Appendix E
Roadway Capacity Analysis

E.1 Roadway Capacity Analysis Approach

This appendix provides detailed technical information on the traffic analysis conducted to assess the impacts of the proposed line and the associated Commercial Motor Vehicle (CMV) Facility. The proposed line has no potential to affect traffic operations. Therefore, the analysis focuses on the CMV Facility, which would be constructed under both the Southern and the Northern Rail Alternatives.

E.1.1 Roadway Network

Figure E-1 illustrates the road network in the vicinity of the associated CMV Facility.

E.1.2 Analysis Years

Traffic analyses were conducted for the following years and scenarios:

- 2024 existing conditions,
- 2031 build alternatives with CMV Facility (2031 build scenario); and
- 2031 No-Action Alternative.

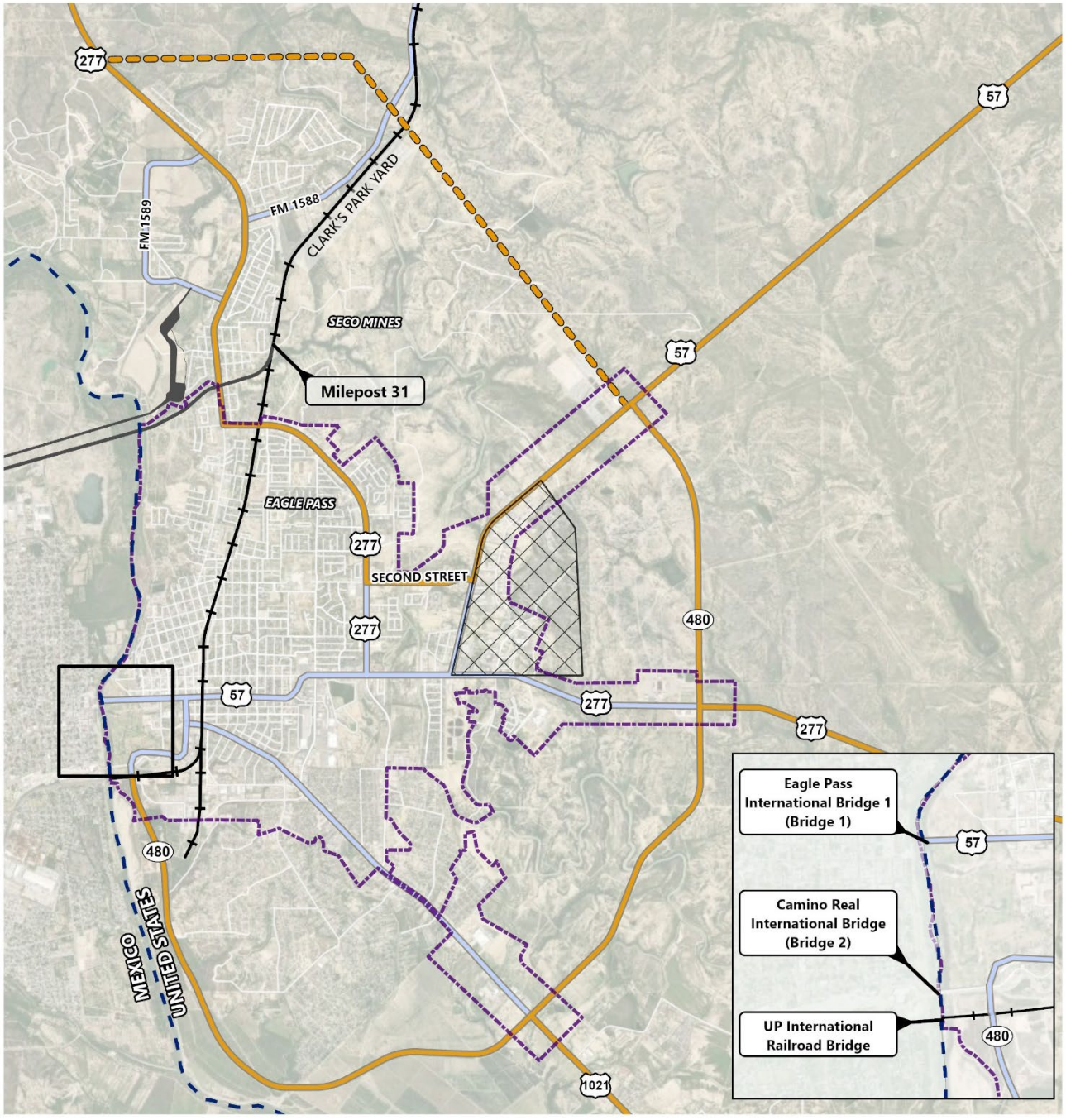
Under the 2031 No-Action Alternative and the 2031 build scenario, the Office of Environmental Analysis (OEA) assumes that the Texas Department of Transportation (TxDOT) will have completed State Loop (SL) 480 to the north of Eagle Pass.

E.1.3 Influence Area

Under the 2031 build scenario, all inbound CMV traffic entering the United States through the New Road Bridge and the CMV Facility would use Farm-to-Market Road (FM) 1589 to connect to U.S. 277 and would follow these routes:

- To SL 480: Most CMV traffic would proceed northbound on U.S. 277 then take a right onto FM 1588 to connect to SL 480. SL 480 would facilitate non-regional connections via U.S. 57 and U.S. 277 southbound, as well as access to regional commercial warehouse processing along U.S. 57.
- To U.S. 277 North: CMV traffic traveling to northern destinations would bypass FM 1588 and continue northbound on U.S. 277.

Figure E-1. Eagle Pass Roadway Network



Source: ArcGIS Online, NearMap

The associated CMV Facility would connect to the existing public roadway network via a new, single access point located on FM 1589, approximately 0.3 miles west of the FM 1589/U.S. 277 intersection.

Therefore, the analysis assesses operational impacts at two intersections: FM 1589/U.S. 277 and FM 1588/U.S. 277 (**Figure E-2**). The analysis also considers CMV traffic from operations at the associated CMV Facility at the new intersection between the associated CMV Facility and FM 1589.

