle safety enforcement
- Construction, maintenance, upgrades to transportation facilities
- Purchasing or upgrading electronic equipment or automated systems at the Ports of Entry in efforts to relieve congestion
- Department of Public Safety (DPS) activities

Vehicle License Tax (VLT)

Source: State

Description: State shared revenues from vehicle license taxes

Requirements:

Eligible Uses:

Public-Private Partnerships (P3)

Source: State

Description: Mix of public-private funding to construct new or enhance facilities used for the transport of people or goods

Requirements:

Eligible Uses:
- Highways
- Railways
- Monorails
- Transit
- Bus systems
- Guided rapid transit
- Parking facilities
- Rail yard and storage
- Vehicles
- Rolling stock and other equipment or property
- Other ADOT facilities and structures

Governor's Office of Highway Safety

Source: State

Description: Provides funding for State and local government highway safety projects

Requirements: NOT to be used for the construction, design, or maintenance of highways or for highway construction research projects.

Eligible Uses:
- Inventories
- Need studies
- Engineering studies
- Systems development
- Program implementation
- Equipment purchasing

Arizona Game and Fish Department

Source: State

Description: Provides funding to preserve natural and cultural resources

Requirements:

Eligible Uses:
- Public access
- Environmental education
- Schoolyard habitat
- Urban wildlife and urban wildlife habitat
- IIAPM

Presented below are the local and private resources that could be used to implement the improvements identified in this study. It is recommended that additional funding sources be investigated prior to the design and construction of the recommended improvement project.

Development Impact Fee — Source: Local

Description: Impact fees or development requirements for targeted projects or areas

Requirements: Amount of the assessment needs to be in direct proportion to the magnitude of the need created by the project

Eligible Uses:
- Utility services that may include water, wastewater, and refuse collection
- Fire and police facilities
- Libraries
- Transportation

Development Stipulations — Source: Local

Description: Developers dedicate appropriate ROW and build adjacent streets

Requirements:

Eligible Uses:

Development Exactions — Source: Local

Description: Require developers to construct off-site facilities necessary to serve their development

Requirements:

Eligible Uses:

Sales Tax — Source: Local

Description: Funds from a portion of a municipality's sales tax

Requirements:

Eligible Uses:
- Motorized and non-motorized improvements

Improvement Districts — Source: Local

Description: District is created for the purpose of financing specific facilities through the sale of obligation bonds

Requirements: Approval of at least 51 percent of affected homeowners to create a district

Eligible Uses:
- Street Lights
- Sidewalk
- Water and /or sewer lines
- Roadway paving
- Roadway widening

Community Facilities District (CFD) — Source: Private

Description: Special district created for the purpose of financing the acquisition, construction, operation and maintenance of public infrastructure improvements

Requirements:

Eligible Uses:
- Water and sewer projects
- Police and fire facilities (and sites)
- Flood control and drainage project
- Roadways
- Public parking structures
- Landscaping and lakes
- Lighting and traffic control
- Parks and recreational facilities
- Schools and school sites
- Pedestrian malls
- Enhanced public services

ACCESS MANAGEMENT

The *San Luis SATS* set forth access management guidelines for the City that included limiting driveways and removing slower-moving traffic from the road. Also included, were recommendations that would assist the City in establishing access management policies and procedures as well as specific corridor recommendations.

Limiting Driveway Spacing and Access

One of the key concepts in access management is control the number, location, and design of driveways to reduce conflicts and improve traffic flow. There are a number of specific elements that can be addressed to limit driveway impacts, including:

- Improve sight distance to increase safety and function of driveways.
- Implement a minimum distance between driveways to reduce conflict points and friction for through traffic. This is based on roadway function and typically can be defined as follows: Major Arterials 300-500 feet, Minor Arterials 100-300 feet and Collectors 100-200 feet.
- Regulate the maximum number of driveways for each lot.
- Establish corner clearance guidelines to keep driveways from being too close to intersections.
- Consolidate or require shared access to minimize the number of driveways and to reduce conflict points.
- Install continuous raised medians to limit driveway access to specific points.

Remove Slower-Moving Traffic

A second key concept in access management is to remove slower moving traffic from the main flow of traffic. Slower moving traffic include vehicles slowing down to turn. Improving the ability to turn quickly off the main road or providing a dedicated lane to facilitate that turn, keeps traffic flowing and improves safety. Techniques to manage turn movements include the following:

- Improve the geometrics of driveways or intersections with adequate turn radius, proper driveway widths, and safe driveway slopes. This allows traffic to leave and enter the traffic flow more efficiently.
- Design commercial driveway entrances with adequate throat length to avoid vehicles backing up on the main roadway waiting to enter.
- Install right turn and left turn lanes to move turning traffic out of the main flow of traffic. Turn bay lengths will vary depending on roadway type and traffic volumes. Left turn lanes can be accommodated either in continuous left turn lanes or as left turn bays in median breaks.

Recommendations

The City is encouraged to implement an access management program that not only addresses roadway design and geometrics issues but also establishes policies that will guide and regulate driveways especially those in high activity areas.

Policy Recommendations

- The program should comprehensively categorize the roadway system by access management categories, provide specific guidelines for each category, and define the design criteria for each category.
- Implement an Access Management Ordinance that provides the specific guidance for access to land uses.

Corridor Recommendations

It should be noted that two or more of the corridors recommended for access management improvements are scheduled to be improved or currently under study. As mentioned before several streets in the downtown area including Main Street and 1st Avenue are scheduled to be reconstructed within the next year. In addition, the initial *Project Assessment* for the Juan Sanchez corridor is currently in progress.

Recommendations for the other major roadways include:

- Improve major intersections by installing right turn and left turn bays as warranted.
- Encourage shared driveway access when appropriate, and consolidate driveways whenever possible.

In addition to those listed, 2nd Avenue recommendations include:

- Improve streets to include bicycle lanes and landscaping

IMPLEMENTATION ACTIONS

The following action items are recommended for the City of San Luis to successfully implement the Multimodal Transportation Plan presented in Chapter 4.

- Present the Transportation Plan to the City Council for approval and adoption.
- Research and apply for funding sources for each project in the transportation plan.
- Include high-priority projects in the City's Transportation Improvement Program (TIP).
- Develop policies and procedures to promote alternative modes of transportation. Review and update street design standards, develop comprehensive access management standards, and detailed traffic impact guidelines and procedures.
- Offer opportunities for public involvement throughout the plan implementation process.
- Promote Public-Private partnerships between the City and the private sector.
- Monitor progress on the transportation plan on a quarterly basis.
- Update the transportation plan on a five-year cycle.

APPENDIX A: SAN LUIS I LPOE OPERATIONAL ANALYSIS

BINATIONAL SAN LUIS TRANSPORTATION STUDY

Final Report

San Luis I LPOE Operational Analysis

November 2013

Prepared For:

ADOT

Prepared By:

TIS Consulting Group

and

JACOBS

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1.0 CURRENT CONDITIONS

This chapter documents the activities and findings resulting from the analysis of the current conditions at the San Luis I Land Port of Entry (LPOE) , as part of Arizona Department of Transportation's (ADOT) *Binational San Luis Transportation Study*. The main objective of the study is to create a transportation plan for the San Luis, Arizona and San Luis Rio Colorado, Mexico region that considers the needs of both cities especially in the vicinity of the LPOE. The LPOE is the key interaction point for the region's travel and an analysis of the port as a transit flow system was part of the project's activities. The analysis will be conducted for the current system conditions as well as for the future conditions. This will be achieved using several methods such as traffic behavior analysis, forecasting tools, and system simulation models which are discussed in the preceding chapter. It should be noted that activities discussed in this document are specific to the San Luis I LPOE.

This chapter focuses on determining the current conditions of the traffic flow at the San Luis I LPOE. The first activity conducted was to identify, classify, and summarize previous studies findings regarding the border conditions, forecasts, plans and recommendations for the region. In addition, several studies were identified containing information related to the border and the cities of San Luis and San Luis Río Colorado, as well as the states of Arizona and Sonora. This review was also used to identify any information regarding border conditions, forecasts, infrastructure plans and recommendations for the region.

Next step activities included gathering historical data of potential external factors that could have an impact on the volume of border crossings at the LPOEs for three modes of crossing the border: trucks, privately owned vehicles (POV), and pedestrians/bicyclists. Trucks will utilize San Luis II LPOE, while the other modes will use San Luis I LPOE. Publicly available information was collected, while other information had to be requested from government institutions –such as the Federal Institution of Information Access and Data Protection (IFAI). The data collected was related to macroeconomic, social and demographic indicators of the two regions under the scope of the study:

For the third step, the information was analyzed and compared to the port's crossing volumes to determine if any of the economic or demographic factors are somewhat related to the crossing travel behavior. A pre-analysis was performed, which consisted of identifying any trends presented in the information, as well as any seasonality or correlation that could aid in identifying the effects (if any) these variables have on the border crossings. The analysis presented in this chapter is the groundwork that is necessary to develop the forecast models later in the report.

The waiting times data provided by U.S. Customs and Border Protection (CBP) was analyzed in order to determine the longest waiting times throughout the day and the impact that the queues may have in the surrounding areas of the port.

DOCUMENTATION OF PREVIOUS STUDIES

Previous studies related to the San Luis – San Luis Río Colorado border, were reviewed in order to prevent work duplication and to gather as much information as possible. Several studies and projects were reviewed, most of them about Yuma County and the City of San Luis, but also about Arizona's borders and the trade with Mexico. There are many studies that analyze the road conditions and traffic of the studied areas, as well as the demographic and economic conditions.

This review seeks to find possible connections between demographic and economic information and the passengers and commercial crossing at the San Luis LPOEs. Specifically, attempting to understand how demographic and economic factors could explain the trade in this area. A matrix, as shown in Figure 1.1, was created to summarize the reviewed literature and the relevant information related to the current study.

The list of the most relevant studies reviewed follows:

1. San Luis II LPOE
2. 2010 - 2033 YMPO Regional Transportation Plan
3. City of San Luis, General Plan 2020
4. City of San Luis, Traffic Circulation Study
5. City of San Luis Small Area Transportation Study
6. Yuma Regional Transit Study
7. Statewide Transportation Planning Framework, Western Arizona Regional Framework Study
8. Programa de Desarrollo Urbano del Centro Población, San Luis Río Colorado,Sonora
9. Proyecto de Desarrollo de San Luis Río Colorado
10. Plan de Modernización de Aduanas
11. El Paso Simulation Report
12. Nogales Mariposa POE Forecasting
13. Logistics Capacity Study of the Guaymas-Tucson Corridor
14. I-10 National Freight Corridor Study
15. Arizona's Global Gateway: Addressing the Priorities of Our Border Communities
16. Arizona Trade Corridor Study
17. Public-Private Partnerships Potential for Arizona-Mexico Border Infrastructure Projects
18. Arizona Multimodal Freight Analysis Study
19. Arizona Rural Transit Needs Study
20. Statewide Bicycle Safety Plan
21. Nogales Cyber Port Project
22. I-10 Phoenix Tucson Bypass Study
23. Mariposa Port of Entry Bottleneck Study

During the review it was found that roadways, leading to the LPOE and in San Luis, were analyzed for current and future condition with corresponding levels of service. Socio-demographic and economic data were also well analyzed in almost all the studies reviewed for mid- to long-term projections for the region.

For the San Luis I LPOE, previous studies contains information about border crossing and the recommendation to move the commercial traffic to a different LPOE due to the resulting queuing and danger caused by trucks driving across downtown San Luis. Some studies discuss the economic advantages of having the San Luis II LPOE ; a new port of entry to service only the commercial traffic crossing of the area, by providing long term growth to the surrounding industrial zone that will flourish because of the facility. However, there is no information of what the current impact of the San Luis II LPOE has been now that it is operating; furthermore, no study has analyzed whether it is working properly, if it has met expectations, if it was well planned to suit the commercial traffic or if it is over/under capacity.

With respect to Arizona's borders, there are some analysis related to the imports and exports between Sonora and Arizona, as well as the destination and origin of different products. It was found that almost 88 percent of the products cross through the Nogales LPOE and come from the state of Sonora, while other products come from Sinaloa and Jalisco.

FIGURE 1.1: LITERATURE MATRIX

Title	San Luis II Land POE	2010 - 2033 YMPO Regional Transportation Plan	City of San Luis, General Plan 2020	City of San Luis, Traffic Circulation Study	City of San Luis Small Area Transportation Study	Yuma regional transit study	Statewide Transportation Planning Framework, Western Arizona Regional Framework	Programa de Desarrollo Urbano del Centro Población, San Luis Río Colorado,Sonora	Proyecto de Desarrollo de San Luis Río Colorado	Plan de modernización de aduanas	El Paso Simulation Report	Nogales Mariposa POE	Logistics capacity study of the Guaymas-Tucson Corridor	I-10 National Freight Corridor Study	Arizona's Global Gateway: Addressing the Priorities of Our Border Communities	Arizona trade corridor study	Public?Private Partnerships Potential for Arizona?Mexico Border Infrastructure Projects	Arizona multimodal freight analysis study	Arizona Rural Transit Needs Study	Statewide Bicycle Safety Plan	Nogales CyberPort Project	I-10 Phoenix Tucson Bypass Study	Mariposa Port of Entry Bottleneck Study
Year	**2011**	**2010**	**2011**	**2011**	**2009**		**2008**		**2010**	**2007**	**1998**				**2003**	**1993**	**2009**	**2007***	**2008**	**2003**	**2003**	**2008**	**2008**
Environmental Review	x	x	x		x	x	x	x	x														
Demographic characteristics		x	x	x	x	x		x	x								x						
Economy study		x	x		x			x	x	x							x	x					
Future socioeconomic characteristics		x	x	x	x	x		x	x														
Land use		x	x		x	x	x	x	x								x						
Future travel demand		x		x	x	x																	
Truck routes / freight		x							x					x				x				x	
Road conditions		x	x	x	x		x	x	x				x	x			x		x			x	
Level of Service		x	x	x	x								x										
Traffic volumes, patterns, trends		x	x	x	x		x										x		x			x	x
Public transportation		x				x	x	x	x														
Road improvements plans/recommendations		x	x		x	x			x							x	x				x		
Mariposa POE												x	x		x		x				x		x
Utilities		x	x					x	x														
Housing conditions		x	x					x	x														
Border crossing					x						x	x	x				x						x
Bicycle/pedestrians facilities		x	x		x	x	x	x	x										x	x			
San Luis POE expansion			x	x	x										x		x						
Port facilities													x			x	x						
Rail		x				x			x			x				x							
Crash data		x	x		x																		
Imports/exports Sonora-Arizona										x							x						
Rural public transportation						x													x				

The objective of the preceding sections is to perform an analysis of the current conditions of San Luis LPOEs, taking into consideration historical crossing volumes and waiting times, in order to define how the LPOE impacts the surrounding areas. The activities performed are:

- **Traffic volume analysis**. Analysis of historical crossing volumes for different modes of transportation (commercial, POV, and pedestrian) to identify factors that could affect its behavior.
- **Analysis of external variables.** Analysis of macroeconomic, social and demographic variables, such as gross domestic product, personal income, crime index, etc., that could have an effect on international crossing volumes. The analysis attempts to identify any general trends, seasonality or shifts that could affect crossing volumes.
- **Correlation of crossing volumes and external factors**. Analysis of the statistical relationship between the number of border crossings for each mode of transportation and external factors. This relationship helps identify which factors correlate positively or negatively to border crossings.
- **Analysis of waiting times.** Analysis of waiting times at different periods of the day at the LPOE. The goal is to identify the period with the longest waiting time and its effect on the rest of the LPOE's operations.

STUDY AREA

There are two LPOEs connecting the City of San Luis, Arizona with San Luis Río Colorado, Mexico; these allow the trade between the two cities and have become vital for the economy of the entire region. San Luis I LPOE is utilized by POVs and pedestrian traffic, and San Luis II LPOE is currently used for commercial trucks only. The main economic activities in the region are farming, manufacturing industry and maquiladoras.

Due to farming operations in Arizona, a considerable amount of people cross the border every day, making San Luis I LPOE a congested port for both pedestrians and POVs and make this LPOE the main concern of our analysis. The primary focus of this study are the facilities within the San Luis I LPOE. Figure 1.2 shows the current infrastructure conditions of San Luis I and San Luis II and its influence zone, which could directly affect its operations.

Table 1.1 includes a list of known issues affecting the LPOEs current operations based on prior interviews with local users and LPOE operators. As mentioned before, POV and pedestrians are the two modes that have made San Luis I LPOE a congested area.

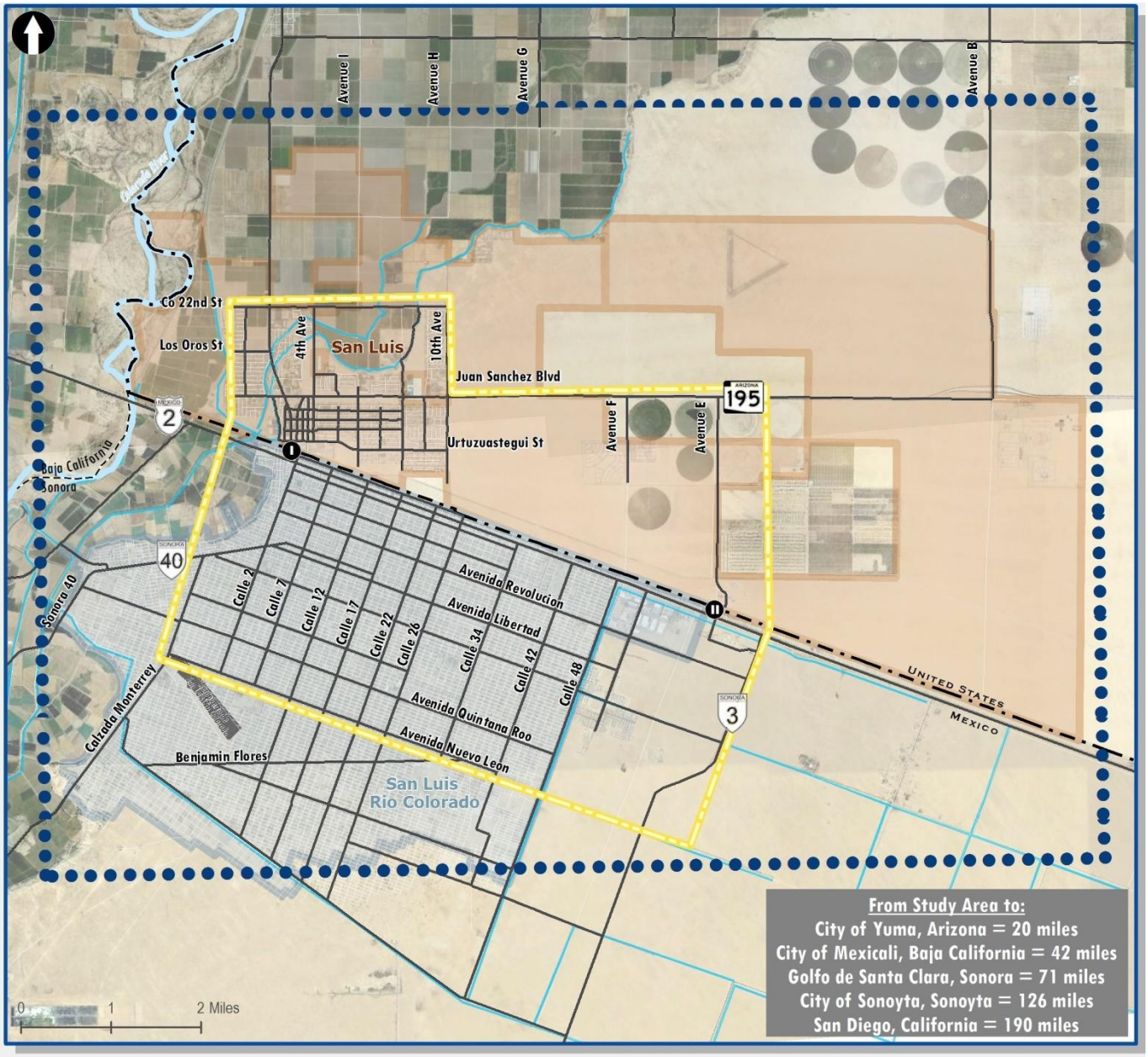


FIGURE 1.2: STUDY AND INFLUENCE AREA

- Study Area
- Influence Area
- Study Roadway
- Land Port of Entry
- Canal
- International Boundary
- San Luis
- San Luis Rio Colorado

Source: ALRIS, SLRC, ADEQ, INEGI, USGS, Google

TABLE 1.1: CURRENT USAGE CHARACTERISTICS OF SAN LUIS POE I

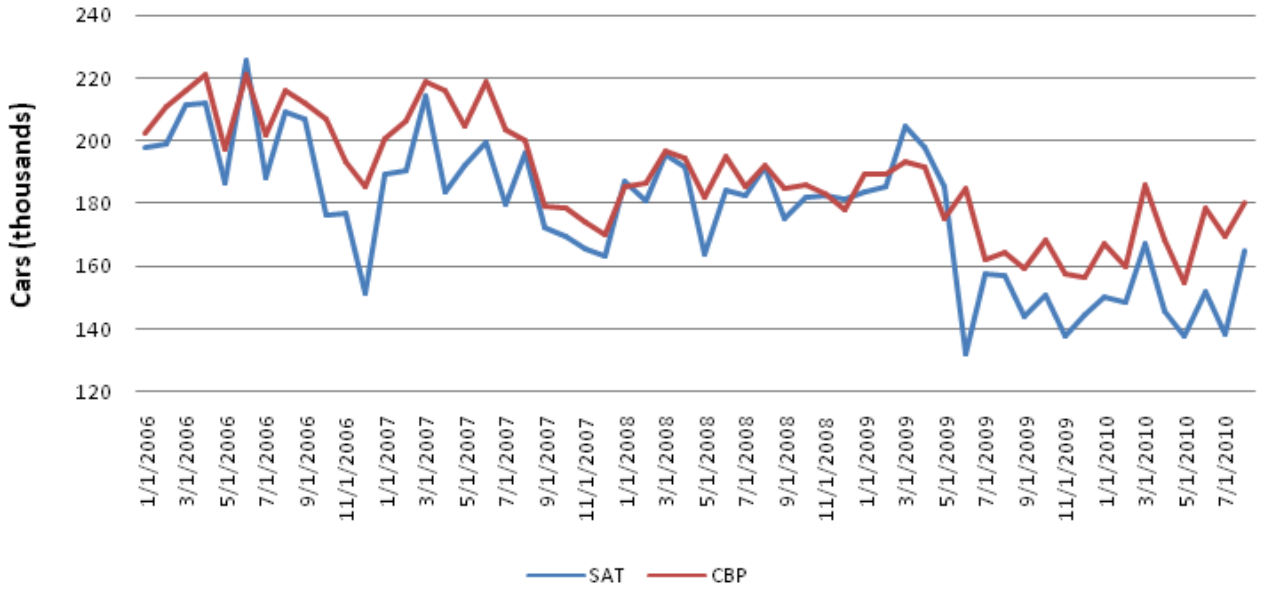
	POV	Pedestrians
POE Area	≈11 acres	
POE northbound capacity	-6 lanes - 1 SENTRI Lane	- 6 workstations - 1 bicycle lane
Usage	- 24/7 - 6 AM – 10 PM	- 3 open booths (24/7) - 24/7
Street queue northbound	Cap. Carlos G. Calles (International Avenue)	N/A
POE southbound capacity	2 lanes (24/7)	1 lane
Distance from POE to reduced queue northbound	168 ft	N/A
Street queue southbound	Main St. 95	N/A
Known issues	- Long queues in northbound traffic.	- Current infrastructure is insufficient. - Fights between pedestrians. - Seasonality: - Long queues during winter (farm)

During the 2010 fiscal year, POV crossings reached two million, making this mode of traffic the most saturated. Table 1.2 below indicates the northbound monthly traffic volumes for the 2010 fiscal year. The comparison of the northbound and the southbound crossings is presented in Figure 1.3.

TABLE 1.2: POV NORTHBOUND AND SOUTHBOUND VOLUMES FOR FY 2010

Month	Northbound (CBP)	Southbound (SAT)	% Difference
Oct-09	189,138	183,607	-3.01%
Nov-09	189,463	185,650	-2.05%
Dec-09	193,350	204,884	5.63%
Jan-10	191,630	197,713	3.08%
Feb-10	175,024	185,523	5.66%
Mar-10	184,732	131,922	-40.03%
Apr-10	162,192	157,855	-2.75%
May-10	164,350	156,787	-4.82%
Jun-10	159,201	144,088	-10.49%
Jul-10	168,565	150,846	-11.75%
Aug-10	157,655	137,719	-14.48%
Sep-10	156,608	144,268	-8.55%
TOTAL	**1,980,862**	**2,091,908**	**-6.96%**

FIGURE 1.3: POV NORTHBOUND AND SOUTHBOUND TRAFFIC VOLUMES FOR FY 2010



The following sections focus on performing more detailed analyses of the LPOE's traffic volumes. This analysis seeks to determine the relationships that exist between relevant economic, demographic and commercial indicators and historic traffic volumes crossing the LPOE.

TRAFFIC VOLUMES ANALYSIS

The objective of the traffic volume analysis is to identify underlying factors that may have an effect on the LPOE border crossings, such as unforeseen events, seasonality and trends. Unforeseen events may be in the form of extraordinary circumstances such as the 9/11 events, while seasonality may be due to short cyclical reasons such as agricultural production. Lastly, trends can be associated to long-term phenomena such as simple economic inflation. The analysis begins with a comparison between the three main modes of transportation (Commercial, POV and Pedestrian).

Figure 1.4 shows a linear chart that represents monthly crossing volumes for the period of January 1995 to May 2011 for the three transportation modes considered. From this figure, one can identify that the most significant shift in behavior occurs during September 2001. The 2001 shift is significant for POV, where the crossing volumes dropped from approximately 240,000 units in August to 140,000 in October. Pedestrian and commercial crossings did not show the same behavior.

Commercial trucks and pedestrian crossings present an evident seasonality; both show the highest peak during the winter (January, February or March), and the lowest dip during the summer, (June, July and August).

FIGURE 1.4: CROSSING VOLUMES (THOUSANDS) IN SAN LUIS LPOE (1995- 2011)

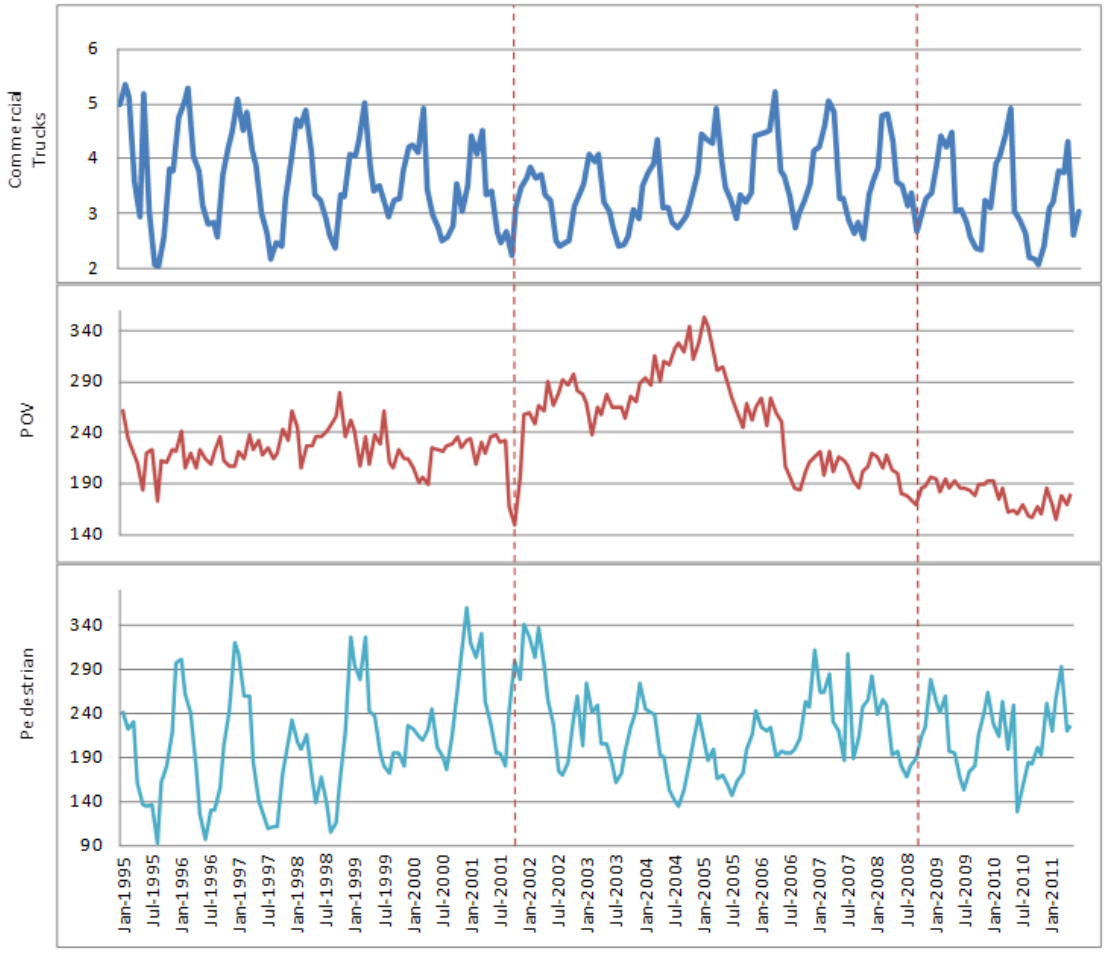


Table 1.3 presents the yearly crossing volumes by type of mode and the volume percentage change from year-to-year. Data shows that POV volumes have been decreasing since 2004, as well as pedestrian volumes in particular over the last 3 years from 2007 to 2009.

TABLE 1.3: YEARLY CROSSING VOLUMES BY MODE

	POV		Pedestrian		Buses	
Year	Volume	% Change	Volume	% Change	Volume	% Change
2002	3,306,378		2,968,278		102	
2003	3,189,867	-3.52%	2,625,907	-11.53%	38	-62.75%
2004	3,755,829	17.74%	2,316,812	-11.77%	74	94.74%
2005	3,472,277	-7.55%	2,227,807	-3.84%	83	12.16%
2006	2,703,263	-22.15%	2,669,311	19.82%	96	15.66%
2007	2,481,013	-8.22%	2,939,684	10.13%	53	-44.79%
2008	2,313,661	-6.75%	2,564,499	-12.76%	64	20.75%
2009	2,253,331	-2.61%	2,537,177	-1.07%	59	-7.81%

ANALYSIS OF EXTERNAL FACTORS (POTENTIAL DRIVERS)

After the preliminary analyses of the traffic volumes, the next step is to perform a similar analysis on the historical behavior of what is called *"external factors"*. These factors refer to all those economic and demographic factors that are neither strictly nor directly related to the border crossing volumes, but may be significant drivers of its behavior. In the same fashion, this analysis attempts to identify any specific trait (peaks, falls, trends, seasonality, etc.) within these factors' historical data. In this section, a time series analysis is presented for each of these potential drivers.

Employment Levels in San Luis Río Colorado (SLRC)

San Luis Río Colorado's economy is based on: 1) farming activity, including agriculture and cattle, 2) services, and 3) manufacturing, driving the trade between Mexico and the United States. A good employment level indicator for these activities is the amount of Beneficiaries of the Mexican Social Security Institute (IMSS - Instituto Mexicano del Seguro Social) in SLRC. These are categorized into these different economic activities; it would be analyzed how the number of employees registered in the Institution fluctuated trough time.

Figure 1.5 illustrates the number of employees registered with the IMMS in San Luis Rio Colorado. For beneficiaries in general, there is no visible tendency; at first sight, almost every December, the number of beneficiaries decreases. Figure 1.5 also illustrates that there is also not much seasonality, this variable is correlated to the manufacturing sector.

