US 290 Traffic Study Report (HB1- Rider 50)

Texas Department of Transportation

Transportation Planning and Programming Division

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Texas Department of Transportation

Table of Contents

List of Figures

List of Tables

Executive Summary

The Texas Department of Transportation (TxDOT) Transportation Planning and Programming (TPP) Division conducted a Traffic Study along the designated hurricane route section of U.S. Highway 290 between US 183 in Austin and Beltway 8 in Houston, as directed by the 88th Texas Legislature. The study evaluated existing (Year 2024) and future (Analysis Year 2029) traffic on a normal day and during hurricane evacuation, safety, travel patterns, hurricane evacuation response, and the impact of the at-grade railroad crossing in Giddings.

This study finds that Houston District and Austin District, located on the two ends of US 290, have the highest traffic demands. The crash rates of urban sections are lower than the TxDOT statewide average.

- The US 290 Houston District Section is a freeway section with the highest mobility capacity, which provides sufficient capacity to accommodate the highest traffic demand.
- The US 290 Austin District Section is a signalized highway between Austin and Elgin, which provides insufficient mobility capacity to handle the second highest traffic demand along the corridor, resulting in excessive congestion and delay. The closely spaced traffic signals and driveways also contribute to the intersection- and driveway-related crashes.

Beyond the two metropolitan sections at the two ends of the study, the US 290 rural sections in between have relatively lower traffic demands but should not be overlooked. Some rural sections indicate higher than statewide average crash rates which can be improved through appropriate signage, pavement marking, lighting, and speed management. TxDOT has been working on addressing two identified traffic bottlenecks in this study:

- In downtown Giddings, the US 290 section exhibits raised traffic demand and restricted capacity caused by traffic signals and the at-grade railroad crossing. TxDOT's Austin District is conducting the Giddings Mobility Study that evaluates various alternatives to relieve US 290 traffic congestion (anticipated to be completed in 2025).
- In Brenham, the one-lane partial cloverleaf ramps at the US 290 and SH 36 interchange also create bottlenecks. TxDOT’s Alternative Delivery Program is improving this interchange to a four-lane, two-way interchange with direct connectors (anticipated completion year 2029).

The hurricane evacuation assessment pinpoints areas where traffic demand surpasses the road's capacity during a Category 5 (the highest level) hurricane event. With proper evacuation interventions including EvacuLanes and Contraflow, most existing US 290 sections are sufficient to handle the evacuation traffic demand in the 2024 existing year and the 2029 analysis year. Westbound US 290 between SH 99 (Grand Parkway near Cypress) and Field Store Road (Waller) is expected to experience congestion during evacuation, as the number of lanes decrease from 5 to 3 and Contraflow is not available until Field Store Road. This section has inadequate capacity to handle the evacuation traffic demand. A potential option for reducing traffic congestion for this section is extending the Contraflow plan up to the lane drop near SH 99 to increase available capacity.

Key findings:

- **February 2024 Field Visit Observation:**
  - Motorists operated above the posted speed limit across various sections of US 290.
  - Insufficient roadway lighting condition present in rural section along US 290.
- **Safety Analysis:**
  - Crash frequency gradually increased from 2,550 in 2019 to the highest of 2,830 in 2023, despite the frequency decline in 2020 caused by the change in travel patterns due to the COVID-19 pandemic and stay-at-home conditions.
  - All urban segments indicated lower crash rates compared to the TxDOT urban statewide average crash rate, while rural segments in the Austin District and Bryan District exhibited slightly higher crash rates than rural statewide average crash rates.
- **Travel Patterns:**
  - The highest traffic volumes exist near the metropolitan areas of Austin and Houston, with noticeable traffic volume rises around Giddings and Brenham.
  - In the Austin District, most trips using US 290 are between Austin, Manor, and Elgin. In the Houston District, most trips using US 290 are between Beltway 8 and SH 99.
  - Approximately 15% of evacuees are expected to use US 290 as the evacuation route during a hurricane event.
- **Traffic Projections:**
  - Based on historical data and travel demand model projections, projected average linear growth rates of 3.4%, 3.6%, and 2.7% for the Austin area, non-metro area, and Houston area, respectively, were used to project volumes to analysis years.
- **Normal Condition Traffic Operation:**
  - US 290 has sufficient capacity to accommodate existing 2024 and projected 2029 traffic demands in most of the study sections, except the Austin-Manor-Elgin section.
  - The projected 2029 highest traffic demand in the Houston section is expected to be accommodated by the corresponding highest capacity. The second-highest traffic demand in Austin and Manor will exceed the capacity and cause substantial congestion.
- **Hurricane Evacuation Assessment:**
  - With proper evaluation interventions including EvacuLanes and Contraflow, most US 290 sections sufficiently handle the high traffic demand during evacuations.
  - Westbound US 290 between SH 99 (Grand Parkway near Cypress) and Field Store Road (Waller) is expected to experience congestion during evacuation, as the number of lanes decrease from 5 to 3 and Contraflow is not available until Field Store Road.
  - Other sections with traffic operational concerns during hurricane evacuation include Brenham, Giddings, Elgin, Manor, and Austin.

Potential Options for Reducing Traffic Congestion

This section discusses the potential options for reducing traffic congestion as part of this study to alleviate the safety, mobility, and operational concerns under both normal conditions and hurricane evacuation scenarios. Potential options for reducing traffic congestion are categorized as short-term (1 to 4 years) and mid-term (5 to 10 years). At this time, there is no dedicated funding or commitment by TxDOT to implement these options.

Short Term (1 to 4 years)

- Perform a Road Safety Audit (RSA) on rural segments in the Austin and Bryan District where crash rates are higher than the statewide average crash rate.
- Provide illumination for the rural sections that lack lighting and exhibit a high percentage of "Dark, Not Lighted" crashes.
- Perform a speed study near urbanized towns within rural sections and provide additional warning signage to alleviate the drastic speed changes.
- Evaluate the impact of major driveways and crossovers on corridor mobility and safety in the Manor and Elgin sections.
- Perform a traffic signal timing optimization review to evaluate the traffic progression along US 290 in the Manor and Elgin sections.
- Extend the Contraflow limit from Field Store Road to SH 99.
- TxDOT continues collaborating with law enforcement to assist traffic controls for the at-grade railroad crossing in Giddings during hurricane evacuations.
- Improve roadway conditions, signage, and pavement markings along US 290 to enhance hurricane route visibility.

Mid Term (5 to 10 years)

- Maintain and enhance pavement markings (including edge line rumble strips) and signage (including radar speed signs) to assist traffic in lane-keeping and speed management.
- Provide railroad preemption to the Giddings at-grade crossing to improve operations. Include a track clearance phase to clear traffic queue and exit phase after the train passes.
- Provide an end-of-queue warning system to alert approaching drivers of slow or stopped traffic ahead caused by train crossings and mitigate potential rear-end crashes.
- Complete US 290 and SH 36 interchange improvements and update Contraflow plan after completion.
- Expand and Diversify Evacuation Routes: Extend the Hurricane Evacuation Route network to include SH 249 (Aggie Expressway), SH 36 (Brenham), and potential Westpark Toll Road to provide more alternative routes for evacuees and alleviate the burden on US 290.
- Provide adequate Dynamic Message Signs along US 290 evacuation routes.

1. Introduction

1.1 Legislatively Mandated Traffic Study

The 88th Texas Legislature passed House Bill 1 (General Appropriations Bill) with attached Rider 50 titled "U.S. 290 Traffic Study." The Rider 50 directs the Texas Department of Transportation (TxDOT) to conduct a traffic study on options for reducing traffic congestion on segments of U.S. Highway 290 (hereafter, US 290) that serve as a hurricane evacuation route. This study evaluated existing conditions (Year 2024) and analysis year conditions (Year 2029) from various perspectives including mobility, safety, travel usage pattern, hurricane evacuation response, and the at-grade railroad crossing in the City of Giddings. This report will guide the TxDOT Districts, Divisions, and other stakeholders for future planning activities along this important highway corridor and hurricane evacuation route.

The exact text for the US 290 study in House Bill 1 Rider 50 is below:

> *"Using funds appropriated above, the Department of Transportation shall conduct a study on options for reducing traffic congestion on segments of U.S. 290 that serve as hurricane evacuation routes and include at-grade rail crossings. In conducting the study, the department shall consider projected traffic and usage patterns, projected usage during disasters, and the potential use of the Texas Rail Relocation and Improvement Fund to address rail crossing issues."*

1.2 Texas Rail Relocation and Improvement Fund Overview.

The Texas Rail Relocation and Improvement Fund is codified in Transportation Code, Title 6, Subtitle A, Chapter 201, Subchapter "O" and described as follows:rai

The Texas Transportation Commission may issue obligations (bonds, notes, and other public securities):

- to provide a method of financing the construction of railroad underpasses and overpasses, if the construction is part of the relocation of a rail facility.
- to provide participation by the state in the payment of part of the costs of relocating, constructing, reconstructing, acquiring, improving, rehabilitating, or expanding publicly or privately owned rail facilities, including any necessary design, if the commission determines that the project will be in the best interests of the state in its major goal of improving the mobility of the residents of the state and will:

  (A) relieve congestion on public highways;

  (B) enhance public safety;

  (C) improve air quality; or

  (D) expand economic opportunity

1.3 Corridor Overview

The US 290 corridor covers approximately 261 miles from Interstate Highway 10 (IH-10), southeast of Segovia, Texas, eastwards via Fredericksburg, Johnson City, Austin, Manor, Elgin, Giddings, and Brenham, to IH 610 in Houston. This study limit of the US 290 corridor spans approximately 145 miles from US 183 in Austin, Texas to Beltway 8 in Houston, Texas, as shown in **Figure 1**.

The US 290 corridor currently serves as an important east-west Principal Arterial roadway between Austin and Houston and also a TxDOT-designated hurricane evacuation route with the evacuation aid of EvacuLane and Contraflow, which is explained in detail in **Section 7**.

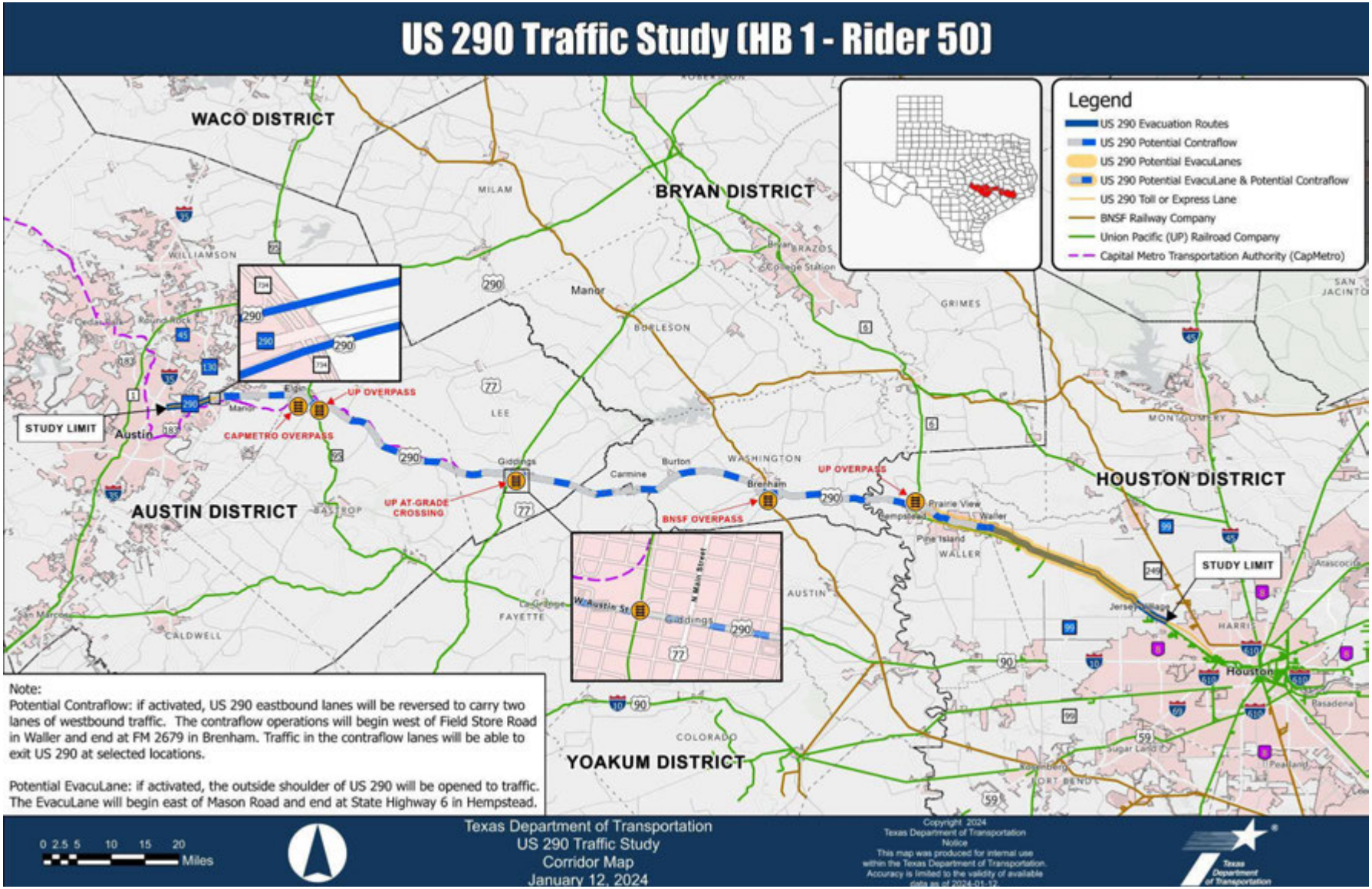


Figure 1. US 290 Traffic Study Map

2. Field Visit Observations

Site visit observations were made February 12-13, 2024, to identify potential safety concerns, traffic control device issues, geometry issues, and operational issues. This study report outlines TxDOT District boundaries, field visit locations, and the methodology for planning and conducting field visits. Key findings are summarized in **Table 1**.

Table 1. Site Visit Summary

District	Key Findings
Austin	Motorists often exceed the speed limit.
	High traffic volumes during peak hours lead to congestion (especially in Manor due to fast-food restaurants).
	Pedestrians cross the main lanes of US 290 unsafely.
	A number of driveways and cross-streets intersect with US 290.
	An active railroad crossing significantly impacts traffic flow on US 77.
	Speed limit abruptly drops from 65 mph to 35 mph before Giddings.
	Nearby buildings limit the right-of-way availability in Giddings.
Yoakum	Motorists frequently drive above the speed limit.
	Abrupt speed limit drops near Carmine.
	Inadequate illumination.
Bryan	Insufficient deceleration lane before the SH 36 interchange northbound ramp.
	The US 290/SH 36 interchange narrow ramps have sharp curves.
	Poor pavement quality near Wildflower Road.
Houston	Motorists often exceed the speed limit.

In summary, this study reveals safety hazards from rapid speed limit changes, speeding motorists, and traffic operation issues under existing traffic conditions.

3. Safety Analysis

The safety analysis evaluated the safety performance of the US 290 study corridor from US 183 in Austin, Texas to Beltway 8 in Houston, Texas. Crash data along the US 290 study corridor was extracted from the Crash Records Information System (C.R.I.S.) maintained by TxDOT. The analysis included data acquisition, data processing, analysis of crash severity and hotspots, exploration of the manner of collision, first harmful event, main contributing factors, and environmental conditions. Corridor crash rates were then calculated using the Annual Average Daily Traffic (AADT) values obtained from the TxDOT Statewide Traffic Analysis and Reporting System (STARS II) and compared to statewide average crash rates for similar facilities.

As shown in **Figure 2**, the study sections were first defined following the TxDOT District boundaries. The Houston District was further divided into urban and rural subsections based on traffic volumes and adjacent land uses.

Figure 2. US 290 Traffic Study Section Map

A summary of findings based on historical crash data from the full-five year, January 2019 to December 2023, study period is listed below.

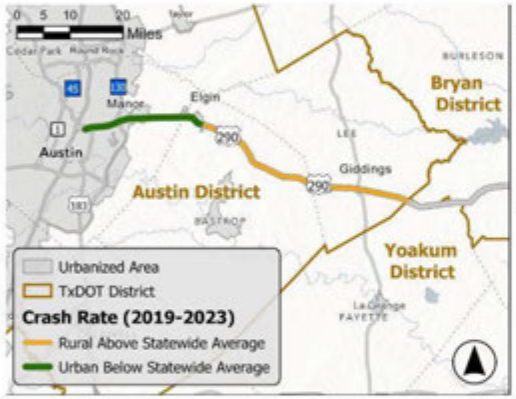
- **Crash Data Overview:**
  - 12,980 crashes along the US 290 study sections between 2019 and 2023.
  - Crash numbers gradually increased from 2,550 in 2019 to the highest of 2,830 in 2023, despite the decline in 2020 caused by the change in travel patterns due to COVID-19 pandemic and stay-at-home conditions.
- **Crash Severity**:
  - 65 (less than 1%) fatal crashes (K)
  - 357 (3%) suspected serious injury (A)
  - 1,237 (10%) suspected minor injury (B)
  - 1,492 (11%) possible injury (C)
  - 9,680 (75%) non-injury crashes (N)
- **Crash Hotspots:**
  - Urbanized areas such as Manor, Elgin, Giddings, Brenham, and Houston.
  - Highest crash concentration: Houston District Urban Section
- **Crash location:** Austin District had the highest percentage of intersection- and driveway-related crashes.
- **Manner Of Collision**:
  - 7,204 (56%) crashes occurred with "Vehicles Traveling in The Same Direction."
  - 3,371 (26%) crashes were "One Motor Vehicle."
- **First Harmful Event:**
  - 9,609 (74%) crashes caused by "Motor vehicle in transport."
  - 2,680 (21%) crashes caused by "Hitting a fixed object."
  - Other harmful events that occurred at 2% or less include: overturned (243 crashes), animal (167), other objects (154), parked car (44), pedestrian (23), and bicyclist (6).
- **Contributing Factors:** "Speeding" contributed to 3,686 (31%) crashes which ranked the top contributing factor.
- **Weather Conditions:** Approximately 30% of crashes in the Houston District Rural Section occurred under rainy weather conditions.
- **Lighting Conditions:** Rural sections had the highest percentage of crashes under "Dark, Not Lighted" conditions compared to urban sections.
- **Crash Rates:**
  - Urban segment crash rates were higher than rural segments.
  - All urban segments indicated lower crash rates than the urban statewide average.
  - Two rural segments in Austin and Bryan District exhibited higher crash rates compared to rural statewide average.