E.2 Existing Conditions

E.2.1 Existing Transportation Infrastructure

E.2.1.1 U.S. 277

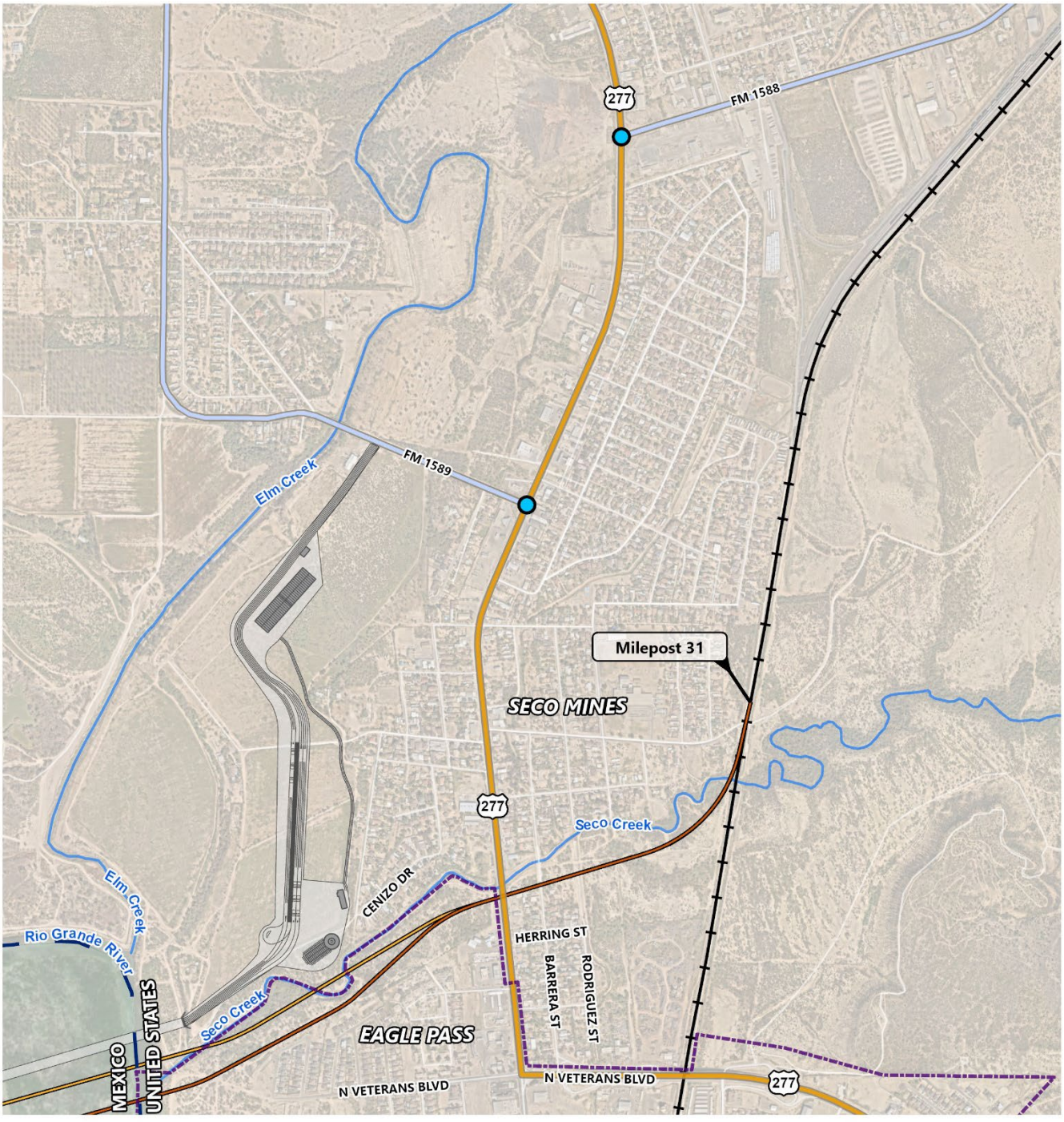
U.S. 277 connects Eagle Pass to Laredo to the southeast and Del Rio to the northwest, providing the connection to points throughout the United States to the north and west. U.S. 277 is a truck route (City of Eagle Pass 2022). North of FM 1589, U.S. 277 has a single lane in each direction, whereas between FM 1589 and just south of FM 1588, it expands to two lanes in each direction, with a fifth middle lane for left turns. Approximately one mile south of FM 1589, U.S. 277 splits between a business loop (Del Rio Boulevard) that heads south into downtown Eagle Pass and a main trunk (N. Veterans Boulevard) that heads east and south.

E.2.1.2 U.S. 57

U.S. 57 serves as the principal route connecting Eagle Pass and San Antonio and is a truck route (City of Eagle Pass 2022). It stretches for 100 miles northeast to Moore, Texas, before merging with I-35. In Eagle Pass, east of its intersection with SL 480, U.S. 57 runs in a northeast-southwest direction before continuing east along East Main Street then East Garrison Street to terminate at the Eagle Pass International Bridge 1 (Bridge 1). U.S. 57 is a four-lane highway near to the intersection with SL 480.

The warehouse area (shown on **Figure E-1**) along U.S. 57 serves as the primary hub for CMV traffic processing near its intersection with SL 480, particularly for those stopping locally before continuing to non-regional routes. It is anticipated that warehouses in this area will continue supporting the increasing demands of cross-border trade.

Figure E-2. Study Intersections



Source: ArcGIS Online, NearMap

E.2.1.3 SL 480

SL 480 is a two-lane road that connects to the Camino Real International Bridge (Bridge 2) and from there runs south, parallel to the Rio Grande River before turning east, looping around to intersect with U.S. 277 east of downtown Eagle Pass, and terminating at U.S. 57 northeast of the city. SL 480 is a truck route (City of Eagle Pass 2022). TxDOT plans to extend SL 480 north of U.S. 57 to connect to U.S. 277, north of Eagle Pass. This extension involves constructing approximately 6 miles of new roadway to U.S. 277, with an interchange at FM 1588. It also includes widening travel lanes on U.S. 277, FM 1588, and U.S. 57 to add turn lanes and medians at the intersections where SL 480 would be constructed.

The completed SL 480 will form an extensive loop that enhances vehicular movement within and beyond the Eagle Pass region. SL 480 serves not only as a key local connector but also as a crucial link for bypassing the urban core of Eagle Pass. By channeling commercial traffic via this loop, the highway minimizes the impact on downtown areas.

E.2.1.4 Eagle Pass Land Port of Entry

The Eagle Pass Land Port of Entry was established in 1896. Today this port of entry, incorporating three international bridges, stands as a critical junction between Texas and Coahuila, Mexico. As discussed in *Chapter 2, Section 2.2.1, Existing Eagle Pass Crossings,* Bridge 1 handles both commercial and non-commercial vehicle traffic and Bridge 2 handles commercial vehicle traffic as well as non-commercial traffic. On Bridge 2, one lane is specifically widened to 25 feet to facilitate the passage of wide loads. Bridge 1 operates daily from 7:00 a.m. to 10:45 a.m. and Bridge 2 is open 24 hours; however, for southbound commercial crossings, Bridge 2 limits operations to between 8:00 a.m. to 10:45 p.m. on weekdays and 8:00 a.m. to 2:00 p.m. on Saturdays. Bridge 2 is open 24 hours a day for non-commercial traffic.

E.2.1.5 Study Area Intersections and Roadways

The intersection of U.S. 277 and FM 1589 is unsignalized, with two designated 12-foot travel lanes in each direction on U.S. 277, along with a center left turn lane. FM 1589, a two-lane, east-west road, terminates at U.S. 277. The eastbound approach of FM 1589 includes a left-turn lane and a 200-foot channelized right-turn lane. This approach is stop-controlled and features a north/south pedestrian crossing.