FIGURE 1.5: EMPLOYEES REGISTERED ON IMSS IN SLRC

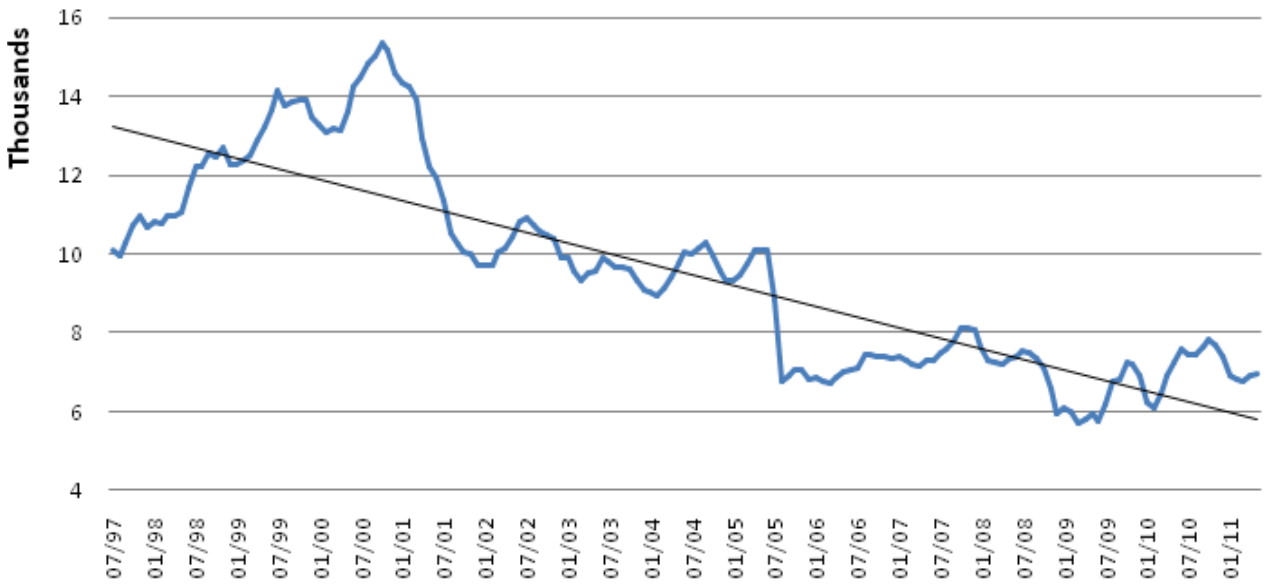
Beneficiaries IMSS SLRC Manufacturing

Since 1997 the number of beneficiaries has been slightly decreasing as depicted in Figure 1.6. Throughout the year, the employees registered do not present many changes; it just decreases over the last 2 months of every year. There are important changes on the last months of 2000 and the first months of 2001; also in 2005, the registered employees decreases; and finally, during the2008-2009 crisis. There is no seasonality present in this data.

The Geography and Statistics National Institute (INEGI) generates two surveys which analyze maquiladoras and export industry, which are strongly correlated to manufacturing:

- EMIME: This survey is just from 1996 to 2006 and refers to the exports of the maquiladora industry; it is really different every year and every month. There was a decrease of activities in the years 2001 and 2005
- IMMEX: Information is available from the second half of 2007 to 2011. There is a decrease in 2008 and 2009. There is no visible seasonality in this data.

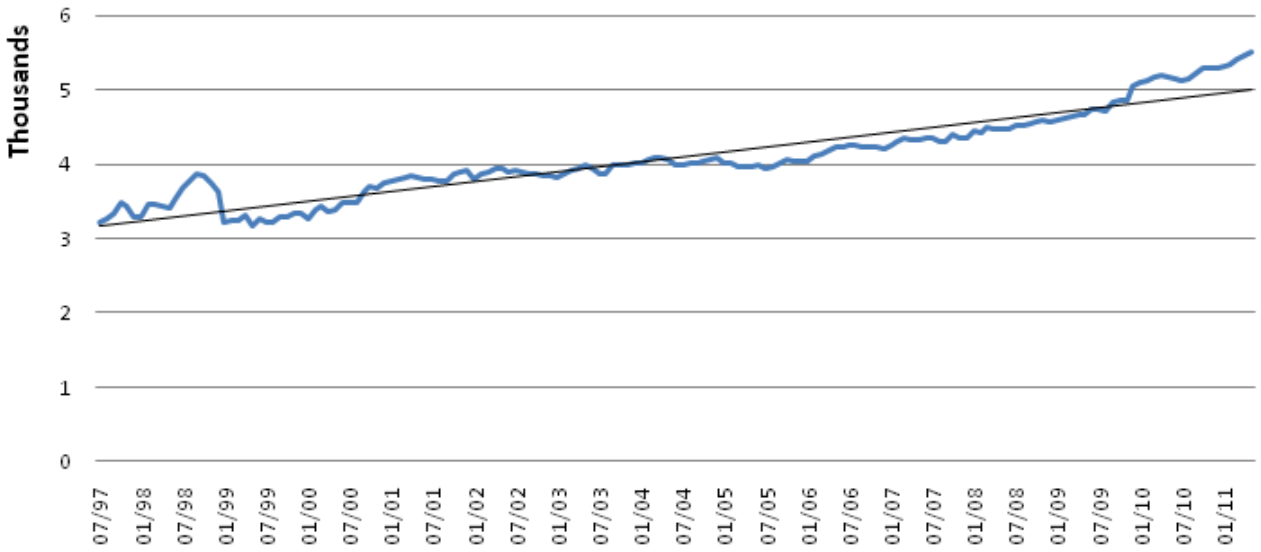
FIGURE 1.6: MANUFACTURE BENEFICIARIES REGISTERED TO IMSS IN SLRC



Beneficiaries IMSS SLRC Services

Figure 1.7 illustrates the number of service employees registered with the IMMS in San Luis Rio Colorado. The services sector presents an upward tendency, even during the 2008-2009 economic crisis. Figure 1.7 also illustrates, there is no seasonality and every month looks the same. This variable was considered because the services area has one of the highest quantities of beneficiaries.

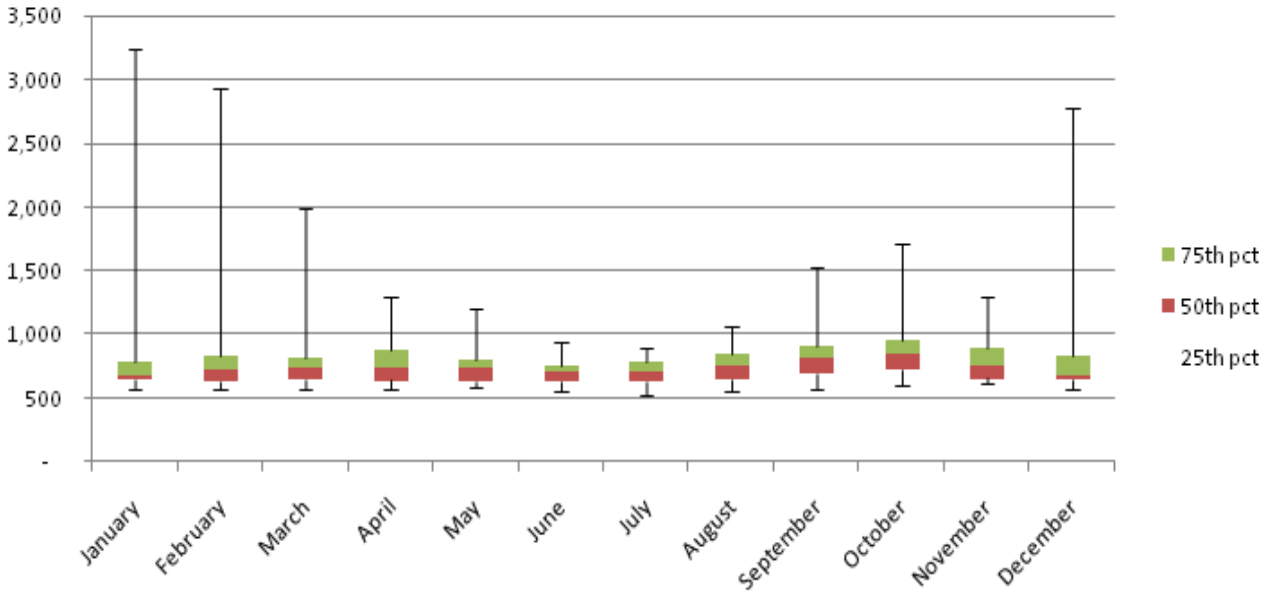
FIGURE 1.7: SERVICES BENEFICIARIES REGISTERED TO IMSS IN SLRC



Beneficiaries IMSS SLRC Farm

Figure 1.8 illustrates the number of farm workers registered with the IMMS in San Luis Rio Colorado. This data has no specific trend; the beneficiaries of IMSS decrease almost every December, except for the last 2 years. The number of beneficiaries that work at farms started increasing in 2009, and has a major peak on January2010; this shows a lot of variability due to the increment of the beneficiaries in the last 2 years.

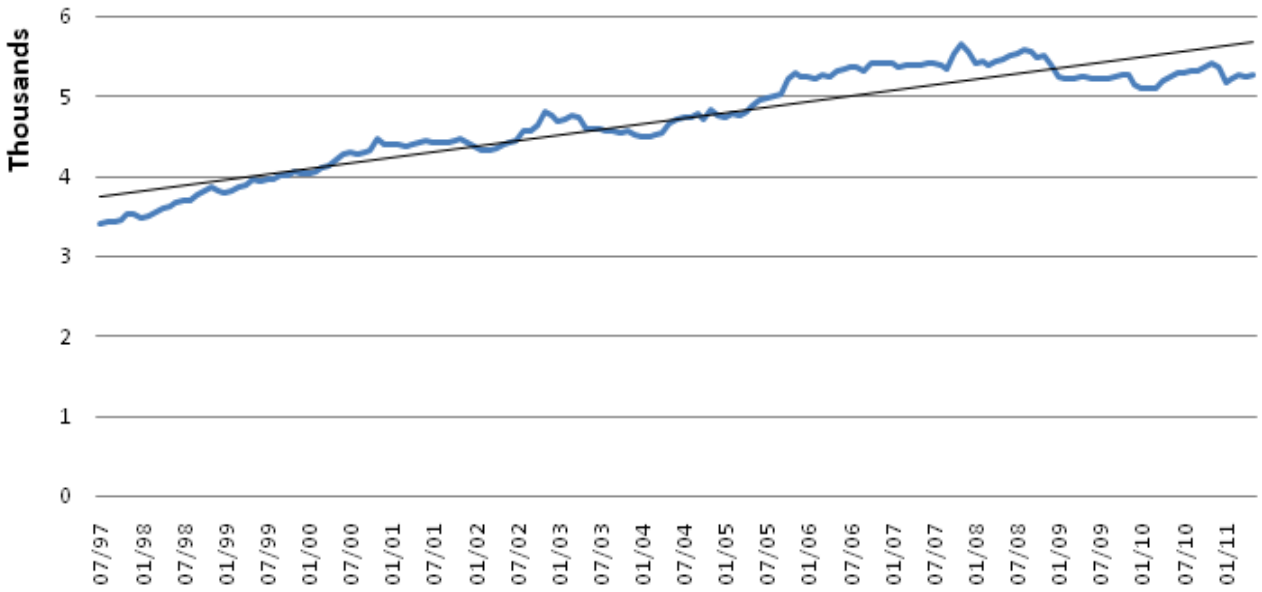
FIGURE 1.8: FARM WORKERS REGISTERED TO IMSS IN SLRC



Beneficiaries IMSS SLRC Trade

Figure 1.9 illustrates the number of trade industry employees registered with the IMMS in San Luis Rio Colorado. As illustrated in the figure, this data shows an upward tendency. The same behavior is shown almost every year, except for the last part of 2008 and the beginnings of 2009; it decreases a little, but then increases again. About seasonality, apparently it does not present any. This variable, and manufacturing beneficiaries, are correlated to Mexico and USA's indicators such as GDP, IPP and CPI.

FIGURE 1.9: TRADE INDUSTRY BENEFICIARIES REGISTERED TO IMSS IN SLRC

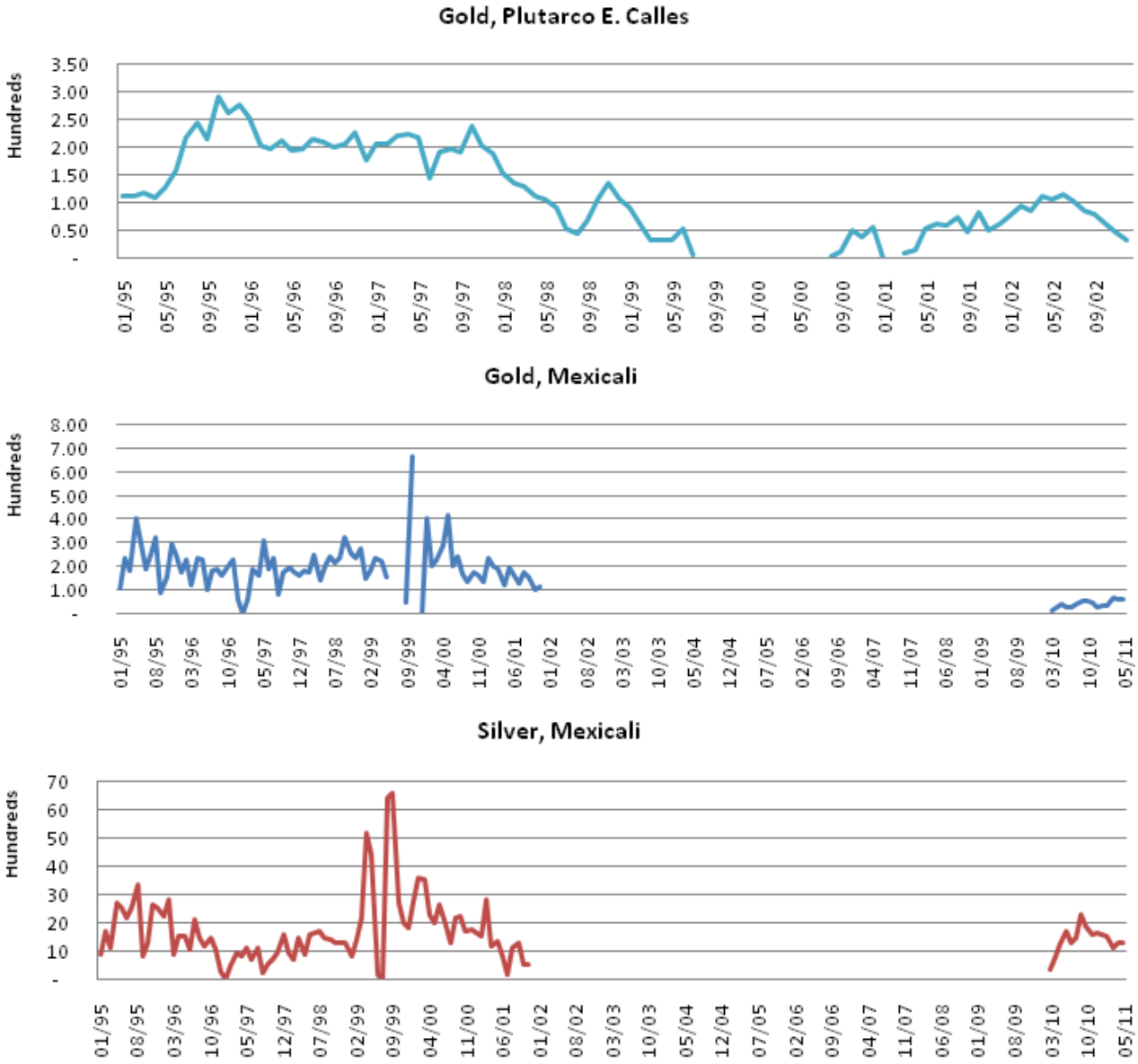


Mining in San Luis Río Colorado

Figure 1.10 illustrates total mining activity in San Luis Rio Colorado, Mexico. Mining in SLRC, or nearby areas was also analyzed, but just a few people work in this sector and production is not very consistent; therefore mining in other sections was analyzed:

- Mining in Mexicali. There are a lot of irregularities and inconsistencies on the information of gold production: one month, the production is 154 kilos, but the next month is just 2 kilos or no production at all (or there is a lack of information). The production stopped in 2001 and started again in 2010. The entire mining industry shows these irregularities. The same happened to silver mining.
- Mining in Plutarco Elías Calles (PEC). There are many data irregularities and inconsistencies regarding the information obtained for the gold mining activities in Plutarco Elías Calles. The production stopped in 2002.

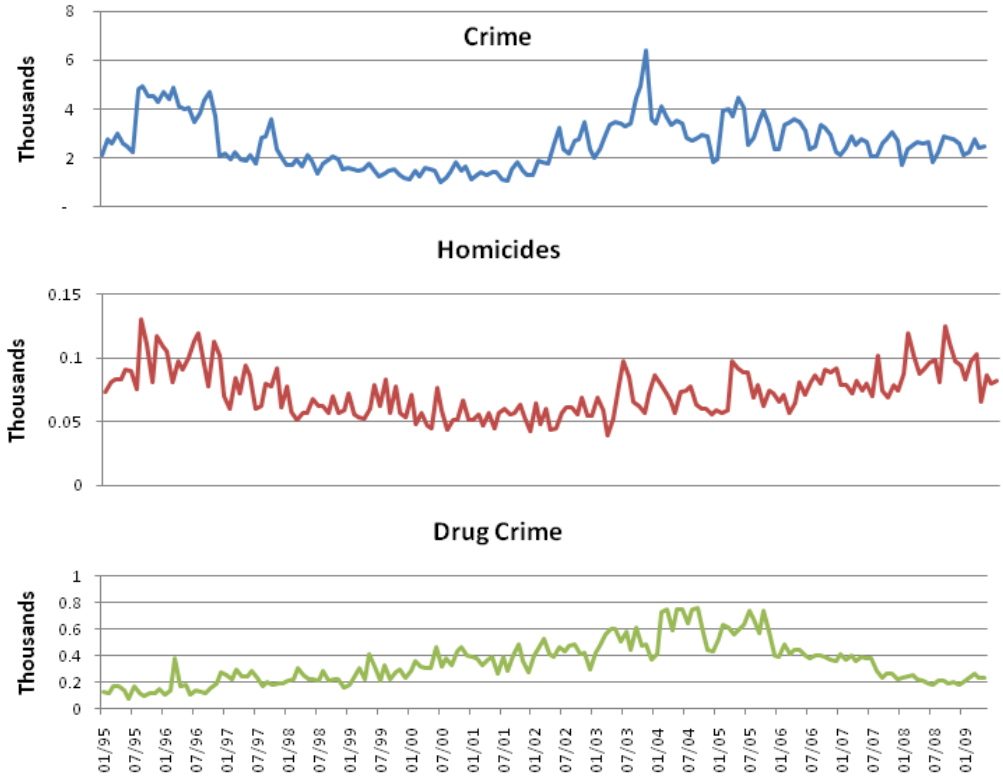
FIGURE 1.10: MINING IN AREAS NEARBY SLRC, KILOGRAMS



Crime in Sonora

Figure 1.11 outlines the number of felonies in Sonora from 1995 to 2009. It was decided to analyze how crime could affect the southbound border crossings, based on the number of felonies, homicides and drug crimes committed in Sonora. Drug crime offenses include everything that has to do with production, distribution, consumption, transportation or selling of drugs. It is expected that these variables behave opposite to the number of crossings.

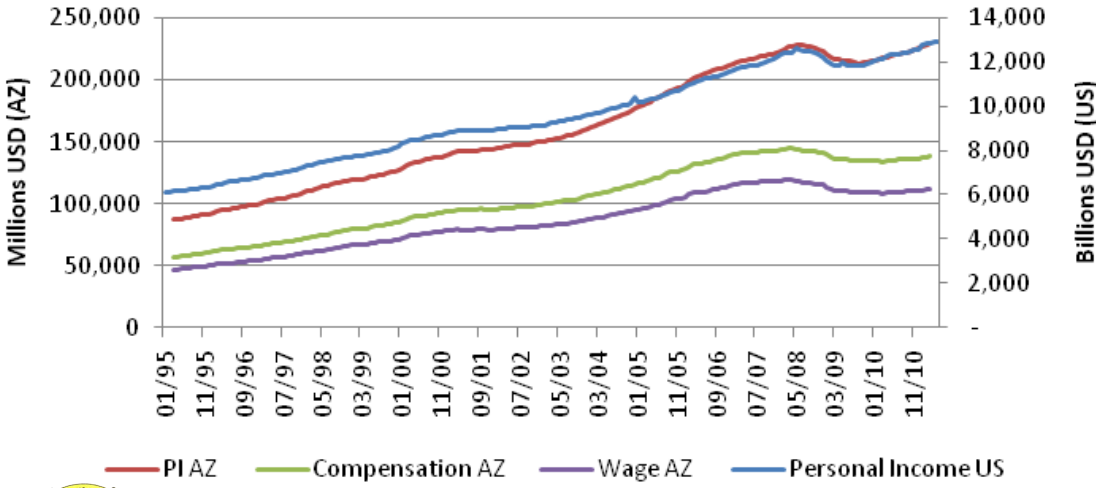
FIGURE 1.11: CRIME IN SONORA (NUMBER OF FELONIES)



Economic Indicators in Arizona

Economic indicators are analyzed to determine if they have an opposite effect on the number of crossings at the LPOE. Personal income, compensation and wage in Arizona are strongly correlated, and they also have a strong relationship with personal income in the United States as shown in Figure 1.12. There is a visible upward tendency through all the series, except for the period 2008-2009, during the economic crisis. The data shows no visible seasonality.

FIGURE 1.12: ECONOMIC INDICATORS U.S.



Industrial Production and Consumer Price Index in Mexico

The Industrial Price Index has a variation with a small growth tendency through time, but there is a visible decrease from May 2008 to January 2009, as shown in Figure 1.13. There is no visible seasonality during this period of time. Note that even though for the Consumer Price Index there is a clearly upward tendency, even during the crisis, it does not present seasonality either as per Figure 1.14.

FIGURE 1.13: INDEX OF INDUSTRIAL PRICE IN MEXICO

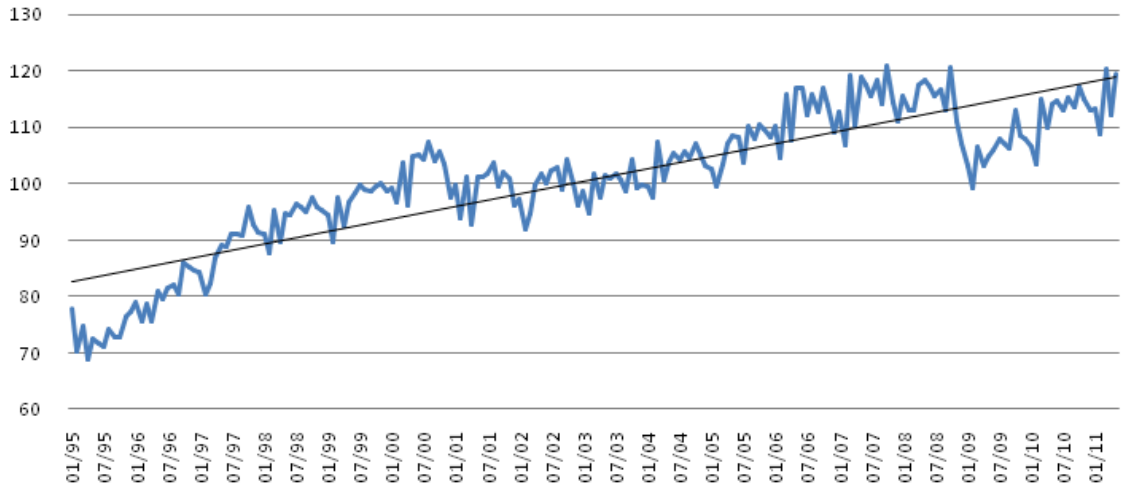
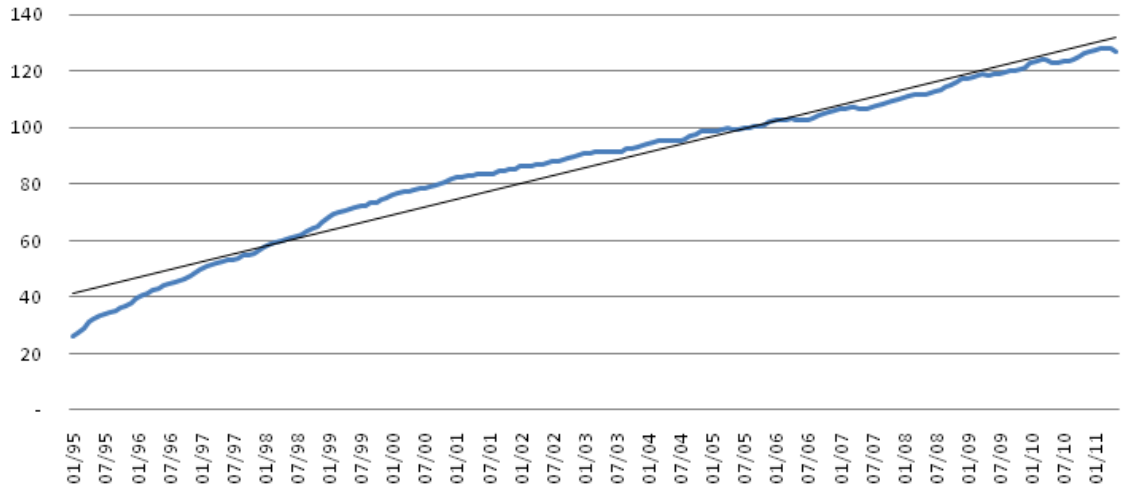


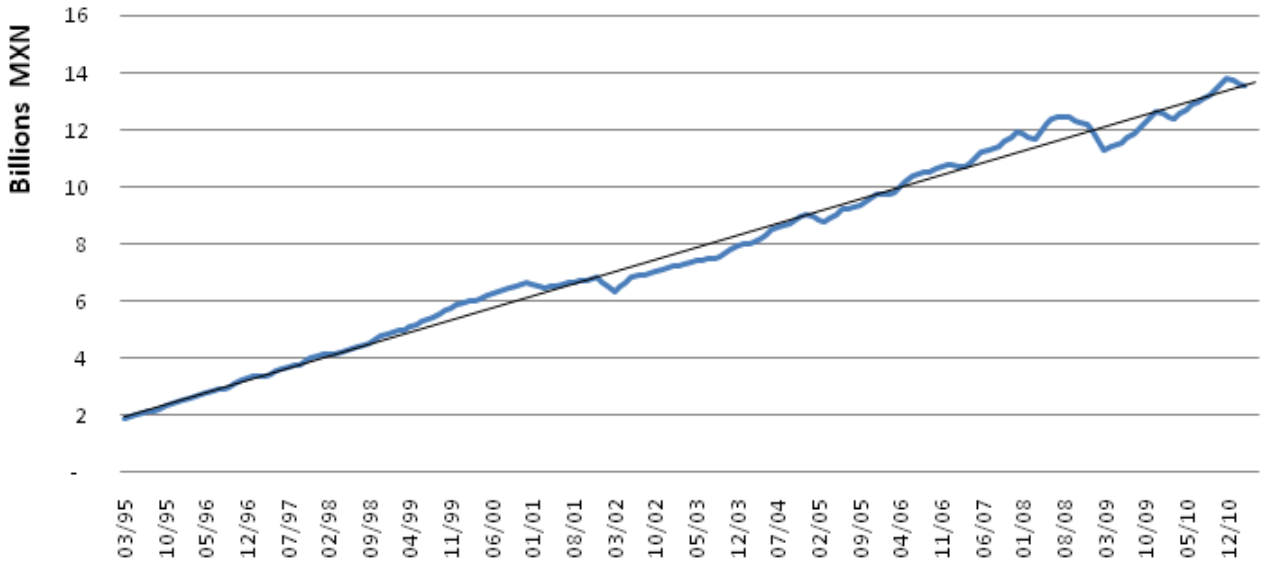
FIGURE 1.14: CONSUMER PRICE INDEX IN MEXICO



Gross Domestic Product (GDP) - Mexico

The GDP information is only available in a quarterly basis. For the purpose of this study, the different data were lineally adjusted to a monthly basis for a better analysis and comparison to other variables. There is a clearly upward trend; but almost every year looks exactly the same, with the exception of a small decrease during the last months of 2008 and the first months of 2009, shown in Figure 1.15. The Mexican GDP does not present any seasonality.

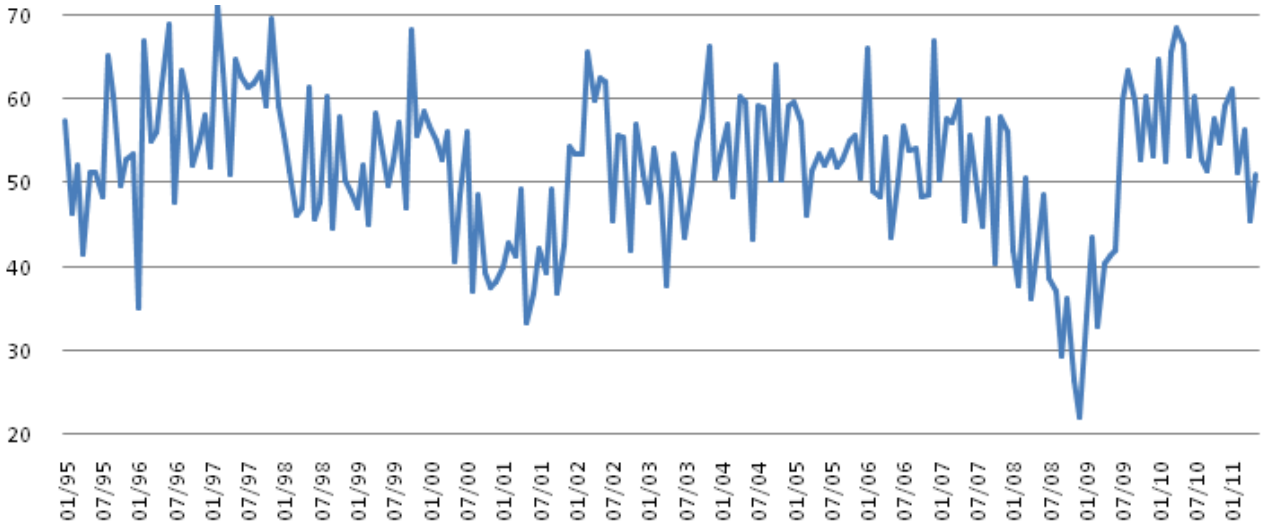
FIGURE 1.15: GROSS DOMESTIC PRODUCT IN MEXICO (BILLIONS OF PESOS)



Index of Industrial Production in the United States

The Index of Industrial Production, displayed in Figure 1.16, has no particular trend; there is a lot of variability throughout the years and a visible decrease during the crisis of 2008-2009. There is no seasonality. This index is not correlated to any variable.

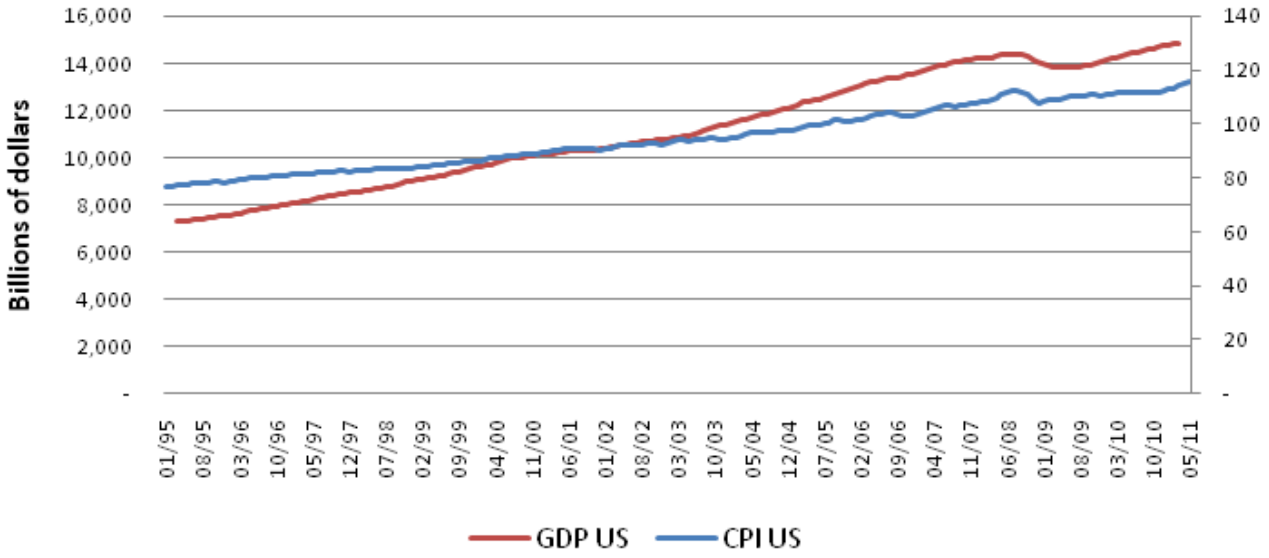
FIGURE 1.16: INDEX OF INDUSTRIAL PRICE IN THE US



Consumer Price Index (CPI) and Gross Domestic Product (GDP) - US

There is a clearly upward tendency; shown in Figure 1.17, but almost every year looks exactly the same with just a minimum decrease during the last months of 2008 and the first months of 2009. It does not present seasonality and it is the same case for the GDP of the U.S.