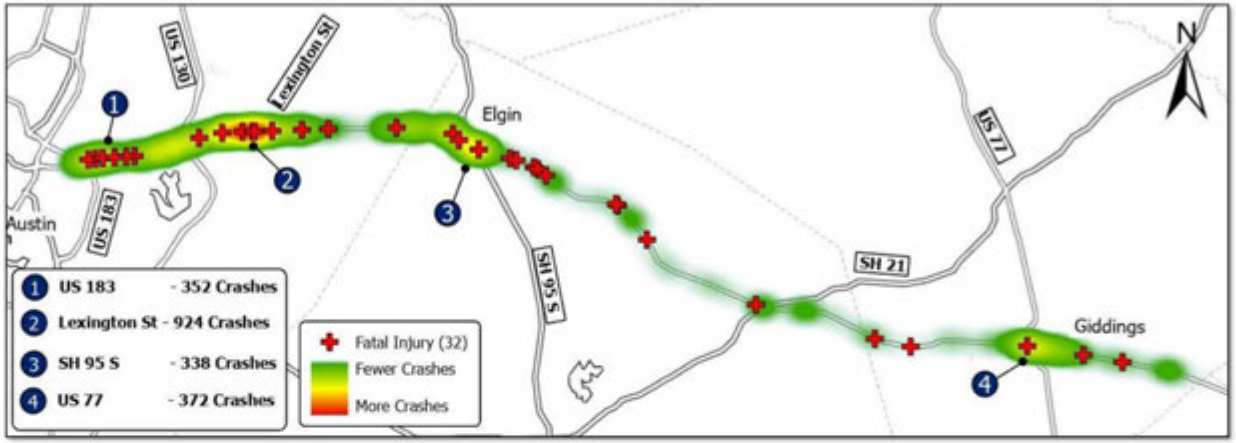
Figure 3 to **Figure 6** summarize the crash analysis for each section of US 290.

US 290 Safety Analysis Summary

Austin District Section

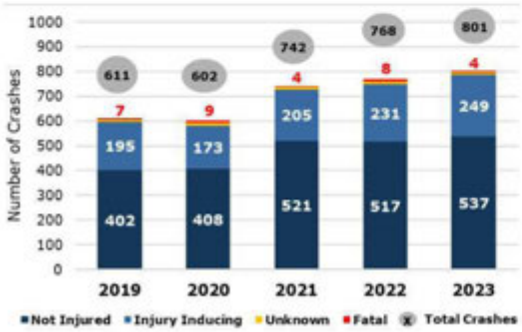
- **57 miles from US 183 to Austin-Yoakum District Boundary.**
- **3,524 total crashes during the 2019-2023 crash analysis period.**

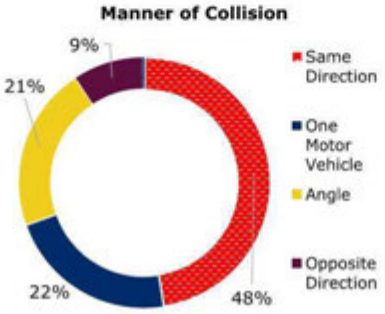


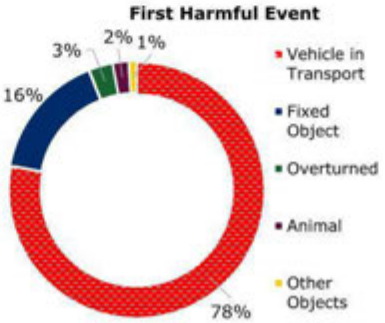


US 290 Crash Rate by Segment

US 290 Segment	Urban or Rural	Number of Crash	Years	Averaged 5 Year AADT	Length	Section Crash Rate	Statewide Average
US 183 to SH 95	Urban	2,590	5	43,741	19	170.8	189.3
SH 95 to Blume Ln	Rural	934	5	16,241	38	82.9	66.7







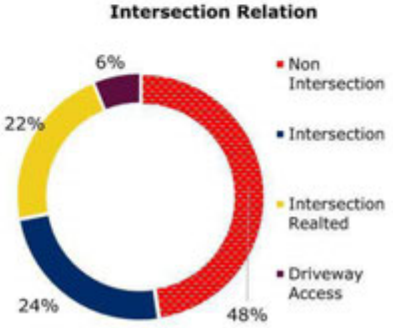
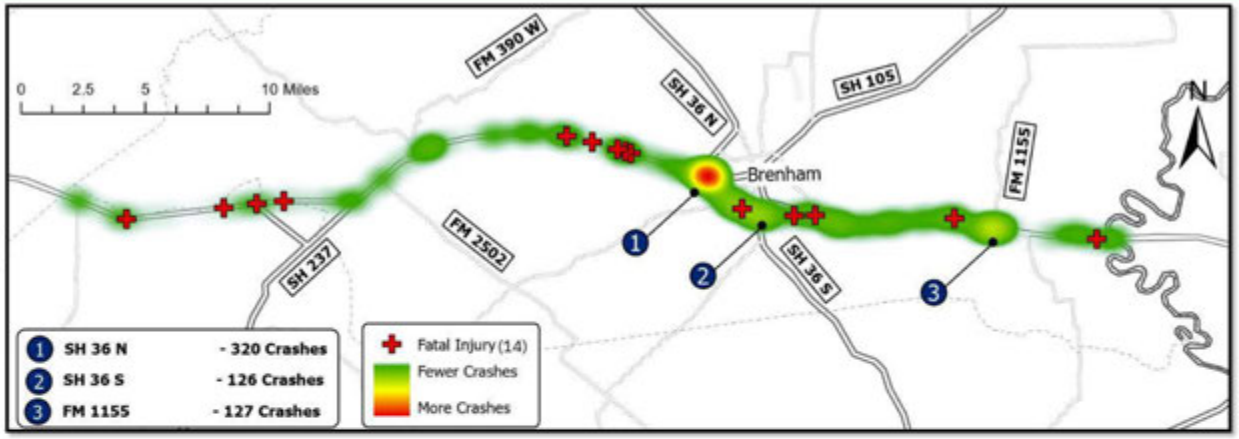


Figure 3. Austin District Crash Analysis Summary

US 290 Safety Analysis Summary

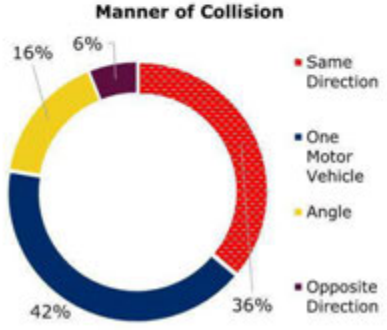
Yoakum and Bryan District Section

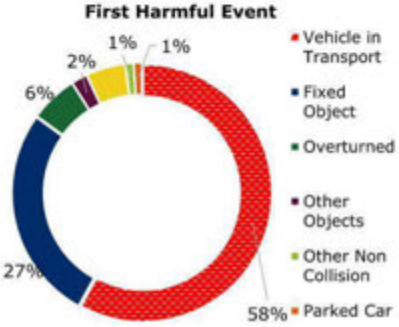
- **40 miles from Austin-Yoakum District Boundary to Bryan-Houston District Boundary**
- **1,311 total crashes during the 2019-2023 crash analysis period.**



US 290 Crash Rate by Segment

US 290 Section	Urban or Rural	Number of Crash	Years	Averaged 5 Year AADT	Length	Section Crash Rate	Statewide Average
Blume Ln to SH 36 N	Rural	416	5	17,169	24	55.3	66.7
SH 36 N to SH 36 S (Brenham)	Urban	502	5	32,007	5	171.9	189.3
SH 36 S to Brazo River	Rural	393	5	25,638	11	76.4	66.7





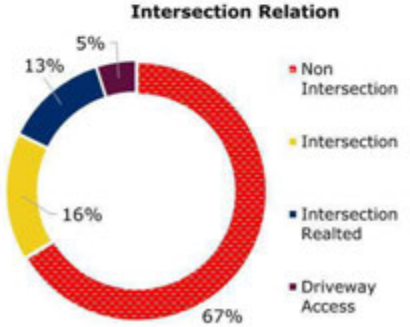
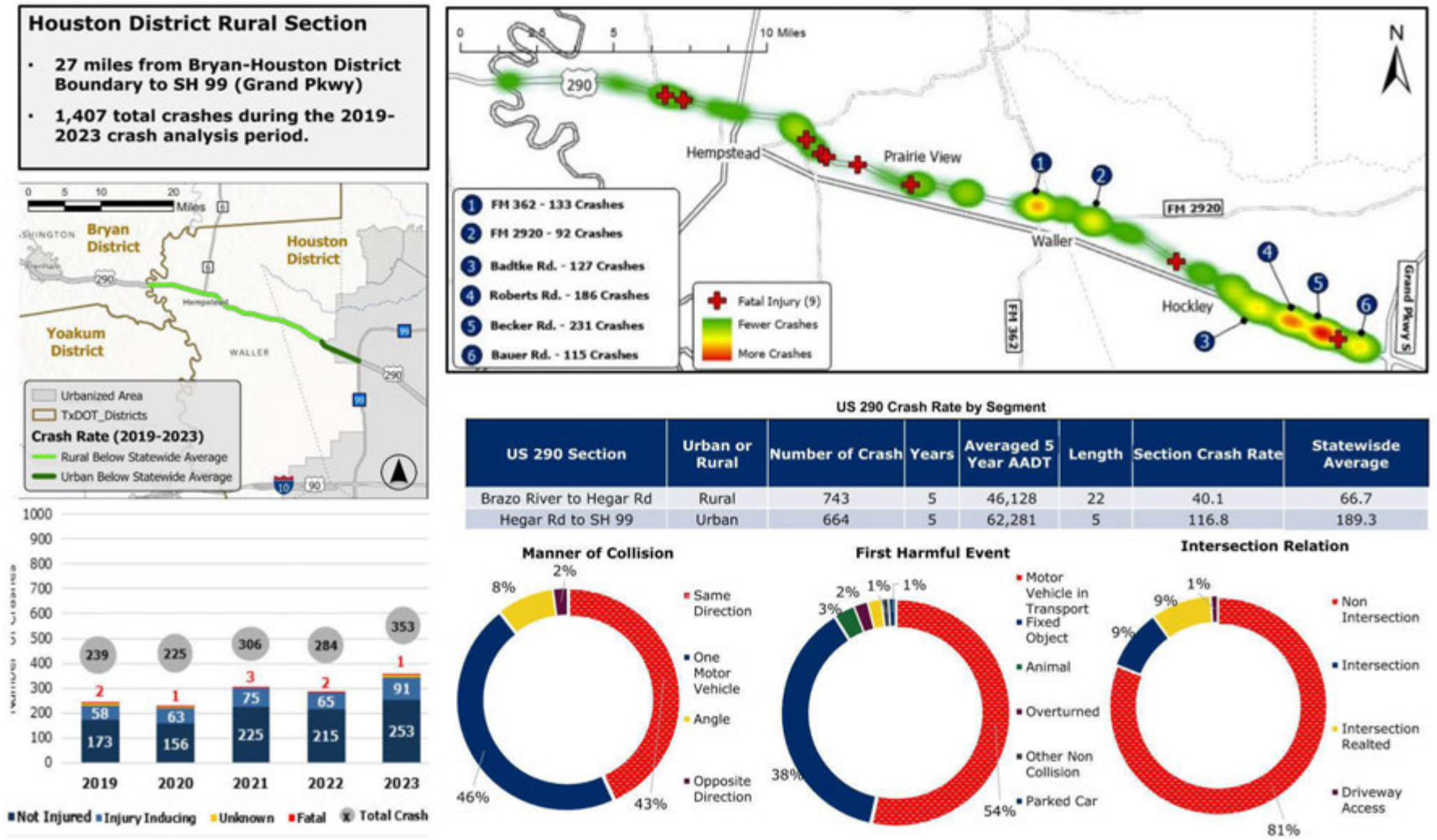


Figure 4. Bryan and Yoakum District Crash Analysis Summary

US 290 Safety Analysis Summary



US 290 Crash Rate by Segment

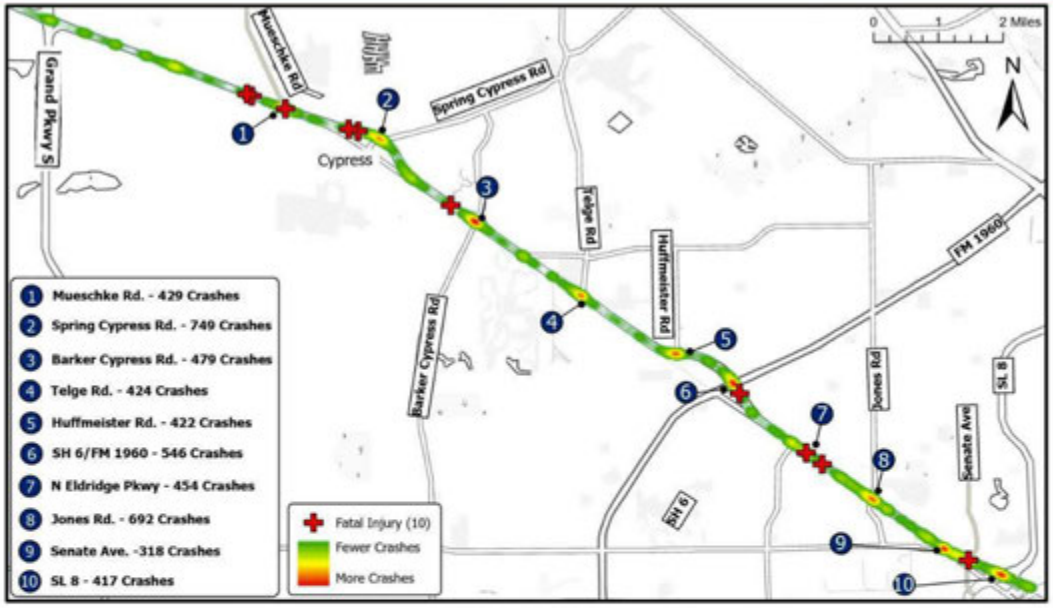
US 290 Section	Urban or Rural	Number of Crash	Years	Averaged 5 Year AADT	Length	Section Crash Rate	Statewisde Average
Brazo River to Hegar Rd	Rural	743	5	46,128	22	40.1	66.7
Hegar Rd to SH 99	Urban	664	5	62,281	5	116.8	189.3

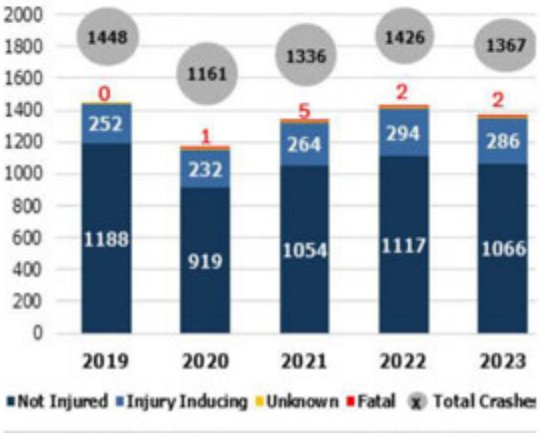
Figure 5. Houston District Rural Section Crash Analysis Summary

US 290 Safety Analysis Summary

Houston District Urban Section

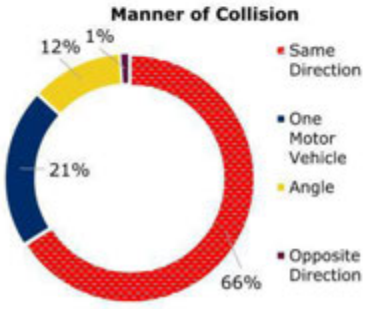
- 16 miles from SH 99 (Grand Pkwy) to Beltway 8
- 6,738 total crashes during the 2019-2023 crash analysis period.

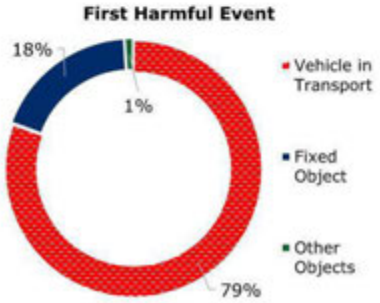




US 290 Crash Rate by Segment

US 290 Section	Urban or Rural	Number of Crashes	Years	Averaged 5 Year AADT	Length	Section Crash Rate	Statewide Average
SH 99 to Beltway 8	Urban	6,738	5	127,944	16	184.0	189.3





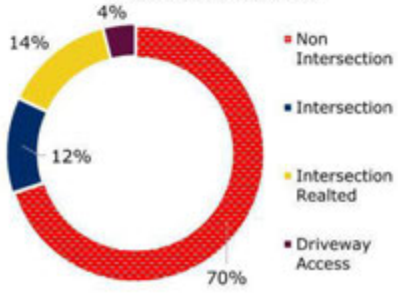


Figure 6. Houston District Urban Section Crash Analysis Summary

4. Travel Patterns

4.1 Historical Traffic Volume

The 2022 AADTs were extracted from the STARS II database at several locations along the US 290 study corridor. As shown in **Figure 7,** high traffic demands appeared at the two ends of the study section, Austin District and Houston District. In the rural sections between the two large cities, there are notable traffic peaks near Giddings and Brenham.