The intersection of U.S. 277 and FM 1588 is signalized. The northbound approach on U.S. 277 consists of two 12-foot lanes, including a through lane and a through/right-turn lane. The southbound approach has three 12-foot lanes, comprising two through lanes and one left-turn lane. The left-turn lane is exclusively a southbound left-turn lane for 200 feet, with the section prior serving as a center left/right-turn lane. FM 1588 terminates at U.S. 277 with a left-turn lane and a channelized right-turn lane featuring a 200-foot bay. The intersection also includes pedestrian crossings across the northbound and westbound approaches, both of which are pedestrian actuated.

E.2.2 Traffic Counts

In May 2024, to establish a baseline, OEA collected weekday peak period (7 a.m. to 9 a.m. and 4 p.m. to 6 p.m.) turning movement counts (TMCs) at both study intersections:

- U.S. 277 and FM 1589
- U.S. 277 and FM 1588

The network peak hour occurred from 7:30 a.m. to 8:30 a.m. and 5:00 p.m. to 6:00 p.m. at both intersections.

The TMCs collected in May 2024 were adjusted to reflect the 30th highest design hour volume (DHV). TxDOT's STARS II service provides traffic data which can be used for both existing analysis and forecasting traffic volumes (MS2 TCDS n.d.). Data from the permanent traffic counter S29, located on U.S. 277 approximately 1 mile north of the U.S. 277/FM 1588 intersection, were used. Traffic count data from three Tuesdays in May 2023 were reviewed and compared to the 2023 DHV, which was projected using a 5-year average AADT growth rate from the traffic counter. The adjustment factors from these dates were averaged to create a single factor of 1.15, which was applied to the TMCs collected in May 2024. This adjustment resulted in the 2024 existing weekday morning and peak hour traffic volumes depicted in the network diagram below (**Figure E-3**).

E.3 Projected Traffic

Transportation conditions in the study area can be expected to change in the future due to potential development/growth and planned transportation infrastructure improvements. A five-year planning horizon after permitting was used to assess future conditions at the study intersections. Existing traffic volumes were projected to the year 2031 to reflect growth under the build scenario and the No-Action Alternative.

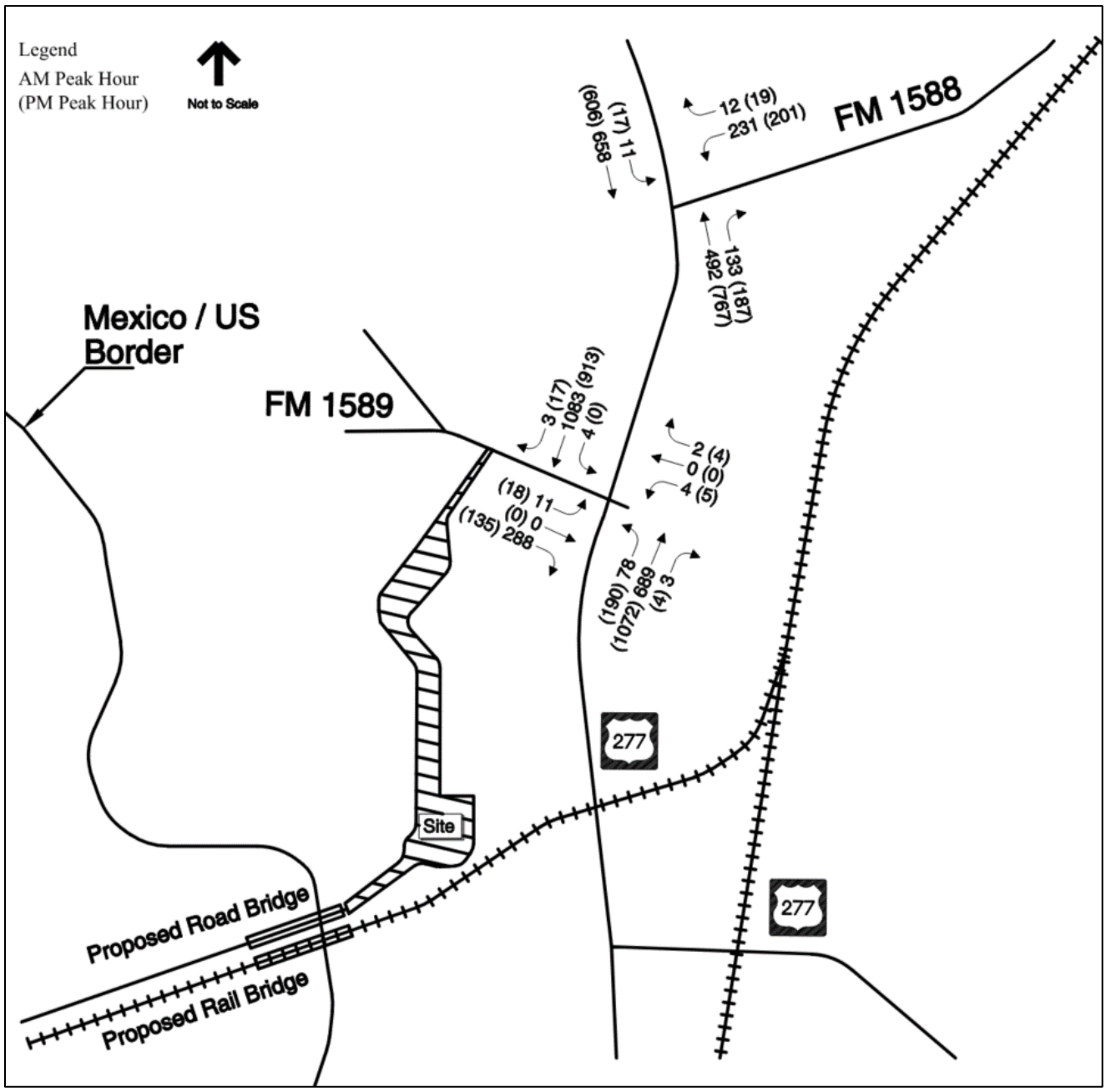
E.3.1 2031 Baseline Traffic Volumes

The 2031 baseline traffic volumes account for generalized regional traffic growth as well as the effects of foreseeable projects influencing traffic by 2031.

E.3.1.1 Anticipated Traffic Volume Growth

The anticipated traffic volume growth was estimated by increasing the 2024 existing conditions traffic volume shown in **Figure E-3** by a growth rate of 1.6 percent per year through 2031.

Figure E-3. Traffic Volumes Under Existing Conditions



E.3.1.2 SL 480 North

TxDOT's project to complete SL 480 will provide an additional connection between SL 480 and U.S. 277. As a result, the volumes on U.S. 277 south of that connection are anticipated to decrease by 38 percent. The impacts of this change are accounted for in the 2031 No-Action Alternative traffic volumes.