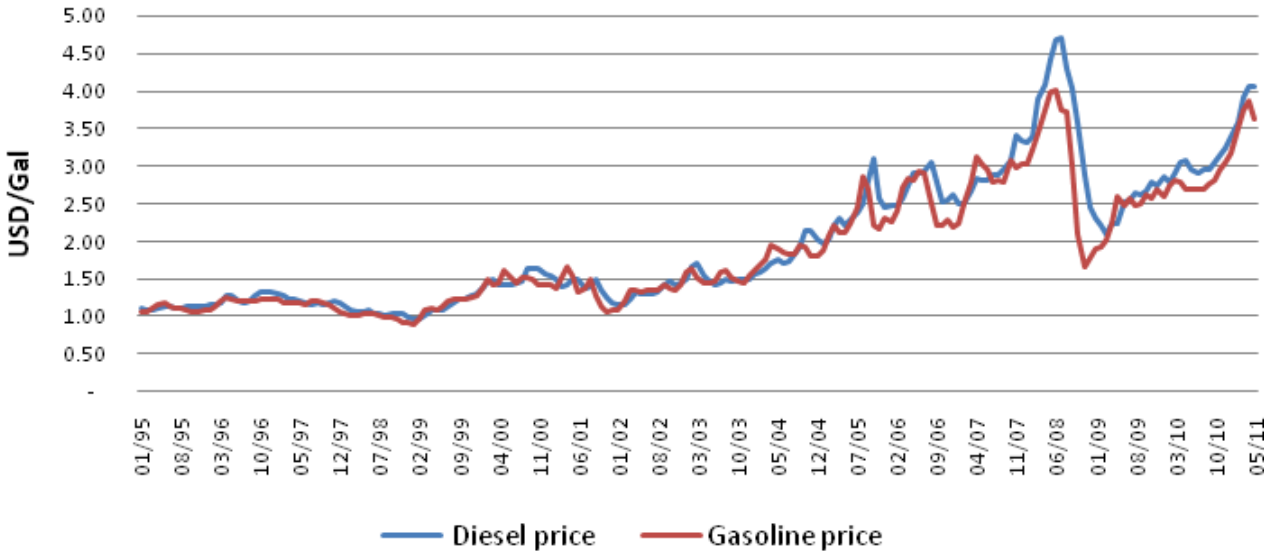
FIGURE 1.17: MACROECONOMIC INDICATORS (GDP AND CPI IN THE US)



Diesel and Gasoline Price

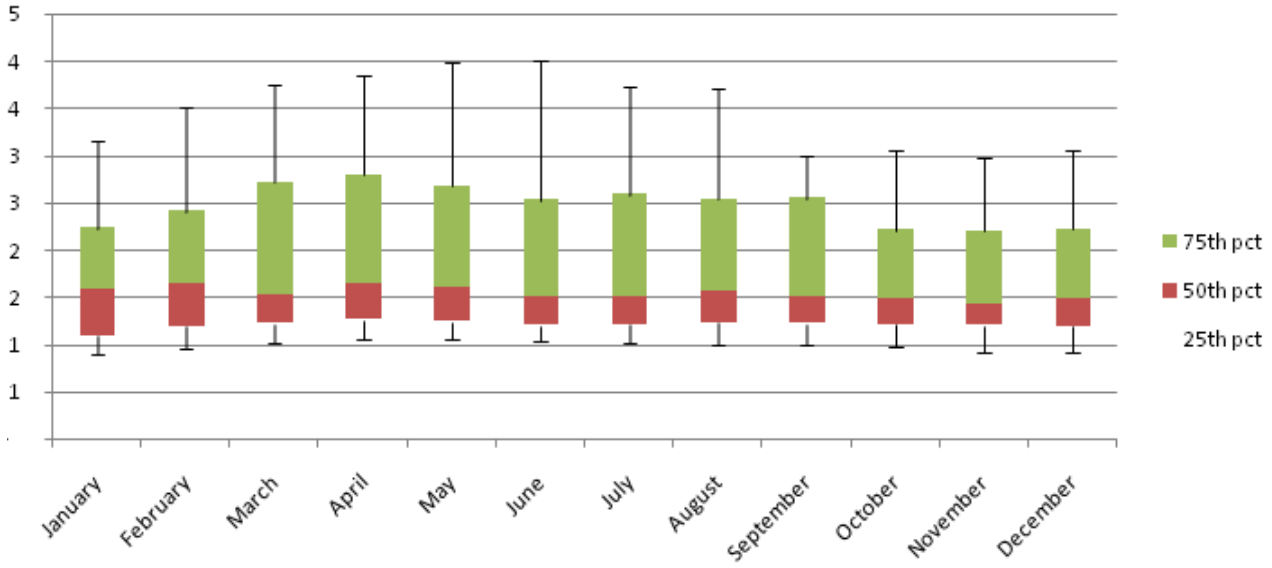
Diesel and gasoline behave almost the same and have a really strong correlation. The price had a great growth in June 2008 and a significant fall in January 2009 as per Figure 1.18.

FIGURE 1.18: DIESEL AND GASOLINE PRICE (DOLLORS PER GALLON)



Note that for the prices of gasoline and diesel, the highest of both appears during the summer; nonetheless, there is no strong sign of seasonality as Figure 1.19 shows.

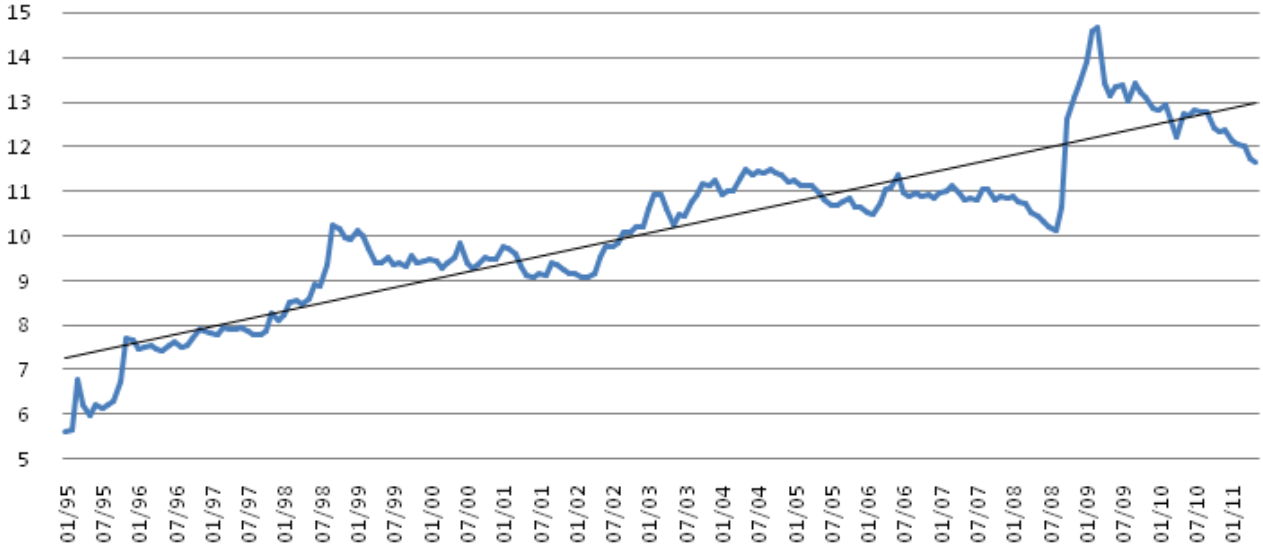
FIGURE 1.19: DIESEL AND GASOLINE PRICE (SEASONALITY)



Exchange Rate

There is a clearly upward trend; as display in Figure 1.20, but almost every year looks exactly the same with just a minimum decrease during the last months of 2008 and the first months of 2009. The data does not present seasonality.

FIGURE 1.20: EXCHANGE RATE (MXN/USD)



Agriculture Production (Yuma)

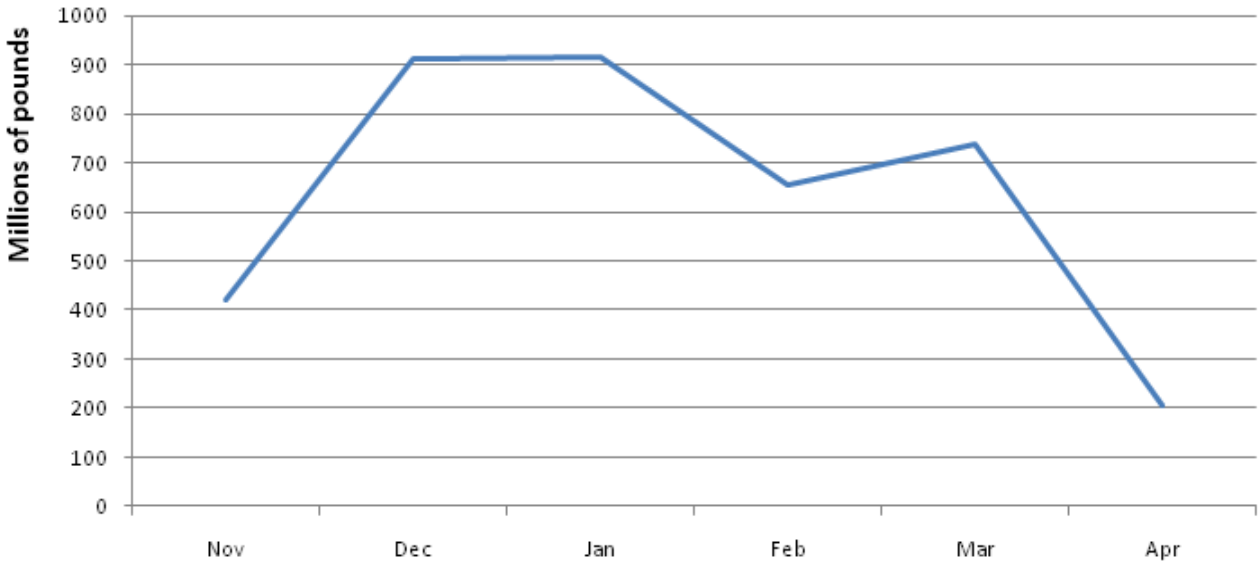
Based on the literature reviewed, agriculture in the Yuma County is an important variable to consider, because labor is provided by the Mexican people crossing every day to work at the farms. During 2010, the major agricultural products in the Yuma County were: broccoli, cauliflower, iceberg lettuce and romaine lettuce; lettuce accounts for most of the total acreage and pounds harvested. Table 1.4 present a summary of amount of products harvested in pounds.

TABLE 1.4: MAIN PRODUCTS GROWN IN SAN LUIS, AZ FOR YEAR 2010 (POUND)

Month	Broccoli	Cauliflower	Iceberg Lettuce	Romaine Lettuce
November	231,152	111,699	8,383,503	953,588
December	1,062,604	799,757	18,266,588	2,778,742
January	1,484,182	1,199,289	18,315,529	3,149,091
February	1,417,706	827,428	13,096,777	2,145,232
March	845,518	659,438	14,758,718	2,415,360
April	241,325	114,474	4,091,102	593,447

Figure 1.21 presents the iceberg lettuce production; all products have almost the same behavior and the same seasonality, starting in November, having a major peak in January and ending in April.

FIGURE 1.21: ICEBURG LETTUCE 2010 PRODUCTION IN SAN LUIS, ARIZONA



Agriculture Production (Mexico)

Agriculture on the Rural Development District of Mexicali and San Luis Rio Colorado is mostly used to supply the Yuma demand, as described in the Fruits and Vegetables Producers Regional Union. There are 4 main products, as Table 1.5 shows, based on the value of the production, and the quantity: green alfalfa, which is produced almost every month, forage sorghum, tomato, and wheat. The largest production takes place during the summer and fall seasons.

TABLE 1.5: MAIN PRODUCTS GROWN IN BAJA CALIFORNIA FOR YEAR 2010 (TONS)

Month	Tomato	Wheat	Green Alfalfa	Forage Sorghum
January				
February			0.5	
March			0	
April			3.22	
May		39.92	8.47	
June	1.64	55.99	17.78	
July	28.25	4.09	5.13	
August	24.12		15.78	22.46
September	45.99		13.47	24.97
October			14.88	16.44
November			7.1	32.76
December			13.62	3.37

Furthermore, Baja California Sur's production was analyzed, since it might cross through San Luis LPOE. There are several products in this area, but the most important are green alfalfa, potato, onion, tomato, Anaheim pepper, wheat and asparagus shown in Table 1.6.

TABLE 1.6: MAIN PRODUCTS GROWN IN BAJA CALIFORNIA SUR FOR YEAR 2010 (TONS)

Month	Potato	Onion	Tomato	Anaheim Pepper	Wheat	Asparagus	Green Alfalfa
January	42.54		3.47	10.85		59.77	6.35
February	33.39		28.43	14.17		11.74	5.74
March	6	16	14	5		18	3
April	1.67	48.49	9.72	10		5.62	18.59
May	9.88	2.76	6.72	3.9	39.92		11.01
June	6.91	2.15	17.74	23.29	55.99		4.32
July		4.89	6.41	22.96	4.09		5.51
August		19.7	12.57	10.05			8.57
September		6.26	0.98			4.53	7.91
October							13.7
November							6.04
December							9.65

Correlation between External Variables

A correlation analysis was performed between external variables, and the resulting matrix is shown in Figure 1.22. If the coefficient of correlation is nearest to 1 or -1, it can be said that those variables are correlated; the darkest colors (green or red) represent a stronger correlation.

- Macro-economic variables are strongly correlated to each other, such as Arizona's personal income, compensation, wage; Mexico's IPP, CPI and GDP; and moreover, these variables are correlated to trade industry beneficiaries.
- The IPP in the US is not correlated to any variable.
- Crime and homicides are not strongly correlated either; but a negative correlation between drug crimes and some variables was found as expected.

FIGURE 1.22: MATRIX OF CORRELATION BETWEEN EXTERNAL VARIABLES

	Ben-SL	Ben-PP	Ben-PEX	Ben-F	Ben-T	Ben-M	Ben-S	Ben-O	EMIME	Au-Mxc	Au-PEC	Ag-Mxc	IMMEX	Crime	Homicides	Drugs	PI-Az	Co-Az	W-Az	IPP-Mx	CPI-Mx	GDP-Mx	IPP-US	CPI-US	Diesel	Gas	PI-US	GDP-US	ER
Ben-SL	1.00																												
Ben-PP	-0.50	1.00																											
Ben-PEX	-0.62	0.52	1.00																										
Ben-F	-0.08	-0.15	0.15	1.00																									
Ben-T	-0.51	0.80	0.49	0.15	1.00																								
Ben-M	0.91	-0.65	-0.69	-0.24	-0.80	1.00																							
Ben-S	-0.50	0.39	0.53	0.47	0.79	-0.76	1.00																						
Ben-O	-0.65	0.64	0.69	0.36	0.87	-0.88	0.91	1.00																					
EMIME	0.91	-0.71	-0.48	0.20	-0.61	0.96	-0.63	-0.76	1.00																				
Au-Mxc	0.56	-0.56	-0.36	0.08	-0.65	0.65	-0.50	-0.60	0.46	1.00																			
Au-PEC	0.10	-0.56	-0.11	0.07	-0.71	0.36	-0.49	-0.55	-0.13	0.51	1.00																		
Ag-Mxc	0.60	-0.49	-0.46	0.19	-0.46	0.59	-0.32	-0.42	0.55	0.64	0.27	1.00																	
IMMEX	0.84	0.46	0.20	0.13	0.51	0.79	-0.06	0.22	N/A	0.30	N/A	0.28	1.00																
Crime	-0.31	0.31	0.57	0.13	0.04	-0.25	0.03	0.21	-0.26	0.08	0.17	-0.06	0.38	1.00															
Homicides	-0.18	-0.13	0.41	0.37	-0.03	-0.19	0.24	0.21	0.08	0.22	0.27	0.19	-0.12	0.54	1.00														
Drugs	-0.41	0.85	0.31	-0.33	0.54	-0.43	0.08	0.32	-0.58	-0.53	-0.49	-0.50	0.31	0.15	-0.35	1.00													
PI-Az	-0.58	0.75	0.60	0.21	0.97	-0.85	0.89	0.95	-0.40	-0.68	-0.77	-0.49	0.61	0.13	0.06	0.55	1.00												
Co-Az	-0.57	0.81	0.59	0.15	0.98	-0.84	0.85	0.93	-0.38	-0.69	-0.79	-0.51	0.62	0.12	0.00	0.61	1.00	1.00											
W-Az	-0.56	0.82	0.58	0.14	0.98	-0.83	0.83	0.92	-0.36	-0.69	-0.80	-0.51	0.62	0.13	-0.01	0.63	0.99	1.00	1.00										
IPP-Mx	-0.32	0.73	0.46	0.17	0.87	-0.64	0.72	0.79	-0.09	-0.58	-0.81	-0.39	0.75	0.17	0.02	0.57	0.89	0.90	0.91	1.00									
CPI-Mx	-0.51	0.59	0.46	0.25	0.94	-0.80	0.93	0.92	-0.20	-0.67	-0.83	-0.45	-0.28	-0.05	-0.01	0.44	0.96	0.96	0.96	0.91	1.00								
GDP-Mx	-0.53	0.66	0.56	0.28	0.94	-0.82	0.93	0.95	-0.30	-0.66	-0.78	-0.44	0.21	0.07	0.08	0.46	0.99	0.98	0.98	0.89	0.98	1.00							
IPP-US	-0.12	-0.06	0.09	0.07	-0.16	-0.03	-0.01	0.03	-0.33	0.04	0.23	0.05	0.05	0.10	0.17	-0.17	-0.18	-0.19	-0.19	-0.20	-0.16	-0.18	1.00						
CPI-US	-0.57	0.64	0.57	0.27	0.94	-0.85	0.93	0.95	-0.41	-0.67	-0.74	-0.46	-0.02	0.09	0.10	0.45	0.99	0.98	0.97	0.87	0.97	0.99	-0.16	1.00					
Diesel	-0.45	0.66	0.55	0.29	0.87	-0.74	0.80	0.87	-0.53	-0.53	-0.57	-0.36	0.61	0.24	0.17	0.42	0.90	0.89	0.88	0.78	0.80	0.88	-0.16	0.90	1.00				
Gas	-0.46	0.67	0.54	0.28	0.86	-0.74	0.79	0.86	-0.49	-0.54	-0.60	-0.37	0.59	0.23	0.14	0.46	0.90	0.89	0.88	0.78	0.81	0.89	-0.10	0.90	0.97	1.00			
PI-US	-0.54	0.69	0.56	0.26	0.96	-0.84	0.91	0.95	-0.34	-0.66	-0.78	-0.46	0.55	0.09	0.06	0.49	1.00	0.99	0.99	0.90	0.97	1.00	-0.18	0.99	0.90	0.90	1.00		
GDP-US	-0.57	0.73	0.59	0.22	0.97	-0.85	0.90	0.95	-0.37	-0.69	-0.78	-0.49	0.59	0.10	0.05	0.54	1.00	0.99	0.99	0.90	0.97	0.99	-0.16	0.99	0.89	0.89	1.00	1.00	
ER	-0.51	0.43	0.48	0.19	0.75	-0.71	0.82	0.82	-0.13	-0.61	-0.78	-0.41	-0.77	-0.04	0.04	0.33	0.87	0.86	0.85	0.80	0.93	0.89	-0.15	0.88	0.64	0.64	0.88	0.88	1.00

CORRELATION (CROSSING MODE VS. POTENTIAL DRIVERS)

Three main modes of travel through the LPOE were analyzed: POVs, pedestrians, and commercial traffic. In this section, a correlation analysis was performed between the external variables previously analyzed and the three different modes of travel. This was done on a monthly basis and with an outlook from one to six months to notice if any variables showed significance when accounting for an effect delay.

Appendix AA shows the correlation between several variables and the modes of transportation, accounting for up to six months of lead for each variable. Those marked with red are the only ones that were somehow correlated; through this analysis we find that the POV mode of entry was correlated to homicides, and farm and services beneficiaries.

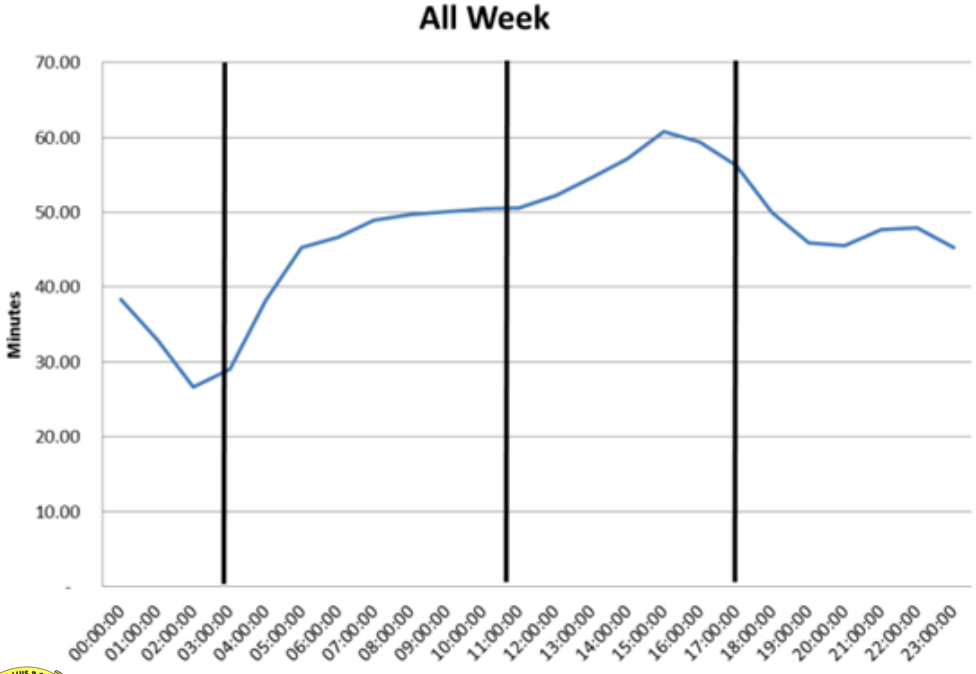
WAITING TIME ANALYSIS AT THE SAN LUIS I LPOE

The purpose of this section is to analyze historical traffic volumes data of the different modes, so that current conditions could be established. Monthly volumes of southbound crossings and waiting times were obtained from CBP and are displayed in Figure 1.23.

Privately Owned Vehicles (POV)

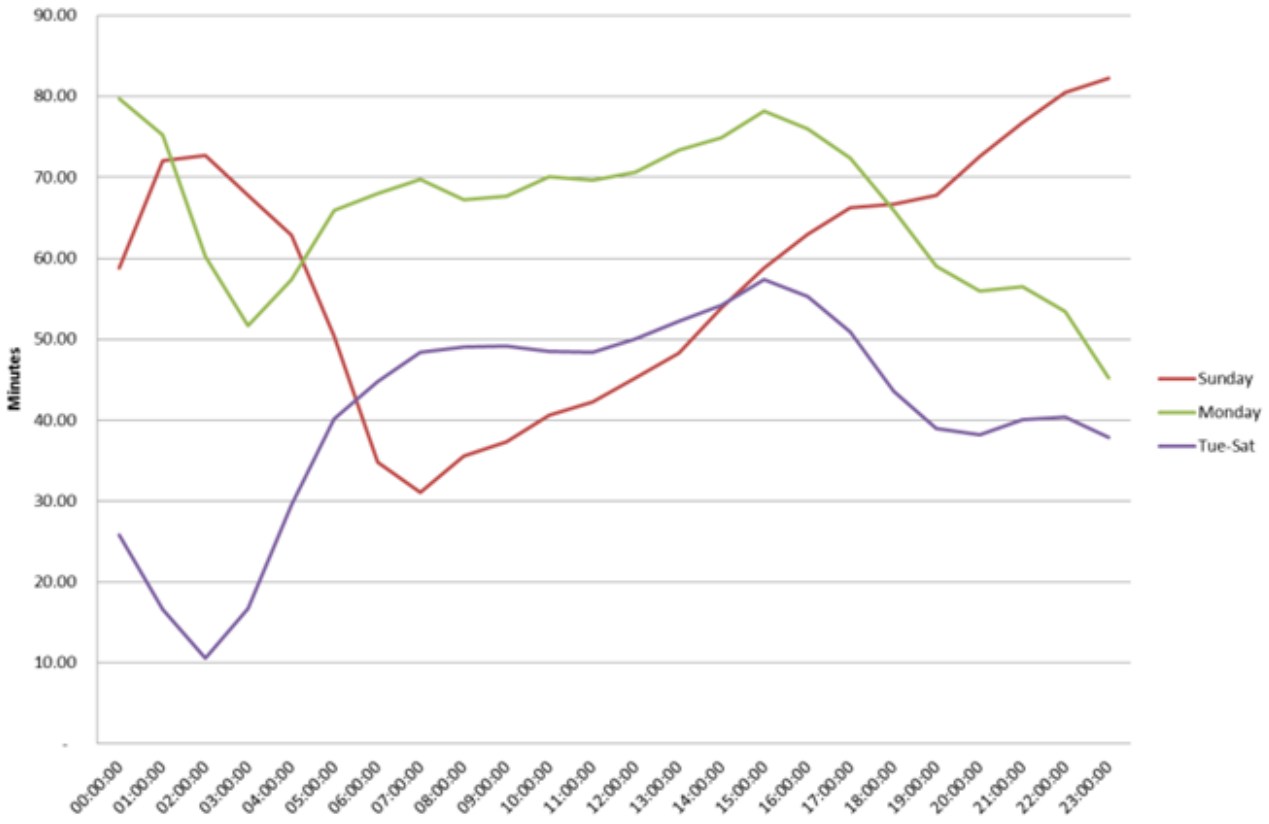
In order to determine the current performance of the San Luis I LPOE, waiting times for the POVs were analyzed, taking the 2010 fiscal year as the basis. CPB provided detailed hourly information by day and month which was analyzed . It was determined that the longest waiting times occur from 1 PM to 5 PM, and the shortest wait times occurs in the early morning hours.

FIGURE 1.23: AVERAGE BORDER CROSSING WAITING TIME, HOURLY



An analysis of the hourly waiting times was conducted for every day of the week, and the average of the time period studied determined that three different behaviors exist during the week as Figure 1.24 shows. It was decided to analyze them separately.

FIGURE 1.24: DIFFERENT BEHAVIORS OF THE BORDER CROSSING HOURLY WAITING TIMES



One of the objectives of analyzing this information is to know how many cars there would be in the queue and how long processing would take at any given hour of the day. To accomplish this, Little's Law was followed, which implies the average arrival rate of the POVs and the average time that the inspection of a unit takes. The following table shows some assumptions made, like the average size of a standard car and the average time within arrivals.

Time within arrivals	3.28	Cars/min
Standard car size	5	M
Standard car size	0.005	km

The number of opened booths at a given time of the day was also considered. At San Luis I LPOE, there are 6 available booths opened 24/7, but there are only 2 lanes to get to the border gate, so this number was considered instead to analyze the length and the number of cars at the queue.

Table 1.7 presents a comparison between the different behaviors during the day and how the waiting times affect the length of the queue.

TABLE 1.7: WAIT TIME AND QUEUE LENGHT (KM) BY DAY OF THE WEEK

Hour	Sunday	Length	Monday	Length	Tue-Sat	Length
0:00:00	58.83	0.49	79.71	0.66	25.85	0.22
1:00:00	72.10	0.60	75.27	0.62	16.65	0.14
2:00:00	72.67	0.60	60.23	0.50	10.60	0.09
3:00:00	67.81	0.56	51.63	0.43	16.77	0.14
4:00:00	62.83	0.52	57.42	0.48	29.50	0.25
5:00:00	50.33	0.42	65.90	0.55	40.19	0.33
6:00:00	34.85	0.29	68.04	0.56	44.79	0.37
7:00:00	31.10	0.26	69.76	0.58	48.38	0.40
8:00:00	35.62	0.30	67.27	0.56	49.03	0.41
9:00:00	37.35	0.31	67.69	0.56	49.12	0.41
10:00:00	40.60	0.34	70.04	0.58	48.47	0.40
11:00:00	42.29	0.35	69.65	0.58	48.43	0.40
12:00:00	45.19	0.38	70.60	0.58	49.99	0.41
13:00:00	48.31	0.40	73.37	0.61	52.23	0.43
14:00:00	53.88	0.45	74.86	0.62	54.24	0.45
15:00:00	58.74	0.49	78.23	0.65	57.42	0.48
16:00:00	62.94	0.52	75.96	0.63	55.27	0.46
17:00:00	66.29	0.55	72.40	0.60	50.95	0.42
18:00:00	66.69	0.55	65.90	0.55	43.55	0.36
19:00:00	67.73	0.56	59.00	0.49	38.99	0.32
20:00:00	72.63	0.60	55.90	0.46	38.17	0.32
21:00:00	76.71	0.63	56.44	0.47	40.02	0.33
22:00:00	80.51	0.67	53.47	0.44	40.38	0.34
23:00:00	82.22	0.68	45.22	0.38	37.92	0.32

As outlined in Table 1.7, Sundays show a distinct different behavior which is almost the opposite to what is happens during the rest of the week. The highest peak on Sundays occurs between 8 P.M. and 11 P.M, and the queue length is 0.68 kilometers, which translates into 135 standard cars per booth; the lightest hours take place in the morning. From Tuesday to Saturday the behavior is almost the same as the average of the entire week; Monday's behavior is more similar to the rest of the week, the same peak hours, but with longer waiting times, length of the queue, and the amount of cars in the queue.

SUMMARY OF CURRENT CONDITIONS

From the analysis performed, it is concluded that although there have been several studies on traffic, social and demographic conditions and various forecasts on these border areas, there are no studies analyzing the actual port operational activities of San Luis I LPOE nor the factors that influence the border crossings. In addition, existing studies mentioned the recent opening the San Luis II LPOE commercial port; however, the results of the operation of this port have yet to be studied.

After analyzing various factors that could affect the border crossings, a strong relationship between macroeconomic factors was observed, both in Mexico and the United States. For other variables, however, no apparent relationships were observed, such as the case of the Industrial Production Index in the United States. Moreover, through analyzing time series, no seasonality was found in most variables, with the clear exception of agriculture in San Luis, which shows a clear seasonality.

While exploring the existence of correlation between the various factors and the waiting times of different modes of traffic, it was observed that there is no strong correlation with most of the variables. Furthermore, as expected after analyzing the volumes of the crossings, a strong relationship between agriculture in San Luis against pedestrian and POVs crossing is shown. This, as noted in the literature review, is due to Mexican workers crossing every day to work at the farms.

Daily and hourly waiting times for POVs were also analyzed. From this it was concluded that there are three different behaviors during the week: Tuesdays to Saturdays, where rush hour is from 3 PM to5 PM. Mondays behave similarly to the rest of the week but waiting times have higher ranges. Finally, Sundays are different from the rest of the week, having almost an opposite behavior.

2.0 FUTURE CONDITIONS

In the previous chapter, the analysis evaluation was started for the current system conditions and it will be completed in this chapter. Additionally, this document discusses the expected traffic forecast by mode and the corresponding impacts at the LPOE.

The first step of this task was to complete the analyses of the current conditions, by examining the crossing volumes at the San Luis I LPOE, AZ. Fiscal Year 2010 (FY 2010) data provided by Customs and Border Protection (CBP) for the Privately Owned Vehicles (POV) and pedestrians was utilized to assess the high congestion rates at the port. Vehicular and pedestrian traffic volume information was dissected and analyzed on a monthly, weekly and hourly basis in order to identify their different behaviors throughout the various time periods.