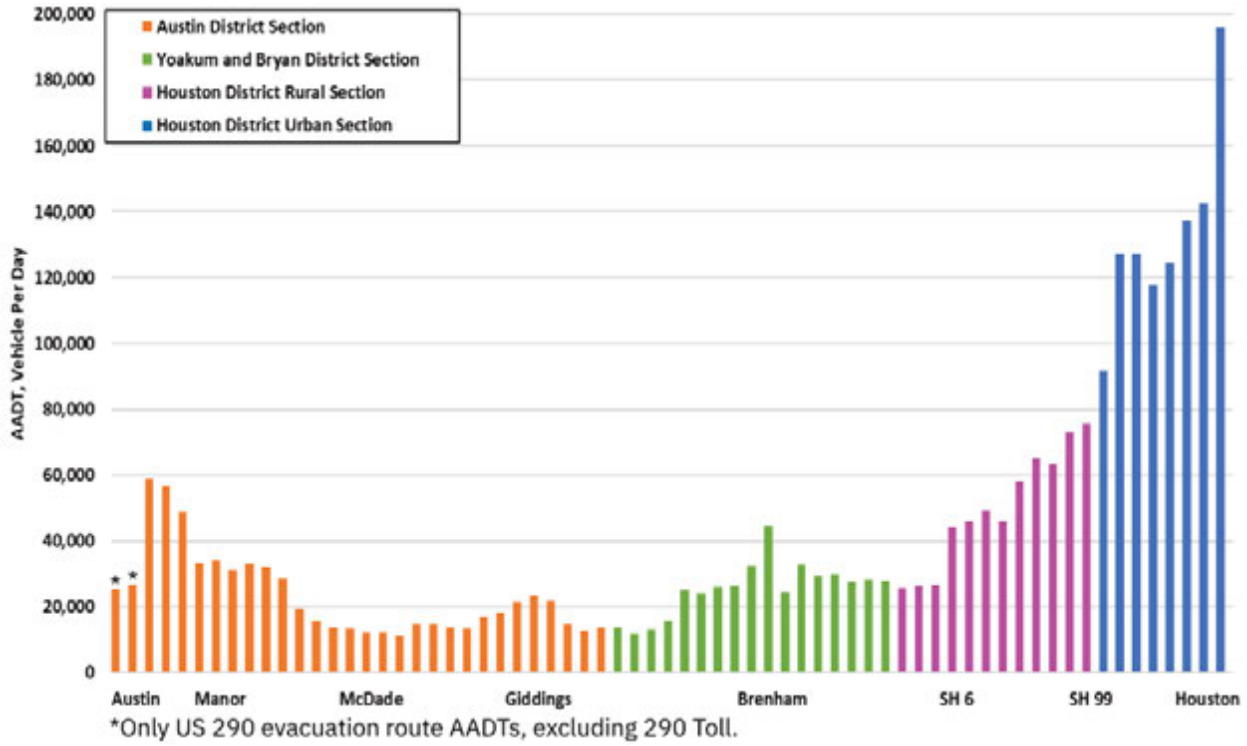


Figure 7. 2022 Normal Condition AADT

The Houston urban area (within SH 99, Grand Parkway) experienced the highest traffic volume, mostly exceeding 100,000 vehicles per day (vpd). The traffic volumes reduced traveling westwards along US 290 and there were approximately 40,000 to 60,000 vpd between SH 99 and SH 6. There were drastic traffic volume changes around SH 6 and SH 99, which could be attributed to significant traffic travel from/to College Station and Cypress.

The second highest peak occurred in Austin District near Parmer Lane, where AADTs were approximately 60,000 vpd. West of Parmer Lane, the 290 Toll (Manor Express) connects to the US 290 main lane and functions as a freeway, while US 290 serves as the frontage road to 290 Toll. US 290 Toll pulled a significant amount of traffic from US 290, so the traffic volumes on US 290 in this section are notably reduced. However, as US 290 Toll is not a TxDOT roadway nor a designated evacuation route, its traffic demand was not included in this study. The traffic volume dropped as traveling east past Manor.

The rural parts of US 290 are between Austin and Houston, with overall AADTs below 40,000. In the Austin District rural section, east of Elgin, the traffic volumes were mostly below 20,000 vpd with a peak near Giddings slightly exceeding 20,000 vpd. Most of the Yoakum District and Bryan District had about 30,000 vpd. However, in the vicinity of Brenham the AADTs had a peak around 40,000 vpd.

4.2 Normal Condition Origin-Destination Analysis

To understand the traffic travel pattern along the study US 290 corridor, “Top Route Analyses” from the Streetlight Insights platform were performed to evaluate the Origins and Destinations (O-D) of trips using US 290 for each study section. Streetlight is a transportation data platform that uses connected device data with machine learning and algorithmic processing to provide insights into travel patterns and trends. In Streetlight, the "Top Route Analysis" is the tool used to visualize road segments with the highest traffic volume between chosen origin and destination zones in this study.

For each study section, “Top Route Analysis” was conducted for the time period of 2022 all days to investigate how traffic entering each section under normal conditions will be distributed from the “Origin” zone (Where Are Trips Going?) as shown in the top half of **Figure 8** through **Figure 15**. The bottom half shows where traffic leaving each section originated from and concentrated in the “Destination” zone (Where Are Trips Coming From?). For each US 290 section, the eastbound and westbound traffic O-D patterns were analyzed separately.

Austin District Section

Eastbound Origin-Destination Analysis

Eastbound trip distribution patterns are shown in the **top half of Figure 8,** illustrating "Where Are Trips Going To" from the US 290 Austin District Section west limit (US 183), with the following findings:

- 39% of trips traveled outside the City of Austin and 61% of trips left US 290 within the Austin city limit (Parmer Lane) and only traveled for about 5 miles on US 290.
- 17% of all eastbound trips using US 290 passed Elgin and continued further east.
- Only approximately 4% of trips travel eastbound leaving Austin District.

Eastbound trip origin patterns are shown in the **bottom half of Figure 8,** illustrating "Where Are Trips Coming From," arriving at the US 290 Austin District section east limit (Austin and Yoakum District boundary), with the following findings:

- 31% of trips came from west of Elgin.
- 17% of trips joined US 290 from Bastrop via SH 21.
- 33% of trips originated from the Giddings area, adding the percentage from 62% to 95%.

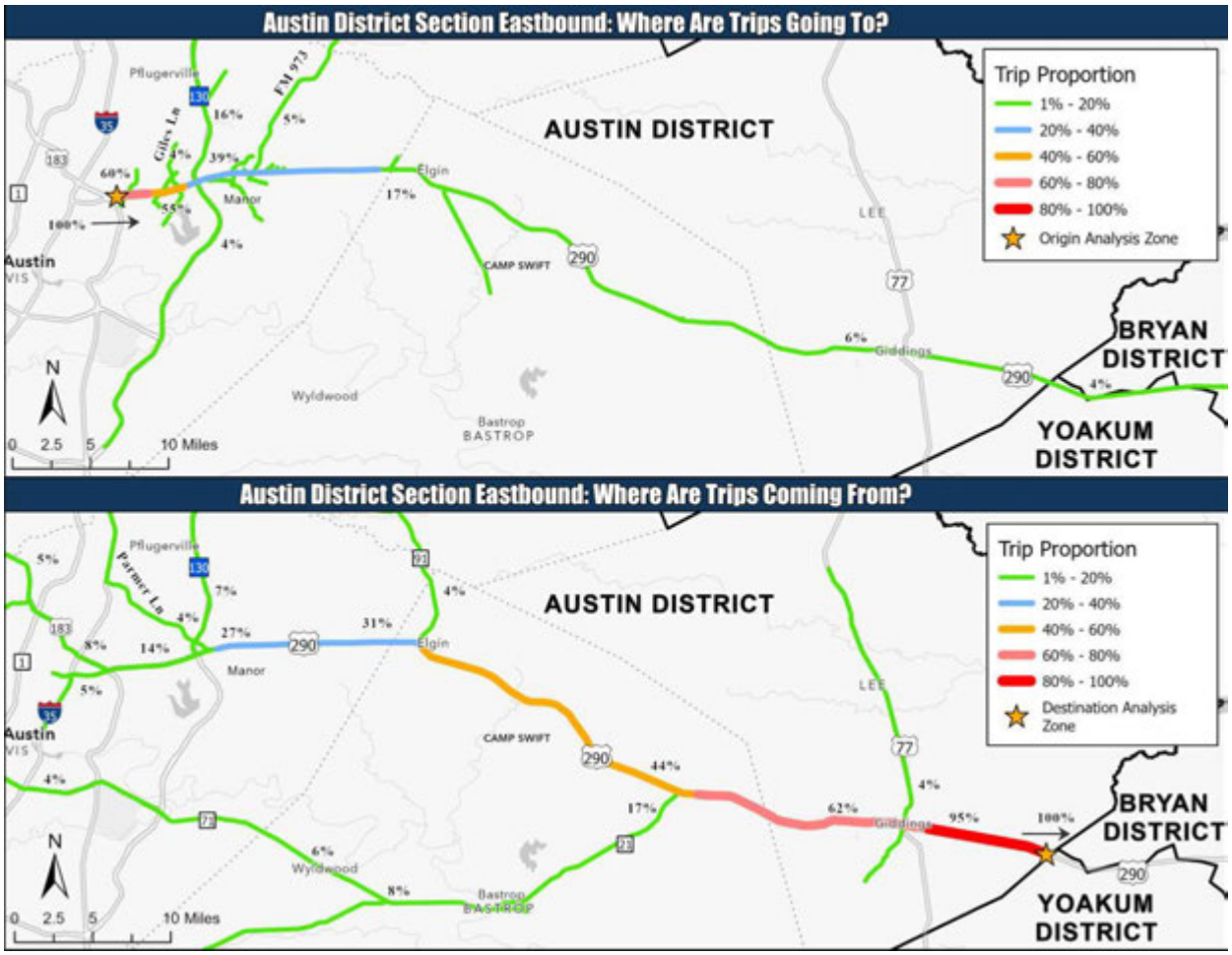


Figure 8. Eastbound Trip Origin-Destination in Austin District Section

Westbound Origin-Destination Analysis

Westbound trip distribution patterns are shown in the **top half of Figure 9,** illustrating "Where Are Trips Going To" from the US 290 Austin District Section east limit (Austin and Yoakum District boundary), with the following findings:

- 13% of trips left US 290 in the Giddings area, as 59% continued westward to Austin.
- 25% of trips arrived in the City of Austin (Parmer Lane) and 8% of trips reached US 183.

Westbound trip origin patterns are shown in the **bottom half of Figure 9,** illustrating "Where Are Trips Coming From," arriving at the US 290 Austin District Section west limit (US 183), with the following findings:

- Less than 6% of westbound trips came from east of the Austin District.
- 81% of trips originated within Travis County, west of the Elgin area.
- Only about 31% of trips originated east of SH 130, which indicates that most trips (69%) originated between a less than 5-mile section between US 183 and SH 130.

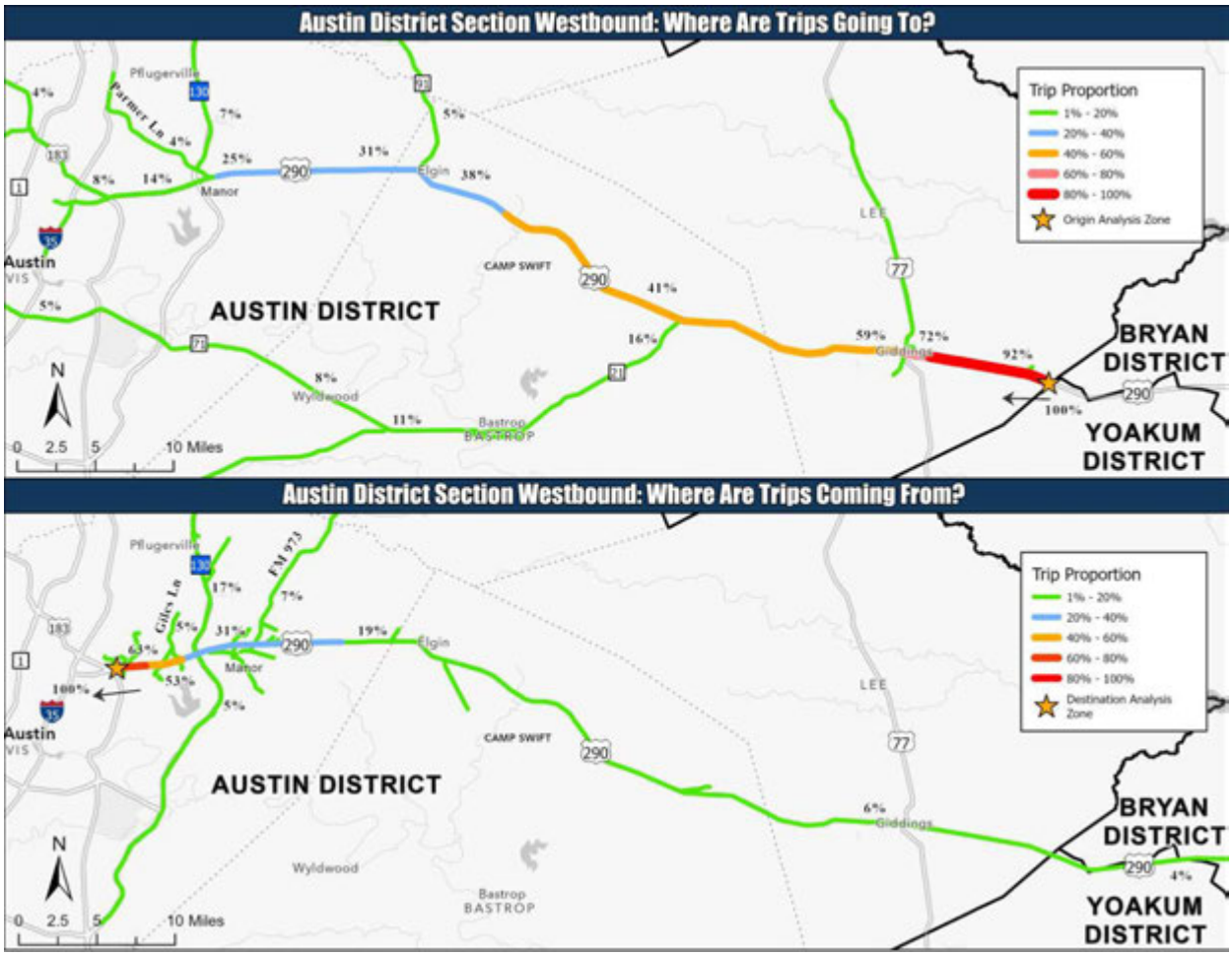


Figure 9. Westbound Trip Origin-Destination in Austin District Section

Yoakum and Bryan District Section

Eastbound Origin-Destination Analysis

Eastbound trip distribution patterns are shown in the **top half of Figure 10,** illustrating "Where Are Trips Going To" from the US 290 Yoakum and Bryan District Section west limit, with the following findings:

- 79% of trips arrived or continued further east of Brenham.
- 57% traveled to Houston District and 39% of trips traveled to SH 99.
- 12% of trips ended inside of Beltway 8 loop in the Houston District.

Eastbound trip origin patterns are shown in the **bottom half of Figure 10,** illustrating "Where Are Trips Coming From," arriving at the US 290 Yoakum and Bryan District Section east limit (Bryan and Houston District boundary), with the following findings:

- 11% of trips came from the Austin and Manor area.
- 42% of trips originated west of the Brenham area and 43% of trips joined US 290 eastbound from the Brenham area, which added up to 85%.