E.3.1.3 CMV Border Crossing Growth

The 2023 Presidential Permit Application for the Puerto Verde Global Trade Bridge project provided to OEA by Puerto Verde Holdings (PVH) included a yearly volume projection of CMV traffic based on a straight-line interpolation between actual 2022 volumes as reported by the U.S. Department of Transportation (USDOT) and 2050 estimates from TxDOT's Texas-Mexico Border Transportation Master Plan (BTMP). The resulting projected CMV traffic is anticipated to be 289,067 inbound trucks in 2031.

In order to estimate the projected CMV outbound traffic, OEA reviewed historic data from Eagle Pass International Bridge System Monthly Traffic Report. **Table E-1** below shows the monthly total crossings and CMV trips for 2022 and 2023.

Table E-2 compares southbound commercial traffic data from **Table E-1** with historic northbound data provided by U.S. Customs and Border Protection (CBP) to determine a directional distribution between inbound and outbound commercial vehicles (CBP 2024).

As shown in **Table E-2**, the typical difference between inbound and outbound commercial traffic is minor. Therefore, future estimates were made using the same number of inbound and outbound vehicles during the peak hours. **Table E-2** also shows that June 2023 was the peak month for inbound and outbound CMV crossings (39,757 total crossings). This corresponds to 9.5 percent of the total yearly volume. The 2023 June daily average for CMV traffic was 756 CMVs travelling southbound (City of Eagle Pass 2024a). It was assumed that there would also be a daily average of 756 northbound trucks for a total daily average of 1,512, indicating that 3.8 percent of June's CMV traffic crosses on the average day.

These percentages were applied to the total proposed CMV traffic to derive a daily June total of 2,110 vehicles. Traffic volume data from TxDOT's permanent counter (S29) in the study area indicates that the adjustment factor from the 2023 June ADT to the June design hourly volume (30^{th}-highest design hour of the year) is 0.086. Applying this factor to the anticipated daily June total CMV traffic yields a peak hour estimate of 182 CMVs (91 vehicles inbound and 91 vehicles outbound), which is representative of the 30^{th}-highest design hour of the year for 2031. Since both inbound and outbound crossings are 91 CMVs each, the total projected 2031 CMV crossings is 182 CMVs.

Table E-1. City of Eagle Pass Traffic Reports

Month	2022				2023			
	Bridge 1	**Bridge 2**	**CMV Traffic**	**Non-CMV Traffic**	**Bridge 1**	**Bridge 2**	**CMV Traffic**	**Non-CMV Traffic**
January	127,820	110,103	14,620	194,784	158,980	122,763	15,992	223,989
February	130,309	111,956	14,452	202,524	152,279	121,750	15,380	223,538
March	154,743	135,638	17,346	239,994	170,615	145,747	18,881	255,015
April	154,267	133,817	15,541	239,754	167,725	142,369	17,151	254,240
May	153,714	131,835	16,348	237,063	175,742	148,078	19,537	265,139
June	146,163	132,510	17,534	233,443	163,654	144,594	19,657	252,868
July	148,206	139,415	16,496	242,136	167,043	142,489	16,986	254,389
August	149,829	127,090	17,958	229,958	170,332	137,529	19,047	253,598
September	160,020	129,005	17,071	240,848	135,666	154,860	15,769	223,473
October	168,944	133,014	16,775	248,404	132,784	165,582	18,501	216,872
November	162,468	129,481	16,677	234,341	176,142	136,181	18,102	250,198
December	184,360	162,585	16,525	280,243	194,736	116,019	12,775	186,284
Total	**1,840,843**	**1,576,503**	**197,343**	**2,823,492**	**1,965,698**	**1,677,961**	**207,118**	**2,859,603**
Average	**153,404**	**131,375**	**16,445**	**235,291**	**163,808**	**139,830**	**17,260**	**238,300**

Table E-2. City of Eagle Pass Traffic Reports and CBP Data

Month	2021		2022		2023	
	CBP (Northbound)	Eagle Pass (Southbound)	CBP (Northbound)	Eagle Pass (Southbound)	CBP (Northbound)	Eagle Pass (Southbound)
January	16,100	15,272	15,500	14,620	16,800	15,992
February	13,300	12,713	15,200	14,452	16,100	15,380
March	16,500	15,927	18,200	17,346	19,600	18,881
April	16,200	15,626	16,100	15,541	17,200	17,151
May	16,200	15,246	17,200	16,348	20,300	19,537
June	17,800	16,925	18,100	17,534	20,100	19,657
July	16,800	16,065	16,900	16,496	18,000	16,986
August	17,300	16,247	18,600	17,958	19,600	19,047
September	17,300	16,311	17,600	17,071	15,300	15,769
October	17,200	16,398	17,600	16,775	18,800	18,501
November	17,100	16,191	17,400	16,677	18,600	18,102
December	16,200	15,897	16,800	16,525	10,500	12,775
Total	**198,000**	**188,818**	**205,200**	**197,343**	**210,900**	**207,778**
Difference	**5%**		**4%**		**1%**	

E.3.2 Trip Generation

As explained above, the CMV crossing volumes in the design hour are anticipated to increase to a total of 182 by 2031. When the CMV Facility is operational, these volumes of 91 CMVs inbound and 91 exiting CMV outbound would be relocated from Bridge 2 to the associated CMV Facility.

E.3.2.1 Trip Distribution

The distribution of traffic associated with the associated CMV Facility was determined by OEA and the trips were assigned to the roadway network. In addition, the associated CMV Facility's vehicular access/egress would be via FM 1589. The following CMV destination and routing patterns were considered:

- Inbound truck traffic would stop at local truck destinations, specifically the warehouse area along U.S. 57. Therefore, this CMV traffic would proceed north on U.S. 277 from FM 1589 and take a right on FM 1588 to connect to SL 480, which would be completed by 2031 and would be the shortest route to U.S. 57.
- Inbound CMV traffic would not stop locally after crossing and continue to their destination. Therefore, these CMV traffic trips would distribute to destinations throughout the United States. Based on a review of likely routes to cities throughout the United States, approximately 30 percent of CMV traffic would travel north on U.S. 277 from FM 1589 towards locations north/west and 70 percent would travel from FM 1589 using the 480 loop to proceed to north/east destinations. This distribution is shown in **Figure E-4** below.

Based on the likely CMV destination and routing patterns described above, CMV traffic trips were distributed estimating that 60 percent would stop locally, and 40 percent would travel directly to their destination. The resulting distribution of CMV traffic volumes at the study intersections is shown on **Figure E-5** and **Figure E-6** below.