Once the crossing volumes were analyzed and segmented following the different observed behaviors, analytical models were used to describe the queuing system as a function of different factors. These factors include arrival patterns, service patterns and system capacity. To simplify the analysis, the LPOE queuing system is assumed to be stable and to follow a single queue-multiple servers model protocol. This means that a single POV/pedestrian arrives at a certain rate to the queue waits a specific period of time and then it's set for inspection by one of the multiple servers available at the LPOE.

During the analysis some impacts are defined for the POV and pedestrian mode. These impacts are determined from the result of the queue length and waiting times observed by the customers and are defined in different schemas. From the POV queues, economic and environmental issues are identified from the idling vehicles in line to potential issues related to the region's traffic congestion. On the other hand, the effect of the queuing for the pedestrian mode was measured with a Level of Server (LOS) defined by the Transportation Research Board of the National Academies, along with other issues such as safety and changes in demand.

The current conditions analysis and the historical LPOE information were used to develop traffic volume forecast models by mode. These models are based on the external factors (potential drivers) identified in Chapter 1 and additional statistical and probabilistic forecasting tools. The objective is to have a valid and defensible procedure to help determine the expected future traffic volumes through the LPOE in the short, mid and long term. In the last part of this study phase, the predicted volumes for these time frames are tested in the same queuing models. These tests will help establish the future conditions of the LPOE as a relationship of future demands and capacity.

CROSSING VOLUMES DETAILED ANALYSIS

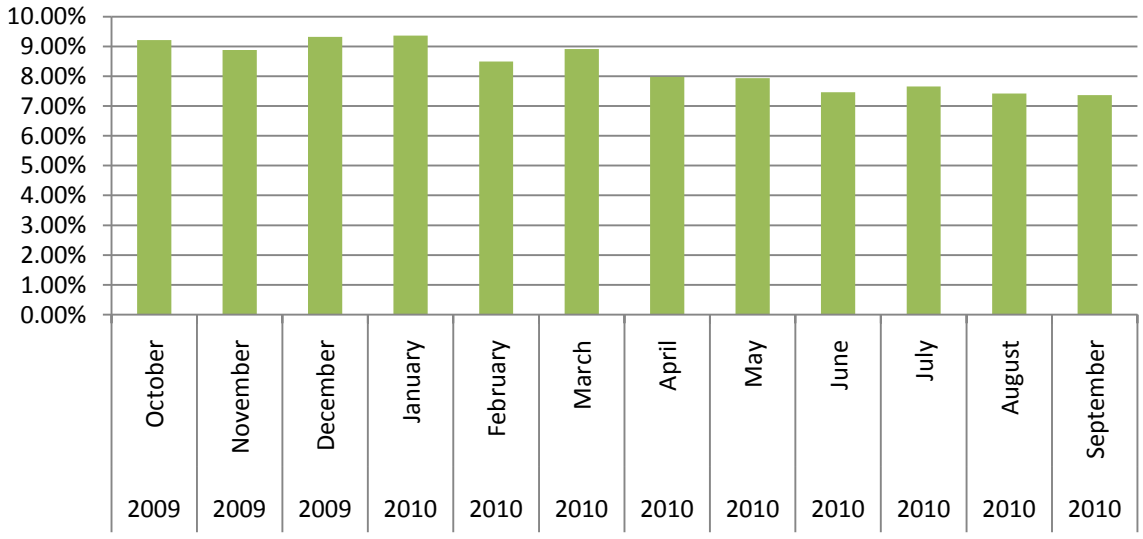
In Chapter 1, monthly volumes of the different transportation modes using the San Luis I LPOE, AZ were analyzed in order to identify their behavior throughout the year. In order to complement the research and analyses already performed, a more extensive analysis was conducted for the San Luis I LPOE, AZ crossing volumes. The purpose of this section is to discuss additional analyses of the historical traffic volume data which will complete the analysis of the current conditions, and will be utilized in the development of the future conditions.

The objective of this task is to have a finite perspective of the different border crossing behaviors during a period of time on a monthly, daily and hourly basis. To achieve this, hourly volumes of northbound crossings obtained from U.S. Customs and Border Protection (CBP) were explored in more detail. The initial step was to aggregate and/or segregate the data in year, month, week and day time intervals. The decomposition of the time series data in such fashion allowed for the identification of potential seasonal components and traffic loads during the day. It is relevant to note that these analyses are focused on POV and Pedestrian border crossing modes only.

Privately Owned Vehicles Border Crossing Volumes

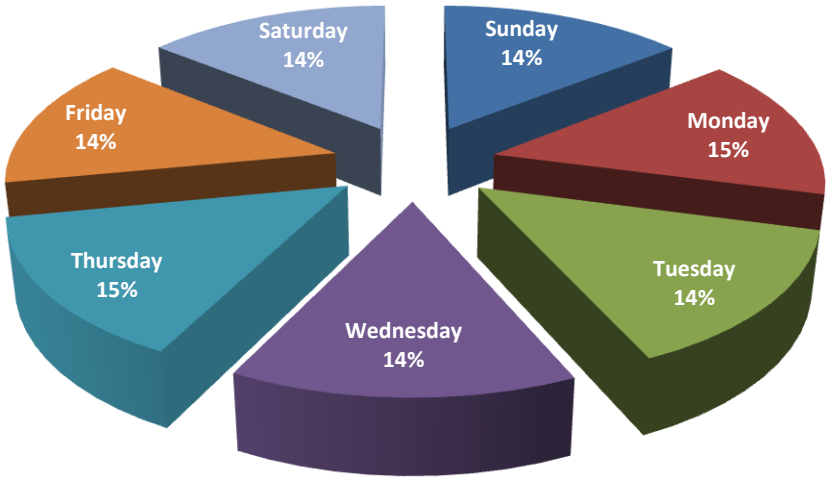
The POV mode, as the major motorized traffic crossing the border every hour, represents a major concern to the region environment and economy. The information provided by CBP for the POV volumes was analyzed more thoroughly and it was observed that the percentile changes of crossing volumes from month to month do not present significant variability; however, there is a significant difference between winter months and summer months. Figure 2.1 shows the monthly distribution of POV crossing volumes in FY 2010. A monthly average of 9% of the total yearly volume crosses the border from October to March. This percent is probably related to the agricultural season which generally starts in November and ends in April each year.

FIGURE 2.1: MONTHLY PERCENTAGE OF POV CROSSINGS (FY 2010)



Likewise, crossings volumes were analyzed on daily basis by comparing the number of vehicles crossing from one day to another. This comparison is presented on Figure 2.2. It can be observed that crossing volumes do not change significantly by day of the week; almost every day shows the same percentage with the exception of Monday and Thursday which present the higher volumes, though not a significant difference.

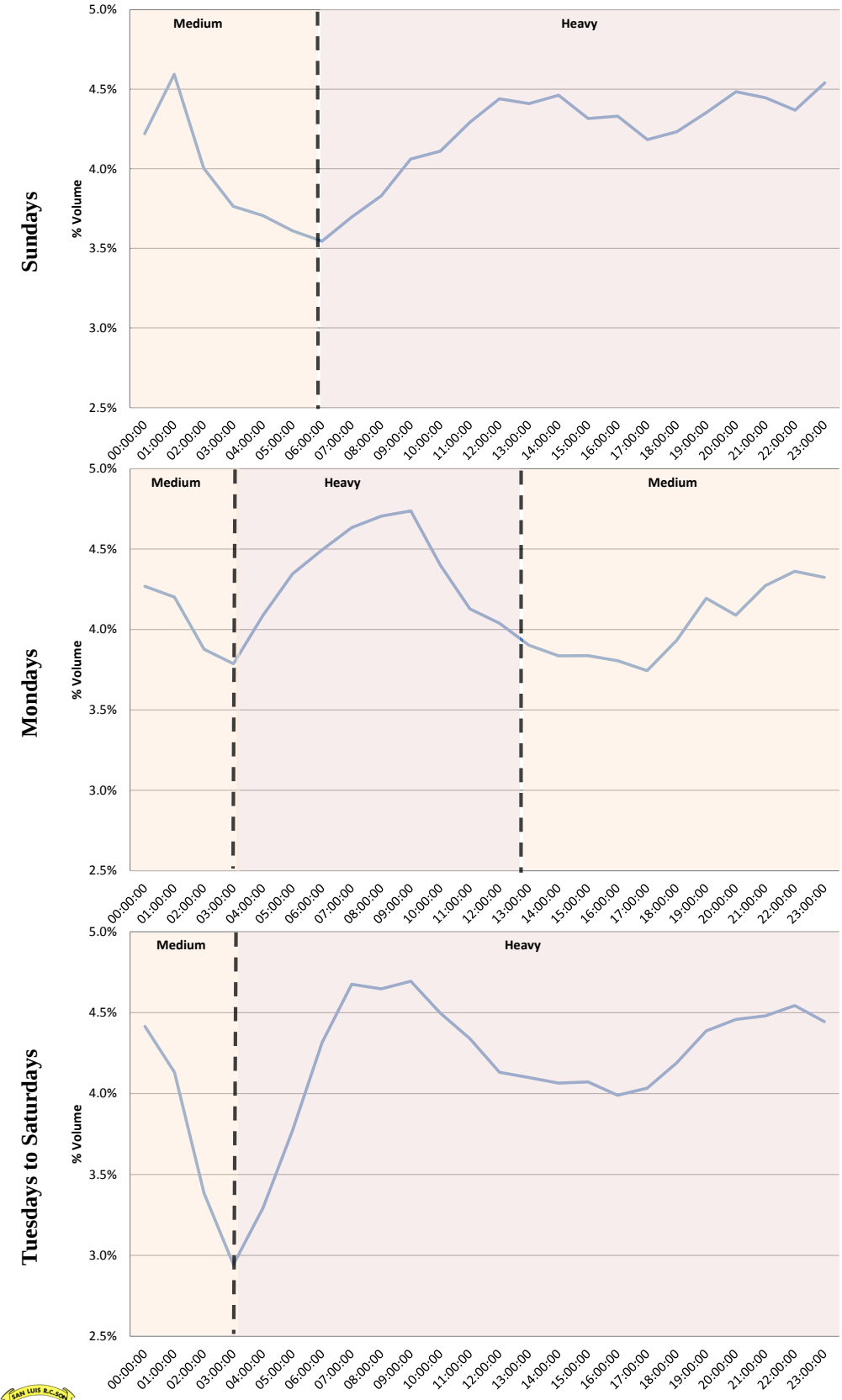
FIGURE 2.2: DAILY DISTRIBUTION OF POV CROSSINGS IN FY 2010



The next step consisted in creating a better resolution comparison. For this, the data was reduced to a crossing volumes distribution on hourly basis. The average of the processed POVs in the LPOE by hour demonstrates that different behaviors exist during the week. This is, the rush hours observed in the POV crossing border stations are a function of the time of the day and of the day of the week. From here, it was observed that crossing volumes have different distributions and behavior during the days of the week. Three behaviors were identified: (1) Sunday, (2) Monday, and (3) Tuesday to Saturday. This is related to the fact that people have different motives to cross the border on these different days and do so at different times during each day. Therefore it was decided to analyze these different days separately, as it was done previously for the waiting times (See Waiting Time Analysis at San Luis I LPOE section in Chapter 1). Figure 2.3 shows the POV crossing volume distributions for the different identified day-segments.

Figure 2.3 displays the different behavior for each day time period. The Sunday segment for instance, has medium traffic volume from midnight to 6:00 am; then it starts increasing and remains heavy for the rest of the day. The Monday segment presents a different behavior; a heavy percentage of the crossings occur during the morning hours, while the rest of the day presents a medium volume. The rest of the week presents a totally different crossing volume distribution; while there is a significant decrease from midnight to 3:00 am, the volume increases almost 2% and remains within this range all day long.

FIGURE 2.3: POV CROSSING VOLUME DISTRIBUTION BY HOUR AND DAY SEGMENT (FY 2010)



After reviewing the POV crossing data, the general conclusion is that different **days of the week** present different daily POV traffic through the LPOE. This is, the daily POV traffic change patterns only in the following day-segments:

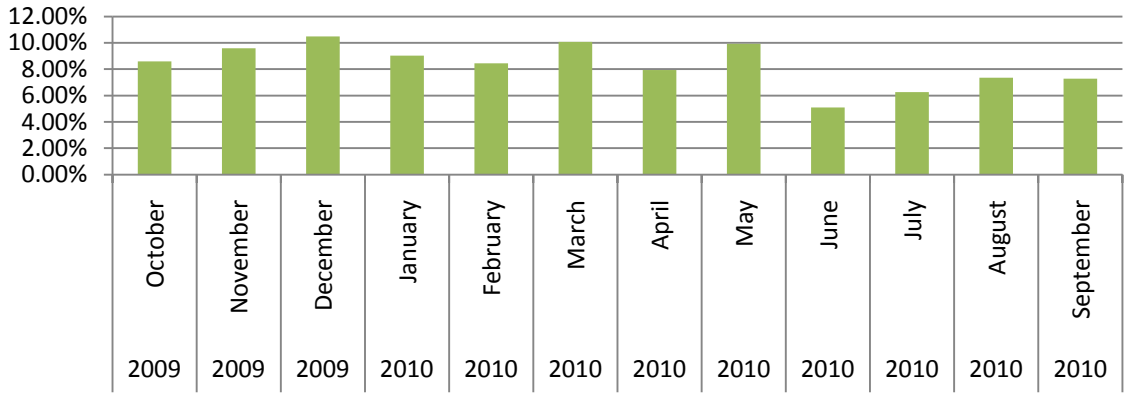
a) Sundays
b) Mondays
c) Tuesdays through Saturdays

Other explored time frames such as day of the month and month of the year have no noticeable effect on the traffic volumes. Therefore, only the segmentation frame by days of the week for motorized vehicles crossings was used during the queuing analysis presented in the following sections, as well as in the environmental and economic impact of the queues derived from this traffic.

Pedestrian Border Crossing Volumes

The pedestrian volumes were analyzed with a similar approach as the POV mode. CBP provided detailed information for the daily pedestrian crossings for FY 2010 which was examined in different timeframes as well; by months, weeks, days and hours through the year. Different conclusions surfaced from these analyses compared to the POV mode. It was found that pedestrians, crossing the border during the winter months, are almost 4% more than during the summer as shown in Figure 2.4. Previous studies suggest that this may be closely related to Yuma's County agriculture seasonality.

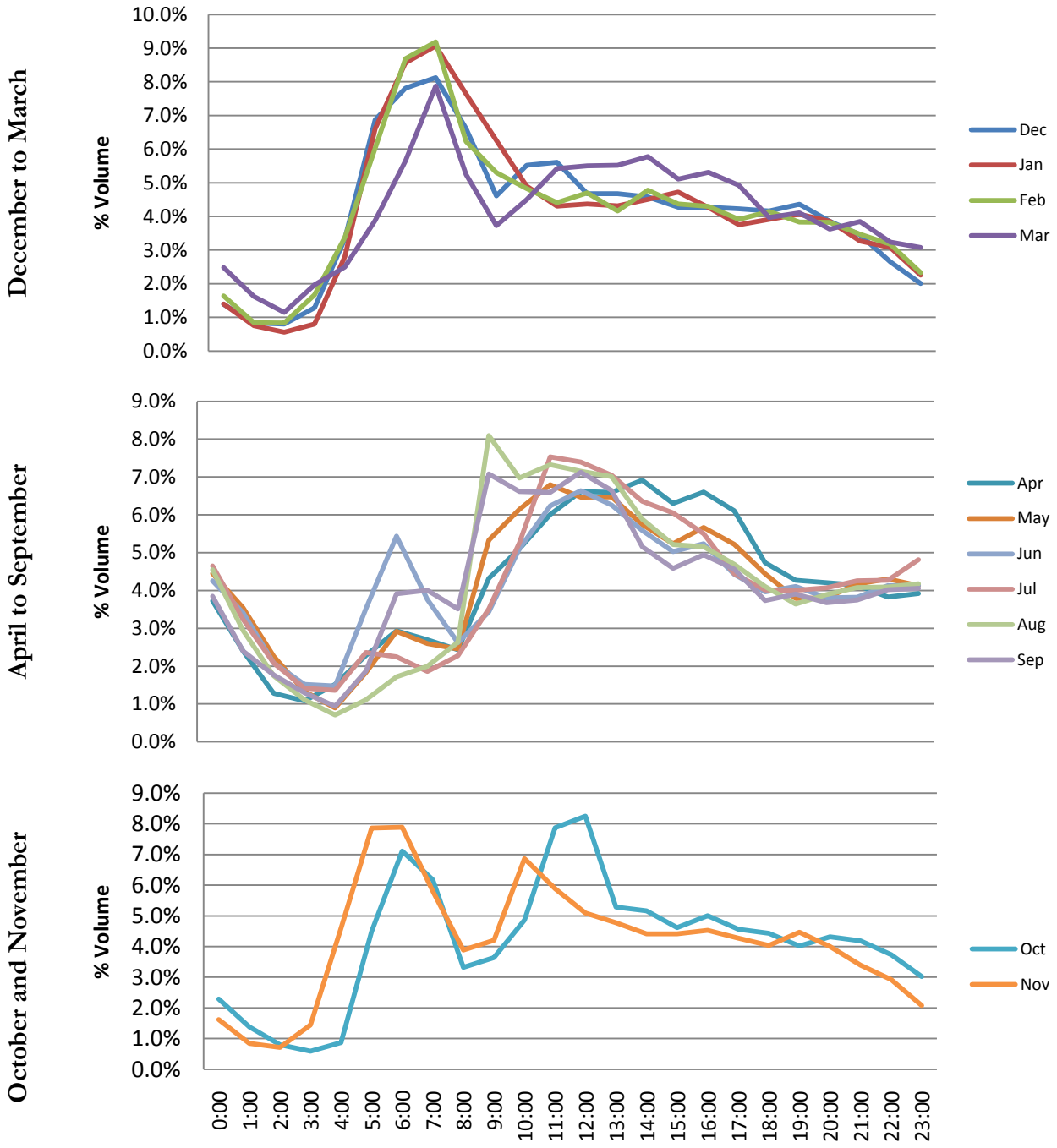
FIGURE 2.4: MONTHLY PERCENTAGE OF PEDESTRIAN CROSSINGS (FY 2010)



Using a more thorough method, the monthly separated data was analyzed to determine if this different behavior through the year was also observed on the weekly and daily basis. For this, the hourly crossings were laid out for every month and tested for differences. The crossing volume distributions through the day behave differently for each of the three parts of the year: (1) winter time, (2) summer, and (3) during the transition of these two seasons. Figure 2.5 shows the average pedestrian volume distribution of the day by hour within the three different time segments mentioned above.

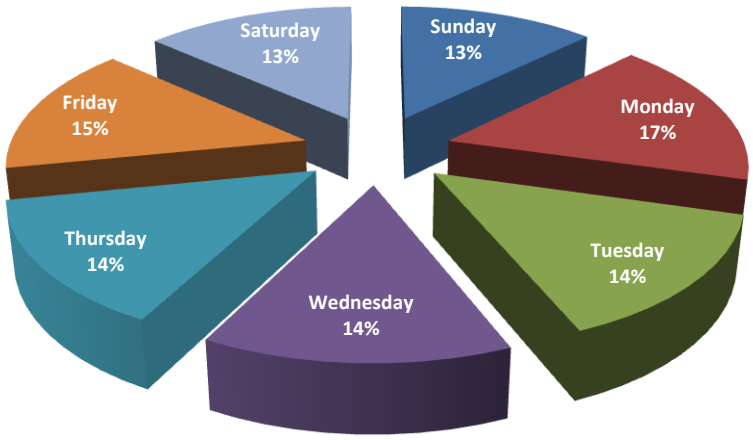
Figure 2.5 shows the proposed window comparisons for the pedestrian's crossings. From December to March the crossing peak hours are early in the morning, from 3:00 a.m. to 8:00 a.m. For the segment that considers the months of April to September the percentage of volume crossings increases towards mid-morning and ends in the afternoon. The last two months segment, October and November, shows a transition from summer to winter with peak hours at the morning and noon.

FIGURE 2.5: DIFFERENT MONTHLY BEHAVIORS OF PEDESTRIAN VOLUME CROSSINGS (FY 2010)



Moreover, an analysis of the daily pedestrian crossing distribution was performed. In Figure 2.6 one can observe that there is a slight increase of crossings during Mondays and a slight decrease during Saturdays and Sundays while remaining fairly even during weekdays.

FIGURE 2.6: DAILY DISTRIBUTION OF POV CROSSINGS (FY 2010)



Pedestrian crossings were also analyzed at a higher resolution to determine if the day of the week also represents a difference on the crossing volumes distribution during the day. It was determined that two different behaviors exist during the week. Figure 2.7 presents the hourly percentage of volume crossings by the identified segments: (1) Sundays, and (2) the rest of the week. These two segments present different crossings behavior through the day.

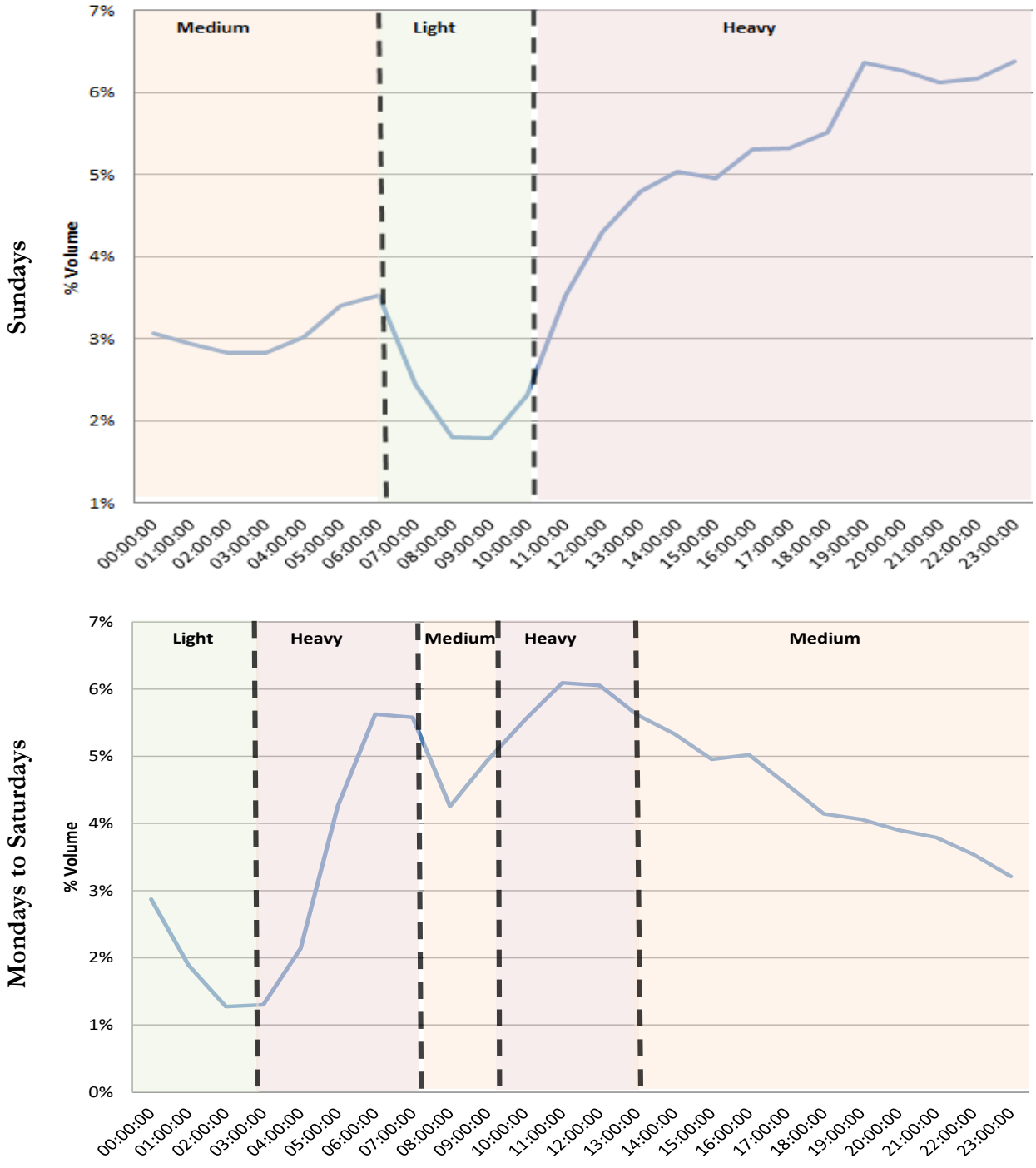
In Figure 2.7 one can observe that Sunday presents a small percentage of the daily volumes during the morning; as crossings start increasing during the evening they remain high until the end of the day. The rest of the week has a significantly different behavior from that of Sundays. For this week segment, higher crossing volumes occur from 3:00 am to 1:00 pm. This may be related to the labor hours of agriculture activities in the region.

After reviewing the pedestrians crossing data from the perspectives above, the general conclusion is that different time factors have certain effect on the daily pedestrian traffic through the LPOE. These time-factors are:

1. **Month of the Year**. The daily pedestrian traffic change patterns in the following months:
   a) December to March
   b) April to September
   c) October and November
2. **Day of the Week**. The daily pedestrian traffic change patterns in the following day-segments:
   a) Sundays
   b) Mondays through Saturdays

This aforementioned segmentation frame for crossing volumes was used during the queuing analysis presented in the forthcoming sections. The general impact of the queues derived from this traffic is also analyzed from this reference.

FIGURE 2.7: PEDESTRIAN CROSSING VOLUME DISTRIBUTION BY HOUR AND DAY SEGMENT (FY 2010)



ADDITIONAL ANALYSES ON SAN LUIS I LPOE, AZ CURRENT CONDITIONS

After the crossing volumes and their different behaviors during the day were identified, the next step was to examine the LPOE as an entity-flow system. The objective of these current conditions additional analyses is to create a model that can easily replicate these conditions (current demand vs. current capacity) and set a reference for future conditions analyses as well.

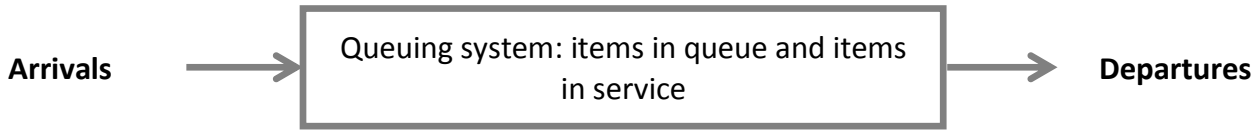
In order to discuss the main ideas related to the system analysis, the operational process followed by the entire LPOE system is shown first. This is followed by the POV queues analyses and a discussion of the observed situations during this process, such as the waiting times and how these queues affect the environment and the users' economy. Lastly, pedestrian queues analyses are also discussed along with a Pedestrian Level of Service (Ped-LOS) derived from the queues at the LPOE.

The systematic and mathematical processes performed to measure these impacts are presented in this section, followed by the results of these processes.

Analytical Queuing Models

Analytical models are mathematical models that can be used to interpret and predict a system behavior. There are different models that can be used in queuing theory and they can be classified based on how the system is structured using different elements. Figure 2.8 shows the basic flow of entities through queuing system.

FIGURE 2.8: FLOW OF ITEMS THROUGH A QUEUING SYSTEM



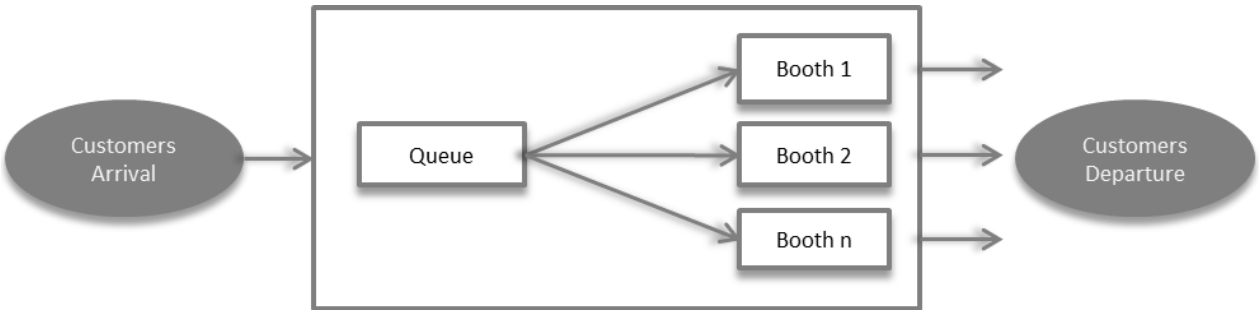
The queuing system considers different elements to study. The basic elements are:

- Arrival process
- Service process
- Number of servers
- Capacity of the servers
- Capacity of the queue
- Service methods and disciplines

The general system used to model the LPOE (for both POV and Pedestrians) functions as a single queue-multiple servers model. This is, customers will arrive to a queue, wait for a server (booth) to be idle, enter the booth for inspection procedures and then exit the system. Analyzing the LPOE as a single queue-multiple server system provides quick and acceptable results for the scope of study.

The model depicted in Figure 2.9 is considered for the LPOE analysis. In order to define important system characteristics, several assumptions and considerations are made. These are discussed next:

FIGURE 2.9: SINGLE QUEUE/MULTIPLE SERVERS MODEL



- **Arrival process.** - Includes the number of units arriving to the system and a certain behavior in the arrival times. Based on similar LPOE's studies the arrivals are considered to follow a Poisson process; this means the time between arrivals would be exponentially distributed.
- **Service process.** - It includes mainly the serving time; in this case it will be the time that takes to do the inspection process. Based on similar POE's studies, the serving rate of a booth at the POE follows an Erlang distribution Phase 4. For these queuing analyses different process times were considered. These times were based on information provided by San Luis, AZ LPOE direction and from the CBP Border Waiting Times report.
- **Number of servers available.** - It refers to the number of booths that could service customers at the same time. This information was retrieved from the CBP's public information and corroborated with San Luis, AZ LPOE Direction as well.
- **Capacity of the servers.** - The capacity considers how many entities can be inspected by each booth at the same time. For these analyses, and as part of the inspection process, only one entity can be assigned per booth.
- **Capacity of the queue.** - If there's a limit of space for queuing, this would be a resource that needs to be considered. In the LPOE analysis, the assumption for this parameter is that the space assigned for POV and pedestrian's queues is next to infinite.
- **Service methods and disciplines.** - The service methods are related to the requirements of each entity and/or the different service processes a single server provide. For this case, the assumption to follow is that all entities follow the same inspection process.

Moving into the mathematical schema used as part of the analytical models, for the general analysis of the queue Little Law's formula was used. The formulation of this law is presented as follows

$$L = \lambda W$$

Where:

$L =$ average number of items in the queuing system,

$W =$ average waiting time in the system for an item,

$\lambda =$ average number of items arriving per unit time.

Following this nomenclature, *L* is the number of vehicles in the queue at a certain time which is an estimate to be determined from field studies; *W* is the expected waiting time of the queue (which is available online through the BWT (Border Wait Time) system and provided by CBP; and λ (lambda) is the arrival rate of the vehicles calculated with queries of crossings provided by CBP. As mentioned above, the system is considered a single queue and multiple servers model.

This mathematical approximation assumes the system is stable, which means that it will remain unchanged for a long period of time. It is important to note that this is not to be totally accurate, but provides approximate results in terms of average queue lengths. The following sub-sections will consider these analytical models to identify the main queues behaviors and impacts for both privately owned vehicles and pedestrians.

Privately Owned Vehicle's Border Crossing Conditions

In this subsection the results obtained from the analytical models for the (POVs) border crossing are discussed. The estimated behavior of the POV queues is discussed followed by the suggested method to measure its impact in the region.