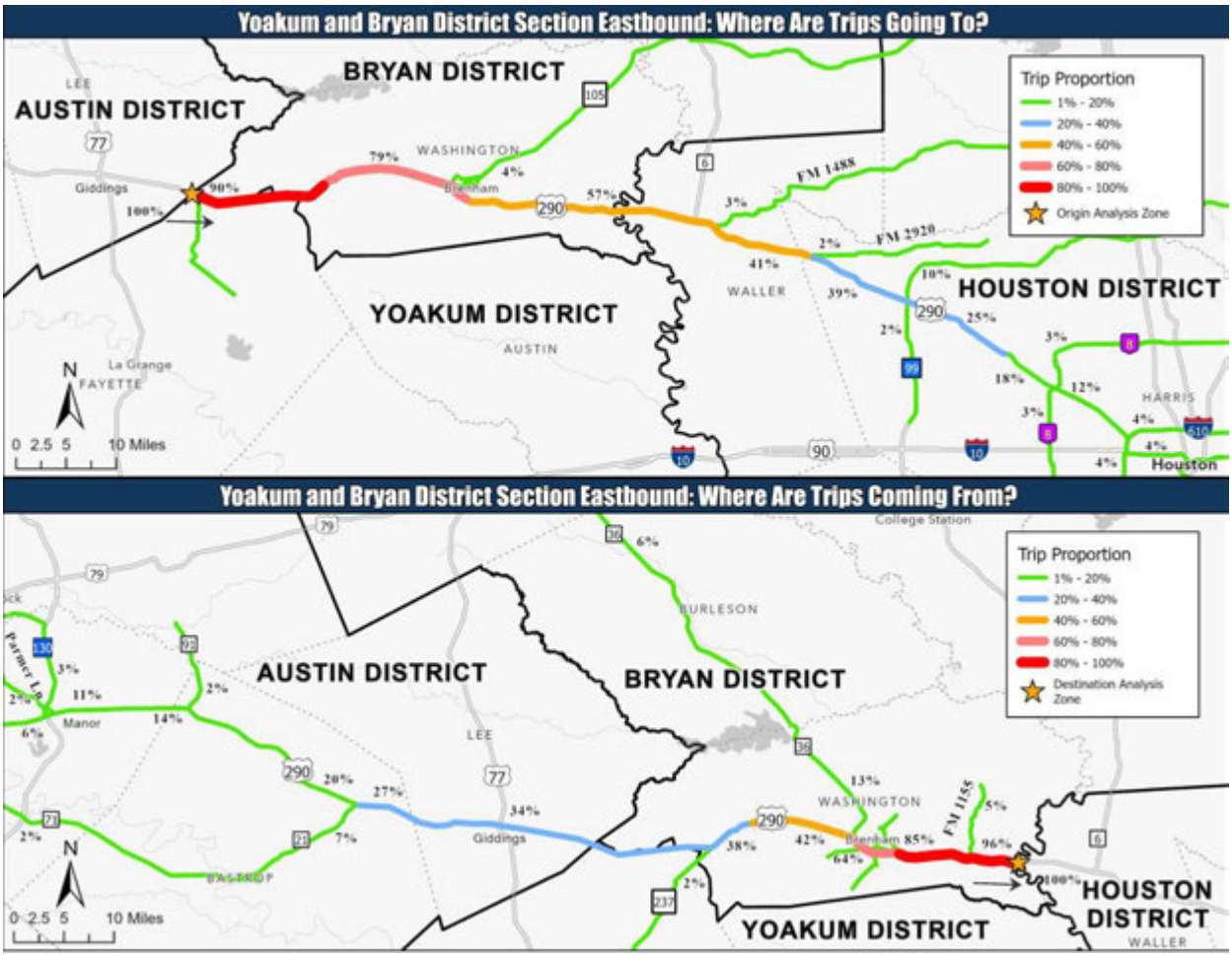


Figure 10. Eastbound Trip Origin-Destination in Yoakum and Bryan District Section

Westbound Origin-Destination Analysis

Westbound trip distribution patterns are shown in the **top half of Figure 11,** illustrating "Where Are Trips Going To" from the US 290 Yoakum and Bryan District Section east limit (Bryan and Houston District boundary), with the following findings:

- 43% of trips passed Brenham and about 35% of trips arrived in the Austin District.
- 14% of trips arrived in the City of Austin (Parmer Lane) and 6% of trips reached US 183.

Westbound trip origin patterns are shown in the **bottom half of Figure 11,** illustrating "Where Are Trips Coming From," arriving at the US 290 Yoakum and Bryan District Section west limit (Austin and Bryan District boundary), with the following findings:

- 13% of trips came within the Beltway 8 loop and 22% of trips came from within the SH 99 area.
- About 52% of trips came from Harris County, east of Waller.
- 15% of trips were added from Brenham, increasing the percentage from 61% to 76%.

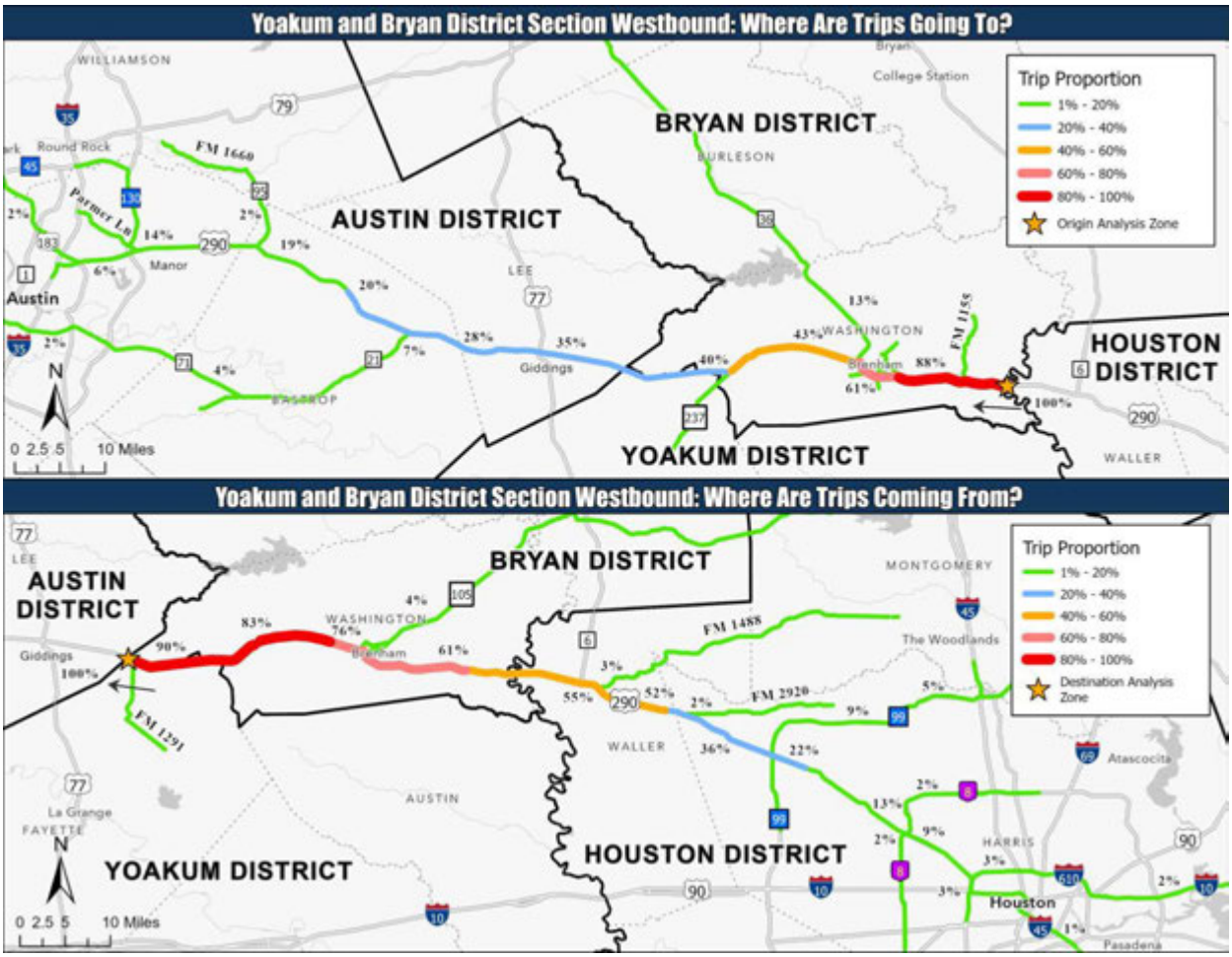


Figure 11. Westbound Trip Origin-Destination in Yoakum and Bryan District Section

Houston District Rural Section

Eastbound Origin-Destination Analysis

Eastbound trip distribution patterns are shown in the **top half of Figure 12,** illustrating "Where Are Trips Going To" from the US 290 Houston District Rural Section west limit (Bryan and Houston District boundary), with the following findings:

- 82% of trips arrived at Waller, which indicates the majority of trips entered Harris County.
- 17% of trips traveled eastbound beyond Beltway 8 loop.

Eastbound trip origin patterns are shown in the **bottom half of Figure 12,** illustrating "Where Are Trips Coming From," arriving at the US 290 Houston District Rural Section east limit (SH 99), with the following findings:

- 19% of trips originated from the US 290 Bryan District Section.
- 14% came from the College Station area via SH 6.
- Only 42% of trips originated west of Waller (Harris County limit), indicating most of the trips (approximately 58%) entered east of SH 99 originated within Harris County.

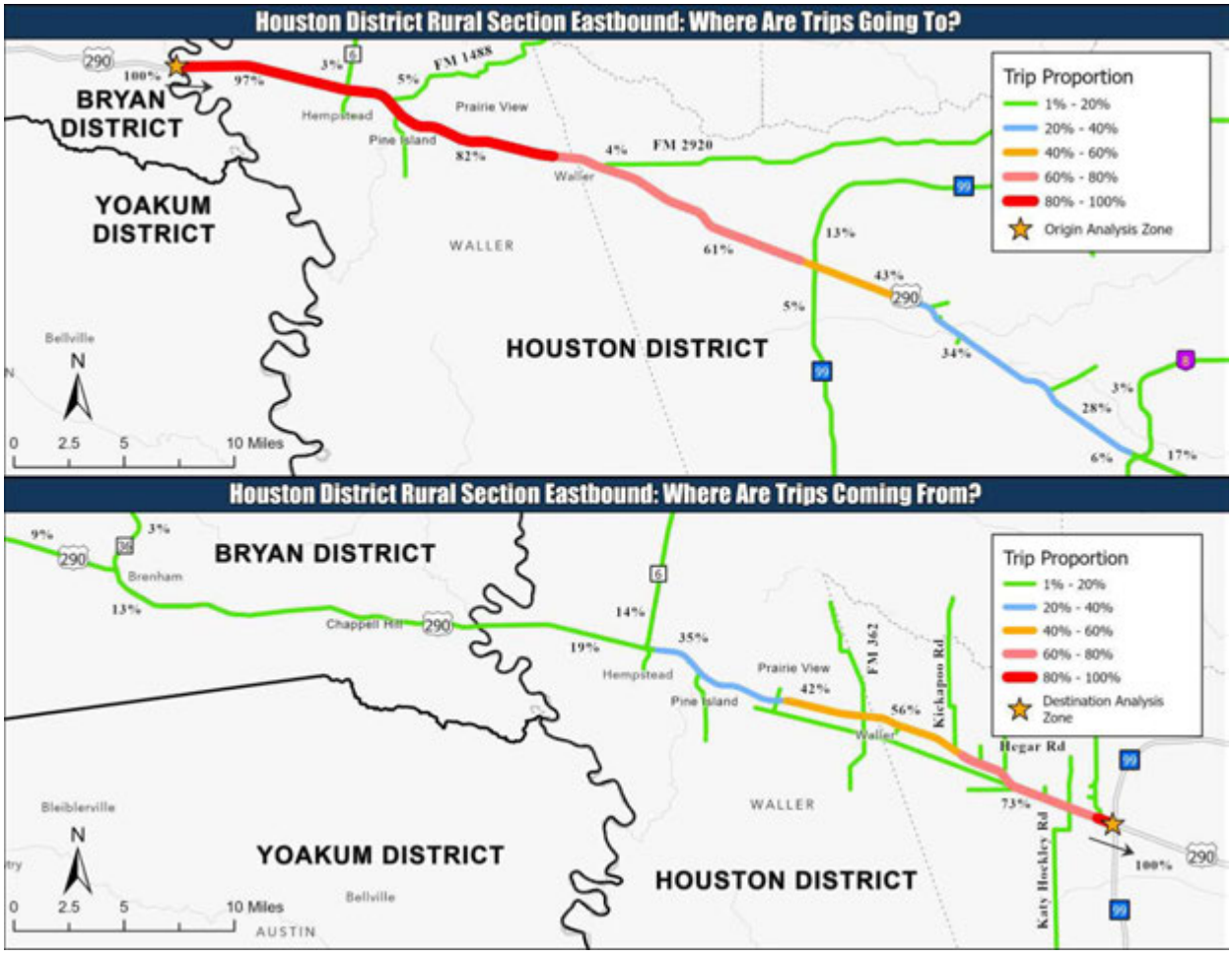


Figure 12. Eastbound Trip Origin-Destination in Houston District Rural Section

Westbound Origin-Destination Analysis

Westbound trip distribution patterns are shown in the **top half of Figure 13,** illustrating "Where Are Trips Going To" from the US 290 Houston District Rural Section east limit – SH 99, with the following findings:

- 55% of trips traveled beyond the City of Waller while 45% of the total trips were within the Harris County limit (Field Store Road in Waller).
- 28% of trips traveled up to Hempstead, with 12% of these trips traveling towards College Station using SH 6 and 15% continuing westbound on US 290.

Westbound trip origin patterns are shown in the **bottom half of Figure 13,** illustrating "Where Are Trips Coming From," arriving at the US 290 Houston District Rural Section west limit (Bryan and Houston District boundary), with the following findings:

- Approximately 21% of trips came from the Beltway 8 area.
- A total of 53% of trips came from SH 99, including westbound US 290 (37%), SH 99 northbound (5%), and SH 99 southbound (11%).
- 63% of trips came from Harris County (east of Waller).
- SH 6 connecting to College Station contributed 3% of US 290 westbound trips to Austin.

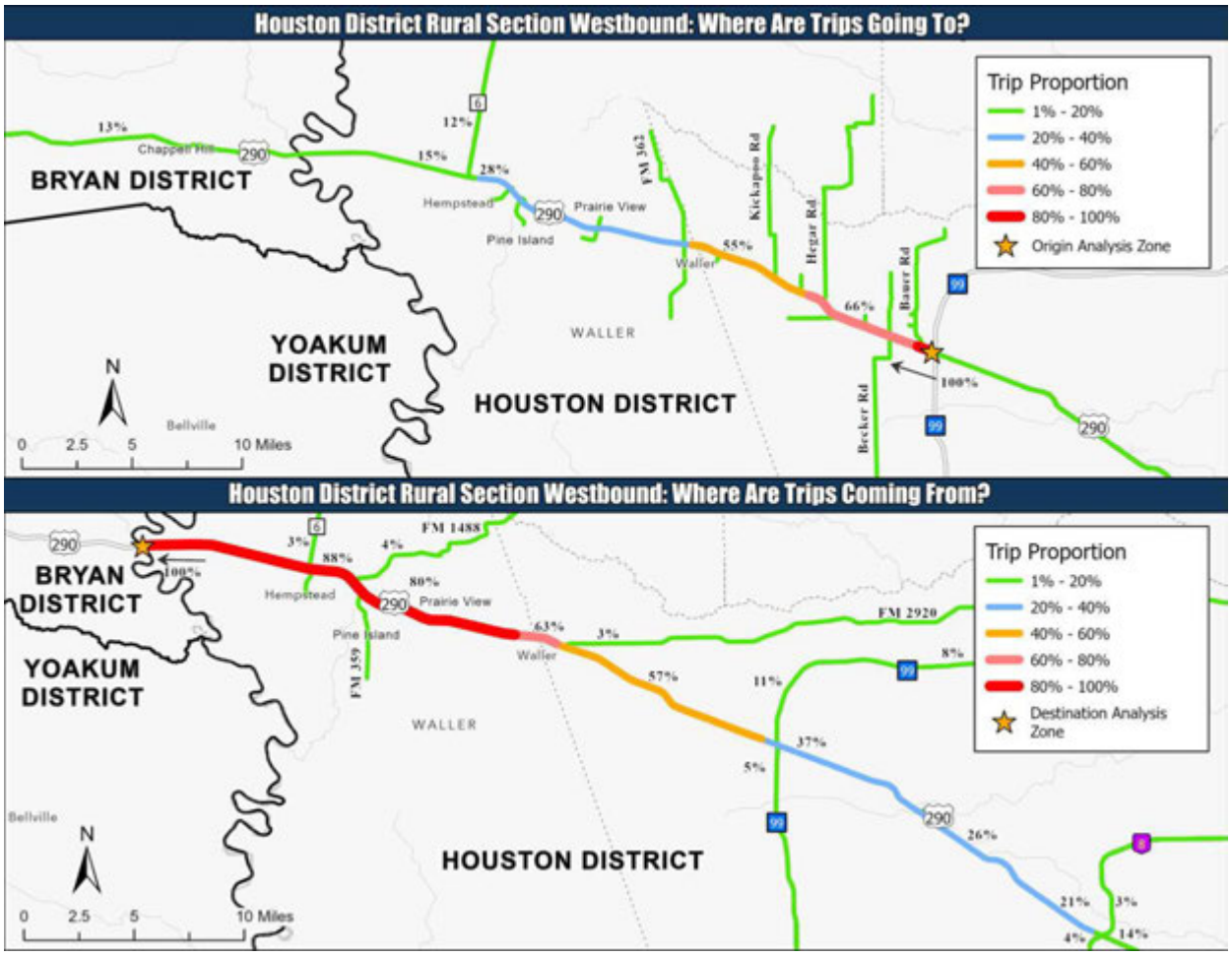


Figure 13. Westbound Trip Origin-Destination in Houston District Rural Section

Houston District Urban Section

Eastbound Origin-Destination Analysis

Eastbound trip distribution patterns are shown in the **top half of Figure 14,** illustrating "Where Are Trips Going To" from the US 290 Houston District Urban Section west limit (SH 99), with the following findings:

- A total of 22% of trips used SH 99 with northbound and southbound equally distributed.
- 34% of trips arrived at FM 1960 and traveled further east, which indicates the majority of trips (66%) left US 290 before FM 1960.
- Only 19% of trips continued eastward past Beltway 8.

Eastbound trip origin patterns are shown in the **bottom half of Figure 14,** illustrating "Where Are Trips Coming From," arriving at the US 290 Houston District Urban Section east limit (Beltway 8), with the following findings:

- 13% of trips originated from west of SH 99 and approximately 7% came from SH 99.
- 17% of trips originated between SH 99 and Telge Rd (added up to 37%).
- Approximately half of the trips originated east of FM 1960.