Figure E-4. Regional CMV Trip Distribution

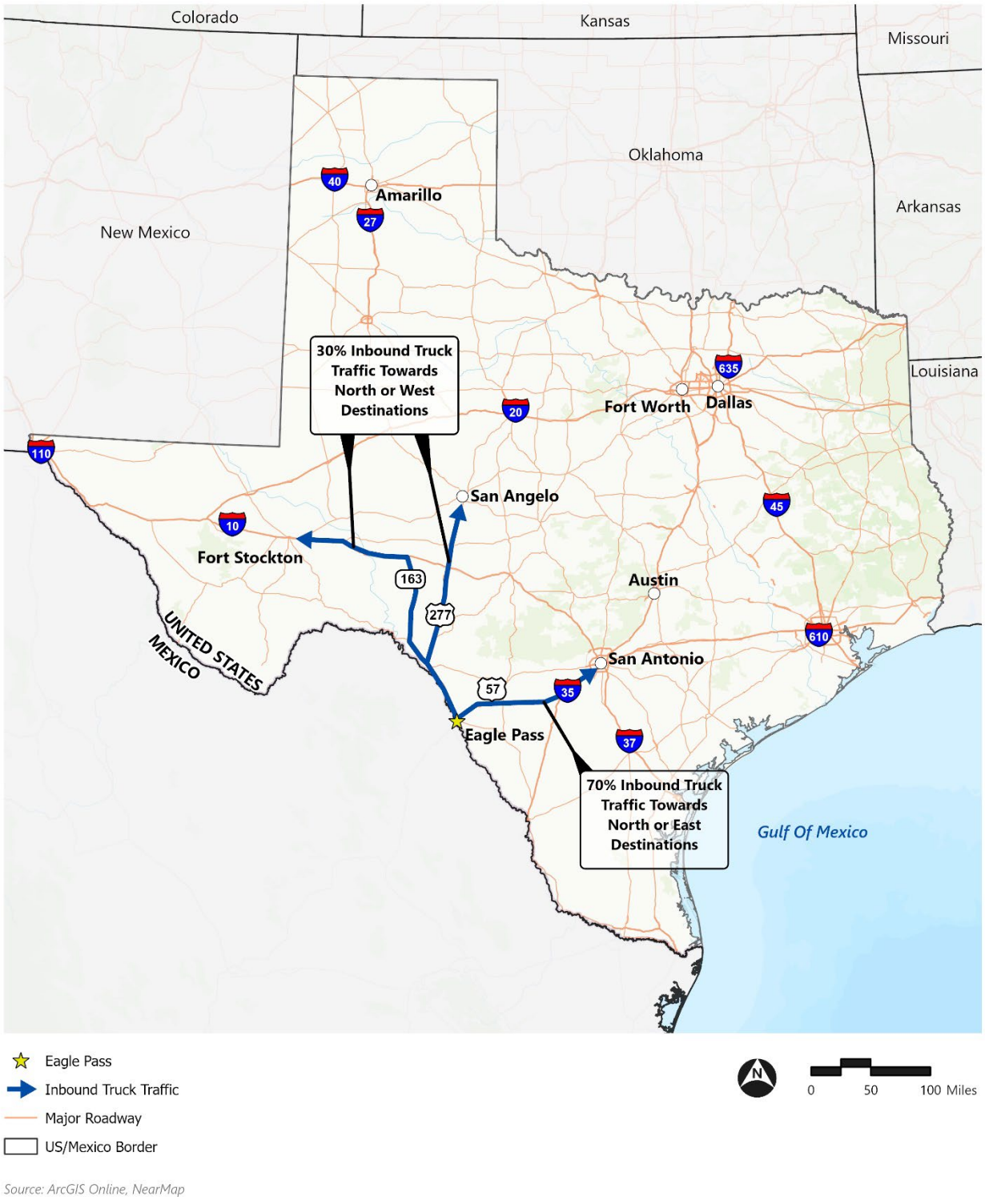


Figure E-5. CMV Traffic Volume Trip Distribution Percentage

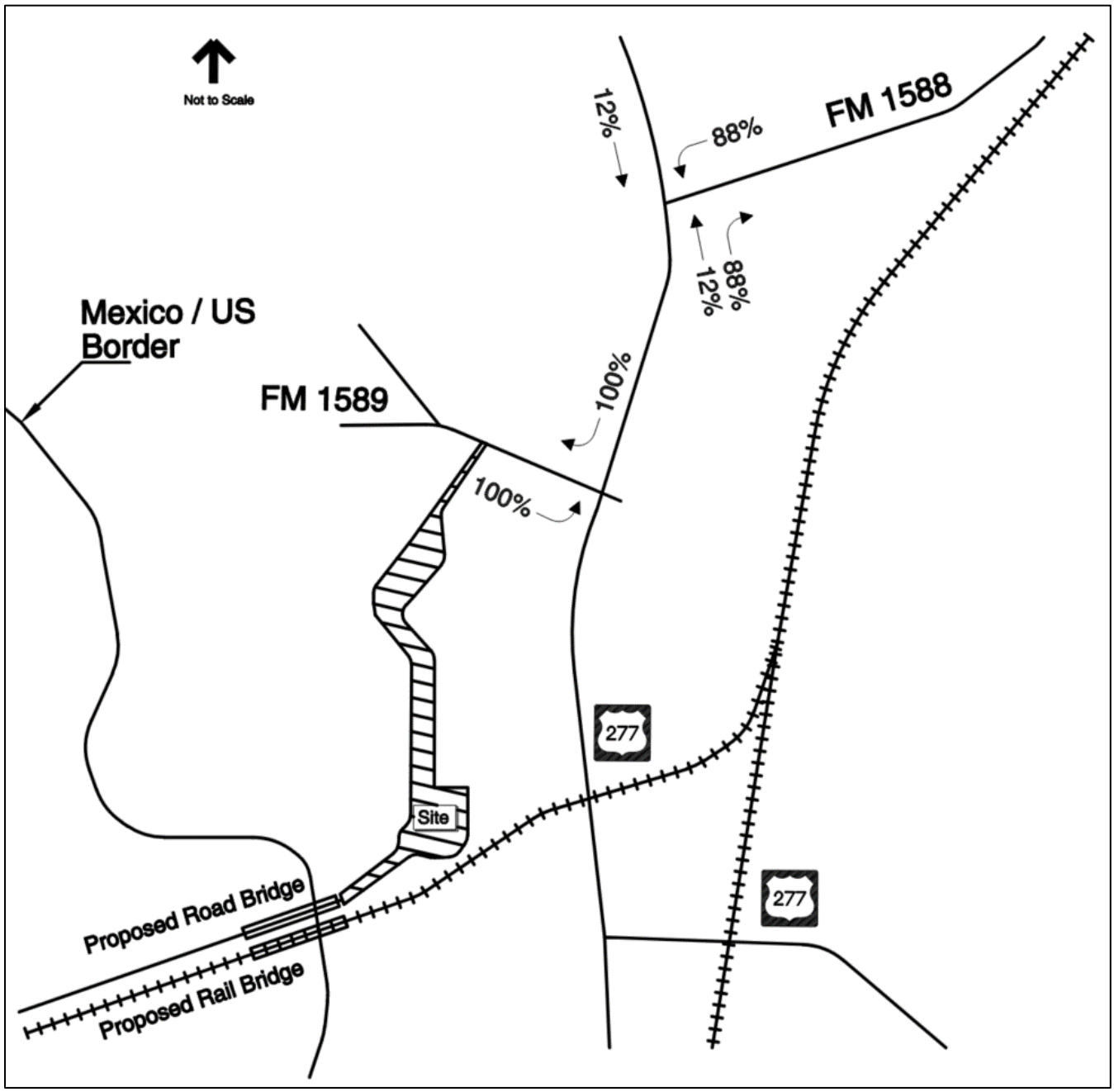
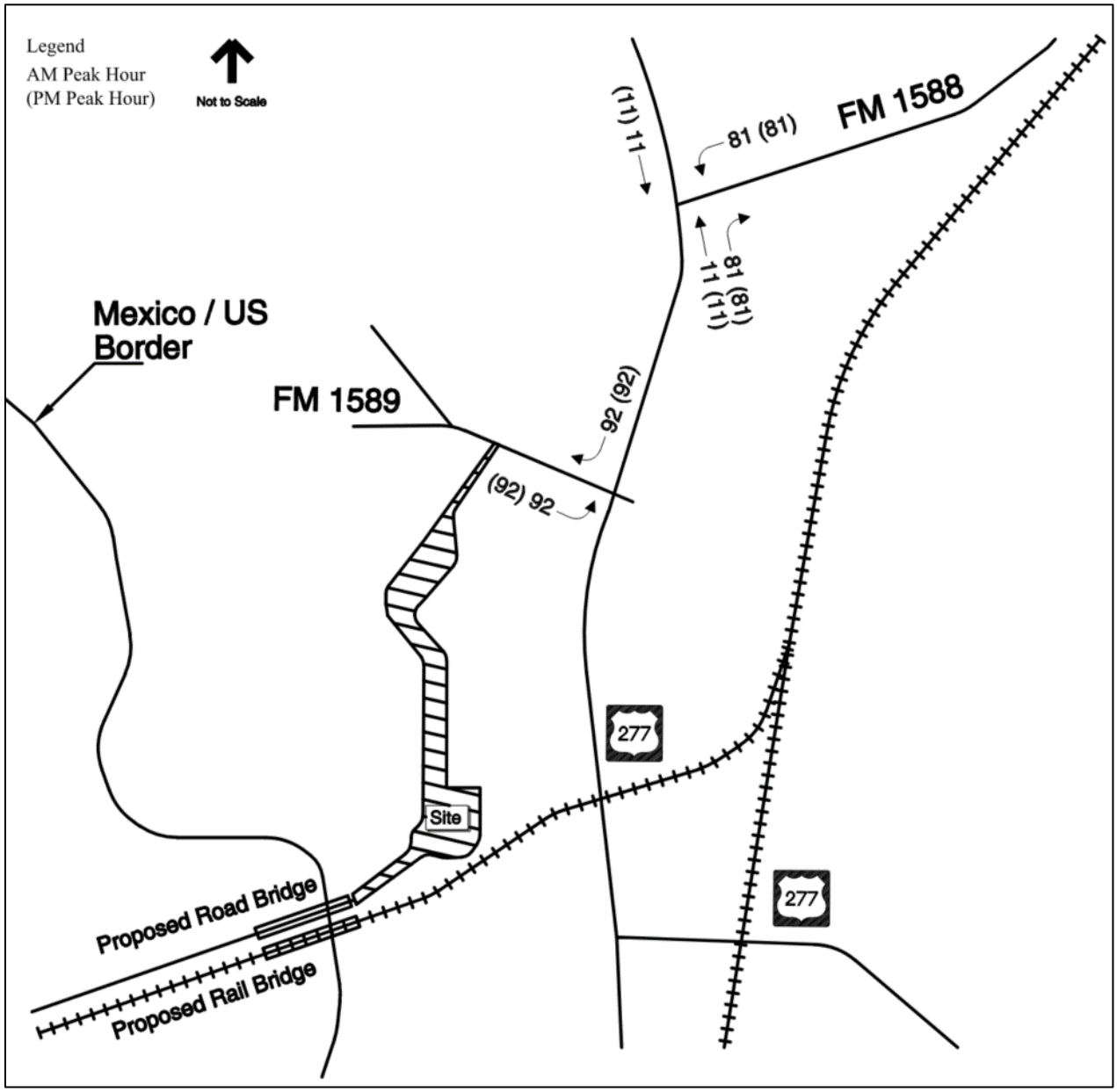


Figure E-6. CMV Traffic Volume Trip Distribution for Existing Conditions



E.3.2.2 Build Alternatives Traffic Volumes

The projected CMV trips associated with the CMV Facility were distributed on the study area roadways and added to the 2031 baseline traffic volumes outlined in *Section E.3.1, 2031 Baseline Traffic Volumes*. The resulting 2031 total traffic volumes under build conditions are shown in **Figure E-7**.

E.3.3 No-Action Alternative Traffic Volumes

The traffic volumes under the No-Action Alternative are the 2031 baseline traffic volumes outlined in *Section E.3.1, 2031 Baseline Traffic Volumes* above. The No-Action Alternative traffic volumes are illustrated in **Figure E-8**.

E.4 Traffic Operations Analysis

The study intersections were evaluated for delay, level of service (LOS), and queue length using simulations developed with SimTraffic Version 11. Existing conditions were modeled based on current (2024) roadway dimensions and lane configurations. Traffic volumes were based on counts conducted in 2024, normalized for time of year, and projected to 2031. The term LOS is used to denote the different operating conditions that occur on a given roadway segment under various traffic volume loads. It is an indicator of travel speed, delay, and freedom to maneuver. LOS provides an index to the operational qualities of a roadway segment or an intersection. LOS range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions.

E.4.1 Model Conditions

Each simulation was conducted using industry standard parameters and software settings. All simulation results reported in this evaluation are the average of five modeling runs for each scenario. The following three scenarios were modeled:

- 2024 Existing Conditions – This scenario was completed using existing intersection geometry. Peak hour factors and heavy truck percentages were obtained from turning movement counts.
- 2031 Build Conditions – This scenario is built on the 2031 baseline traffic volumes with the relocation of CMV traffic crossing inbound and outbound at the CMV Facility.
- 2031 No-Action Conditions – This scenario used baseline traffic volumes and no change on the site. No other modifications to the area's street network are expected.