POV's Queues Behavior

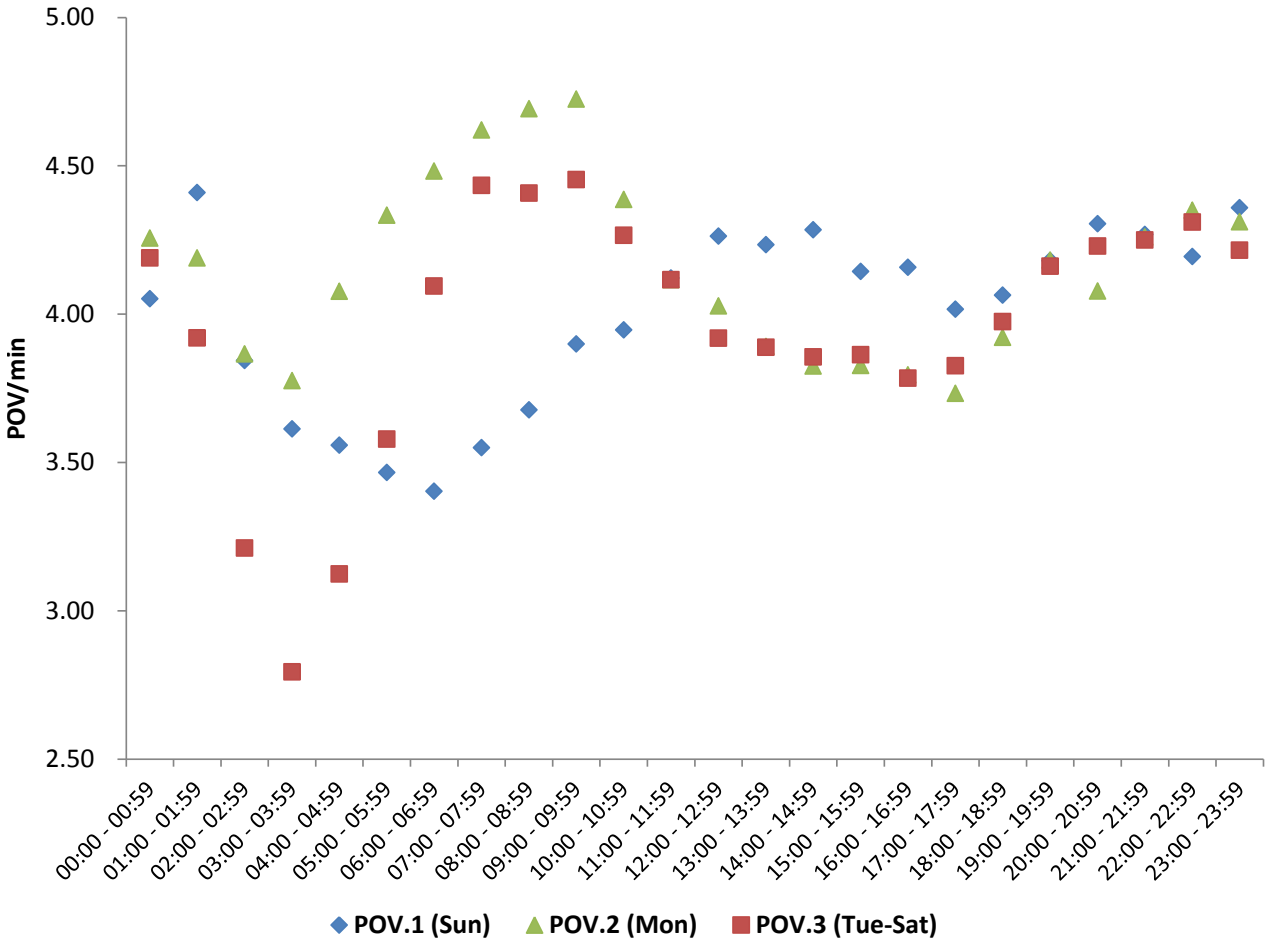
As mentioned before, a single queue/multiple servers model was used for the POV queuing analysis. According to the different behaviors of the crossings through the week observed in the Privately Owned Vehicles Border Crossing Volumes sub-section, queues were analyzed under the following segments:

TABLE 2.1: POV CROSSING MODE SEGMENTATION

Segment	Day
POV.1	Sundays
POV.2	Mondays
POV.3	Tuesdays through Saturdays

The analytical model was set to six open booths at all times, but different service cycle times are considered throughout the day. This cycle time includes the inspection time, the idle time of the booth, and the pull-up time; the second is fairly rare since the system is mostly at full capacity and the latter refers to the time from where one vehicle is released from inspection and the next moves forward. From the San Luis I LPOE, AZ data this cycle time is estimated to an average of 89.94 seconds, and the entire system has an average service rate of 4.04 vehicles per minute. Figure 2.10 shows the service rate per hour for the three different segments.

FIGURE 2.10: POV SERVICE RATE



It is important to note that a low rate does not equal a slow service. As this rate is estimated from the available cycle time's data, it reflects system utilization as well. Overall, the maximum observed rate serves 285 vehicles within an hour.

Table 2.2 presents the analyses' summary results for each segment. In the summary, each segment contains two attributes and three resulting figures. These are: (1) the open booths by hour, (2) the average waiting time in the queue by each vehicle, (3) the average cars in the queue, and (4) queue behavior –the latter is shown with a symbol (▲)for increasing queues and (▼) for decreasing or stable queues. Attributes (1) and (2) were retrieved from public databases during the early stages of the project (U.S. Bureau of Transportation Statistics 2012) and complemented by CBP (U.S. Customs and Border Protection 2012); result figures (3) and (4) were estimated by the analytical queuing models from the available data.

TABLE 2.2: POV QUEUING MODELS RESULTS SUMMARY

Hour	POV.1 (Sun) Open Booths: 6			POV.2 (Mon) Open Booths: 6			POV.3 (Tue-Sat) Open Booths: 6		
	WT (min)	Avg. Que. (POVs)	Status	WT (min)	Avg. Que. (POVs)	Status	WT (min)	Avg. Que. (POVs)	Status
0:00	59	238	▲	80	339	▲	26	108	▲
1:00	72	318	▼	75	315	▲	17	65	▲
2:00	73	279	▲	60	233	▲	11	34	▲
3:00	68	245	▲	52	195	▲	17	47	▲
4:00	63	224	▲	57	234	▼	29	92	▼
5:00	50	174	▲	66	286	▼	40	144	▼
6:00	35	119	▲	68	306	▼	45	183	▼
7:00	31	110	▼	69	320	▼	48	214	▼
8:00	36	131	▼	67	316	▼	49	216	▲
9:00	38	147	▼	67	319	▼	49	219	▼
10:00	41	160	▼	70	307	▲	48	207	▲
11:00	42	174	▼	70	287	▲	48	200	▲
12:00	45	193	▼	71	284	▲	50	196	▲
13:00	48	204	▲	73	283	▲	52	203	▲
14:00	54	231	▼	74	284	▲	54	209	▲
15:00	59	243	▲	78	299	▼	57	221	▼
16:00	63	262	▼	76	288	▲	55	209	▲
17:00	66	266	▲	72	270	▲	51	195	▼
18:00	66	270	▼	66	258	▼	44	173	▼
19:00	68	283	▼	59	245	▼	39	162	▼
20:00	72	311	▼	56	228	▲	38	161	▼
21:00	77	327	▲	56	240	▼	40	169	▼
22:00	80	338	▲	53	232	▼	40	174	▼
23:00	82	356	▼	45	193	▲	38	159	▲

For the POV border crossing, Mondays and late Sundays represent the longest queues and waiting times. During Monday's and Sunday's heavy hours an average of 300 vehicles are expected in the queue, as compared to the heavy periods for the other weekdays where the average expected vehicles in the queues is around 200 units.

It is important to note that these numbers represent the entire number of units in the system. If the two (2) uniform lanes configuration feed is assumed, then the average length of the queues is reduced.

The expected length of the two (2) queues that feed the system is shown in Figure 2.11. The assumed standard measurement for a vehicle, considering the spaces between entities is 25 feet. Table 2.3 presents the perceived length of both queues each hour.

FIGURE 2.11: EXPECTED QUEUE LENGTHS (2 QUEUES FEED SYSTEM)

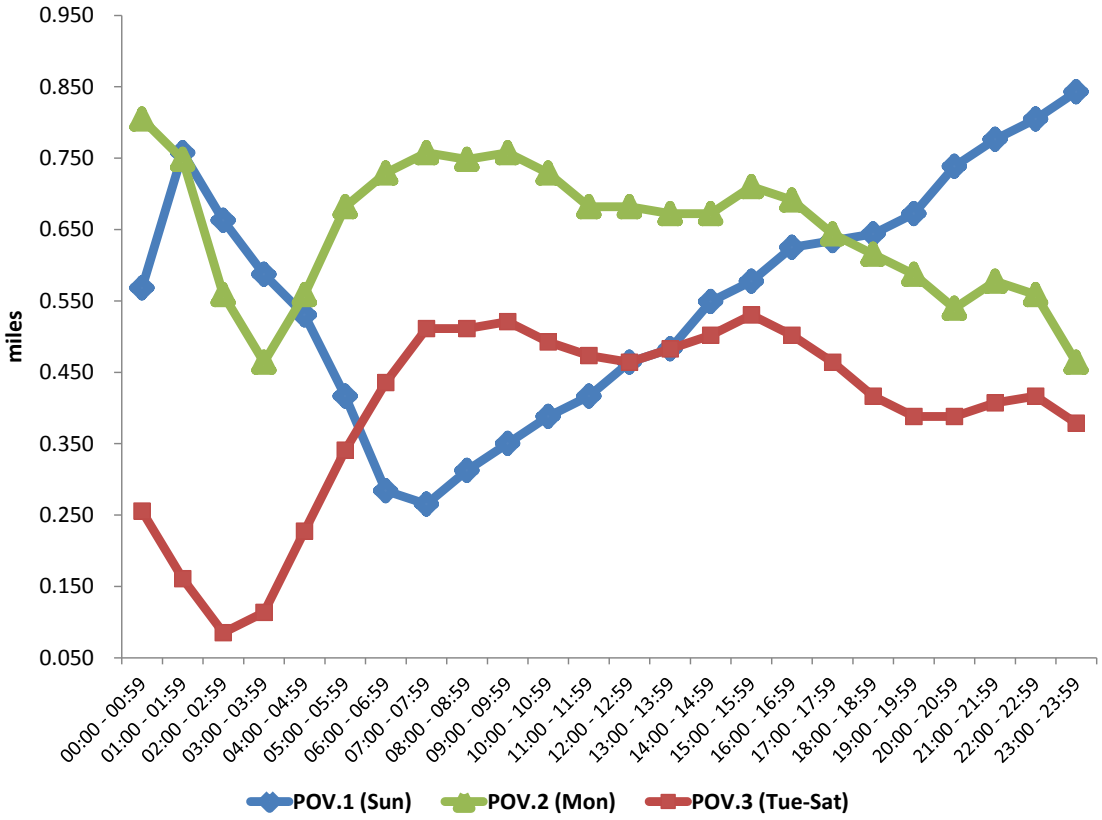


TABLE 2.3: LENGTH OF THE QUEUE (MILES)

Statistic	Sun (med)	Sun (hi)	Mon (med)	Mon (hi)	T-S (med)	T-S (hi)
Mean	0.54	0.56	0.62	0.70	0.15	0.44
Max	1.35	1.67	1.77	1.48	1.39	1.13

These overall results are to be considered in the next section to help identify the general impact of the queue in the region. In a similar fashion, they will be considered when analyzing the future system conditions.

POV's Queue and Idling Impact

Once the expected behavior of the POVs queuing to use the LPOE is identified, the next step is to measure its impact to the surrounding area in San Luis, AZ/San Luis Río Colorado, MX. In order to determine the general effect of the vehicles at the LPOE region two basic metrics were used: (1) the amount of gas spent due to idling, and (2) the CO2 emissions from the queuing vehicles. These provide a quick, yet quantifiable way to size the impact from the economic and environmental perspectives respectively.

Both of these metrics are function of the waiting times (or idle times), and the quantity of vehicles in the queue. The POV crossing mode's waiting times, explored in Chapter 1 and the previous sub-section POV's Queues Behavior, are summarized in Table 2.4.

TABLE 2.4: OBSERVED WAITING TIMES (MINUTES BY POV)

Statistic	Sun (med)	Sun (hi)	Mon (med)	Mon (hi)	T-S (med)	T-S (hi)
Mean	60	57	65	67	17	46
Max	160	161	234	160	175	141

Besides providing an overview of the implications of long waiting times at the LPOE, such as negative trends on users crossing for retail purposes that may impact the economy of both cities, this data is used to estimate the aforementioned metric values. Overall, the long waiting times imply hundreds of idle vehicles during the day. Studies show that idle medium size automobiles (i.e. with a three liters engine) burn approximately 8.45 U.S. fluid ounces of a gasoline in ten minutes, resulting in a huge economic impact due to the fuel consumption. This fuel consumption can be interpreted as another important issue: air pollution. An idle car burning one gallon of fuel will emit 20 pounds of CO_2 (carbon dioxide) into the atmosphere (Government of Canada 2009).

Considering these consumption and emission rates along the POV's waiting times and transit volumes an impact was determined with the proposed metrics. Table 2.5 presents an annual report of these estimations for the FY 2010 data (gas price: 3.44 USD/gal; source: U.S. Energy Information Administration 2010).

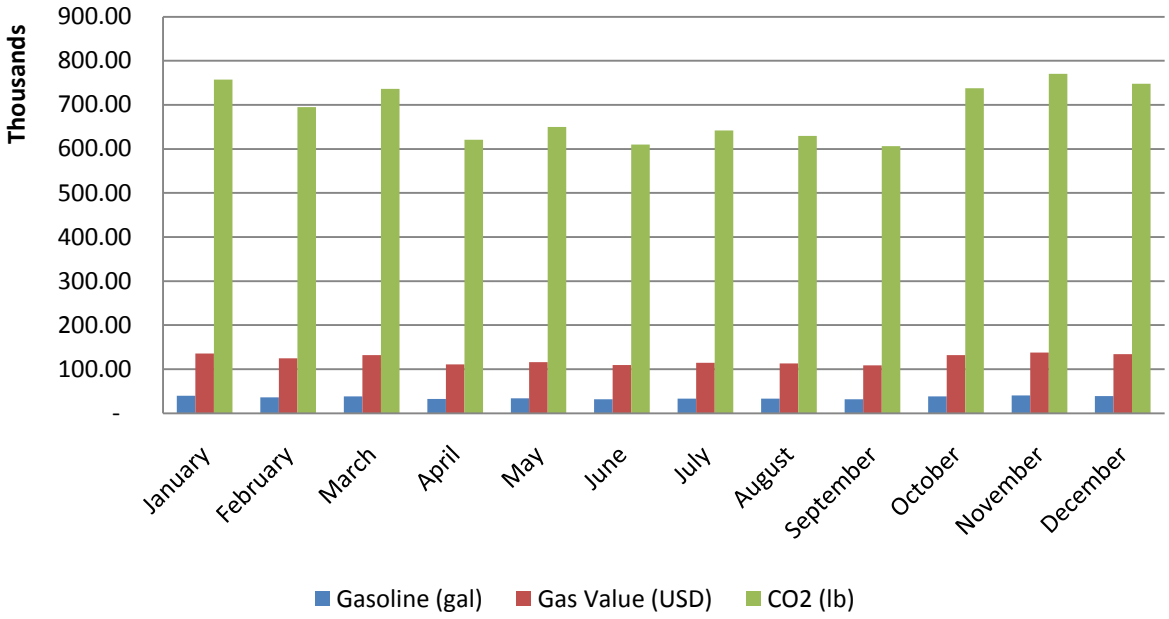
TABLE 2.5: ECONOMIC AND ENVIRONMENTAL EFFECTS OF POV QUEUING (FY 2010)

Month	Gasoline (Gal)	Gas Value (USD)	CO2 (lb)
January	39,468.76	$ 135,570.55	757,580.31
February	36,207.26	$ 124,367.68	694,977.66
March	38,340.58	$ 131,695.39	735,925.54
April	32,320.86	$ 111,018.35	620,380.42
May	33,850.12	$ 116,271.17	649,733.67
June	31,790.20	$ 109,195.61	610,194.79
July	33,428.46	$ 114,822.85	641,640.31
August	32,802.51	$ 112,672.77	629,625.45
September	31,587.71	$ 108,500.09	606,308.15
October	38,431.78	$ 132,008.67	737,676.18
November	40,116.61	$ 137,795.84	770,015.40
December	38,955.27	$ 133,806.79	747,724.27
Year	**427,300.11**	**$ 1,467,725.74**	**8,201,782.15**

An estimate of 430 thousand fuel gallons with a $1.5 million USD value is consumed by the idling vehicles at the San Luis I LPOE, AZ. This means an estimated 8.2 million CO_2 pounds emitted into the atmosphere as a consequence of idle mid-sized vehicle engines.

As shown in Figure 2.12, the impact is not only affecting the economic growth of the region; one must also consider the monetary impact to the LPOE users because of idle vehicles, the consumption of a non-renewable resource such as gasoline or diesel, and the environmental impact of CO_2 emissions.

FIGURE 2.12: IMPACT OF POV QUEUING (FY 2010)



As a reference, the New York City metropolitan area is a heavily congested traffic zone. It produces an average of 396 million CO_2 pounds a year by idling vehicles (Burgess, Peffers, and Silverman 2009). As shown in Table 2.6, the POV queues at the San Luis I LPOE, AZ produce 2.07% of the CO_2 produced by idle cars in New York; but if the CO_2 produced per vehicle at San Luis I LPOE is compared to the one produced per vehicle in the NYM area it is 186% higher, which is rather significant.

TABLE 2.6: ENVIRONMENTAL EFFECTS COMPARISON BETWEEN NEW YORK METRO AND SAN LUIS I LPOE, AZ

Region	Idle CO2 (lb/year)	Approx. Pop. in Region	Approx. Cars per Region	Idle CO_2 (lb/car)
New York Metro	396 M	18.9 M	10.78 M	36.74
San Luis AZ/SLRC MX	8.2 M	297,000	120,000	68.35
NYM vs. San Luis AZ/SLRC MX	**2.07%**	**1.57%**	**1.12%**	**186%**

Pedestrian's Border Crossing Conditions

As in the previous subsection, the results of the analytical model implementation for the pedestrian's border crossing mode are now discussed. First, the behavior of the queue is presented followed by a suggested method to measure the level of service observed by the users.

Pedestrian Queues

Pedestrian crossings were analyzed with the same single queue/multiple servers-model method. The analysis results are presented by the time segmentation shown in Pedestrian Border Crossing Volume sub-section. Table 2.7 shows a summary of the segmentation's dimensions used.

TABLE 2.7: PEDESTRIAN CROSSINGS ANALYSES SEGMENTATION

Segment	Day	Month
Ped.1	Sunday	All
Ped.2	Monday through Saturday	December to March
Ped.3	Monday through Saturday	April to September
Ped.4	Monday through Saturday	October and November

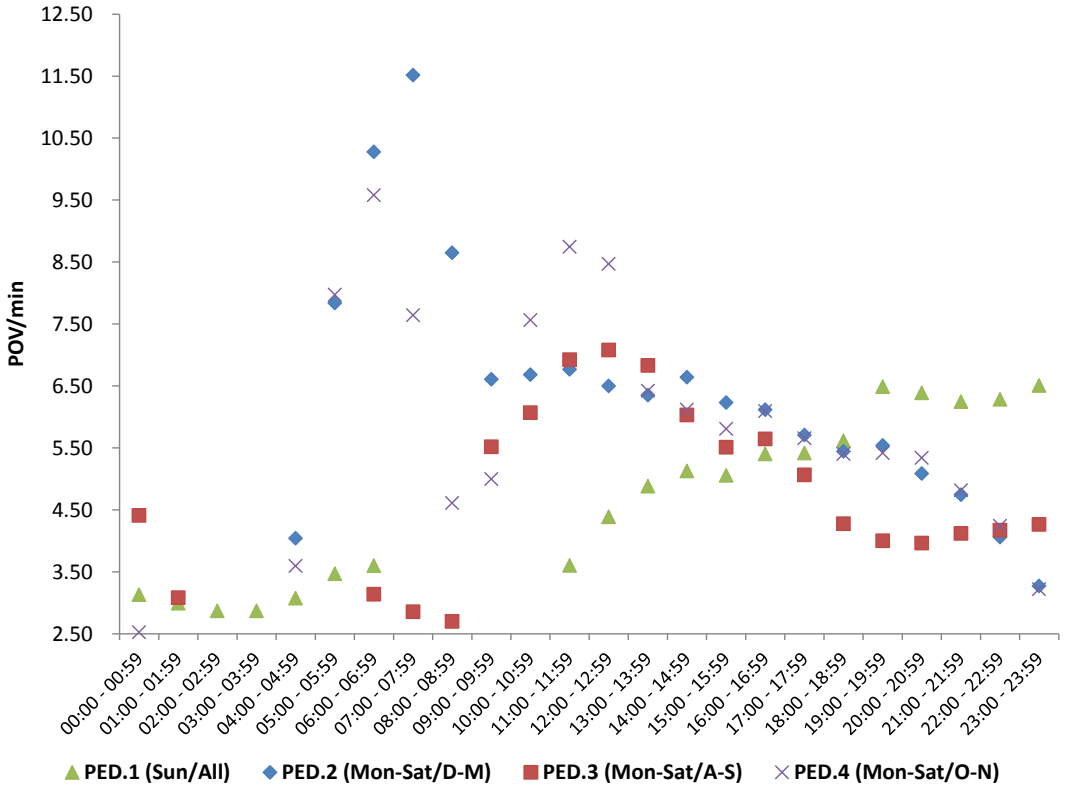
For this crossing mode, the analytical model was set to different open booths at the different times, and different service cycle times are considered throughout the day. This cycle time includes the inspection time, the idle time of the booth, and the pull-up time –the second is fairly rare since the system is mostly at full capacity and the latter refers to the time from where one pedestrian is released from inspection and the next moves forward inspection. From the San Luis I LPOE, AZ data, the cycle time and average service rate is estimated for the different segments and shown in Table 2.8. An important factor to consider is that when the line is getting long, additional officers open a couple of additional lanes to cover this demand, which is also added to the available servers (Schroeder 2012). In a similar way, Figure 2.13 shows the service rate per hour for the four different segments.

TABLE 2.8: PEDESTRIAN CAPABILITY BY SEGMENT

Open Booths per Segment				
Time	Ped.1	Ped.2	Ped.3	Ped.4
00:00 - 00:59	2	2	2	2
01:00 - 01:59	2	2	2	2
02:00 - 02:59	2	2	2	2
03:00 - 03:59	2	3	3	3
04:00 - 04:59	2	5	5	5
05:00 - 05:59	2	5	5	5
06:00 - 06:59	4	6	6	6
07:00 - 07:59	4	4	4	4
08:00 - 08:59	4	4	4	4
09:00 - 09:59	4	4	4	4
10:00 - 10:59	4	4	4	4
11:00 - 11:59	4	4	4	4
12:00 - 12:59	4	4	4	4
13:00 - 13:59	4	4	4	4
14:00 - 14:59	4	4	4	4
15:00 - 15:59	4	4	4	4
16:00 - 16:59	5	4	4	4
17:00 - 17:59	6	4	4	4
18:00 - 18:59	6	4	4	4
19:00 - 19:59	5	4	4	4
20:00 - 20:59	6	4	2	4
21:00 - 21:59	6	4	2	4
22:00 - 22:59	6	4	2	4
23:00 - 23:59	2	2	2	2
Average Cycle Time (sec)	60.47	47.93	64.56	51.80
Average System Service Rate (PED/min)	4.67	5.45	4.68	5.18

It is important to note that a low rate does not equal a slow service. As this rate is estimated from the available cycle time's data, it reflects system utilization as well. Overall, the maximum observed rate serves 11.50 pedestrians per minute. The highest rates are observed during the winter months.

FIGURE 2.13: PEDESTRIAN SERVICE RATE



Moving onto the analyses' results, the summary for each segment is presented in Table 2.2 in a similar way as in the POV section. In this summary, each segment contains one attribute and three result figures. These are: (1) the average waiting time in the queue by each user, (2) the average number of people in the queue, and (3) the queue behavior; the latter is shown with a symbol (▲) for increasing queues and (▼) for decreasing or stable queues. As mentioned in the POV section, attribute (1) is retrieved from BTS and complemented by CBP; result figures (2) and (3) were estimated by the analytical queuing models from available data.

Table 2.9 displays the busiest times for each segment. As mentioned before, the weekdays have different patterns throughout the months:

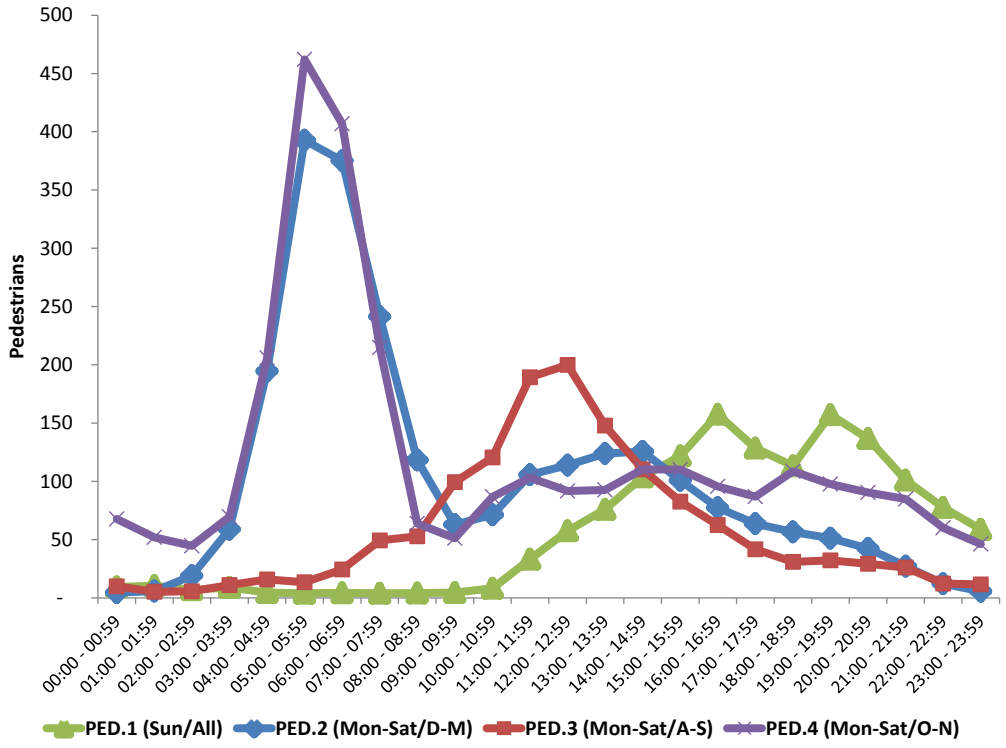
- Sunday's heavy traffic for all months occurs in the afternoons with an average of 115 people in queue.
- December to March shows the heaviest traffic is early in the morning (4 to 8 am) with an average of 270 users in queue.
- April through September shows the heavy traffic later in the morning and early afternoon (from 9 am to 2 pm) with an average of 150 people waiting for inspection.
- October to November show a relatively high pedestrian traffic throughout the whole day, with averages of 300+ people in queue in the busiest hours.

TABLE 2.9: PEDESTRIAN QUEUING MODELS RESULTS SUMMARY

Hour	PED.1 (Sun/All)			PED.2 (Mon-Sat/D-M)			PED.3 (Mon-Sat/A-S)			PED.4 (Mon-Sat/O-N)		
	WT (min)	Avg. Que. (Ped)	St	WT (min)	Avg. Que. (Ped)	St	WT (min)	Avg. Que. (Ped)	St	WT (min)	Avg. Que. (Ped)	St
0:00	3	9	▼	2	4	▼	2	10	▼	27	68	▼
1:00	3	10	▼	4	6	▼	2	5	▼	36	52	▼
2:00	2	7	▼	17	19	▲	3	6	▼	46	45	▲
3:00	3	9	▲	30	59	▲	8	11	▼	52	69	▲
4:00	1	4	▲	48	194	▲	14	16	▲	57	206	▲
5:00	1	4	▲	50	393	▲	6	13	▲	58	462	▲
6:00	1	4	▼	36	375	▲	8	24	▼	42	407	▼
7:00	2	4	▼	21	241	▼	17	49	▼	28	215	▼
8:00	2	4	▼	14	118	▼	20	53	▲	14	64	▲
9:00	2	4	▲	10	63	▲	18	99	▲	10	51	▲
10:00	3	8	▲	11	71	▲	20	121	▲	11	87	▲
11:00	9	33	▲	16	106	▼	27	189	▲	12	103	▼
12:00	13	57	▲	18	114	▼	28	200	▼	11	92	▼
13:00	16	76	▲	20	124	▲	22	148	▼	14	93	▼
14:00	20	104	▼	19	126	▼	18	110	▼	18	110	▼
15:00	24	122	▲	16	101	▼	15	83	▲	19	110	▲
16:00	29	158	▲	13	77	▼	11	62	▼	16	96	▼
17:00	24	128	▲	11	64	▼	8	42	▼	15	87	▼
18:00	20	113	▲	10	56	▲	7	31	▼	20	109	▲
19:00	24	157	▼	9	51	▼	8	32	▼	18	98	▼
20:00	21	137	▼	8	42	▼	7	29	▲	17	90	▼
21:00	16	101	▲	6	27	▼	6	26	▲	18	85	▼
22:00	12	78	▲	3	12	▼	3	12	▲	14	60	▼
23:00	9	59	▼	2	6	▼	3	12	▲	14	46	▼

As presented previously, days from Monday to Saturday have three different behaviors through the year, winter and summer time, and the transition of the agricultural seasons. The number of open booths changes from winter to summer. This is related to the fact that during the winter months the SENTRI and bicycle lanes are open from 6:00 a.m. to 10:00 p.m., while during summer these lanes are open until 7:00 p.m. Figure 2.14 shows a graphical representation of the average queues for each pedestrian border crossing segments. The behavior of the queue has an impact to the level of service observed by the LPOE users. The expected level of people in line is used to evaluate the congestion in the pedestrian area.

FIGURE 2.14: EXPECTED PEDESTRIANS IN QUEUE



Level of Service for Pedestrian Border Crossing

Pedestrian traffic service levels at the LPOE were estimated using the expected queue lengths, pedestrian flows and speed of the queue. Ped-LOS is a measurement used to evaluate the capacity and comfort for an active pedestrian space. According to the proposed metric, for a queue ranked with a LOS "A" pedestrians can move freely and no conflict occurs with other pedestrians. On the other hand, a level "F" queue presents unavoidable contact with others and severely restricted speeds. This can be easily determined by the volume-to-capacity ratio, which is the existing relationship between the demands (in terms of pedestrian's arrivals per minute to the queue, ***v***) and the service rate of the system (pedestrians that can be inspected by the system per minute, ***c***). Table 2.10 contains the different ranges of volume to capacity ratio and corresponding LOS used in the evaluation of the queues behavior. (Kittelson & Associates, Inc 1999).

TABLE 2.10: PEDESTRIAN LEVEL OF SERVICE REFERENCE

Ped-LOS	Expected Flows and Speeds (volume/capacity ratio)
A	0.0 - 0.3
B	0.3 - 0.4
C	0.4 - 0.6
D	0.6 - 0.8
E	0.8 - 1.0
F	>1.0

This ratio interprets the system's ability to work through the required demand. The closer to 1 the ratio is (or above) means that the arrivals are faster than the service rates; on the other hand, lower ratios represent those times where the system flows faster than the arrivals. Table 2.11 shows the estimated LOS for the San Luis I LPOE, AZ pedestrian's crossings for FY 2010 by the different time segments. Overall, most parts of the segments are highly congested with Ped-LOS of "E" and "F". The best Ped-LOS identified is "C", which occurred only in very few time intervals.