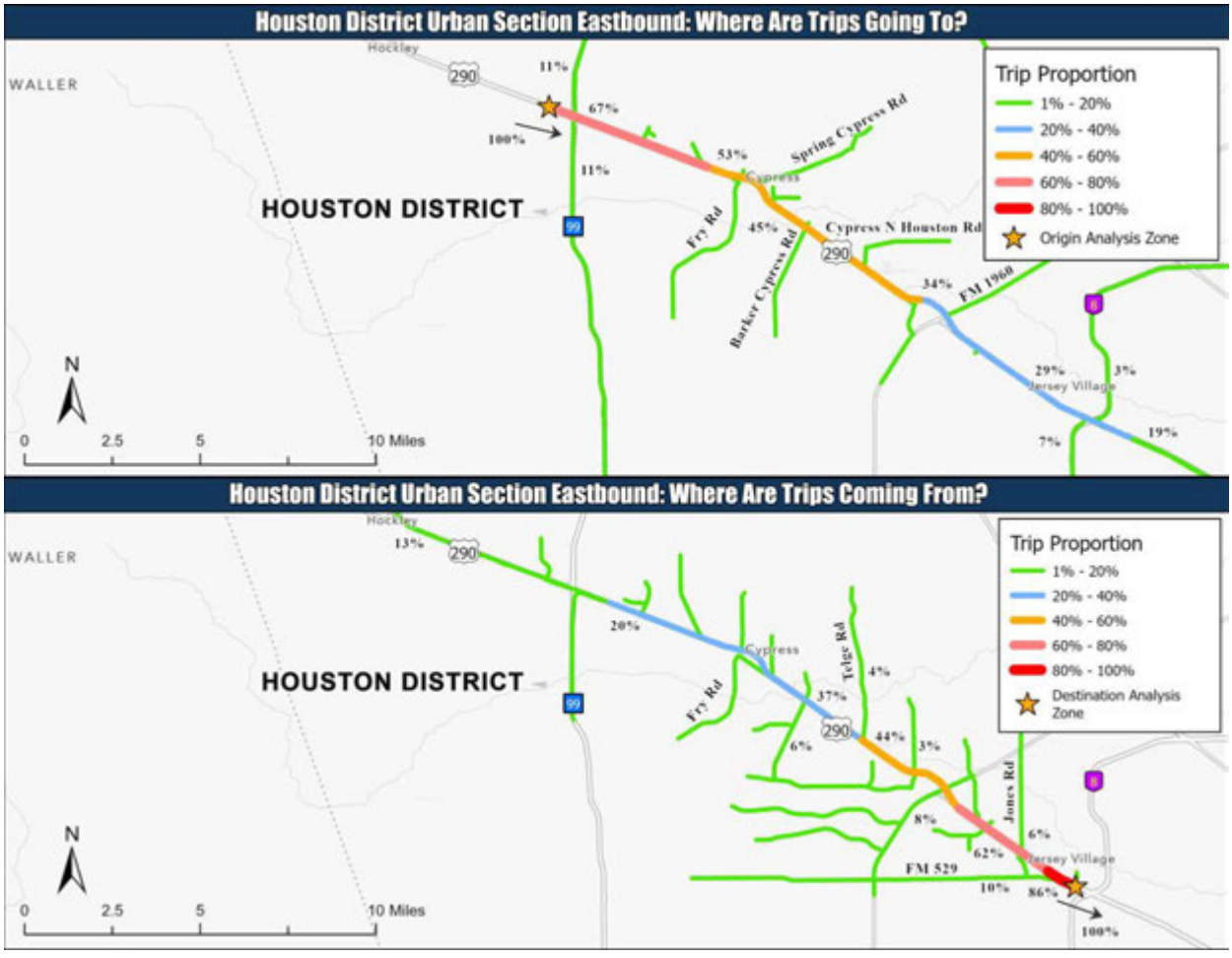


Figure 14. Eastbound Trip Origin-Destination in Houston District Urban Section

Westbound Origin-Destination Analysis

Westbound trip distribution patterns are shown in the **top half of Figure 15,** illustrating "Where Are Trips Going To" from the US 290 Houston District Urban Section east limit – Beltway 8, with the following findings:

- 50% of trips passed FM 1960 and 17% of trips reached SH 99.
- 13% of westbound trips traveled on US 290 west of SH 99.

Westbound trip origin patterns are shown in the **bottom half of Figure 15,** illustrating "Where Are Trips Coming from," arriving at the US 290 Houston District Urban Section west limit (SH 99), with the following findings:

- 25% of trips came from the vicinity of Beltway 8 (16% from east of Beltway 8, while 6% and 3% were from its northbound and southbound, respectively).
- Only 45% of trips originated east of Fry Road, which indicates that most trips (55%) originated between a less than 5-mile section between Fry Road and SH 99.
- 10% and 9% of trips contributed by SH 99 northbound and southbound, respectively.

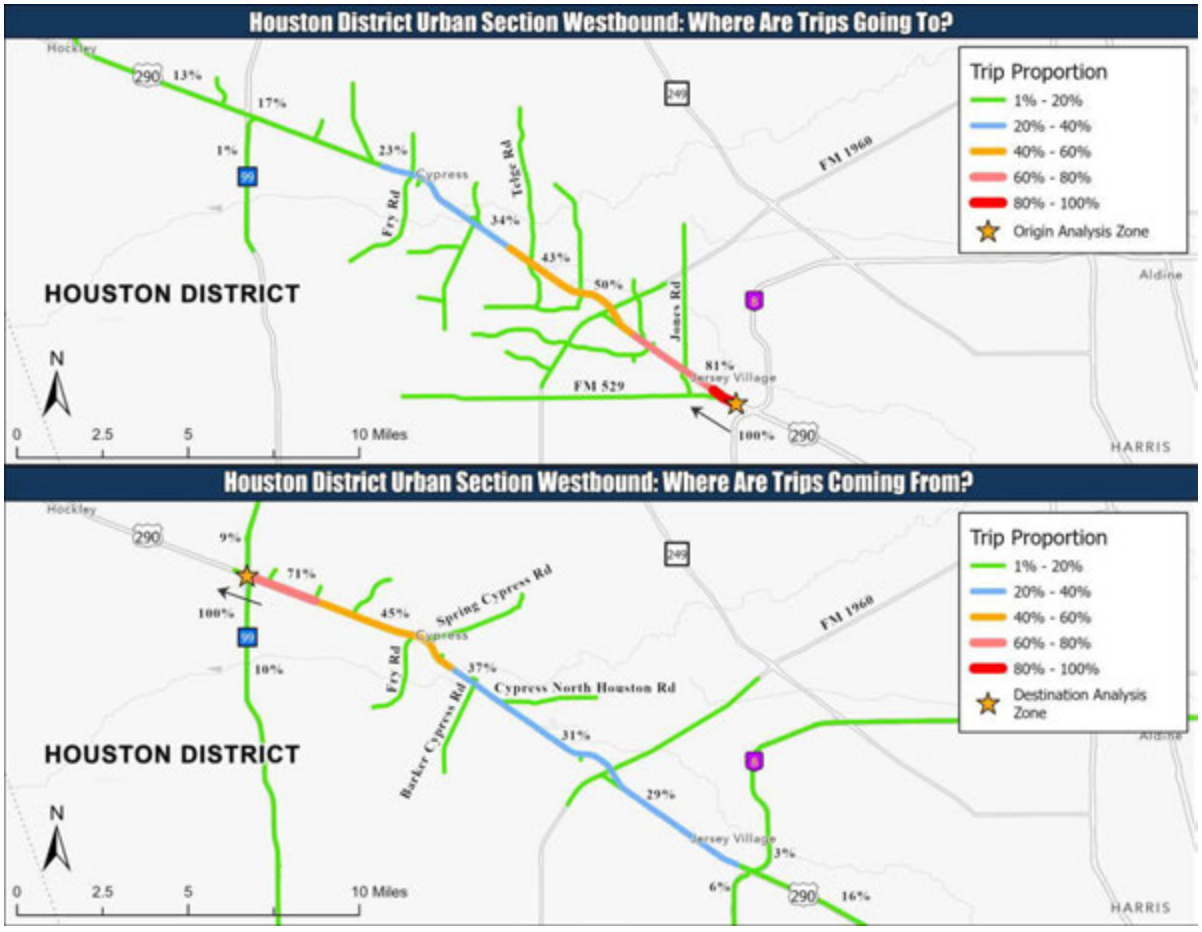


Figure 15. Westbound Trip Origin-Destination in Houston District Urban Section

Summary of Origin-Destination Analysis Findings:

- Austin District Section:
    - The urbanized area including Austin, Manor, and Elgin was found to be a significant cluster of trip generations and destinations, which caused a concentrated traffic pattern in the Austin District Section. For both directions, more than 80% of trips traveled between US 183 and Elgin and more than 60% of US 290 trips only traveled within the City of Austin, between US 183 and Parmer Lane.
    - Due to the distance from the Austin urbanized area, the US 290 east end of the Austin District distributed or collected trips in longer distances which indicates that more drivers tend to make longer trips.
- Yoakum and Bryan District Section:
    - US 290 trip distances were longer in this section due to the rural land use except the City of Brenham. On the west end of US 290, 57% of eastbound trips passed this section and arrived in the Houston District. Similarly, 55% of westbound trips passed this section and arrived in the Austin District.
    - However, due to the proximity to Brenham, a significant number of trips were attracted to (45%) or generated by (43%) Brenham on the east end of this section.
- Houston District Rural Section:
    - The Houston urbanized area is an area of significant trip generation and destination. 61% of eastbound trips arrived at SH 99 and 53% of westbound trips originated within SH 99.
    - 28% of westbound trips traveled to the SH 6 interchange in Hempstead, where 12% of these trips traveled towards College Station using SH 6 and 15% continued westbound on US 290.
- Houston District Urban Section:
    - US 290 Houston District Urban Section is a freeway section with ramps and frontage roads with access to significant amounts of adjacent developments. Therefore, most trips originated and were distributed within 5 to 10 miles of the analysis zone.
    - Approximately 13% of US 290 westbound trips from Beltway 8 traveled west of SH 99, exiting Houston District Urban Section under normal conditions.

4.3 Evaluation of Historical Hurricane Evacuation Patterns

To understand the hurricane evacuation pattern of potential evacuation areas, a Top Route Analysis was conducted in StreetLight.

The Houston-Galveston Area Council (H-GAC) is a regional organization that helps local governments in the area work together to address and solve common challenges, including evacuation planning that contains details like evacuation corridors and evacuation connections. H-GAC annually designates a Hurricane Surge Zone Map ("Zip-Zone Map") to inform the public about the areas most vulnerable to hurricane storm surges. **Figure 16**, which overlays postal zip codes, also highlights evacuation routes and connections. The Zip-Zone map is a crucial tool for officials and emergency responders, enabling them to conduct phased evacuations based on the affected Zip-Zones within the coastal counties.

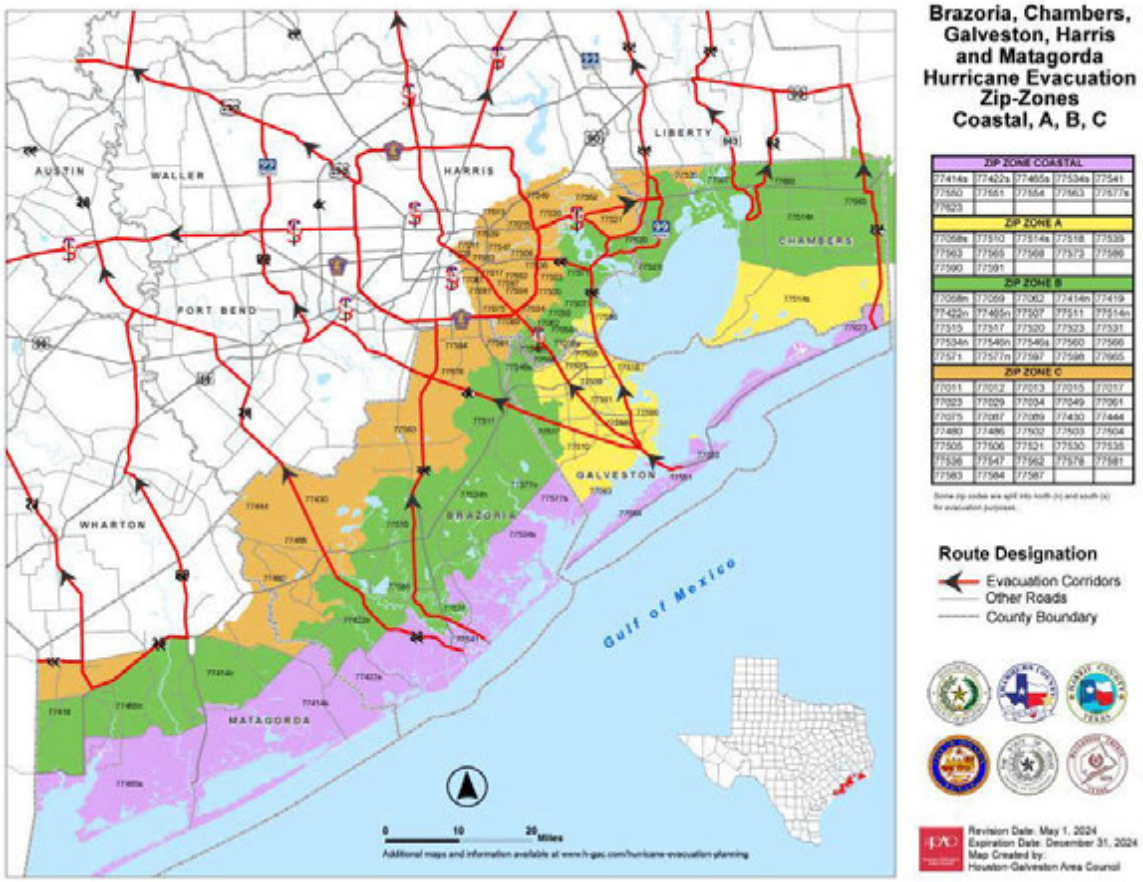


Figure 16. Houston-Galveston Area Hurricane Evacuation Zip-Zones Map

There are four such Zip-Zones: Coastal, A, B, and C. Evacuation orders are given to different zones depending on storm severity, storm path, and other factors.

Origin-destination analyses were run in StreetLight to support traffic demand assumptions about what percent of traffic traveling from the evacuation Zip-Zones may utilize US 290 during a hurricane evacuation in the time period of 66 hours before landfall. In addition to the listed evacuation routes, SH 249 and the Westpark Tollway were included in this analysis as these roads were identified as major

potential inland routes which are likely to carry traffic in the event of an evacuation. **Figure 17** shows the H-GAC evacuation Zip-Zones along with the TxDOT evacuation routes. High-volume routes including both SH 249 and Westpark Tollway are also called out on this figure.

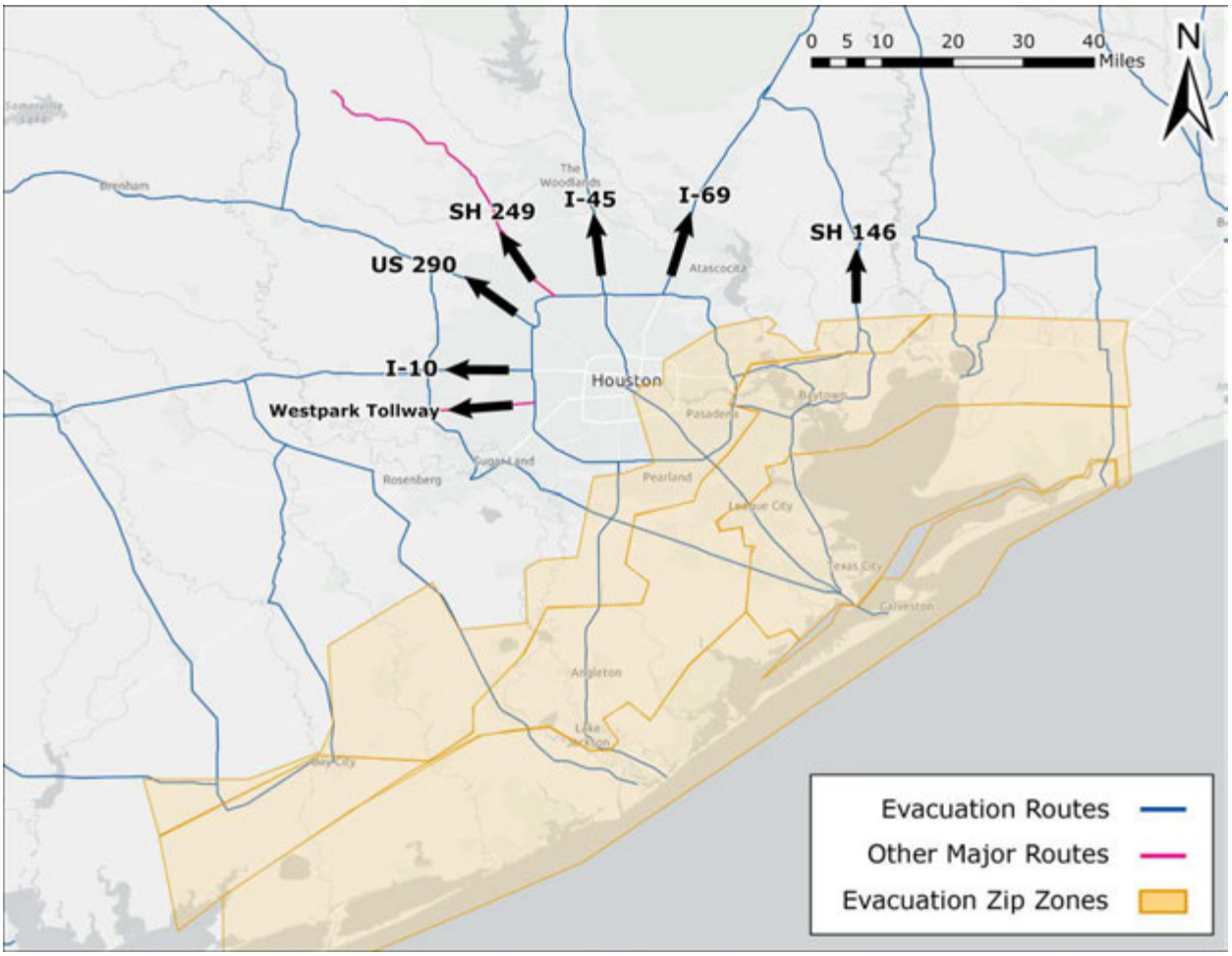


Figure 17. Houston-Galveston Area Evacuation Zip-Zones and Routes

The analysis was run for three time periods: before hurricane event (July 2017), the week of Hurricane Harvey (August 21-27, 2017), and after the hurricane event (September 2017). Hurricane Harvey was selected for evaluation as it was the most major hurricane event that affected the Houston area during the period when StreetLight had available data. **Table 2** shows the percentage breakdown for each of these routes for the three analyzed time periods.