Figure E-7. Total CMV Traffic Volume Distribution for Build Alternatives

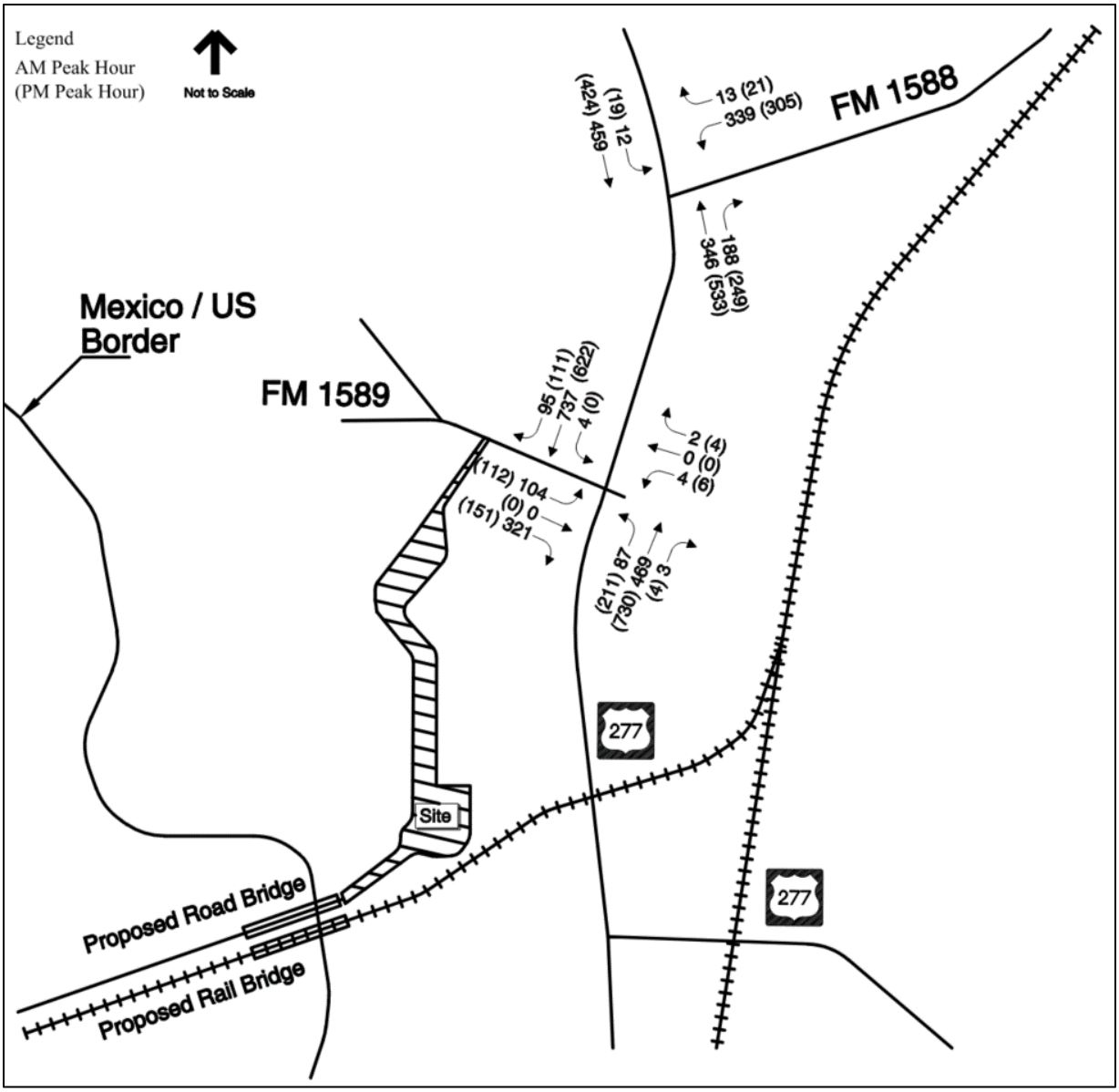
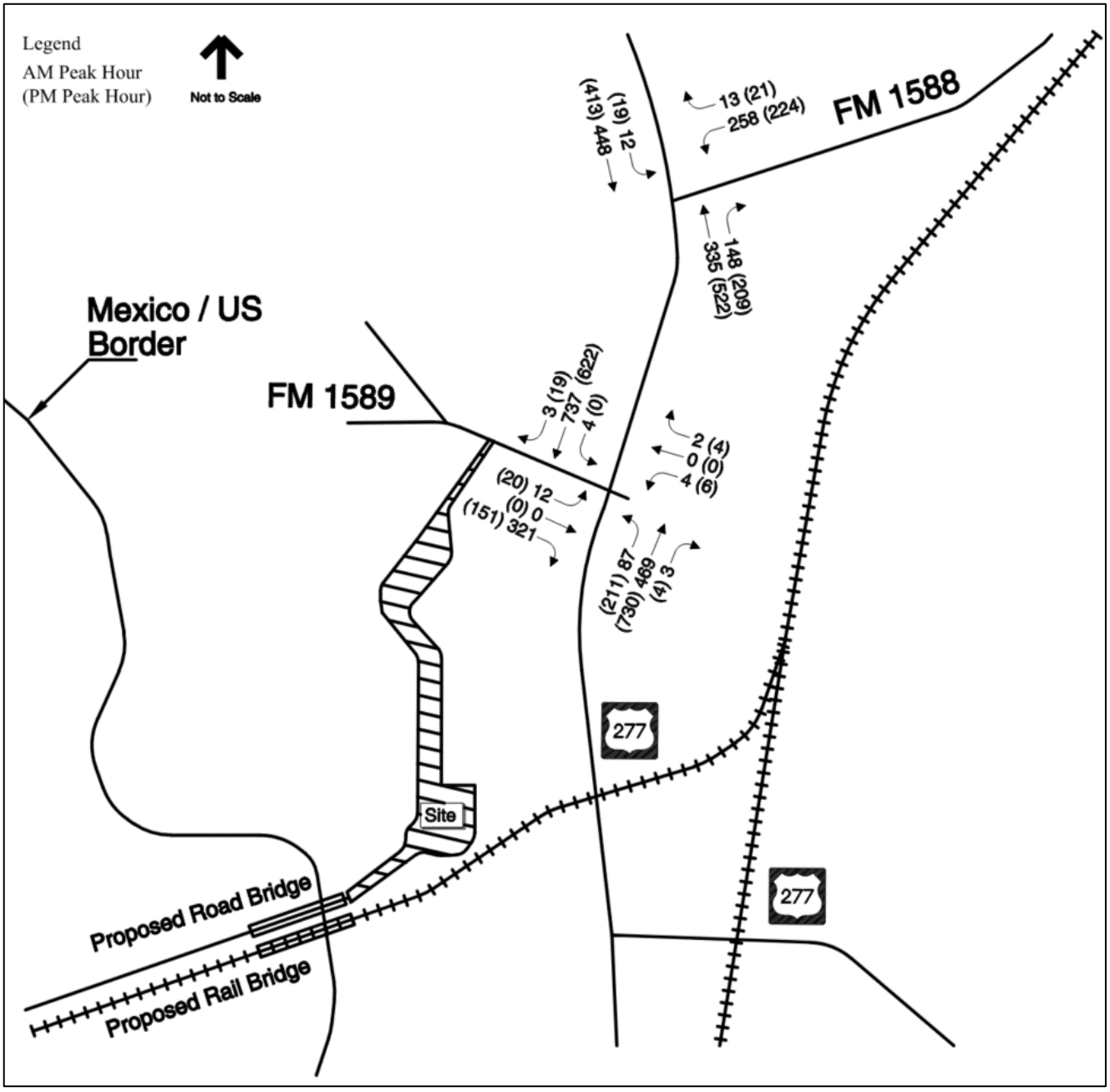


Figure E-8. CMV Traffic Volume Distribution for No-Action Alternative



E.4.2 Evaluation of Intersection Operations

LOS is reported differently for signalized and unsignalized intersections (**Table E-3**). For signalized intersections, the LOS analysis considers the operation of all traffic entering the intersection and the LOS designation is for overall conditions at the intersection. For unsignalized intersections, the analysis assumes that traffic on the mainline is not affected by traffic on the side streets. Thus, the LOS designation is for the critical movement exiting the side street and is typically the left turn out of the side street or site driveway.