TABLE 2.11: PEDESTRIAN LOS

Hour	PED.1 (Sun/All)		PED.2 (Mon-Sat/D-M)		PED.3 (Mon-Sat/A-S)		PED.4 (Mon-Sat/O-N)	
	v/c ratio (ρ)	LOS	v/c ratio (ρ)	LOS	v/c ratio (ρ)	LOS	v/c ratio (ρ)	LOS
0:00	0.96	E	0.59	C	0.70	D	0.56	C
1:00	0.96	E	0.82	E	0.62	D	0.69	D
2:00	1.00	E	1.72	F	0.68	D	1.37	F
3:00	1.07	F	2.07	F	0.88	E	2.67	F
4:00	1.13	F	1.94	F	1.85	F	2.22	F
5:00	1.04	F	1.31	F	1.48	F	1.20	F
6:00	0.69	D	1.12	F	0.91	E	0.80	D
7:00	0.74	D	0.75	D	0.95	E	0.60	D
8:00	0.99	E	0.76	D	2.04	F	1.08	F
9:00	1.30	F	1.01	F	1.10	F	1.51	F
10:00	1.53	F	1.01	F	1.14	F	1.16	F
11:00	1.22	F	0.96	E	1.02	F	0.97	E
12:00	1.11	F	0.98	E	0.96	E	0.76	D
13:00	1.05	F	1.05	F	0.88	E	0.95	E
14:00	0.99	E	0.94	E	0.91	E	0.95	E
15:00	1.07	F	0.98	E	1.02	F	1.05	F
16:00	1.00	F	0.93	E	0.90	E	0.93	E
17:00	1.04	F	0.95	E	0.84	E	0.96	E
18:00	1.16	F	1.02	F	0.94	E	1.00	F
19:00	0.98	E	0.92	E	0.99	E	0.99	E
20:00	0.98	E	0.93	E	1.04	F	0.90	E
21:00	1.01	F	0.86	E	1.01	F	0.88	E
22:00	1.04	F	0.81	E	1.02	F	0.76	D
23:00	0.48	C	0.72	D	1.03	F	0.78	D

SYSTEM ANALYSES ON SAN LUIS I LPOE, AZ FUTURE CONDITIONS

One of the main focuses of this Chapter is to complement the analyses of the LPOE future conditions, which will be address in this section. The best approach to present the analysis and its results is to divide this section into two main topics: forecast and analytical modeling. The forecasts in this study are based on statistical models that seek to predict the behavior of the crossing volumes at the LPOE. This is achieved by establishing a mathematical relationship between the relative change of certain economic variables and the crossing volumes. The analytical modeling of the future conditions will consider the results of both the proposed LPOE queuing models and the traffic forecast models. In a similar way as for the current conditions, the predicted demands are to be tested over the current capacities to determine its impact. At the same time, this would help determine the required capacity (i.e. operations and/or infrastructure wise) for the LPOE to align with future demand. The analytical modeling of the LPOE system can assist in the evaluation of any changes in either volume or capacity without incurring large investments such as prototypes or construction. Nevertheless, the first step is to identify the future border crossing volumes.

The LPOE Future Volume Forecasts

One of the main objectives of this study is to provide recommendations for future infrastructure and capacity needs at the San Luis I LPOE, AZ. These recommendations are mostly based on projected usage of the border infrastructure in 5, 10 and 20 years into the future for different modes of transportation primarily POV and pedestrian. For this purpose, analytical and statistical tools are used to analyze historical data of the external factors in order to identify pattern and behaviors in the dataset that interact with border crossings and that can explain their variability. Once the factors' interactions are identified, one can use this information to forecast future changes in the patterns of border crossings.

Forecast Methodology

The following outlines the general steps in this methodology:

1. Based on expertise knowledge, gather important factors that can potentially cause variability in the number of border crossings
2. Pre-process the data for consistency in resolution, time frame, trend, seasonality, etc.
3. Use statistical methods (regression analysis) to analyze candidate external factors
4. Form a statistical model that can explain the variability in the number of border crossings per mode of transportation
5. Test and select an adequate forecasting procedure that can use the results provided by the regression analysis to develop future projections of infrastructure usage for different modes of transportation

Once this methodology has been completed, the next step is to develop future projections of border crossings.

Explanatory Models

As discussed earlier, during the first phase of the project an explanatory model was developed to help identify the most relevant factors with respect to variations in the number of border crossings. For the purposes of this study, a regression analysis is performed on the candidate factors in order to identify their relevance. Nonetheless, since border crossing are time dependent, one of the major problems with the data is its inherent trend, and in some cases seasonality. Additionally, for some variables, their measurement intervals can be different and thus have to be adjusted. For example, crossings could be measured per day, week, or month, but industrial production is only available by month. Therefore, one of the first steps in the development of the explanatory models is to prepare the data by making sure time periods are comparable, major outliers are identified, and other efforts are pursued to ensure consistency between explanatory variables and forecast variables.

Collection and Pre-Process of Data

The first step in the process is to gather historical data of external factors that could potentially have an impact on the volume of border crossings per type of mode at the LPOE, truck, POV, and pedestrian. This data collection process is performed primarily in two ways; first through the gathering of publicly available data, and second through direct requests and/or f*reedom of information* mechanisms (the latter of which was used mainly in Mexico). Most of the data collected at this stage of the study is related to the macroeconomic, social and demographic conditions in the San Luis, AZ/San Luis Río Colorado, MX region.

Table 2.12 presents the measurement intervals, or resolution of the data that is available from the different sources for all of the variables considered. As one can observe, most of the data was collected with at the monthly level, while some economic indicators such as GDP are only published on a quarterly basis. Additionally, the monetary exchange rate between the Mexican Peso and the U.S. Dollar is available on a daily basis. All of the variables were ultimately converted to a monthly basis using a linear fit for those months without data. In the case of the exchange rate, the rate published for the first day of the month was used.

TABLE 2.12: RESOLUTION AND PRE-PROCESS OF DATA

Variable (abbreviation)	Data Resolution	Conversion to Monthly
Commercial Trucks (trk)	Monthly	None
Privately-Owned Vehicles (pov)	Monthly	None
Pedestrians (ped)	Monthly	None
IMSS*-Farm (ssf)	Monthly	None
IMSS-Commerce (ssc)	Monthly	None
IMSS-Transformation (sst)	Monthly	None
IMSS-Services (sss)	Monthly	None
IMSS-Other Sectors (sso)	Monthly	None
IMSS-All Sectors (sum of all in SLRC) (ss)	Monthly	None
IMSS-All Sectors (sum of all in P. Peñasco) (sspp)	Monthly	None
IMSS-All Sectors (sum of all in Plutarco E.C.) (sspec)	Monthly	None
Gold Production (SLCR) (gold)	Monthly	None
Gold Production (Plutarco E.C.) (goldp)	Monthly	None
Silver Production (silv)	Monthly	None
Crime in State of Sonora (crim)	Monthly	None
Homicides in State of Sonora (hom)	Monthly	None
Personal Income in AZ (piaz)	Quarterly	Linear Fit
Compensation in AZ (caz)	Quarterly	Linear Fit
Wage in AZ (waz)	Quarterly	Linear Fit
Index of Industrial Production in MX (iipm)	Monthly	None
Index of Industrial Production in U.S. (iipu)	Monthly	None
Consumer Price Index in MX (cpim)	Monthly	None
Consumer Price Index in U.S. (cpiu)	Monthly	None
Gross Domestic Product in MX (gdpm)	Quarterly	Linear Fit
Gross Domestic Product in U.S. (gdpu)	Quarterly	Linear Fit
Diesel price (dslp)	Monthly	None
Gasoline price (gasp)	Monthly	None
Personal Income in U.S. (piu)	Monthly	None
Monetary Exchange Rate (exch)	Daily	First month day
Main Agricultural Production in Yuma County, AZ (agri)**	Monthly	None

*Beneficiaries of the Mexican Institute of Social Security program (active registered employees) for different sectors.
**The produce considered for this variable is broccoli, cauliflower, and lettuce (iceberg and romaine).

Once the resolutions (time frames) for the variables are consistent, the next step is to determine the length of history for the analysis. One should use the data that can provide a satisfactory representation of future behavior. Therefore, a historical plot of each of the variables was used in order to isolate any one time or unusual changes in the data that could affect the behavior and the reliability of the models being developed. One can observe that the events of September 11, 2001, have a drastic effect on the behavior of most of these variables, as discussed in Chapter 1.

Therefore, in order to better represent future interactions between these variables, it is best to omit time frames that may be affected by extraordinary events. The selected window of time to use for this project's analyses starts from March, 2002 to May, 2011.

Data collected over time often reflects both long term trends and seasonality. In this case, the interest of this study lies in determining the effect of the variables on the number of border crossings by transportation mode. Thus, the analysis focused mainly on the effect of the variable changes by only using the first-order differentials (or month-to-month changes). This "differencing" filters out much of the dependency of the variables on characteristics like trend and seasonality. Ultimately, the regression analysis for selecting the external factors is performed based on the relationship between the changes of the independent variables and the changes of the dependent variable (Truck, POV, and Pedestrian crossings).

Sub-Selection of External Factors per Mode of Transportation

The initial selection of the external factors was performed primarily based on general and empirical knowledge of the area. However, this knowledge does not mean that there is in fact a strong relationship between the external factors and the number of border of crossings. For this purpose, the data pre-process should also be used to identify those factors whose time series have the highest correlation with historical border crossings data. This correlation must also consider any lag that may exist, since one cannot assume that changes in one factor immediately affect the other.

Table 2.13 shows the correlation of the external factors with the number of border crossings by mode of transportation. Since the analysis is performed on the first-order differentials of the data, these values represent the correlations between the monthly changes of each external factor to the monthly changes in the number of border crossings. Additionally, as mentioned previously, the lag that exists in the correlation between these variables must be accounted for. In Table 2.13 each factor is represented by its acronym shown in Table 2.12; its highest correlation with the response variable; and the months of lag at which this correlation occurs. Finally, one must note that if a negative lag was chosen; this means that a change in the value of the external factor precedes a variation in the number of border crossings.

TABLE 2.13: HIGHEST LAGGED CORRELATIONS PER EXTERNAL FACTOR

Mode	Variable/Correlation Level/Lag				
PED	ss/0.231/-5	**sspp/0.164/-2**	sspec/0.272/-5	ssf/0.167/0	**ssc/0.231/-4**
	sst/0.197/-5	**sss/0.219/-8**	**sso/0.263/-4**	gold/0.195/0	goldp/0.127/-4
	silv/0.256/-6	**crim/0.211/-6**	**murd/0.214/-5**	drug/0.241/-7	**piaz/0.224/0**
	caz/0.227/0	**waz/0.227/0**	iipm/0.071/-6	**cpim/0.506/-11**	**gdpm/0.288/-3**
	iipu/0.477/-9	**cpiu/0.287/-6**	gdpu/0.223/0	dslp/0.141/-6	**gasp/0.244/-7**
	piu/0.180/-12	exch/0.188/0	**agri/0.595/0**		
POV	ss/0.143/-6	**sspp/0.228/-6**	**sspec/0.241/-3**	ssf/0.182/-3	ssc/0.109/-1
	sst/0.127/-6	sss/0.179/-10	**sso/0.227/-2**	gold/0.166/-7	goldp/0.193/-1
	silv/0.195/-6	crim/0.191/-1	**murd/0.208/-5**	drug/0.101/-10	piaz/0.048/0
	caz/0.050/0	waz/0.050/0	iipm/0.078/-3	**cpim/0.200/-1**	gdpm/0.146/-5
	iipu/0.424/-7	cpiu/0.134/-7	gdpu/0.048/0	dslp/0.146/-7	gasp/0.147/-8
	piu/0.162/-10	exch/0.088/-9	**agri/0.369/0**		
TRK	**ss/0.269/-5**	**sspp/0.386/-4**	**sspec/0.219/-8**	**ssf/0.242/-1**	**ssc/0.297/-3**
	sst/0.233/-5	sss/0.186/-11	sso/0.156/-7	**gold/0.254/-10**	goldp/0.120/-6
	silv/0.248/-9	**crim/0.258/-4**	murd/0.120/-3	drug/0.114/-8	**piaz/0.304/0**
	caz/0.305/0	**waz/0.305/0**	iipm/0.085/-8	**cpim/0.510/-11**	**gdpm/0.354/-3**
	iipu/0.337/-9	**cpiu/0.262/-6**	**gdpu/0.302/0**	dslp/0.177/-7	**gasp/0.277/-7**
	piu/0.116/-10	**exch/0.284/-12**	**agri/0.595/-0**		

From the Table 2.13, one can observe that there are variables that have higher lagged correlation levels for the different modes of transportation. For the purpose of this study, those variables with correlations higher than **0.20** are used as the candidate factors (in **bold**) for explaining the variability in the number of border crossings. These external factors are selected for further analysis.

Regression Analysis of Candidate External Factors

In order to determine the factors that most affect the number of border crossings, regression analysis is performed on the lagged time-series for the candidate variables. As explained earlier, these variables are represented as the first-order differentials. Thus, the regression analysis helps identify those factors whose changes in value are most strongly associated with the changes observed in the number of border crossings by transportation mode. Once the primary factors are identified, the data values are transformed back to their original values to develop the forecast models.

Regression models are constructed based on the basic rules of regression analysis, which include constraining to the basic assumptions of linearity such as the normality and constant variance in fitted versus actual plots, as well as independence of time. The objective of this analysis is to identify the combination of factors that ultimately can explain the variability in the number of border crossings. The null hypothesis for each variable in the model states that if rejected, the probability of

having done so in error should be less than 5%. Additional considerations in the model construction process include identifying outlier value points and reducing the *multicollinearity* between the selected variables.

Table 2.14 summarizes the final regression model developed by transportation mode. As mentioned earlier, since the data is transformed to its first-order differentials, this model represents the changes in the number of border crossings as a response to the changes in each factor in the model. In the right-most column is the adjusted R^2, which represents the variability in the response explained by the model. In other words, 35.7% of the variability in the changes of truck border crossings is represented by the factors in the model. The models for POV and Pedestrian crossings show that 27.0% and 39.5% variability observed in the border crossings' month-to-month fluctuations respectively.

TABLE 2.14: FINAL REGRESSION MODEL (FIRST-ORDER) BY TRANSPORATION MODE

Border Crossing Mode	Regression Model Coefficients*LAG	R^2 adj
ΔPED	4997 * ΔIIPU-9 + 0.2519 *ΔAGRI0	39.5%
ΔPOV	3090 * ΔIIPU-7 + 0.08763 *ΔAGRI0	27.0%
ΔTRK	361 * ΔEXCH-12 + 0.00563 *ΔAGRI0	35.7%

These R^2 values are considered satisfactory considering they represent the users' decisions through economic and demographic factors. They are deemed acceptable for potential consideration in the development of the predictive models. These variables are used as external factors for making future border crossing forecasts. The factors are summarized again in Table 2.15.

TABLE 2.15: MAIN IDENTIFIED DRIVERS OF TRANSPORTATION CROSSINGS BY MODE

Border Crossing Mode	External Factors with High Correlation To Border Crossings
Pedestrian	Index of Industrial Production in the United States (nine-month lag) Main Agricultural Production in Yuma County, AZ (no lag)
Privately-Owned Vehicle	Index of Industrial Production in the United States (seven-month lag) Main Agricultural Production in Yuma County, AZ (no lag)
Truck	MXN/USD Exchange Rate (twelve-month lag) Main Agricultural Production in Yuma County, AZ (no lag)

Forecasting Models

Once the main factors were identified by the correlation/regression analyses, the next step is to build the forecasting models for the main transportation modes using the San Luis I LPOE, AZ. Following the methodology presented in the previous section, the forecasting modeling of the port traffic volumes focuses on the following main activities:

1. **Testing and determination of the best forecast method for the external drivers.** This activity searches for different ways to forecast the macro and micro economic factors identified as main drivers of the transportation mode behavior. The methods tested rely on a variety of statistics and probabilistic tools and are all based on the available historical data.

2. **Testing and determination of the best forecast method for each transportation mode**. This step is required to consider the different factors that can be used for the forecast (i.e. seasonal behavior, external drivers, historical data, breakpoints, or the combination of these). In the same fashion as for the drivers' forecasts, several statistical and probabilistic tools are explored for the best results. This test considers model stability and ease of approach. A method that is both easy to apply, easy to interpret and with acceptable results is preferred.

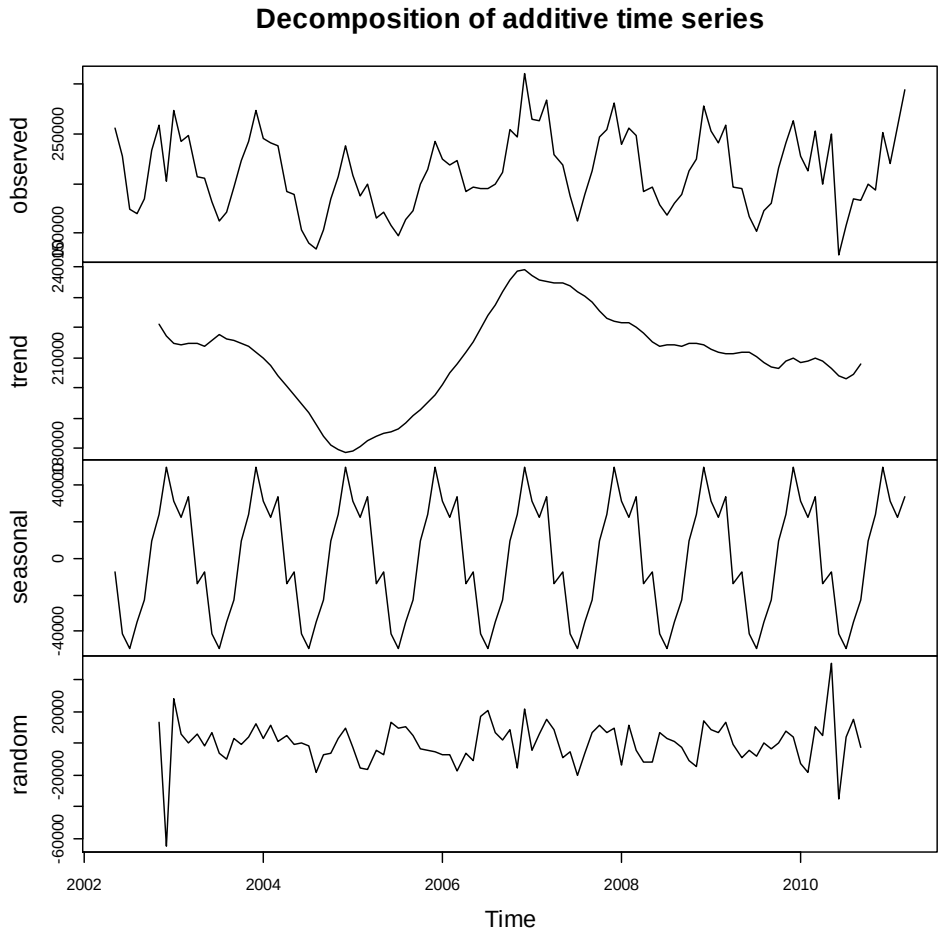
3. **Design and validation of different forecast scenarios.** The last part of the forecast activities consists of combining the results of the previous steps. This exercise focuses on having specific volumes for each of the time windows and growth scenarios. This provides a quantitative projection that can work as a reference for comparisons and as an input for future simulation models.

These activities are essential to estimate the future traffic volumes at the San Luis I LPOE, AZ. The volumes are to be confined to the time frames considered for this project, which are 5, 10 and 20 years. As in any statistical analysis, the forecasted data is based on confidence intervals and must be used with caution and with an understanding of the underlying assumptions. The next subsections discuss the aforementioned steps taken for each transportation mode at the LPOE. The algorithms and work related to these activities were developed by the consulting team and coded in the open source software "The R Project for Statistical Computing" (R Development Core Team 2008).

Pedestrian

The pedestrian traffic at the San Luis I LPOE, AZ is considered one of the crossing modes with the highest demand. The pedestrian crossing volumes at this LPOE represent nearly 30% of the total Arizona's pedestrian border crossing volume. In 2010 San Luis pedestrian volumes were ranked #2 among Arizona's LPOEs and #11 among the entire Mexican-U.S. ports of entry. In the past few years, it has been following a relatively steady trend with a significant seasonal behavior. This periodic behavior constitutes an approximate +/- **25%** of the average monthly volume. Figure 2.16 shows a decomposition of the pedestrian crossings from the available time series data. In the figure one can observe the trend, seasonal and random components of the pedestrian traffic considered in the forecast. The relevance of this decomposition is discussed in the following sections.

FIGURE 2.16: PEDESTRIAN CROSSING VOLUMES DECOMPOSITION



External Drivers related to Pedestrian Traffic

The factors highly related to the Pedestrian traffic were shown in the Table 2.14. These factors could be interpreted as how pedestrian traffic at San Luis I LPOE, AZ reacts mostly to changes in the main agricultural production levels in Yuma County, AZ and to the U.S. Index of Industrial Production. Therefore, the first step in the forecast method is to define forecast scenarios for each of these drivers.

Several forecast techniques were tested for the different drivers depending mostly on their stationary behavior. For those drivers that presented high uncertainty associated with long forecast time windows, the best technique was based on the analyses of the gains (or losses) of magnitude of each driver known as *binomial lattice analysis*. In this technique, the driver's data (external factor) is tested for a 5-year window, and the observed gains are extrapolated to a monthly gain.

In turn, these gains were fitted into a binomial behavior to identify the probability of a positive or negative gain. For drivers showing highly seasonal behavior, such as the agricultural production in Yuma County, a different forecasting technique was used. Auto-regressive models (ARIMA) that consider simple moving averages and specific periodic components showed better results.

Figure 2.17 shows the 5 years decomposition of the U.S. Index of Industrial Production on the left while the right plot shows its binomial lattice forecast. On the other hand, Figure 2.18 shows the ARIMA predictions for the agricultural production in Yuma AZ. These are the identified main drivers of the pedestrian crossings at the San Luis I LPOE, AZ.

FIGURE 2.17: GAIN ANALYSES AND LONG TERM FORECAST FOR THE IIPU

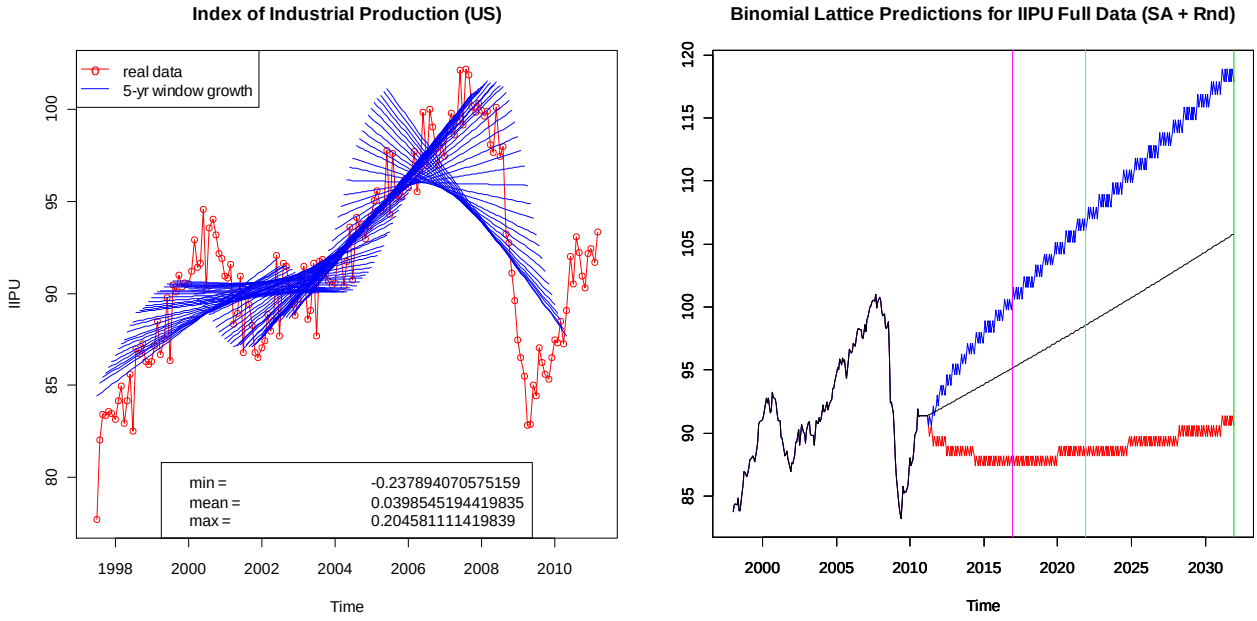
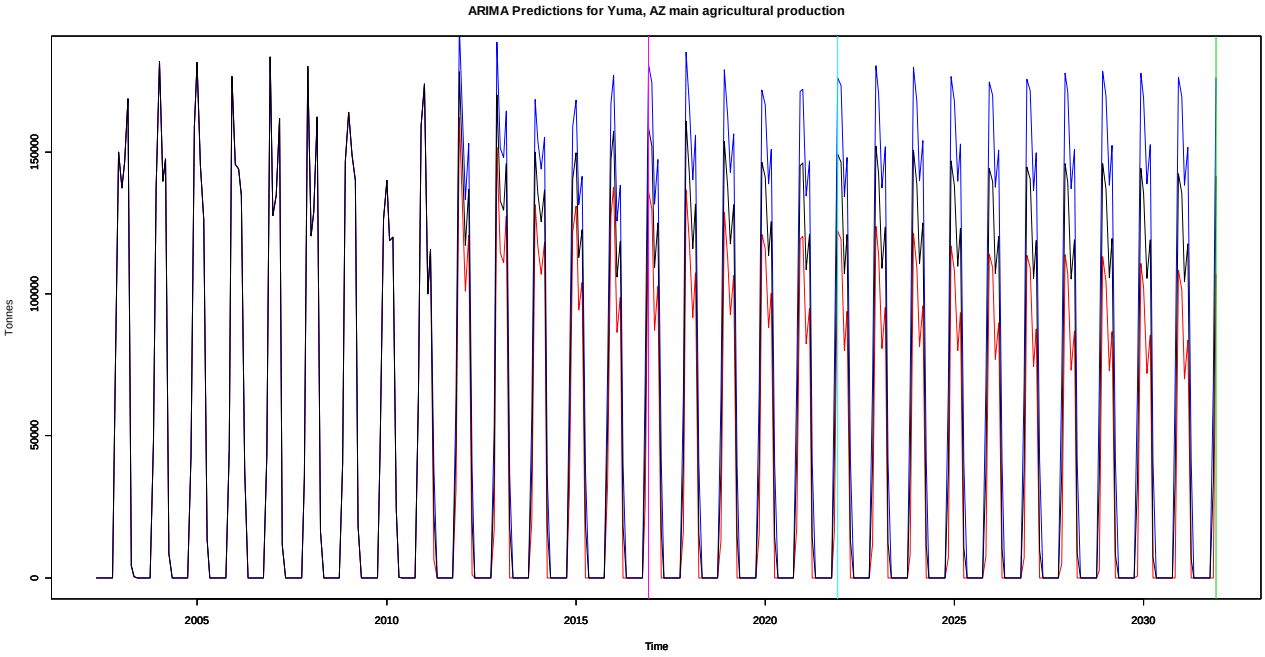


FIGURE 2.18: LONG TERM FORECAST FOR YUMA COUNTY, AZ AGRICULTURAL PRODUCTION



The different factors shown in the figures present three levels of prediction. Since it's a very challenging task to have a certain value for each prediction, the aforementioned levels refer to three different behaviors: the optimistic shown in a blue line (represent the high 85% confidence interval of the predictions), the expected shown in a black line (represent the mean of the predictions) and the pessimistic shown in red (which represents the lower 85% confidence interval of the predictions). These form the different scenarios that will define the upper and lower bounds of the transportation crossing modes. The forecast numbers for these drivers by each prediction level are shown in Table 2.16.

TABLE 2.16: FORECAST FIGURES FOR DRIVERS OF PEDESTRIAN AND POV CROSSINGS

United States Index of Industrial Production (IIPU)						
Level	+5 years		+10 years		+20 years	
	Jan 2017	% Increment	Jan 2022	% Increment	Jan 2032	% Increment
Hi 85	101.53	12%	107.02	18%	117.88	30%
Expected	95.22	5%	98.64	8%	105.80	16%
Lo 85	87.45	-4%	88.22	-3%	90.57	0%

Main Agricultural Production Levels in Yuma County (AGRI)						
Level	+5 years		+10 years		+20 years	
	2016-17	% Increment	2021-22	% Increment	2030-31	% Increment
Hi 85	721,241	25%	735,552	28%	745,047	29%
Expected	600,310	4%	578,649	0%	540,114	-6%
Lo 85	483,429	-16%	434,698	-25%	363,483	-37%

The Pedestrian Traffic Forecast

The next step considered several forecast methods to obtain the best fit. As mentioned before, several tools were explored. Some included binomial trees, auto-regressive models, exponential smoothing and dynamic regression models. Having the pedestrian crossing mode a highly seasonal behavior, the auto-regressive models with external drivers (called ARIMA models w/exogenous factors) presented the most stable model for long-term predictions. The ARIMA models consider the response of pedestrian traffic crossing the border to its own seasonal and average behavior plus the external drivers mentioned in the previous sub-section. These models test the lagged response as well, which means that this response may not be immediate and may take some time to respond. Once the forecasts of the external drivers were defined, they are then fed into the ARIMA model. The response of the model is presented in the Figure 2.18.

FIGURE 2.18: SHORT-, MID- AND LONG-TERM FORECAST FOR PEDESTRIAN TRAFFIC

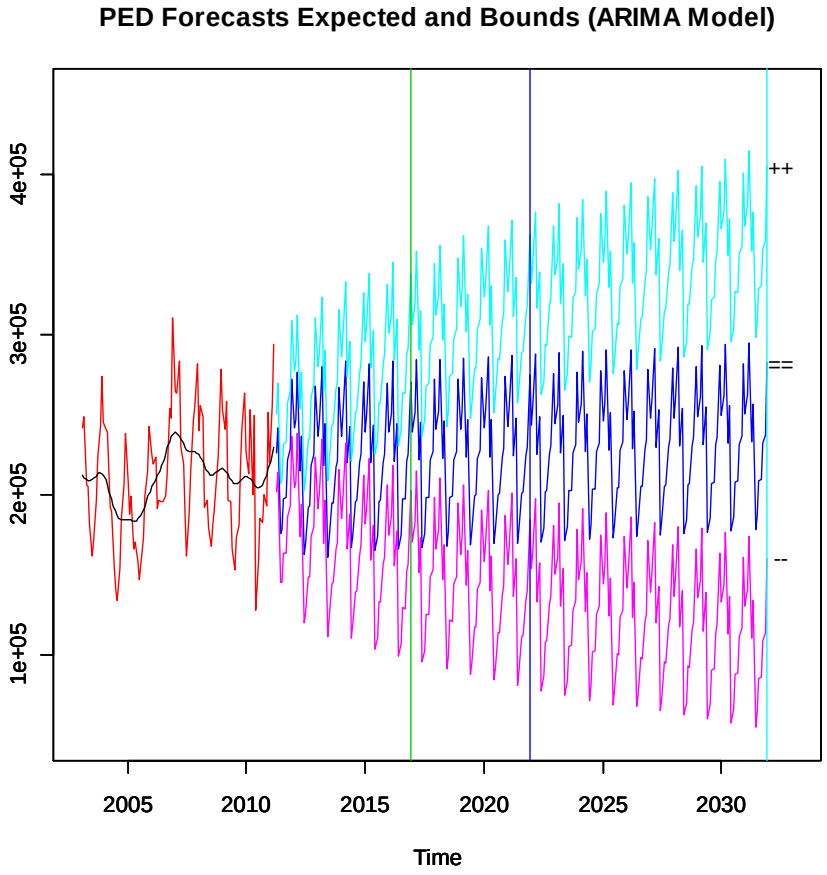


Figure 2.18 shows the upper and lower bounds, as well as the expected values of the prediction. These bounds are defined from the combination of the three factors scenarios: pure **optimistic** scenario (shown with "**+**" signs); pure **expected** scenarios (shown with "**=**" signs); and the more **pessimistic** scenarios (shown in "**–**"signs). Table 2.17 shows the yearly average pedestrian crossing for each time frame.