Table 2. Traffic Distribution from Zip-Zones to Evacuation Routes

Route	Percentage of Total Traffic		
	Before Condition	Hurricane Harvey	After Condition
	July 2017	August 21-27, 2017	September 2017
I-69	20.5%	21.5%	21.2%
I-10	21.5%	21.1%	19.0%
I-45	21.3%	21.1%	21.1%
US 290	**13.2%**	**12.5%**	**13.0%**
SH 146	6.5%	6.5%	6.8%
Westpark Tollway*	4.7%	4.5%	5.7%
SH 249*	6.5%	6.6%	7.0%
Other Evacuation Routes	5.8%	6.2%	6.2%

* Indicates route is not designated as an evacuation route.

Results for US 290 varied between 12.5% and 13.2%. In all time periods, US 290 was the 4th most used inland route for evacuation Zip-Zone traffic, exceeded only by the three interstates (I-69, I-10, and I-45). Results from this analysis indicated that approximately 15% of evacuation trips would utilize US 290 as a travel route regardless of a hurricane. This finding was later applied to hurricane evacuation assessment.

5. Traffic Projection Methodology

Historical counts from the STARS II database for the study area were selected for analysis with 5-year, 10-year, and 20-year linear annual historical growth rates being calculated. Additionally, travel demand models with projected growth rates along US 290 were referenced. The travel demand data utilized was from the Capital Area Metropolitan Planning Organization (CAMPO), TxDOT's Statewide Analysis Model Version 4 (SAM-V4), and H-GAC.

Based on varying growth trends, volumes, and land uses observed for different sections of US 290, the study area was split into three segments with separate proposed growth rates. **Figure 18** shows the Austin Area segment within Travis County, the Houston Area segment within Harris County, and the Non-Metro Area segment that falls between these two counties.

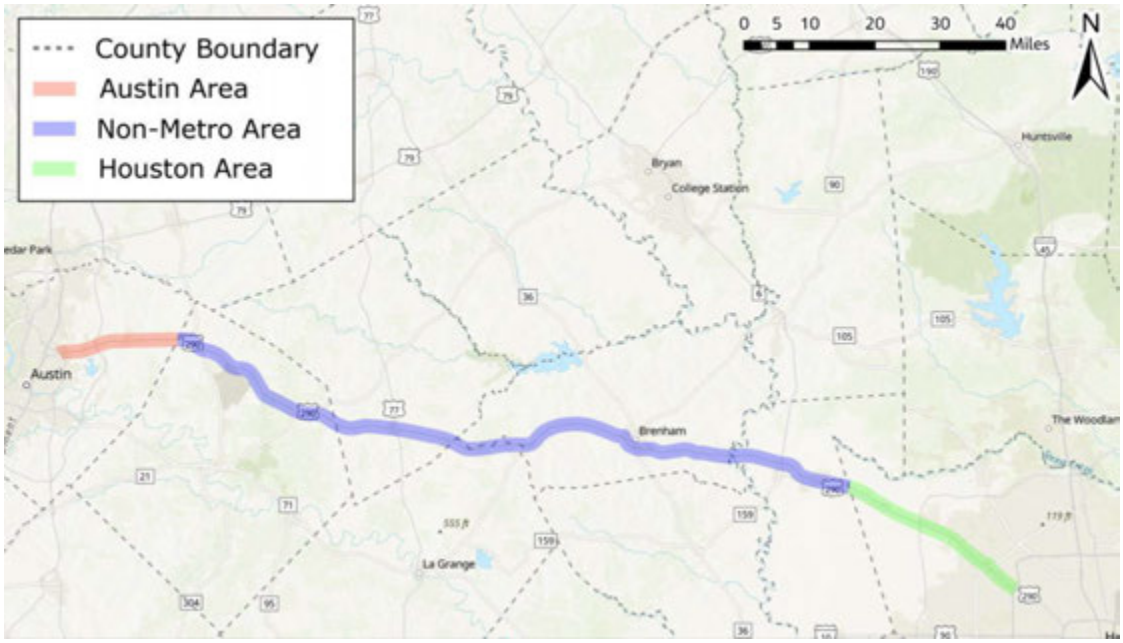


Figure 18. US 290 Growth Rate Segments

After comparing the available data on growth trends along US 290, growth rates were determined for the three segments. **Table 3** shows the proposed linear annual growth rates for each segment along US 290 between 2024 and 2029.

Table 3. US 290 Linear Annual Growth Rates by Segment

Roadway Segment	Growth Rate
US 290 (Austin Area)	3.4%
US 290 (Non-Metro Area)	3.6%
US 290 (Houston Area)	2.7%

Long-term (20+ years) projections to identify the areas with long-term mobility improvement needs for the year 2050 were developed based on 2024 volumes and proposed annual growth rates. In 2050, traffic along US 290 eastbound and westbound exhibit similar mobility patterns to 2024 and 2029. The findings are summarized in the bulleted items below:

- In the Austin-Manor-Elgin section, projected 2050 demand is expected to significantly surpass existing capacity (restricted by the signalized highway), continuing to worsen the already excessive congestion and delay in this US 290 section, with over 2.5 V/C ratios in 2050.
- In downtown Giddings, the active UPRR railroad at-grade crossing is still expected to cause queues and delays without alternative improvements implemented from the US 290 Giddings Mobility Study. The peak V/Cs are expected to remain under 1.0 in the near-term year 2029 but will be exceeded by 2050.
- In Brenham, the US 290 and SH 36 interchange bottleneck is anticipated to be addressed by 2029 with a new 4-lane, two-way interchange with direct connectors. The completed interchange is expected to alleviate the bottleneck at this interchange with better mobility and safety. However, by 2050, the Brenham area will require more capacity to handle traffic growth and local traffic demand.
- In Houston, the existing highest capacity will not suffice the projected 2050 traffic demand. Traffic congestion and delay are expected without additional capacity or alternative solutions.

Additional details regarding the long-term (2050) projection and analysis are provided in **Appendix A**.

6. Normal Condition Traffic Operation

US 290 is primarily a rural, at-grade, divided highway with two lanes in each direction, except for the urbanized sections near Austin, Giddings, Brenham, and Houston. Beginning from US 183 in Austin to SH 95 in Elgin, US 290 is mostly controlled by closely spaced traffic signals with significant amounts of cross streets and driveways. The US 290 corridor in the vicinity of Giddings operates as an undivided, low-speed, signalized highway, with an at-grade Union Pacific railroad crossing in the center of Giddings. West of Brenham, the existing interchange with SH 36 acts as a bottleneck along US 290 with one-lane ramps in both directions. The US 290 section east of SH 6 operates as a freeway with frontage roads, ramps, and grade-separated interchanges.

The operational analysis of the US 290 study corridor focused on the main lane operations. It is segmented into distinct sections based on roadway characteristics and Distance From Origin (DFO) ranges. The freeway section, mainly located in the Houston District, has a DFO range of 230-266. The multilane highway section spans from SH 6 in Hempstead to Giddings, with DFOs ranging from 179 to 230 and from Giddings to Elgin, which spans DFO 147 to 172. The signalized highway section stretches from Austin to Elgin and includes a segment in Giddings, with DFO from 127 to 146 and 173 to 178. A notable bottleneck point has been identified at the US 290 and SH 36 interchange, located at DFO 208. **Figure 19** highlights the US 290 roadway characteristics.

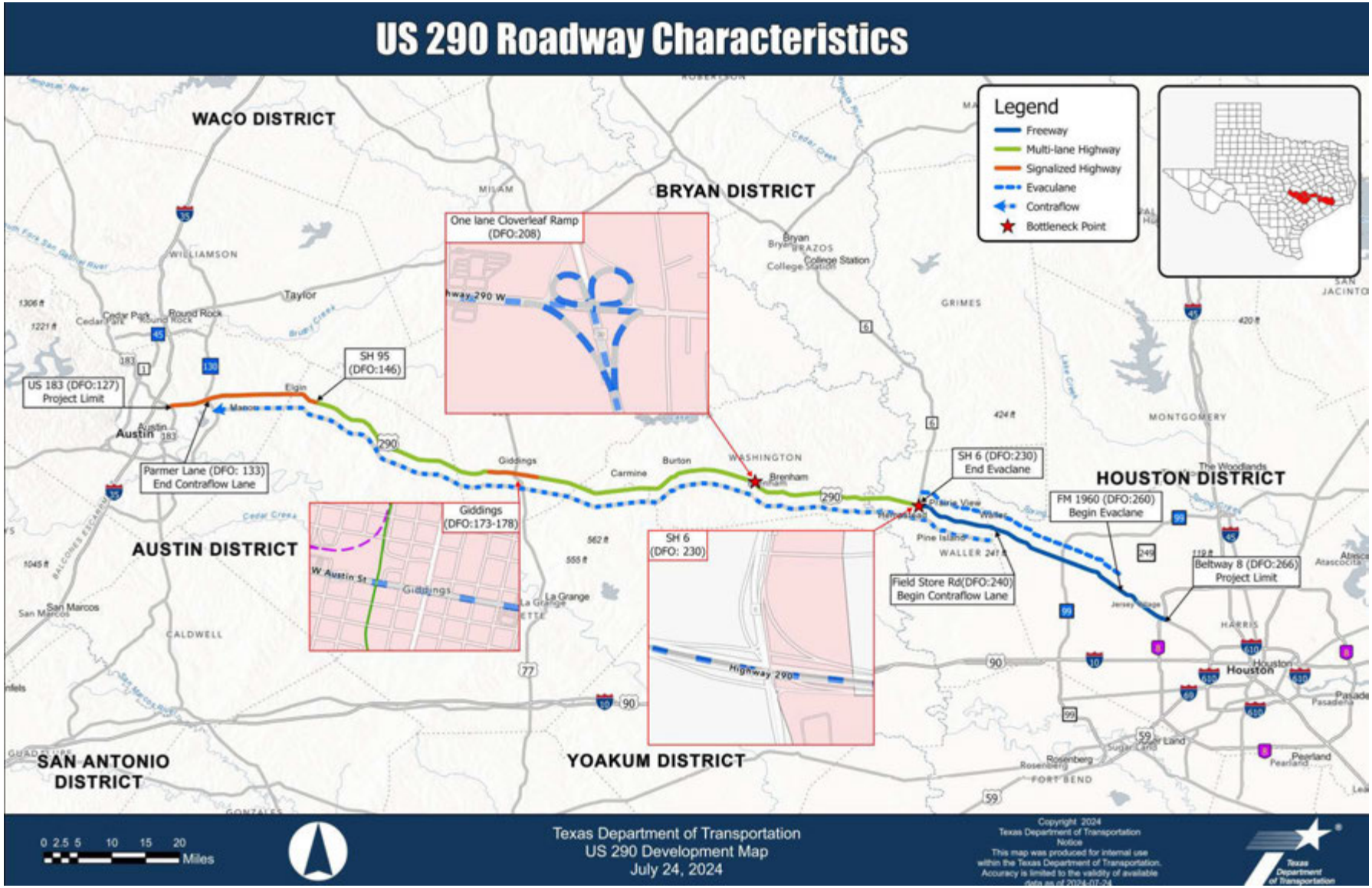


Figure 19. US 290 Roadway Characteristics

It was acknowledged that the TxDOT Alternative Delivery Program is in the process of improving the interchange of US 290 at SH 36 in Brenham, Texas. The project is expected to begin construction in 2027 and to be completed by 2029.

As shown in **Figure 20**, the proposed improvement will convert US 290 at SH 36 to a 4-lane, two-way interchange with direct connectors. The completed interchange is expected to alleviate the bottleneck at this interchange with better mobility and safety.

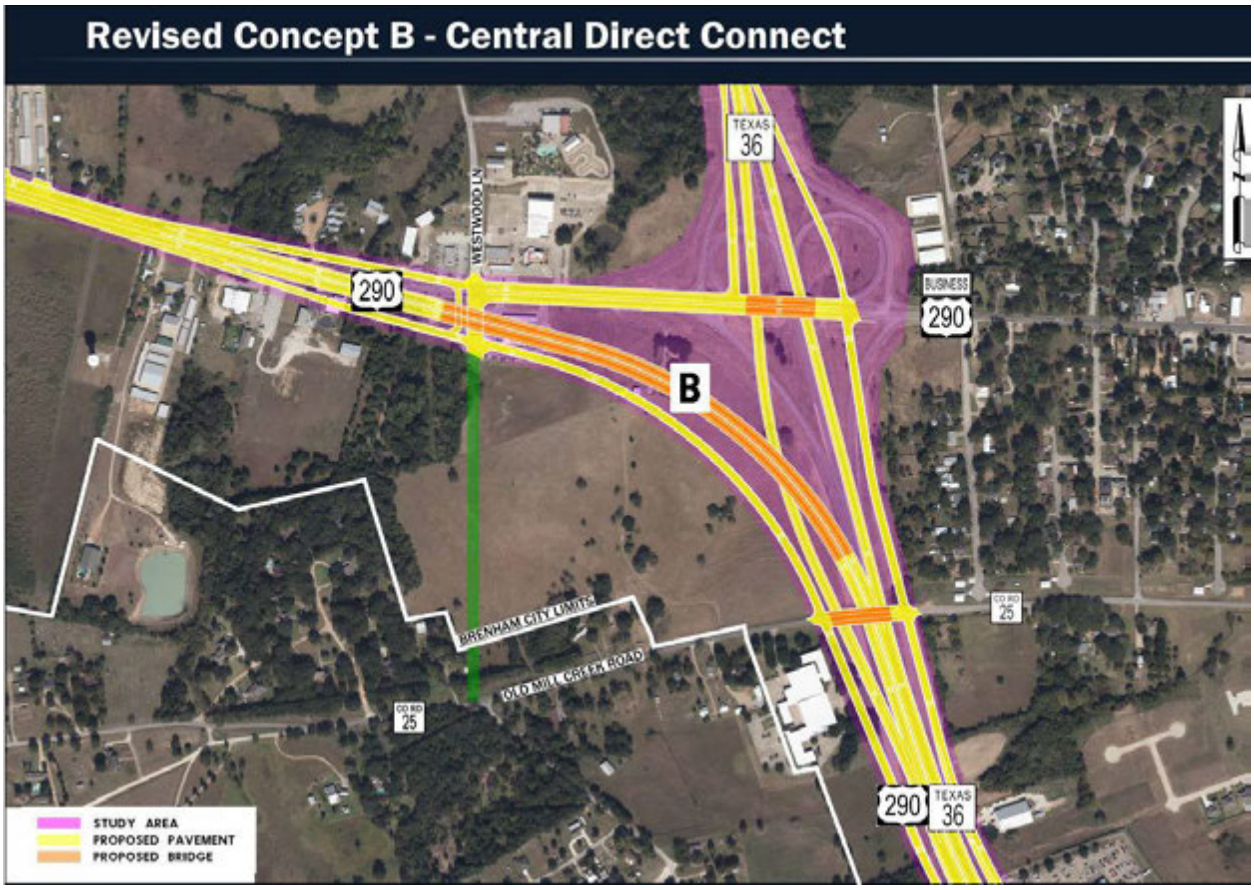


Figure 20. US 290 and SH 36 Interchange Improvement Concept

6.1 Capacity Calculation

In this analysis, capacity calculation methods for various road types are referenced from both the Highway Capacity Manual (HCM) and the National Cooperative Highway Research Program (NCHRP) Report 825: Planning and Preliminary Engineering Applications Guide to Highway Capacity Manual.

Freeway

For freeways, capacity is calculated using **Equation 1**, where FFS (free-flow speed) is adjusted to account for the impact of percentage of heavy vehicles (%HV). A standard assumption of 10% HV is used in this calculation.

$$\boldsymbol{Capacity = \frac{2,200 + 10 * (min(70, FFS) - 50)}{1 + \frac{\%HV}{100}} * Lanes} \qquad \textbf{Equation 1}$$

Multilane Highway

Equation 2 calculates adjustments for heavy vehicles and how they influence the overall capacity of a multilane highway, using the base capacity determined by **Equation 3** and **Equation 4**, which depends on the free-flow speed (FFS). For this calculation, a level terrain coefficient (ET) of 1.5 is assumed.

$$\boldsymbol{Capacity = BaseCapacity * f_{HV} * Lanes} \qquad \textbf{Equation 2}$$

$$\boldsymbol{BaseCapacity = 1,000 + 20 * FFS; for\ FFS \leq 60;} \qquad \textbf{Equation 3}$$

$$\boldsymbol{BaseCapacity = 2,200, for\ FFS > 60} \qquad \textbf{Equation 4}$$

$$\boldsymbol{f_{HV} = \frac{1}{1a + PT * (ET - 1)}} \qquad \textbf{Equation 5}$$

$f_{HV} = adjustment\ for\ heavy\ vehicles$

$PT = Proportion\ of\ trucks\ and\ buses\ in\ the\ traffic\ stream$

$ET = Passenger - car\ equivalents$

Signalized Highway

Signalized highway capacity is determined by the number of lanes and the percentage of green time (g/C) in a single cycle. For this analysis, a g/C ratio of 50% is assumed, **Equation 6** details the calculation of signalized highway capacity under these conditions.

$$\boldsymbol{Capacity = \frac{g}{C} * Lanes * 1,900,\ \text{where}\ \frac{g}{C} = percentage\ green\ time} \qquad \textbf{Equation 6}$$

Ramp

The capacity of the one-lane, partial cloverleaf ramp at the US 290 at SH 36 was assumed to be 1,490 vehicles per hour (VPH), per NCHRP 825.