Table E-3. Level of Service and Delay Summary

Level of Service	Signalized Intersection Delay (sec)	Unsignalized Intersection Delay (sec)
A	<10.0	<10.0
B	10.1 – 20.0	10.1 – 15.0
C	20.1 – 35.0	15.1 – 25.0
D	35.1 – 55.0	25.1 – 35.0
E	55.1 – 80.0	35.1 – 50.0
F	>80.0	>50.0

Source: National Academies of Sciences, Engineering, and Medicine 2022

E.4.3 Intersection Operations Analysis

Table E-4 through **Table E-6** summarize the traffic analysis results at each study area intersection under the 2024 existing conditions, 2031 build scenario, and 2031 No-Action Alternative.

Under the 2031 No-Action Alternative, network performance improves compared to the 2024 existing conditions due to the reduction and reallocation of through traffic on U.S. 277 following the completion of SL 480. With the additional CMV traffic under the 2031 build scenario, the network's performance would be impacted by the lengthy delays and queues on FM 1589 that would extend from U.S. 277 back into the associated CMV Facility. Such congestion is common at unsignalized intersections where the stop-controlled approach experiences increased volumes with less room to find gaps in traffic on the non-stop-controlled approach.

Given the impacts that would result from the associated CMV Facility, and based on coordination with TxDOT, OEA anticipates that TxDOT would signalize the intersection of U.S. 277 and FM 1589 to ensure acceptable operations. Modeling shows that signalizing that intersection would open gaps in U.S. 277 traffic to process the vehicles queuing on FM 1589. As a result, the intersection operations would return to an acceptable LOS, as shown in **Table E-4** through **Table E-6**.

Table E-4. Intersection Capacity Analysis Summary at CMV Facility Access Road and FM 1589

	2024 Existing Conditions			**2031 No Action Alternative**			**2031 Build Scenario**			**Improvement (Signalize U.S. 277 and FM 1589)**		
Approach	Delay[1]	LOS[2]	Q95[3]	Delay[1]	LOS[2]	Q95[3]	Delay[1]	LOS[2]	Q95[3]	Delay[1]	LOS[2]	Q95[3]
AM Peak Hour												
FM 1589, Eastbound	-	-	-	-	-	-	2.9	A	9	0.4	A	6
FM 1589, Westbound	-	-	-	-	-	-	7.1	A	106	1.9	A	101
CMV Facility Access Road, Northbound	-	-	-	-	-	-	9.1	A	115	7.2	A	115
Overall	-	-		-	-		5.2	A		1.4	A	
PM Peak Hour												
FM 1589, Eastbound	-	-	-	-	-	-	55.7	F	294	1.7	A	
FM 1589, Westbound	-	-	-	-	-	-	3.9	A	79	6.7	A	90
CMV Facility Access Road, Northbound	-	-	-	-	-	-	258.7	F	968	7.5	A	116
Overall	-	-		-	-		55.6	F		4.1	A	

Notes:
[1] Delay expressed in seconds per vehicle.
[2] LOS for signalized intersection delay is A (0 to 10), B (10 to 20), C (20 to 35), D (35 to 55), E (55 to 80), and F (greater than 80).
[3] 95th percentile queue length expressed in feet (greatest of approach).

Table E-5. Intersection Capacity Analysis Summary at U.S. 277 and FM 1589

	2024 Existing Conditions			2031 No Action Alternative			2031 Build Scenario			Improvement (Signalize U.S. 277 and FM 1589)		
Approach	Delay[1]	LOS[2]	Q95[3]	Delay[1]	LOS[2]	Q95[3]	Delay[1]	LOS[2]	Q95[3]	Delay[1]	LOS[2]	Q95[3]
AM Peak Hour												
FM 1589, Eastbound	16.6	C	155	11.7	B	143	50.2	F	713	14.6	B	189
Tire Shop, Westbound	12.7	B	26	11.0	B	27	12.7	B	23	19.7	B	26
U.S. 277, Northbound	1.9	A	60	1.7	A	55	2.5	A	64	5.5	A	78
U.S. 277, Southbound	3.5	A	4	3.0	A	12	3.8	A	34	13.8	B	218
Overall	4.7	A		4.3	A		14.3	B		11.5	B	
PM Peak Hour												
FM 1589, Eastbound	11.1	B	73	8.8	A	76	502.2	F	1799	16.2	B	193
Tire Shop, Westbound	15.8	C	27	10.9	B	30	17.1	C	33	7.1	B	34
U.S. 277, Northbound	3.2	A	83	3.0	A	78	3.7	A	87	9.3	A	114
U.S. 277, Southbound	3.4	A	13	3.0	A	5	3.6	A	48	10	A	241
Overall	3.8	A		3.6	A		65.4	F		11.5	B	

Notes:
[1] Delay expressed in seconds per vehicle.
[2] LOS for signalized intersection delay is A (0 to 10), B (10 to 20), C (20 to 35), D (35 to 55), E (55 to 80), and F (greater than 80).
[3] 95th percentile queue length expressed in feet (greatest of approach).

Table E-6. Intersection Capacity Analysis Summary at U.S. 277 and FM 1588

	2024 Existing Conditions			**2031 No Action Alternative**			**2031 Build Scenario**		
Approach	Delay[1]	LOS[2]	Q95[3]	Delay[1]	LOS[2]	Q95[3]	Delay[1]	LOS[2A]	Q95[3]
AM Peak Hour									
FM 1588, Westbound	13.2	B	115	12.6	B	131	15.5	B	215
U.S. 277, Northbound	6.0	A	114	5.6	A	93	6.8	A	123
U.S. 277, Southbound	7.5	A	100	7.8	A	87	8.9	A	89
Overall	7.7	A		8.0	A		9.5	A	
PM Peak Hour									
FM 1588, Westbound	14.9	B	125	13.3	B	122	16.5	B	183
U.S. 277, Northbound	7.5	A	163	7.0	A	144	9.1	A	190
U.S. 277, Southbound	7.1	A	101	7.2	A	89	8.2	A	91
Overall	8.2	A		8.2	A		10.3	B	

Notes:

[1] Delay expressed in seconds per vehicle.

[2] LOS for signalized intersection delay is A (0 to 10), B (10 to 20), C (20 to 35), D (35 to 55), E (55 to 80), and F (greater than 80).

[3] 95th percentile queue length expressed in feet (greatest of approach).