TABLE 2.17: FORECAST FIGURES FOR PEDESTRIAN CROSSINGS

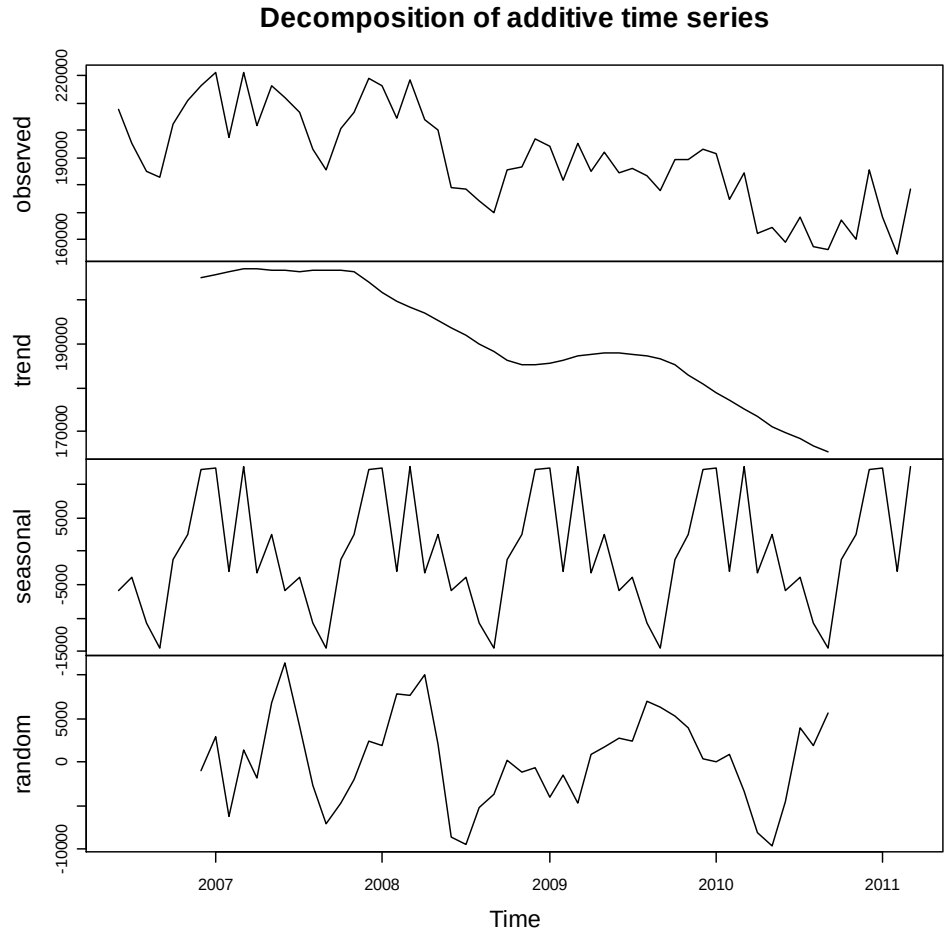
Pedestrian Border Crossing (PED) - Monthly						
Level	+5 years		+10 years		+20 years	
	2017	% Increment	2022	% Increment	2032	% Increment
Hi 85	294,944	38%	319,711	50%	356,321	67%
Expected	224,981	6%	228,724	7%	235,969	11%
Lo 85	153,078	-28%	136,117	-36%	113,409	-47%

It is important to mention that a similar methodology was used for the POV and commercial traffic. Certainly the external drivers are somewhat different, but some are shared and tested in the same fashion. The next part of this section presents the external drivers forecast and predictions for both POV and commercial traffic.

Privately owned vehicles (POV)

The POV traffic presents the highest volumes as expected. Nevertheless, the last few years show a reduction in the monthly volumes. This negative trend is rather noticeable as compared to the pedestrian traffic reduction. The decomposition of the POV volumes is shown in Figure 2.19. One can observe that the seasonal component is not as obvious as expected, and the negative trend is more noticeable as well.

FIGURE 2.19: POV CROSSING VOLUMES DECOMPOSITION



External Drivers related to POV Traffic

In the same fashion as the Pedestrian traffic explored in the previous sections, POV traffic at the San Luis I LPOE, AZ reacts to changes in the main agricultural production levels in Yuma County, AZ and to the U.S. Index of Industrial Production. The main difference is that the lag used for the IIPU in the POV forecast is set to -7 months, while the IIPU lag for the pedestrian model is -9 months. The same forecast method is used with these factors and the results are shown in Figure 2.16 and Figure 2.17.

The POV Traffic Forecast

Privately owned vehicles show mostly a trend behavior and not much of a noticeable seasonality. Due to this specific behavior, dynamic regression models are used to create the predictions for the POV traffic for the short-, mid- and long-range time frame. These dynamics models are similar to those shown in the Explanatory Models sub-section. These models do not consider specific seasonal nor trend components, but are based merely on the external components discussed in the previous subsection.

The model is fed with the predicted data from the forecasts of the agricultural and industrial production models. Figure 2.20 shows the upper and lower bounds as well as the expected crossings behavior once the external drivers' optimistic, pessimistic and expected scenarios are reflected in the prediction model.

FIGURE 2.20: SHORT-, MID- AND LONG-TERM FORECAST FOR POV TRAFFIC

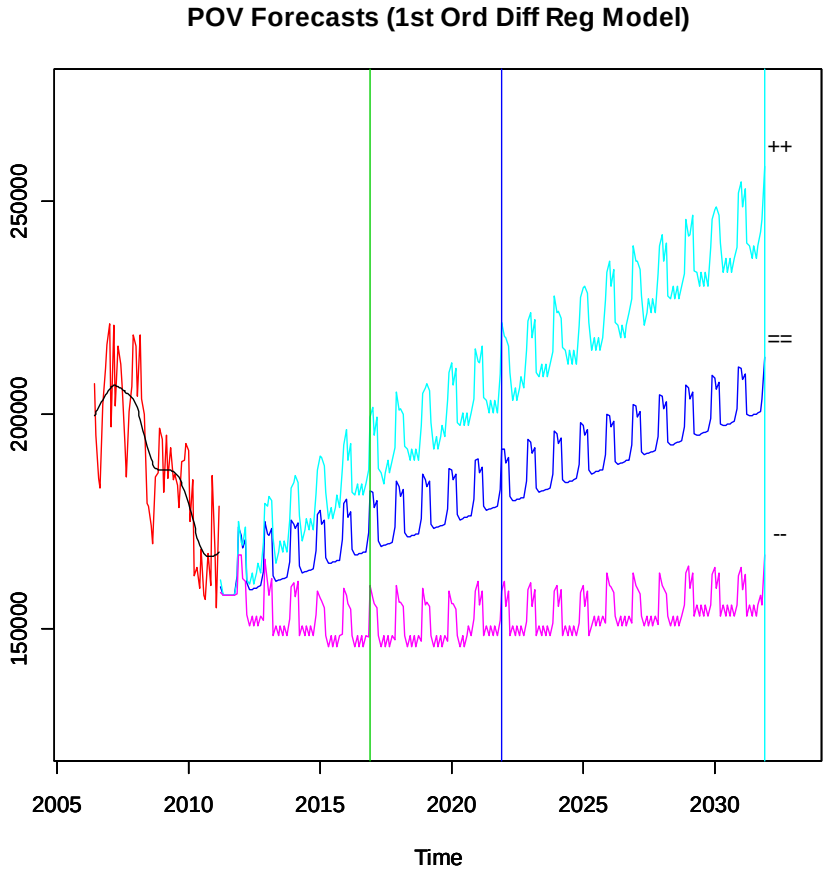


Figure 2.20 shows the upper and lower bounds, as well as the expected values of the prediction. As for the Pedestrian mode predictions, these bounds are defined from the combination of the three factors scenarios: pure **optimistic** scenario (shown with "**+**" signs); pure **expected** scenarios (shown with "**=**" signs); and the more **pessimistic** scenarios (shown with a "**–**"sign). Table 2.18 shows the forecasted POV yearly average crossing volumes by time frame and level.

TABLE 2.18: FORECAST FIGURES FOR POV BORDER CROSSINGS

Privately Owned Vehicle Border Crossing (POV) - Monthly						
Level	+5 years		+10 years		+20 years	
	2017	% Increment	2022	% Increment	2032	% Increment
Hi 85	191,909	15%	211,153	27%	244,639	47%
Expected	173,862	4%	184,248	10%	203,936	22%
Lo 85	150,340	-10%	152,417	-9%	157,598	-6%

Commercial Crossing

Since San Luis II LPOE, AZ has only been operational for two years, not enough data is available to perform meaningful analyses of the commercial crossings at this location. Hence additional data from San Luis I LPOE, AZ prior to 2011 was also utilized for these analyses.

The commercial traffic at San Luis I LPOE, AZ is rather high once compared to the other Arizona's ports of entry. In 2010, it was ranked #2 among Arizona's LPOEs with 12% of the traffic entering the State and #13 among the entire Mexican-U.S. commercial ports of entry. Since the San Luis II commercial port of entry started operations, the commercial transit does not currently congest the immediate areas. Overall, CBP does not report heavy waiting times or outstanding transit-related issues for this border crossing mode. Nevertheless, as part of the study, a traffic forecast was also developed to have an overview of the expected volumes for the short-, mid- and long-term.

The data available for commercial trucks was decomposed in the similar way as the pedestrian and POV data. Showing a different behavior, the commercial traffic is extremely seasonal and does not show a specific trend as the other border crossing modes. These behaviors can be observed in Figure 2.21 where the data time components of the crossing trucks are shown. The trend factor is rather small in magnitude, while the seasonal component shows approximate deviations of **-20%** to **+30%** of the observed average.

External Drivers related to Commercial Truck Traffic

As mentioned in the previous sections, the commercial traffic in the San Luis I LPOE, AZ reacts mostly to changes in Mexican Peso/U.S. Dollar exchange rate and to the main agricultural production levels in Yuma County, AZ. These drivers were explored and forecasted in similar way using binomial lattice method for the exchange rate and ARIMA models for the agricultural data. Figure 2.22 shows the 5 year gain analyses for the MXN/USD exchange and the binomial lattice forecast outcome, while Table 2.19 shows the forecast for this driver. The agricultural forecast is the same as shown in Figure 2.17 and Table 2.16.

FIGURE 2.21: COMMERCIAL CROSSING VOLUMES DECOMPOSITION

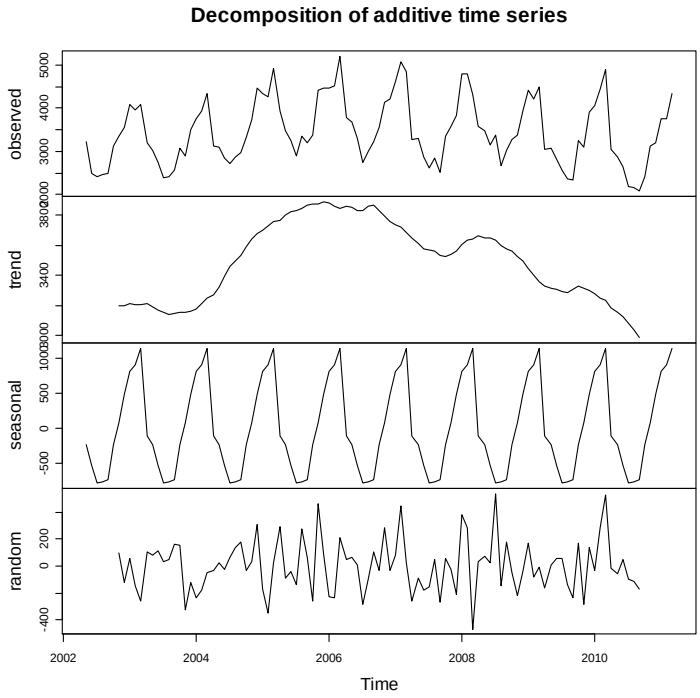


FIGURE 2.22: GAIN ANALYSES AND LONG-TERM FORECASTS FOR THE MXN/USD EXCHANGE RATE

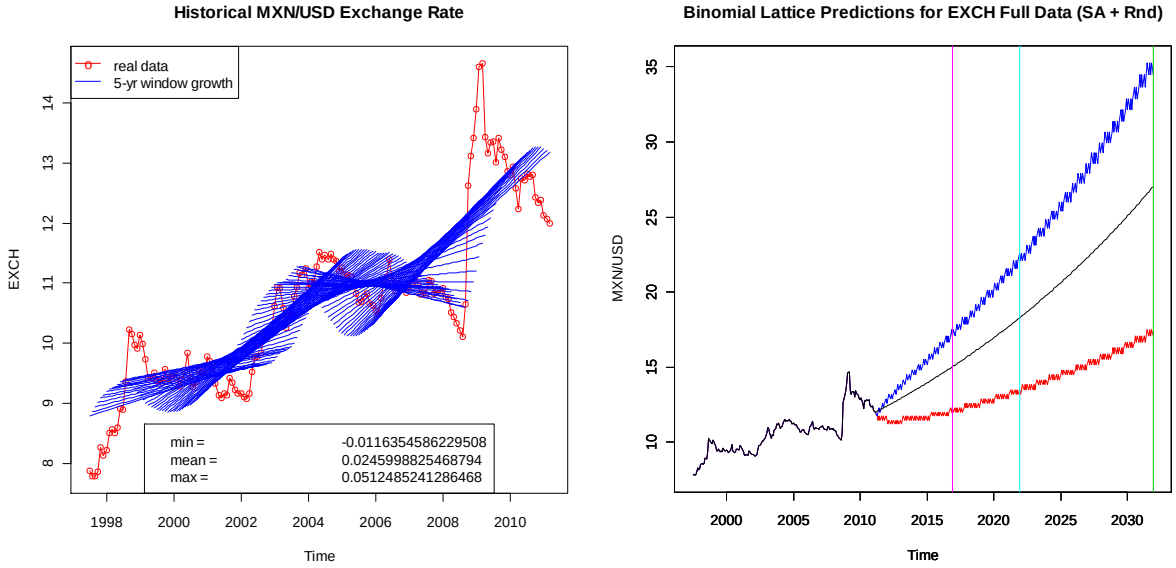


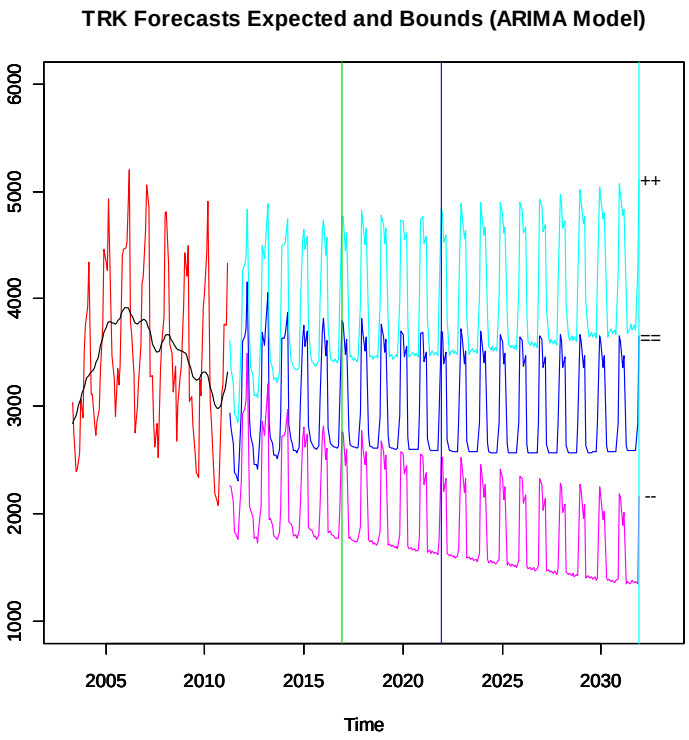
TABLE 2.19: FORECAST FOR DRIVERS OF COMMERCIAL CROSSINGS

MXN/USD Exchange Rate (EXCH)						
Level	+5 years		+10 years		+20 years	
	Jan 2017	% Increment	Jan 2022	% Increment	Jan 2032	% Increment
Hi 85	17.46	46%	22.08	84%	34.47	187%
Expected	15.07	26%	18.33	53%	27.02	125%
Lo 85	12.00	0%	13.18	10%	17.06	42%

The Commercial Traffic Forecast

As the pedestrian mode, the commercial mode is highly seasonal. For this reason, the forecast for commercial trucks using the San Luis II LPOE, AZ was modeled with the auto-regressive tools with external drivers (ARIMA models with exogenous factors). Using the data input from the previous step where the external drivers were forecasted, these optimistic, pessimistic and expected truck crossing volume predictions are developed. Once the forecasts of the external drivers were defined, they are fed into the ARIMA model. Figure 2.23 shows the predicted behavior for the commercial traffic in the San Luis II LPOE, AZ.

FIGURE 2.23: SHORT-, MID- AND LONG-TERM FORECAST FOR COMMERICAL TRAFFIC



The figure above shows the upper and lower bounds, as well as the expected values of the prediction. As in the same way as the previous predictions, these bounds are defined from the combination of the three factors scenarios: pure optimistic scenario (shown with "**+**" signs); pure expected scenarios (shown with "**=**" signs); and the more pessimistic scenarios (shown in "**–**" signs). Table 2.20 shows the expected crossing quantities for each prediction time frame and scenario.

TABLE 2.20: FORECAST FIGURES FOR TRUCKS BORDER CROSSINGS AT SAN LUIS II LPOE, AZ

Commercial Trucks Border Crossing (TRK) - Monthly						
Level	+5 years		+10 years		+20 years	
	2017	% Increment	2022	% Increment	2032	% Increment
Hi 85	3,919	26%	3,969	27%	4,196	35%
Expected	3,013	-3%	2,948	-5%	2,925	-6%
Lo 85	2,067	-34%	1,880	-40%	1,594	-49%

SUMMARY OF FUTURE CONDITIONS

The activities reported and discussed throughout this document consider the analytical aspect of the project. This analytical aspect focuses mostly on San Luis I LPOE, AZ as an entity-flow system, where several engineering tools were used to provide interesting and useful results. A critical milestone of this task was the update of the border crossing volumes data provided by U.S. Customs and Border Patrol Field Office and was instrumental in conducting a more in depth analysis. The update consisted of detailed volume and waiting time information for the main border crossings modes at the San Luis I LPOE, AZ containing hourly data for a full year worth of border activity.

After updating the information and revisiting certain tasks performed in the previous phases, the team was able to present additional analyses. This review focused on identifying different traffic patterns for the pedestrian and privately owned vehicles; the results show that crossings behaviors are function of different seasonal factors. For instance, the traffic volumes for privately owned vehicles change throughout the day differently for Sundays than for the rest of the week; on the other hand, the pedestrian traffic changes throughout the day and also by the month of the year. Not only pedestrians cross the border at different times during Sundays, Mondays, and the rest of the week; but also cross at different times from December to March, then from April to September, and from October to November. Other factors, such as business hours and lunch time are more consistent throughout the observations. This seasonal traffic behavior is highly related with the agricultural and industrial activities of the region, which means these segments had to be studied separately since different segments have different users' behaviors at the same hour of the day. Therefore, this segmentation was used for the analytical queuing models activities.

The results obtained from the queuing system analytic activities provide an overview of the current conditions (how the current capacities meet the current demands) and how these conditions are measured from the users' waiting times and queue lengths perspectives. For the POV border crossing mode, the results show that the LPOE is constantly at full capacity. At the time of the analyses, the six (6) available booths for POV inspection provided an average service rate of 4.04 vehicles per minute during a 24 hours period. The estimated length of the queues in the POV area reaches an average above the 0.60 miles in the busiest times; however in 2010 the longest estimated queue was approximately 1.80 miles long. As a complement to these analyses, the average queues were measured in terms of their impact on the economy and environment in the region. After certain assumptions were considered, which were discussed in their specific section, estimations such as gas consumption and CO_2 emitted from the queuing vehicles were compared with other congested areas. Overall, the estimations show that the idle vehicles in the San Luis I LPOE, AZ produced 8.2 million pounds of CO_2 in 2010, which equals approximately 68 pounds per car in the region.

For the pedestrian traffic, similar analyses were conducted using available data. As the pedestrian border crossing behavior is more seasonal than the POV, the port capacity changes as a function of the demand. The average system service rate for the pedestrians at the LPOE ranged from 2.5 to upmost 11.5 people per minute depending on the timeframe. Pedestrian queues were evaluated

using a specific Level of Service schema and it was found that an "E" and "F" level is observed mostly during the day. These levels are determined from the relationship between the pedestrian's arrivals per minute to the queue and the service rate of the system. Overall, pedestrian throughput is really restricted and there is an unavoidable congestion between users.

Having determined the current conditions of the San Luis I LPOE, AZ border crossings, the next step was to establish the future demand and evaluate the port capacity. Creating these scenarios is basic for the underlying objective of the study, since it will allow testing the current port capacity under predicted future traffic demands. Even though the focus of the study sets on the congested POV and pedestrian crossing modes, the commercial truck was also considered and the future volume forecasted. The results show that the truck crossing volumes at San Luis II LPOE, AZ have a certain relationship with the United States industrial production levels, the Mexican Peso/U.S. Dollar exchange rate, and the agricultural production levels in the immediate Arizona region. Working with these factors as external drivers of the traffic and following certain assumptions, the estimations for future volumes were predicted. The predictions done over the three different time periods included the expected behavior, as well as an optimist and pessimist trend scenarios.

The resulting forecasts from the Pedestrian and Commercial border crossing modes are rather seasonal and stationary, while the POV mode follows the drivers' trends more closely. In general terms, the pedestrian traffic through the port follows closely the agricultural seasons and the expected volumes are rather stationary in the short-, mid- and long-term. Commercial traffic behaves similarly to the pedestrian volumes in terms of seasonality, but does not show a noticeable increment in the predicted terms. The POV mode, on the other hand, is more sensitive to the trends of the industrial production levels; therefore the POV volume's predictions show an expected increasing trend rather than a stationary behavior.

Overall, the volumes' predictions were discussed in detail throughout the document. In conclusion, the analytical stage of the study helps support the results that pedestrian and POV traffic through the San Luis I LPOE, AZ are expected to increase. A very preliminary review of the current port operation is not sufficient to determine if the port infrastructures will be sufficient to address the future POV and pedestrian demand. The implementation of SENTRY and REDI lanes at the LPOE has improved service and wait times for the current conditions, but no evaluation was conducted for the future conditions.

On the other hand, the commercial traffic is expected to have more than sufficient installed capacity at San Luis II to satisfy future demand.

Although not part of the scope of this study, to complete the analysis, the forecasted volumes should be tested over the current San Luis I LPOE, AZ capacity, deficiencies should be identified (infrastructure or operations) and recommendations should be prepared to maximize the future LPOE utilization.

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APPENDIX AA

TABLE AA.1: INDEX OF ABBREVATIONS

Variable	Abbreviation
Beneficiaries IMSS (SLRC)	Ben-SL
Beneficiaries IMSS (PP)	Ben-PP
Beneficiaries IMSS (PEC)	Ben-PEX
Beneficiaries IMSS SLRC Farm	Ben-F
Beneficiaries IMSS SLRC Trade	Ben-T
Beneficiaries IMSS SLRC Manufacture	Ben-M
Beneficiaries IMSS SLRC Services	Ben-S
Beneficiaries IMSS SLRC Others	Ben-O
EMIME SLRC	EMIME
Gold Mxc	Au-Mxc
Gold PEC	Au-PEC
SilverMxc	Ag-Mxc
IMMEX Son	IMMEX
Crime Sonora	Crime
Homicides	Homicides
Drugcrimes	Drugs
PI AZ 2	PI-Az
Compensation AZ	Co-Az
Wage AZ	W-Az
IPP MX	IPP-Mx
CPI MX	CPI-Mx
GDP MX	GDP-Mx
IPP US	IPP-US
CPI US	CPI-US
Diesel price	Diesel
Gasolineprice	Gas
Personal Income US	PI-US
GDP US	GDP-US
Exchange Rate	ER

APPENDIX B: Origin - Destination Survey

BINATIONAL SAN LUIS TRANSPORTATION STUDY

Origin - Destination Survey

November 2013

Prepared For:

ADOT

Prepared By:

JACOBS

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LIST OF FIGURES

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1.0 INTRODUCTION

An Origin-Destination Survey was conducted to get a better understanding of the daily travel characteristics between the two cities, surrounding communities, region, and daily activities at the San Luis I LPOE. The survey was conducted at the northbound and southbound terminals on the U.S. side of San Luis I LPOE for one day during the week of March 12th. Privately owned vehicles (POV), pedestrians, and bicyclists were surveyed for three periods:

- Morning (6:00 AM - 10:00 AM)
- Mid-day (11:00 AM - 1:00 PM)
- Evening (4:00 PM - 7:00 PM

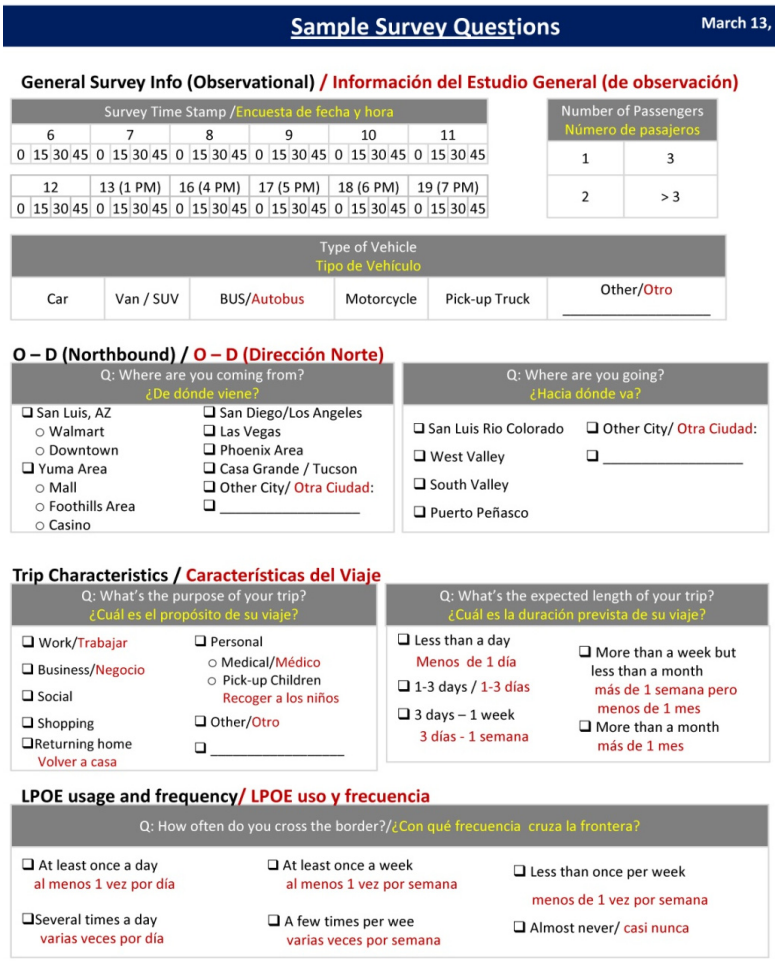
A total of 1,605 drivers and 448 pedestrians were surveyed. The total number of drivers at the respective terminals were 719 northbound and 886 southbound with a capture rate of 10 to 12 percent of the total southbound traffic in the afternoon. In comparison, the pedestrians surveyed were 249 northbound and 199 southbound with a capture rate of two to three percent of total southbound pedestrians in the afternoon.

Survey Questions

In general, drivers and pedestrians were asked the same questions such as "where are you going", "how long is your trip", "how often do you cross the border", and "what is the purpose of your trip" as shown in Figure 1.1.

Overall, the majority of the trips is contained between San Luis and San Luis Rio Colorado for shopping, family visits, or medical appointments. In addition, it observed that farm workers constituted a large portion of the pedestrian traffic at the LPOE

FIGURE 1.1: SAMPLE SURVEY QUESTIONS



Sample Survey Questions March 13,

General Survey Info (Observational) / Información del Estudio General (de observación)

Survey Time Stamp /Encuesta de fecha y hora

6				7				8				9				10				11			
0	15	30	45	0	15	30	45	0	15	30	45	0	15	30	45	0	15	30	45	0	15	30	45

12				13 (1 PM)				16 (4 PM)				17 (5 PM)				18 (6 PM)				19 (7 PM)			
0	15	30	45	0	15	30	45	0	15	30	45	0	15	30	45	0	15	30	45	0	15	30	45

Number of Passengers / Número de pasajeros

1	3
2	> 3

Type of Vehicle / Tipo de Vehículo

Car	Van / SUV	BUS/Autobus	Motorcycle	Pick-up Truck	Other/Otro _____

O – D (Northbound) / O – D (Dirección Norte)

Q: Where are you coming from? / ¿De dónde viene?

- ❑ San Luis, AZ
  - ○ Walmart
  - ○ Downtown
- ❑ Yuma Area
  - ○ Mall
  - ○ Foothills Area
  - ○ Casino
- ❑ San Diego/Los Angeles
- ❑ Las Vegas
- ❑ Phoenix Area
- ❑ Casa Grande / Tucson
- ❑ Other City/ Otra Ciudad:
- ❑ _____

Q: Where are you going? / ¿Hacia dónde va?

- ❑ San Luis Rio Colorado
- ❑ West Valley
- ❑ South Valley
- ❑ Puerto Peñasco
- ❑ Other City/ Otra Ciudad:
- ❑ _____

Trip Characteristics / Características del Viaje

Q: What's the purpose of your trip? / ¿Cuál es el propósito de su viaje?

- ❑ Work/Trabajar
- ❑ Business/Negocio
- ❑ Social
- ❑ Shopping
- ❑ Returning home / Volver a casa
- ❑ Personal
  - ○ Medical/Médico
  - ○ Pick-up Children / Recoger a los niños
- ❑ Other/Otro
- ❑ _____

Q: What's the expected length of your trip? / ¿Cuál es la duración prevista de su viaje?

- ❑ Less than a day / Menos de 1 día
- ❑ 1-3 days / 1-3 días
- ❑ 3 days – 1 week / 3 días - 1 semana
- ❑ More than a week but less than a month / más de 1 semana pero menos de 1 mes
- ❑ More than a month / más de 1 mes

LPOE usage and frequency/ LPOE uso y frecuencia

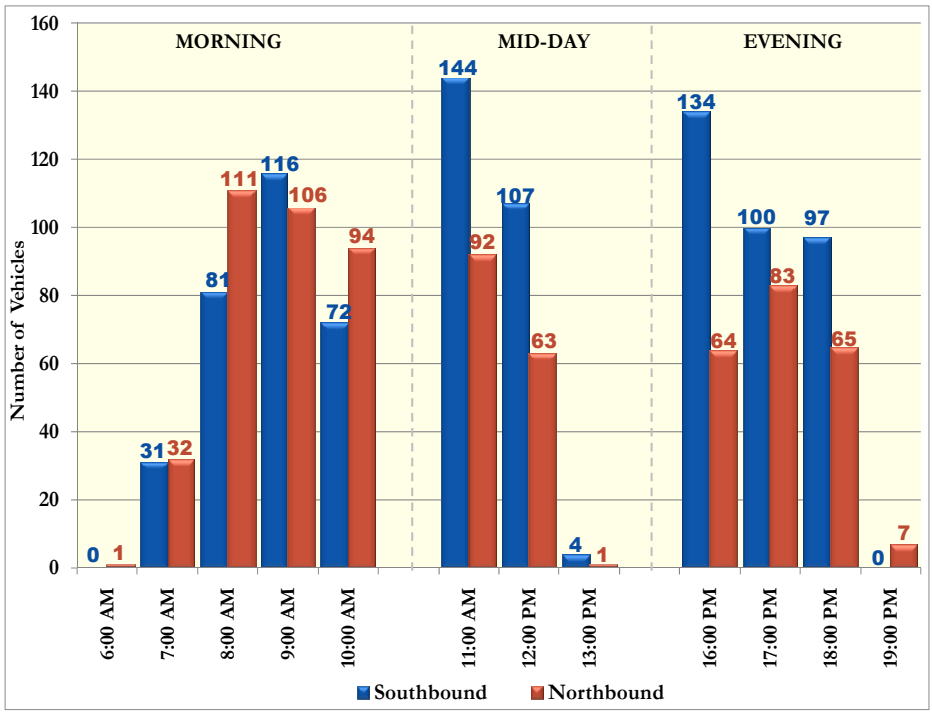
Q: How often do you cross the border?/¿Con qué frecuencia cruza la frontera?

- ❑ At least once a day / al menos 1 vez por día
- ❑ Several times a day / varias veces por día
- ❑ At least once a week / al menos 1 vez por semana
- ❑ A few times per wee / varias veces por semana
- ❑ Less than once per week / menos de 1 vez por semana
- ❑ Almost never/ casi nunca

2.0 PRIVATELY OWNED VEHICLES SURVEY RESULTS

Figures 2.1 to 2.7 display survey results for POVs; next to each figure there is a summary of findings for the item displayed.