6.2 Demand Calculation

To calculate the demand for US 290, it's crucial to understand several key factors. The design hour (K) factor represents the proportion of Annual Average Daily Traffic (AADT) occurring during the peak hour, defined as the 30th highest hourly traffic flow of the year. The Design Hourly Volume (DHV) quantifies this peak hour traffic in vehicles per hour. By multiplying AADT by the K factor, the study team obtain the DHV. The directional distribution (D) factor indicates the proportion of DHV traveling in the heavier direction. The Directional Design Hourly Volume (DDHV) is calculated by multiplying D by DHV.

AADT, D factor, direction of the D factor, K factor, road type, road ID, and the longitude/latitude along the area of interest were extracted from the TxDOT Roadway Inventory database. This data was then cleaned and integrated into a GIS map, providing a visual overview that facilitated the division of the corridor into distinct segments. Averaging within these segments yielded the average D factor for each. Applying the averaged D factor to the individual K factor and individual AADT provided us with the DDHV. **Equation 7** uses the D factor for each segment, along with the AADT and K factor to calculate the DDHV.

$$DDHV = AADT * D * K \qquad \textbf{Equation 7}$$

D: *the proportion of DHV occurring in the heavier direction*
K: *the proportion of AADT on a roadway segment or link during the Design Hour*

The demand calculation methodology for US 290 focuses on main lanes only, separating westbound (WB) and eastbound (EB) traffic. The 2022 AADT is projected to 2024 and 2029 based on TPP concurred linear annual growth rates. These rates differ for the Austin area (3.4%), non-metro area (3.6%), and Houston area (2.7%) segments of US 290.

6.3 Volume to Capacity (V/C) Ratio

In transportation planning and engineering, the volume-to-capacity (V/C) ratio is a metric used to assess the operational efficiency and level of service of a roadway segment. This ratio compares the traffic volume (V) on the roadway to its maximum capacity (C), which is derived from the calculation. The V/C ratio serves as a diagnostic tool for congestion, indicating how close a roadway is to reaching its operational limit. A V/C ratio of 1.0 or higher signifies that the demand for road space exceeds its available capacity, often resulting in traffic congestion and delays.

Figure 21 illustrates the eastbound traffic demand compared to the calculated capacity of US 290 under normal conditions for analysis years 2024 and 2029. From US 183 (western study limit) eastwards, the signalized highway sections from US 183 to SH 95 in Elgin exhibited relatively low capacities mostly due to the signalized intersection traffic control delay. West of Parmer Lane, where US 290 serves as the 290 Toll frontage road, the traffic demand is significantly below capacity. This is because the 290 Toll relieves the traffic demand. However, in the vicinity of Parmer Lane where the 290 Toll ends and all eastbound traffic merges to the US 290 signalized highway, the traffic demand exceeds the capacities and is likely to cause a bottleneck.

Farther to the east, the traffic demand decreases gradually. The lane reduction at FM 973 reduces US 290 capacity, which causes congestion through Elgin. East of Elgin, US 290 capacities are generally above the moderate traffic demand in the rural areas except the Giddings section, where closely spaced traffic signals and the at-grade railroad crossing constrict capacity. The next identified bottleneck is the US 290 and SH 36 one-lane ramp near Brenham, with the lowest capacity along the corridor.

East of SH 6, which connects to College Station, the traffic demand increases from 3,000 VPH progressively to almost 12,000 VPH near Beltway 8 (eastern study limit) in Houston. Fortunately, this section has been updated to the freeway with ramps, access control, and frontage roads. The number of lanes also increases eastwards from 2 lanes to 5 lanes including a High-Occupancy Vehicle (HOV) lane. The upgraded US 290 section is expected to be able to handle design hourly volume in 2024 but slightly short to accommodate the growing traffic demand in 2029.

Figure 22 indicates the volume-to-capacity (V/C) ratio along US 290 under normal conditions for analysis years 2024 and 2029. The red horizontal line at the V/C ratio of 1.0 indicates the threshold of the operational limit. Where the V/C ratios are above the 1.0 red line, operations could result in excessive congestion and other operational issues. The Austin/Manor section is above the threshold in 2024 and continues to worsen in 2029 extending to Manor. Giddings sees peaks but does not exceed a V/C of 1.0. The one-lane ramp near Brenham exceeds the limit in 2024 but is expected to be addressed in 2029 with the completion of the US 290 and SH 36 interchange as mentioned previously. The Houston freeway section can accommodate significant traffic demand in most locations except the interchange with Beltway 8 in 2029.

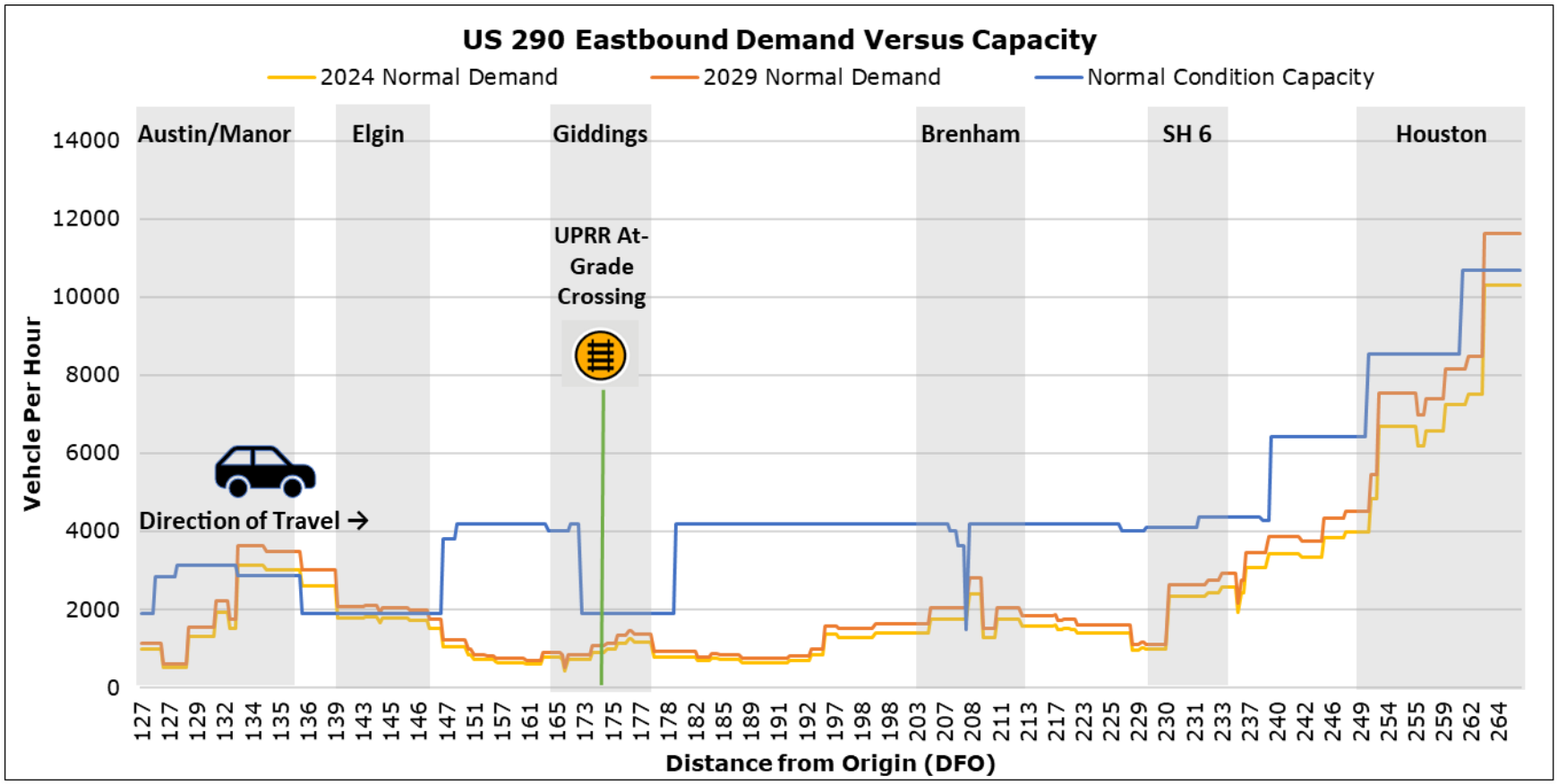


Figure 21. US 290 Main Lane Eastbound Demand Versus Capacity

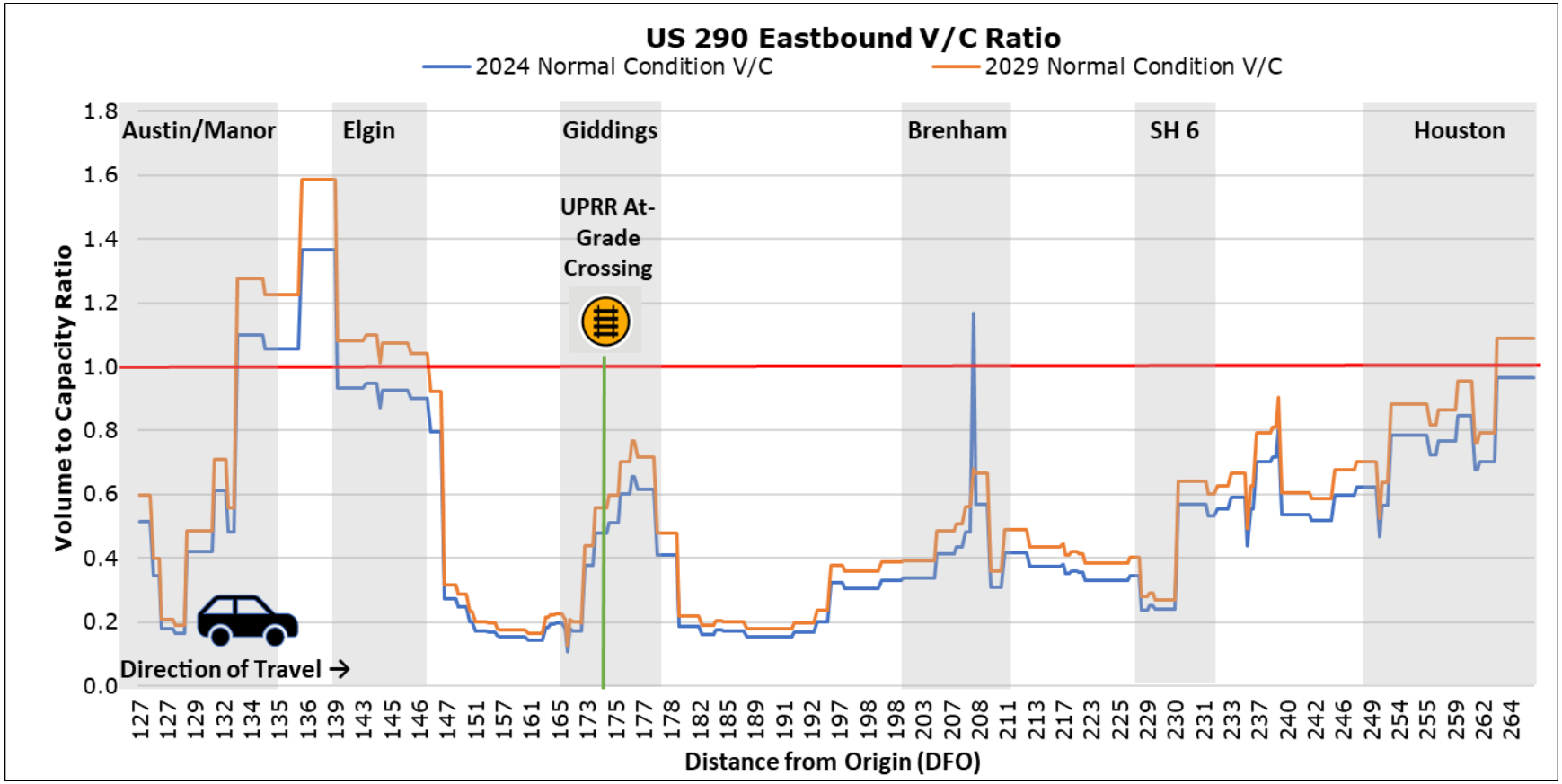


Figure 22. US 290 Main Lane Eastbound V/C Ratio

Figure 23 illustrates the westbound traffic demand compared to the calculated capacity of US 290 under normal conditions for analysis years 2024 and 2029. From Beltway 8 westwards, the traffic demand decreases from about 12,000 VPH to approximately 4,000 VPH just before SH 6. At the maximum capacity location, the US 290 freeway has lanes 6 lanes including an HOV lane and a reversible HOV lane located in the median. The reversible HOV lane is assigned to westbound capacity calculations because the directional factor (D) indicates westbound the predominant travel direction during the peak hour. Based on **Figure 23**, this US 290 section can provide higher capacity than the demand travel volumes in both 2024 and 2029 normal conditions.

West of SH 6, similar capacity constraints are found in the one-lane ramp near Brenham and Giddings signalized highway section. Approaching Elgin, the traffic demand gradually exceeds the reduced capacity due to the signals starting in Elgin. Although an additional lane is added west of FM 973, the excessive traffic demands originating from the adjacent Manor developments are still above US 290 capacity. Until westbound US 290 traffic reaches Parmer Lane, where half of the westbound trips turn onto Parmer Lane or SH 130 and some traffic choosing to take the 290 Toll, demand results in a drastic drop on US 290 (serves as 290 Toll frontage road). The westbound capacity of US 290 from Parmer Lane and US 183 is generally larger than the traffic demand despite a lane drop near US 183.

Figure 24 shows the US 290 westbound V/C ratio results. Like eastbound, it was found that the Austin/Manor section V/C is above the threshold in 2024 and continues to worsen in 2029. Giddings sees peaks but does not exceed 1.0. The one-lane ramp near Brenham exceeds the limit in 2024 but is expected to be addressed in 2029 with the completion of US 290 and SH 36 interchange. The Houston freeway section can accommodate the significant traffic demand in most locations in 2029.

Based on the eastbound and westbound comparison of capacity, traffic demand, and V/C ratios evaluation, US 290 demonstrates sufficient capacity to accommodate existing 2024 and projected 2029 traffic demands in most of the study sections with the following notes:

- The highest traffic demand in the Houston section is expected to be accommodated by the corresponding highest capacity due to the US 290 widening projects ranging from IH 610 to FM 2920.
- The second-highest traffic demand in Austin/Manor exceeds the 2024 and 2029 capacity and causes substantial congestion.
- In Giddings, despite reduced capacity caused by signalization, the at-grade railroad crossing, and low speed limit, this US 290 section can handle 2029 projected traffic demand.
- The existing partial cloverleaf one-lane ramps near Brenham have V/C exceeding the limit in 2024 but are expected to be addressed in 2029 by the completion of US 290 and SH 36 interchange.

Additional details regarding the long-term (2050) projection and analysis are provided in **Appendix A**.