FIGURE 2.1: POV SURVEY RESULTS - TIME OF DAY



Of the Total Trips

- 40% occurred in the *morning* (6 - 10 AM)
- 34% in the *evening* (4 - 7 PM)
- 26% during *mid-day* (11 AM - 13 PM)
- 11 AM Peak Hour: 236 trip

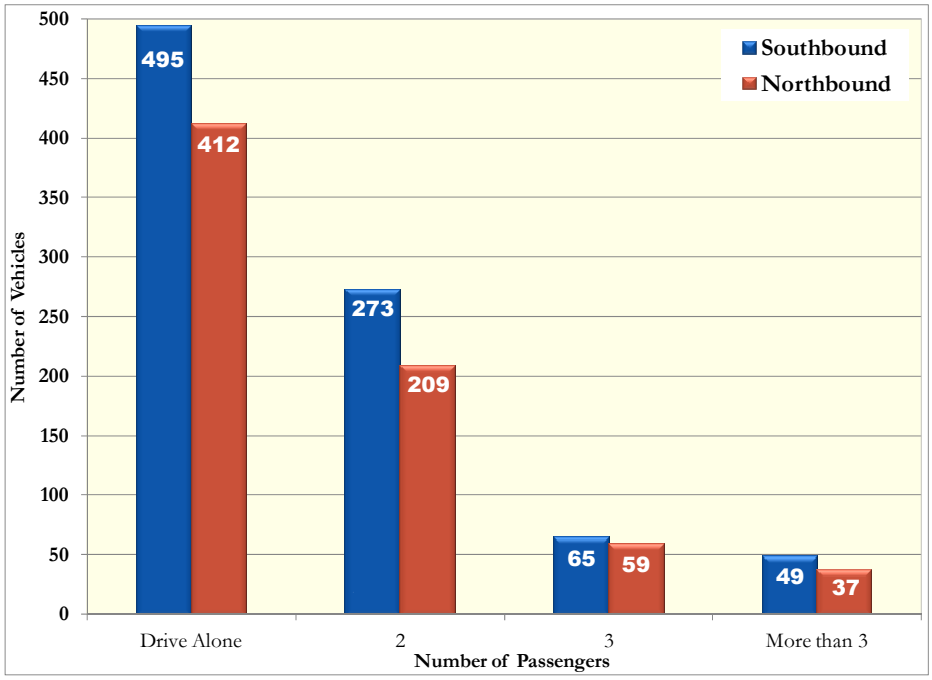
Northbound Facts

- 48% were morning trips
- 30% were evening trips
- 8 AM Peak Hour: 111 trips

Southbound Facts

- 37% were evening trips
- 34% were morning trips
- 11 AM Peak Hour: 144 trips

FIGURE 2.2: POV SURVEY RESULTS - NUMBER OF PASSENGERS



Of the Total Drivers

- 57% *drove alone*
- 43% carpooled
- Average Occupancy: 1.48

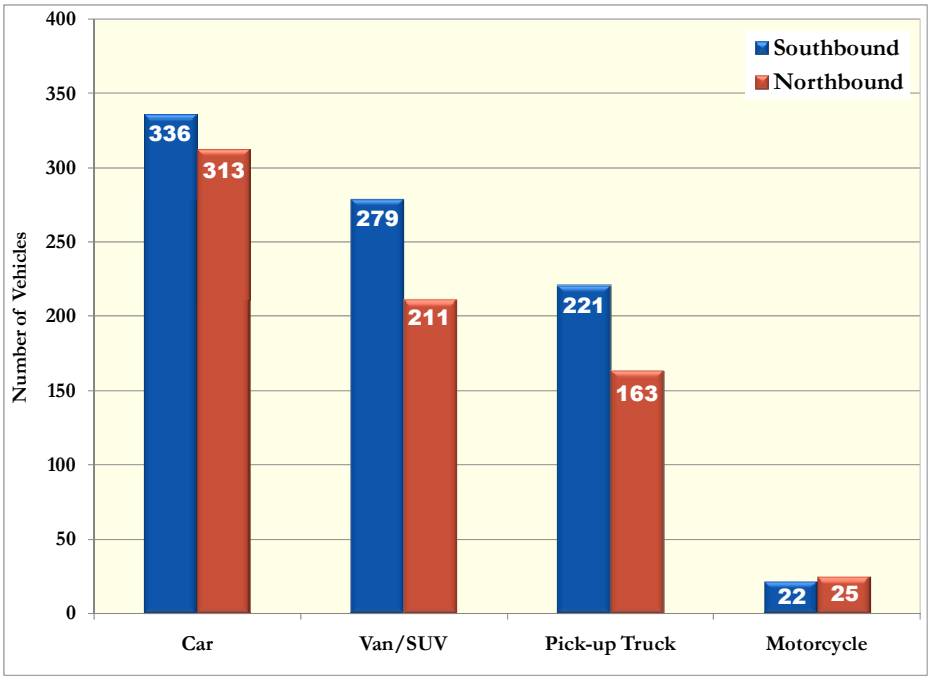
Northbound Facts

- 57% *drove alone*
- 43% carpooled

Southbound Facts

- 56% *drove alone*
- 44% carpooled

FIGURE 2.3: POV SURVEY RESULTS - VEHICLE TYPE



Of the total Vehicles

- 41% were *Cars*
- 31% were *Van/SUV*
- *24% **were** Pick-up Trucks*

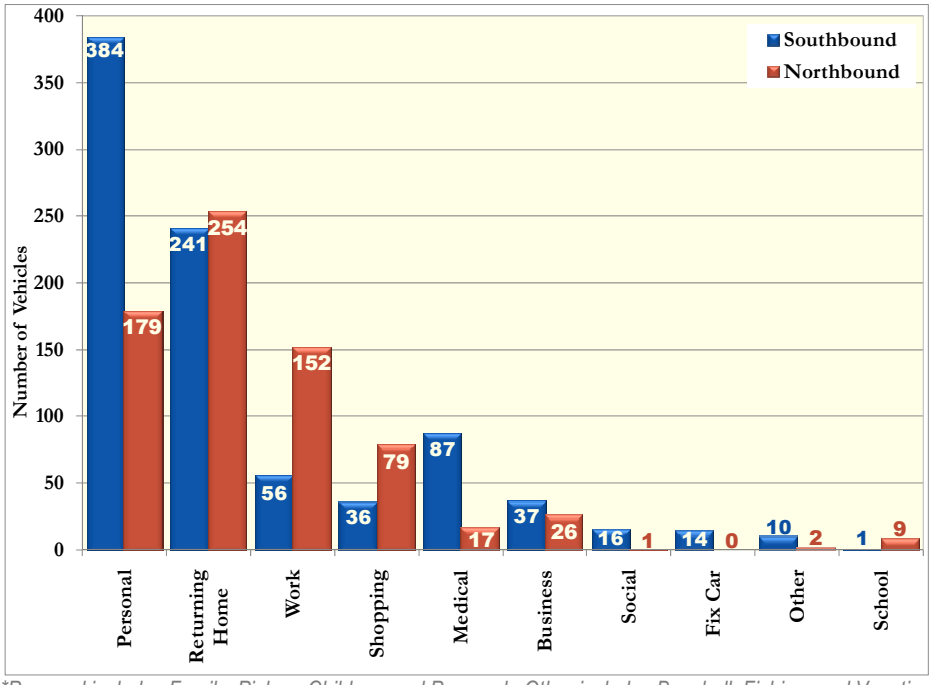
Northbound Facts

- 44% *Cars*
- 30% *Van/SUV*
- 23% *Pick-up Trucks*

Southbound Facts

- 39% *Cars*
- 33% *Van/SUV*
- 26% *Pick-up Trucks*

FIGURE 2.4: POV SURVEY RESULTS - TRIP PURPOSE



**Personal includes Family, Pick up Children, and Personal. Other includes Baseball, Fishing, and Vacation*

Of the Total Trips

- It seems that there is a trip exchange between the two directions; the highest purpose southbound is Personal while the northbound is Home Trips.

Northbound Facts

- 35% *Home(returning home)*trips
- 25% *Personal* trips
- *21% Work* trips

Southbound Facts

- 44% *Personal* trips
- 27% *Home* trips
- *10% Medical* trips

FIGURE 2.5: POV SURVEY RESULTS - TRIP ORIGIN AND DESTINATION

Southbound

Other Origins - Other Destination: 71

Southbound Facts

- Majority of trips ***end*** in San Luis Rio Colorado:
- 54% from San Luis,
  - 216 *Personal* trips
  - 118 *Home* trips
- 29% from Yuma Area,
  - 100 *Personal* trips
  - 71 *Home* trips
- 9% from Somerton,
  - 21 *Personal* trips

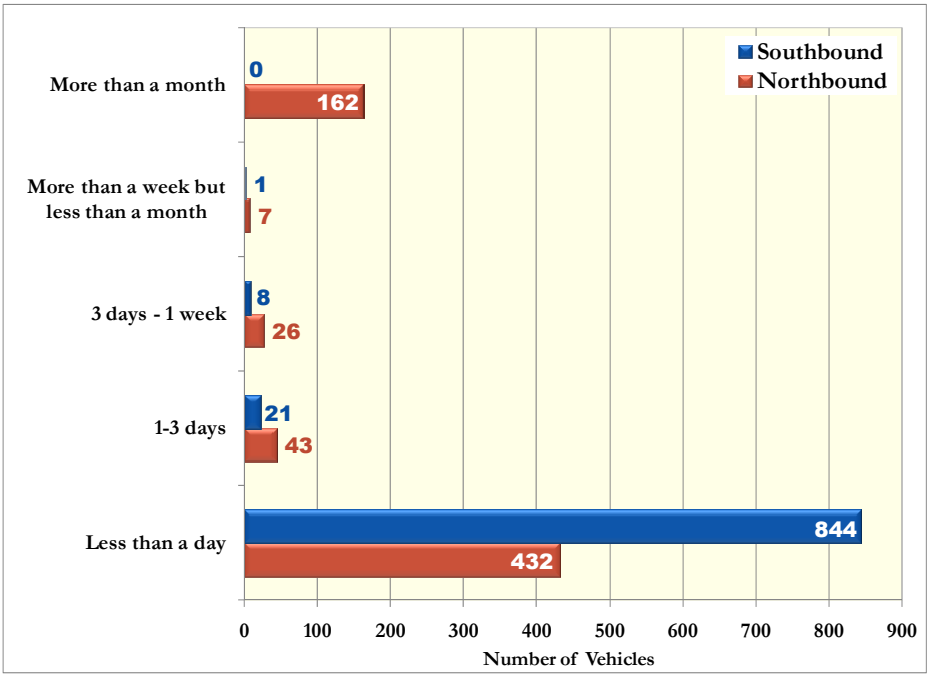
Northbound

Other Origins - Other Destination: 61

Northbound Facts

- Majority of trips ***originate*** in San Luis Rio Colorado:
- 53% to San Luis,
  - 147 *Home* trips
  - 96 *Personal* trips
- 33% to the Yuma Area,
  - 76 *Work* trips
  - 62 *Personal* trips
- 6% to Somerton,
  - 23 *Home* trips

FIGURE 2.6: POV SURVEY RESULTS - EXPECTED TRIP LENGTH



Of the Total Trips

- More than half (83%) were day trips (*less than a day*)
- 10% were to last *more than a month*

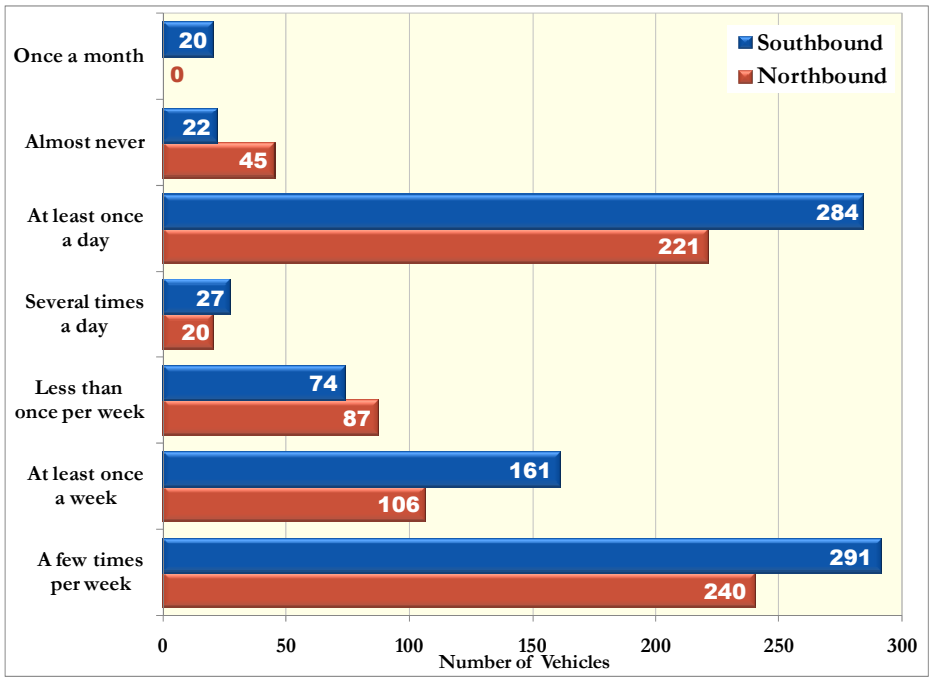
Northbound Facts

- 64% *day* trips
- 43% of trips were to last *more than a month*

Southbound Facts

- 97% *day* trips
- 2% of trips were for *1 - 3 days*

FIGURE 2.7: POV SURVEY RESULTS - BORDER CROSSING



Of the Total Drivers

- 33% cross the border *a few times per week*
- 29% *at least once a day*

Northbound Facts

- 33% *a few times per week*
- 27% *at least once a day*

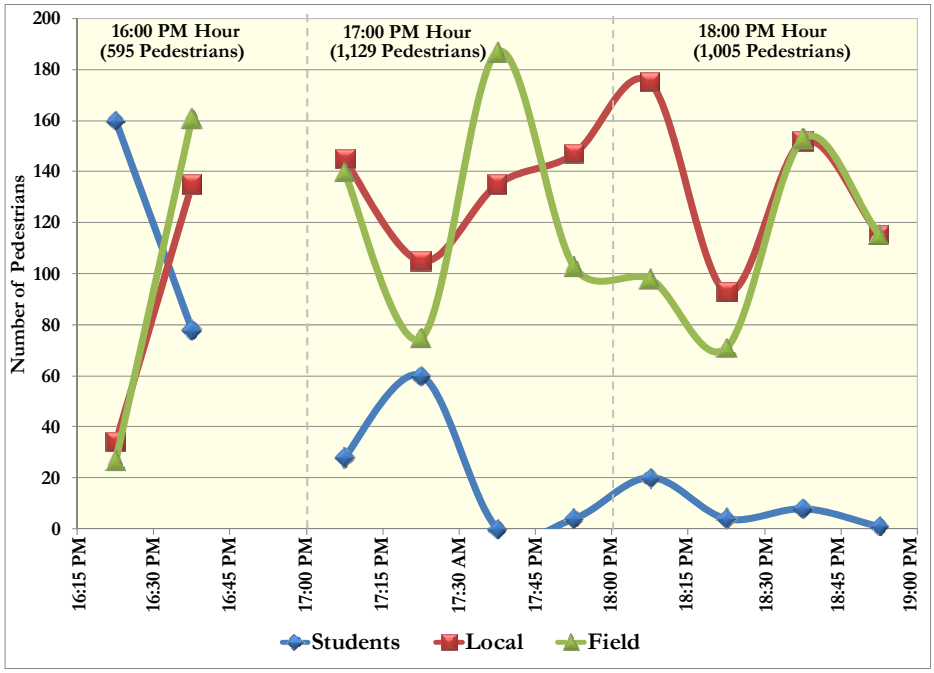
Southbound Facts

- 33% *a few times per week*
- 31% *at least once a day*

3.0 PEDESTRIAN AND BICYCLISTS SURVEY RESULTS

Figures 3.1 to 3.7 display survey results for pedestrians.

FIGURE 3.1: PEDESTRIAN SURVEY RESULTS - SOUTHBOUND PEDESTRIANS



Counted Pedestrians

- 2,729 southbound pedestrians were counted from 16:15 PM to 19:00 PM
- 363 Students
- 1,236 Local
- 1,130 Field

Survey Pedestrians

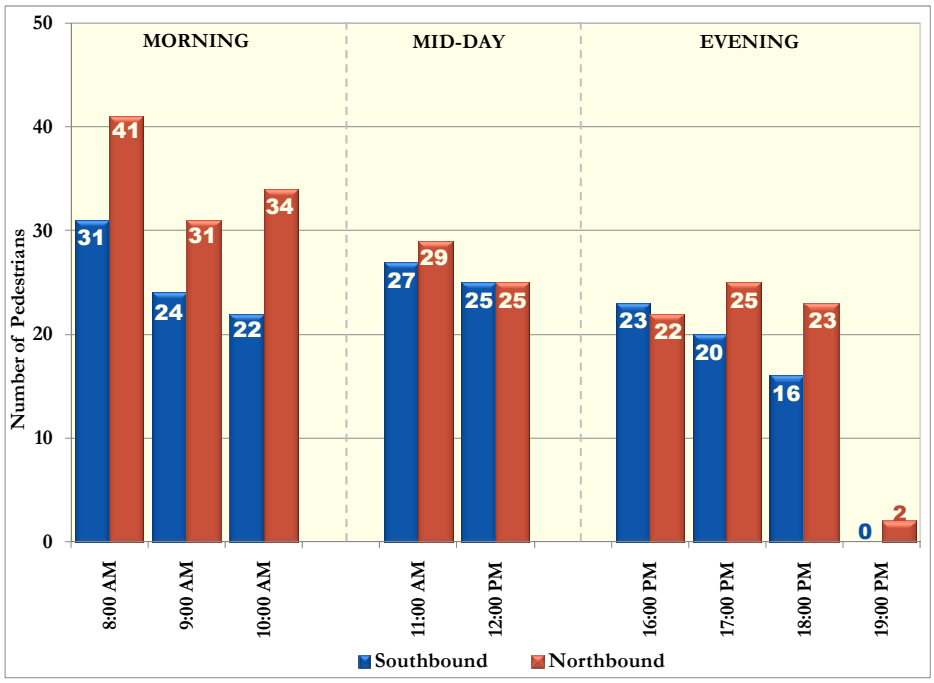
- 448 total pedestrians were surveyed
- Northbound: 249
- Southbound: 199

Capture Rate

- 2 -3% of total pedestrians in the afternoon.

**Students: Children and/or teenager with school uniform and/or backpack; Local: People carrying groceries and/or adults/young adults with work purposes (other than field); Field: People coming from either local or region field work.*

FIGURE 3.2: PEDESTRIAN SURVEY RESULTS - TIME OF DAY



Of the Total Trips

- 47% occurred in the *morning* (6 - 10 AM)
- 29% in the *evening* (4 - 7 PM)
- 24% during the *mid-day* (11 AM - 13 PM)
- 8 AM Peak Hour: 72 Pedestrians

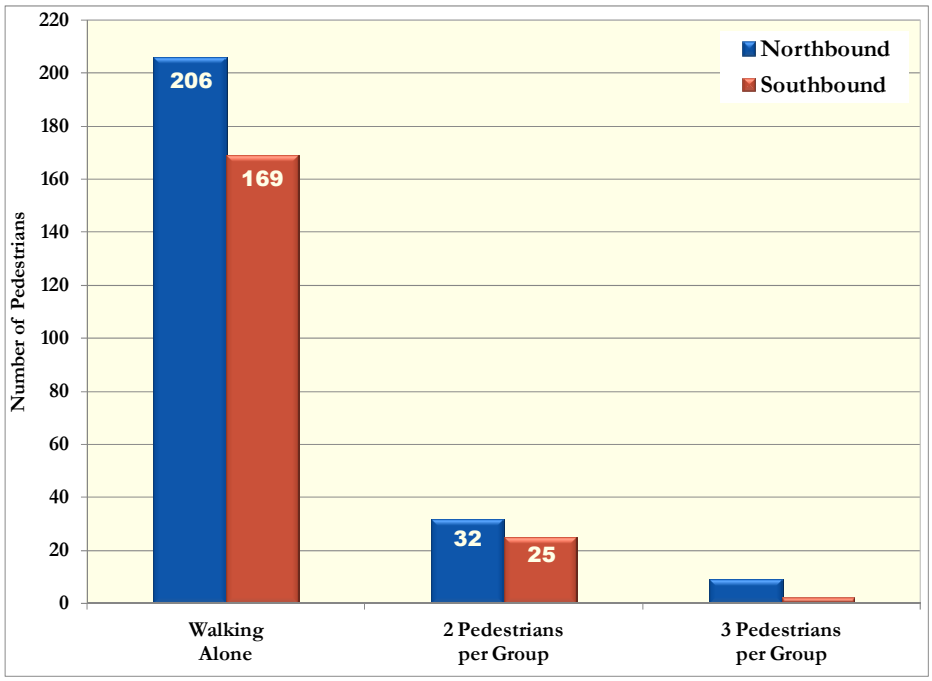
Northbound Facts

- 49% were *morning* trips
- 29% were *evening* trips
- 8 AM Peak Hour: 41 Pedestrians

Southbound Facts

- 44% were *evening* trips
- 30% were *morning* trips
- 8 AM Peak Hour: 31 Pedestrians

FIGURE 3.3: PEDESTRIAN SURVEY RESULTS - NUMBER OF PEDESTRIANS



Of the Total Pedestrians

- 85% walked alone
- 15% walked with a group

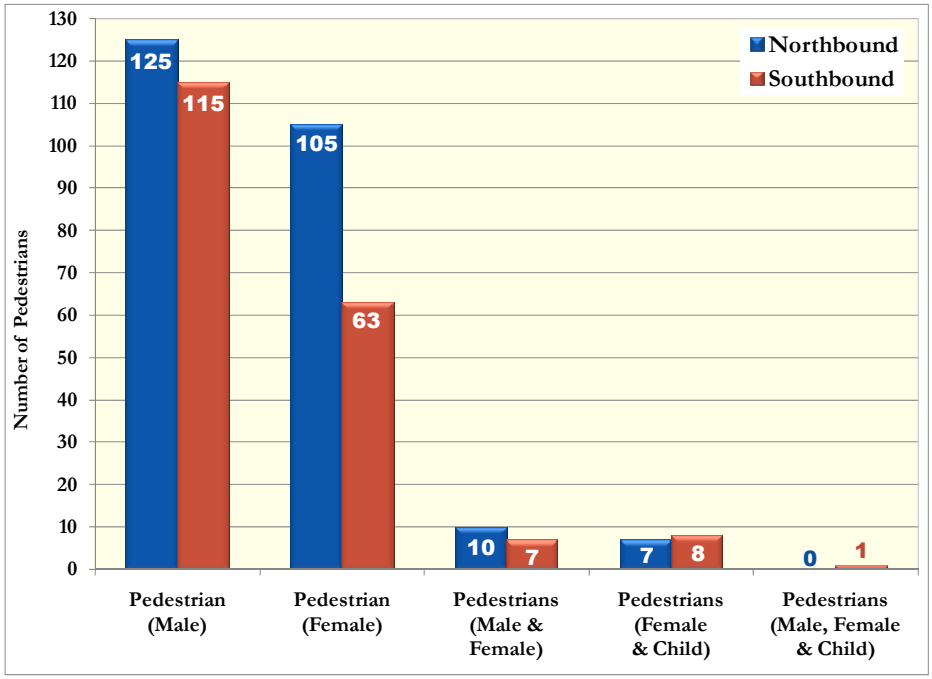
Northbound Facts

- 83% walked alone
- 17% walked in a group

Southbound Facts

- 86% walked alone
- 14% walked in a group

FIGURE 3.4: PEDESTRIAN SURVEY RESULTS - GENDER



Of the Total Pedestrians

- 55% of were male
- 37% were female

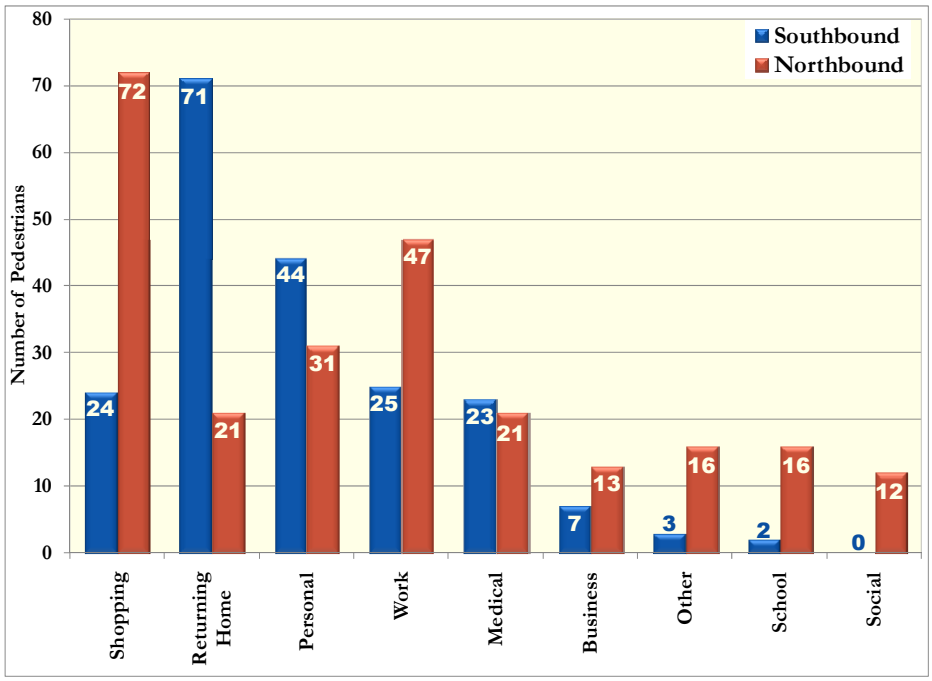
Northbound Facts

- 50% male
- 42% female
- 3% traveled with a child

Southbound Facts

- 59% male
- 32% female
- 4% traveled with a child

FIGURE 3.5: PEDESTRIAN SURVEY RESULTS - TRIP PURPOSE



*Personal includes Family, Pick up Children, and Personal.

Of the Total Trips

- It seems that there is a trip exchange between the two directions; the highest purpose southbound is *Home* trips while the northbound is *Shopping* trips

Northbound Facts

- 29% *Shopping* trips
- 19% *Work* trips
- 12% *Personal* trips

Southbound Facts

- 36% *Home* trips
- 22% *Personal* trips
- 13% *Work* trips

FIGURE 3.6: PEDESTRIAN SURVEY RESULTS - TRIP ORIGIN AND DESTINATION

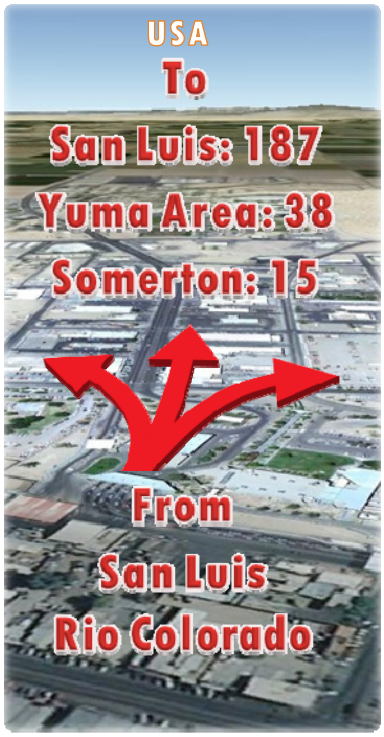
Southbound

Other Origins – Other Destination: 23

Southbound Facts

- Majority of trips ***end*** in San Luis Rio Colorado:
- 58% from San Luis,
  - 32 *Personal* trips
  - 33 *Home* trips
  - 22 *Shopping* trips
- 21% from Yuma Area,
  - 17*Home* trips
- 10% from Somerton,
  - 9 *Home* trips

Northbound

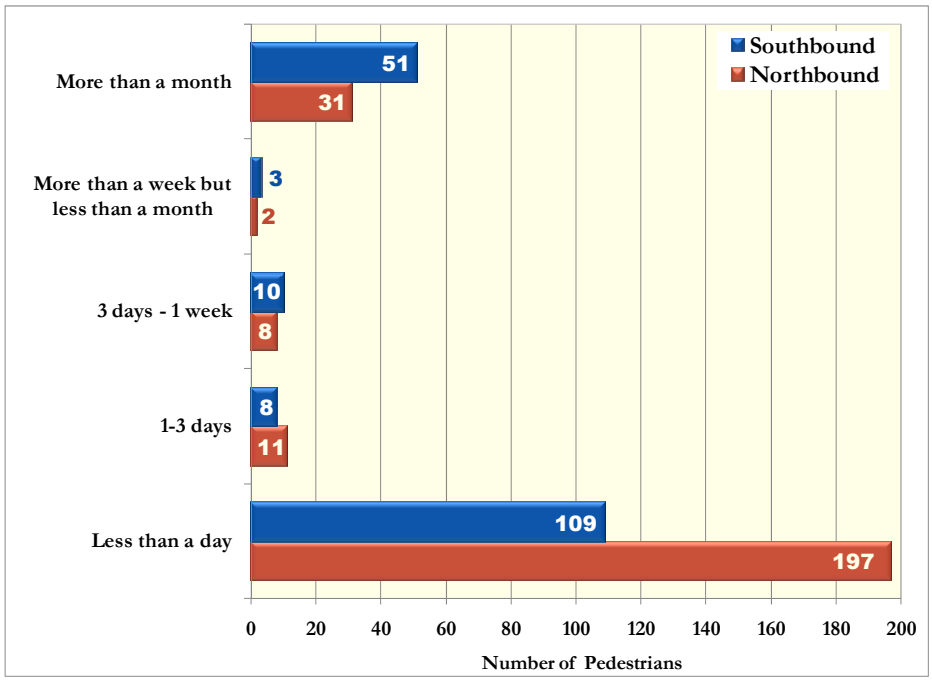


Other Origins - Other Destination: 9

Northbound Facts

- Majority of trips ***originate*** in San Luis Rio Colorado:
- 75% from San Luis,
  - 64*Shopping* trips
  - 33 *Work* trips
- 15% to Yuma Area,
  - 10 Work trips
  - 7Shopping trips
- 6% to Somerton,
  - 5Personal trips

FIGURE 3.7: PEDESTRIAN SURVEY RESULTS - EXPECTED TRIP LENGTH



Of the Total Trips

- 70% of total trips were day trips *(less than a day)*
- 20% of total trips were to last *more than a month*

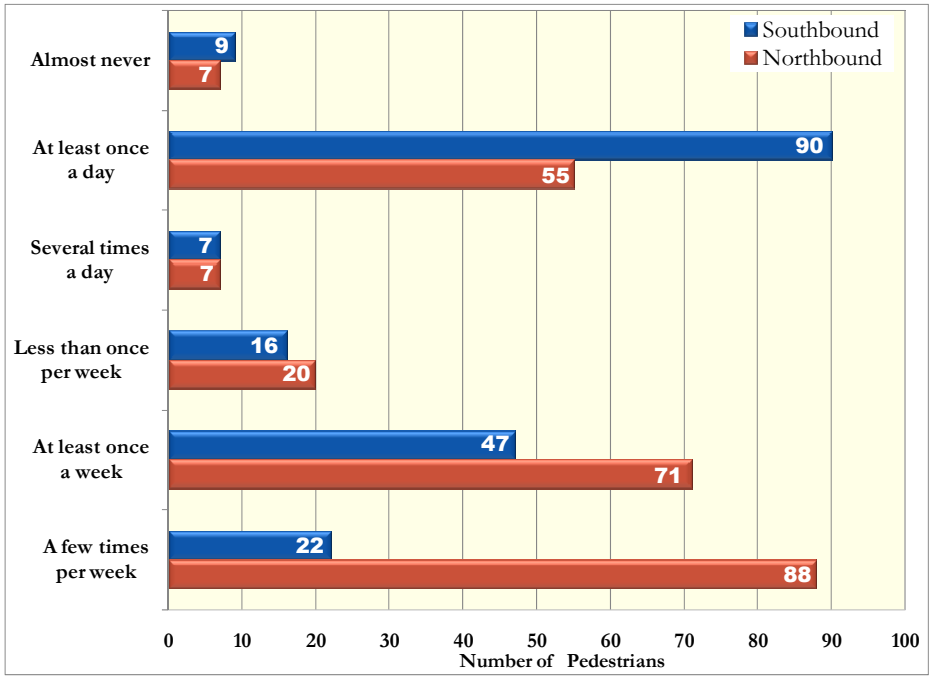
Northbound Facts

- 79% day trips
- 12% of trips were to last *more than a month*

Southbound Facts

- 60% day trips
- 28% of trips were to last *more than a month*

FIGURE 3.8: PEDESTRIAN SURVEY RESULTS - BORDER CROSSING



Of the Total Pedestrians

- 33% cross the border *at least once a day*
- 27% *a few times per week*

Northbound Facts

- 35% *a few times per week*
- 29% *at least once a week*

Southbound Facts

- 47% *at least once a day*
- 25% *at least once a week*