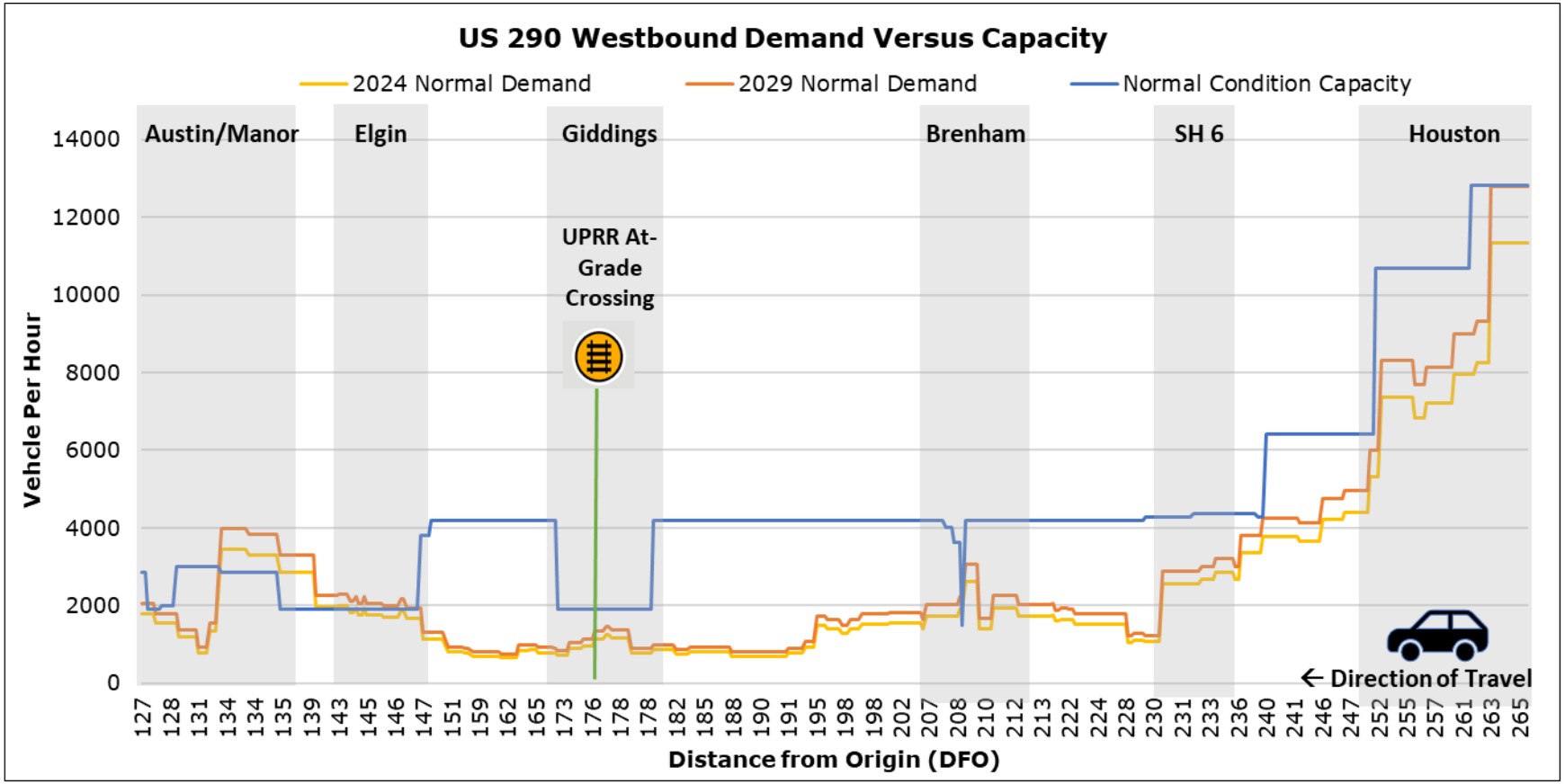


Figure 23. US 290 Main Lane Westbound Demand Versus Capacity

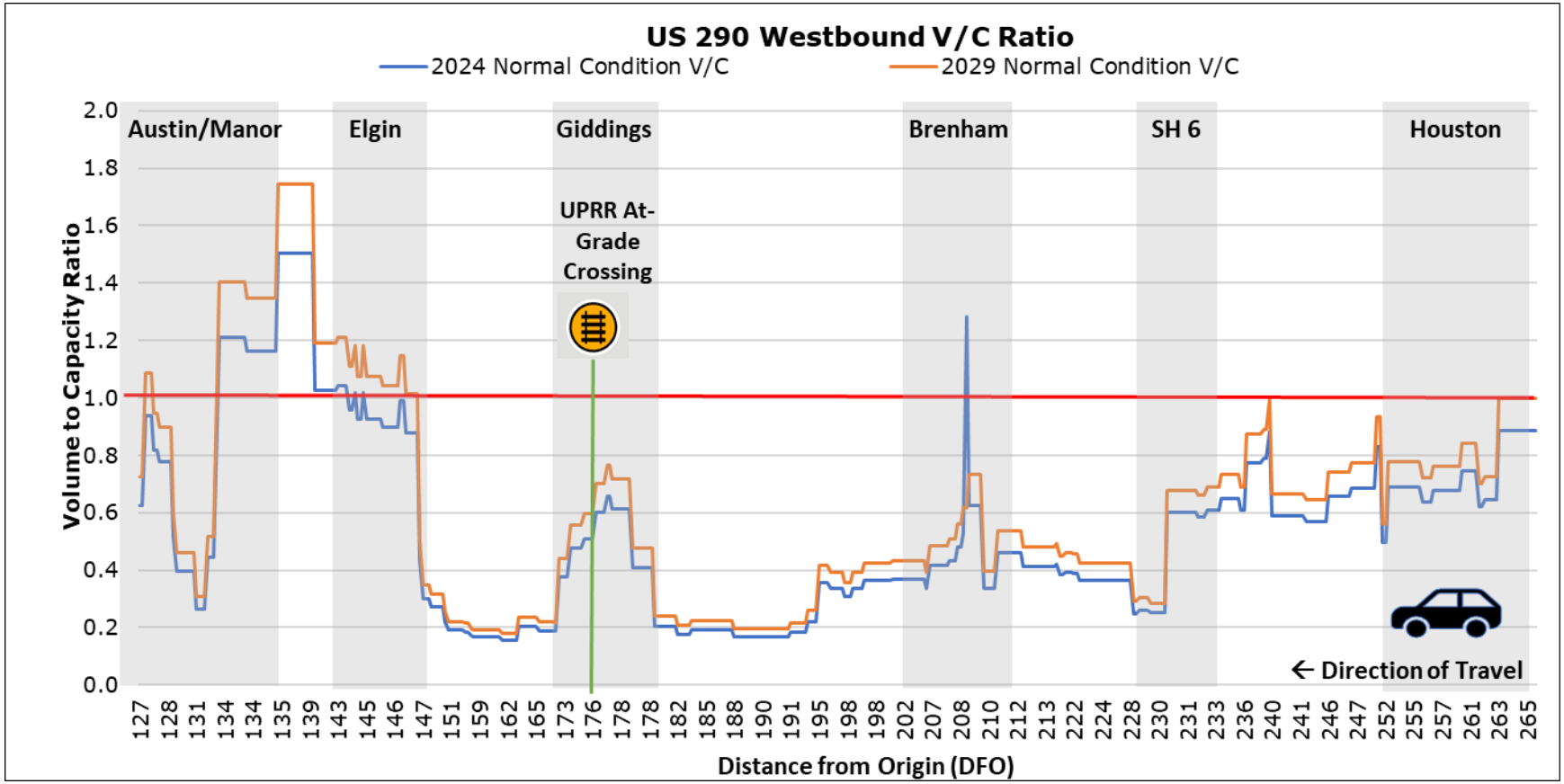


Figure 24. US 290 Main Lane Westbound V/C Ratio

7. Hurricane Evacuation Assessment

This hurricane evacuation assessment is performed by setting assumptions related to the formation and impact of the hurricane, reviewing evacuation policy, projecting demand under hurricane events, and analyzing the capacity of the US 290 corridor. Conclusions and proposed options for reducing traffic congestion are also made by analyzing the V/C ratio along US 290. The goal of this study is to pinpoint areas where traffic demand surpasses the road's capacity and provide potential solutions.

7.1 Hurricane Evacuation Assessment Assumptions

- Evacuation demand is generated by the H-GAC evacuation Zip-Zone Map and US Census Block Groups being impacted by a Category 5 hurricane landfall with at least 12 inches of storm surge.
- Evacuation begins 66 hours before potential hurricane landfall in Houston.
- Evacuees will use one of the five marked TxDOT evacuation routes, including IH-10, US 290, IH-45, and IH-69.
- Beltway 8 and Grand Parkway/SH 99 will add traffic onto US 290 and remove none.
- SH 6 and US 77 will remove traffic from US 290 and add none.
- Evacuation response has been coordinated throughout the roadway between study endpoints – Beltway 8 in Houston and US 183 in Austin.
- At least 80% of background traffic (regular traffic, other than evacuation traffic) remains on US 290 during evacuation.
- Different scenarios were studied, which involve combinations of factors including the years of analysis (2024 and 2029), traffic demand multipliers (1.0x and 1.5x), and evacuation interventions (none, EvacuLanes, and Contraflow).

7.2 Hurricane Evacuation Intervention: EvacuLane and Contraflow

TxDOT has designated and monitored specific roads as part of the hurricane evacuation network. Some have interventions to facilitate quick evacuations aimed at moving traffic away from coastal areas as quickly as possible inland or to higher ground.

During evacuation, two plans are executed to expand the capacity of the network: Evaculane and Contraflow Plans. EvacuLane is a shoulder used to add carrying capacity when the Houston-Galveston area is threatened by a hurricane and voluntary evacuations are issued.

The Contraflow plan is another strategy that helps move citizens safely and efficiently out of harm's way during large-scale evacuations. When activated, the eastbound lanes of US 290 are temporarily reversed, allowing eastbound lanes of traffic to flow westbound. Drivers using these reversed lanes will have designated exits to leave US 290.

7.3 Hurricane Evacuation Assessment Summary

Like the normal conditions analysis, V/C ratios are also calculated to assess the operational efficiency of roadways, as shown in **Figure 25**. With full evaluation interventions including EvacuLane and Contraflow, the V/C ratios are largely contained below the threshold of 1.0 for most of US 290 sections except:

- The US 290 section between SH 99 and Field Store Road in Waller. Along US 290 west from Houston, the roadway capacity decreases with the number of lanes which reduces from 5 to 3 lanes near the US 290 and SH 99 interchange. The Contraflow is not available until Field Store Road, located in Waller. The gap between the decreased capacity and increased evacuation demand is expected to cause congestion and delays during hurricane evacuation events.
- In Brenham, the US 290 and SH 36 interchange.
- In Giddings, the downtown traffic signals and at-grade rail crossing.
- Between Austin and Manor, with closely spaced traffic signals, driveways, and crossovers.

The analysis of V/C ratios also reveals that US 290 faces challenges in handling hurricane evacuation traffic in the urban area non-freeway sections with signal-controlled intersections. The implementation of EvacuLane and Contraflow proves to be a highly effective strategy in mitigating congestion, significantly reducing areas of concern.

The findings highlight the importance of prioritizing capacity improvements in the urban area non-freeway sections and implementing robust traffic management strategies for EvacuLane and Contraflow to ensure the safe and efficient evacuation of residents during hurricane events as any obstruction can trigger gridlock and potential panic among evacuees.

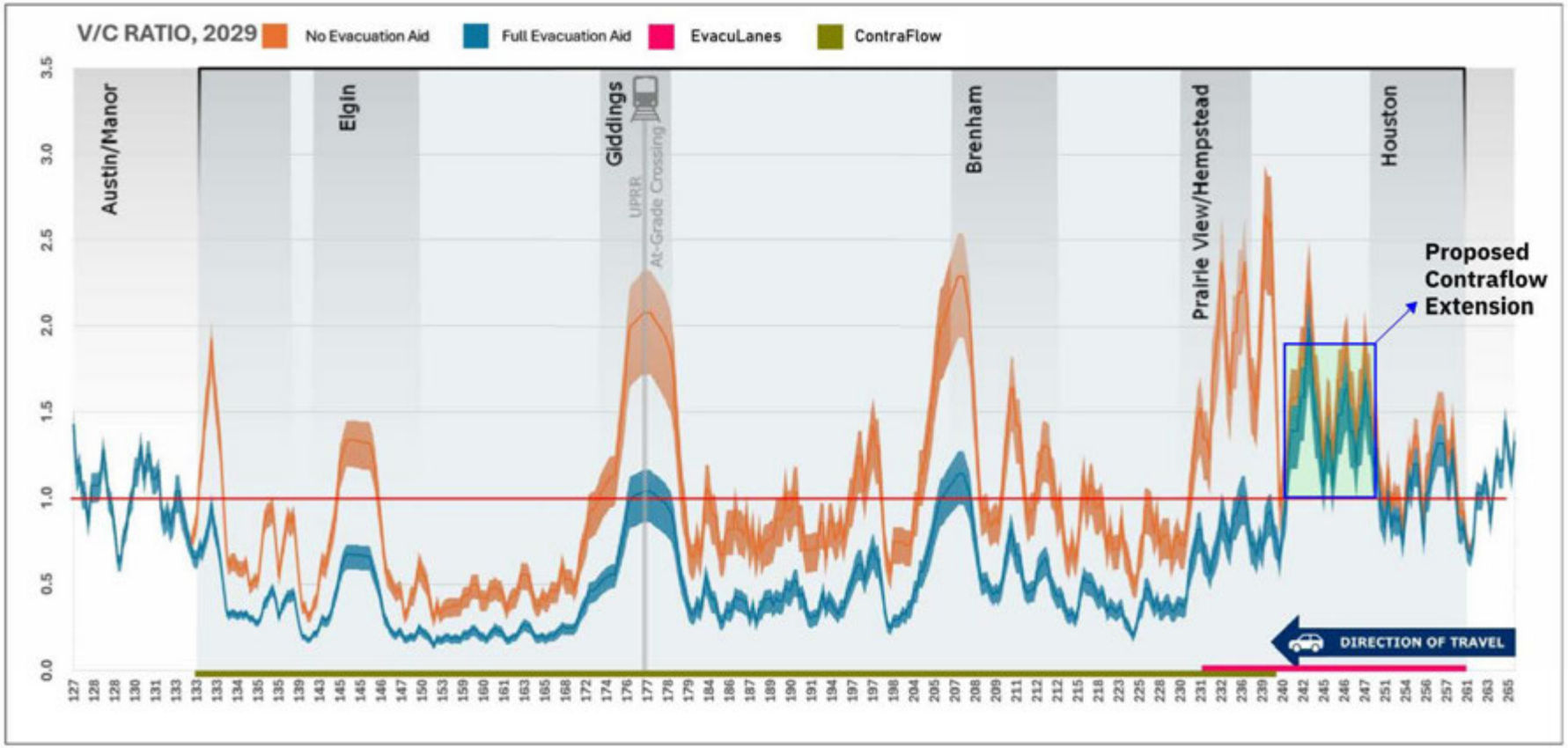


Figure 25. US 290 Main Lane Westbound V/C Ratios During Hurricane Evacuation

8. Railroad Crossing Impact Evaluation

8.1 Railroad Crossings along US 290

As shown in **Figure 1. US 290 Traffic Study Map**, existing rail crossings are located in Elgin, Giddings, Brenham, and Hempstead. The only at-grade rail crossing within the study limits is in Giddings. Public comments received during the Giddings Mobility Study conducted by the Austin District indicate that the at-grade crossing causes substantial delays during normal traffic operations. Studies and improvements to allow for better emergency access are ongoing. The railroad crossings along US 290 are listed in **Table 4**.

Table 4. Railroad Crossings along US 290

Location	Operator	Grade-separated or At-grade
Elgin (West of Central Avenue)	CapMetro	Grade-separated
Elgin (East of FM 1704)	Union Pacific	Grade-separated
Giddings (East of Caldwell Street)	Union Pacific	At-grade
Brenham (East of FM 389)	BNSF	Grade-separated
Hempstead (West of SH 6)	Union Pacific	Grade-separated

8.2 Giddings Mobility Study

The Giddings Mobility Study was initiated by the Giddings City Council and Lee County Commissioners Court to explore preliminary options for improving mobility, safety, and emergency response times, as well as addressing conflicts with the railroad in Giddings. The study, which is being managed by TxDOT's Austin District, aims to identify improvements that will alleviate existing traffic issues in downtown Giddings and accommodate future growth. Through collaboration with local stakeholders and the public, the study seeks improvement options that meet both current and future needs. **Figure 26** presents the preliminary relief route alternatives. Further development, including design, environmental review, and funding, will be contingent upon the study's findings.

The US 290 Traffic Study team and the Giddings Mobility Study team coordinated throughout the study schedule. Two coordination meetings were held to discuss progress and share information. As of August 2024, the Mobility team is in the process of setting evaluation criteria for alternative relief routes. They estimate a 50% to 70% diversion of traffic to the proposed relief route from US 290. The Mobility Study is currently estimated to be completed by July 2025; however, the schedule is subject to change.

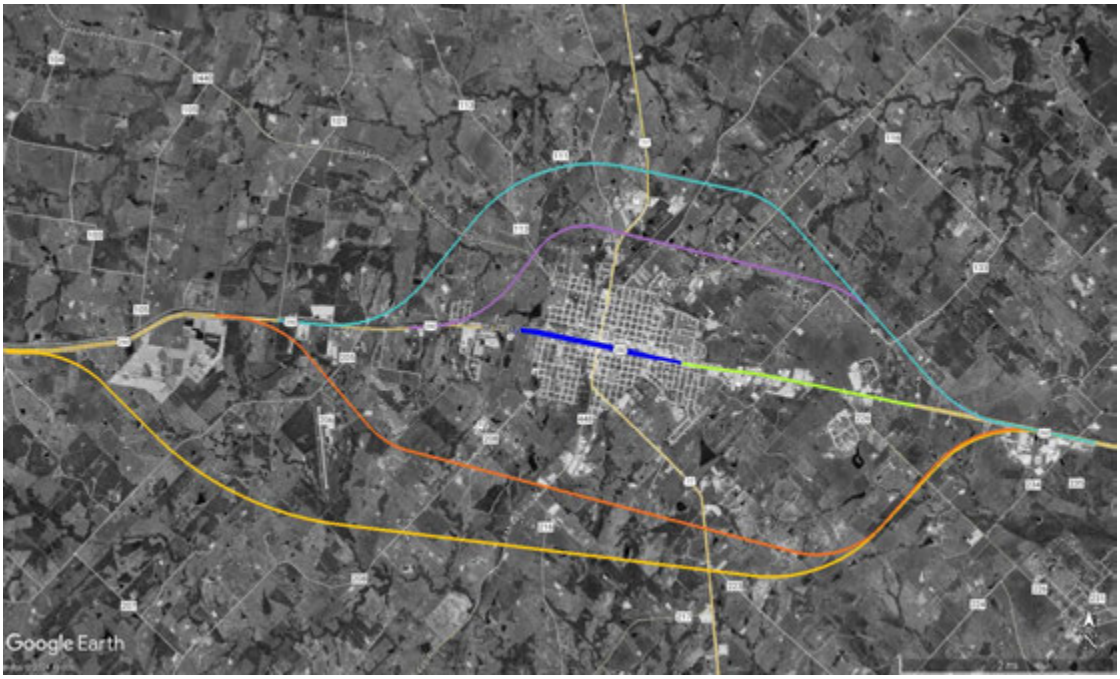


Figure 26. US 290 Giddings Mobility Study Relief Route Alternatives[1]

[1] Presented at the April 9, 2024, Community Workshop #2

9. Study Coordination

The Traffic Study kickoff was held on December 21, 2023 with the TxDOT Project Manager and Jacobs Engineering Group Inc. team.

A kickoff meeting with TxDOT Districts (Austin, Bryan, Yoakum, and Houston) and Divisions (TPP, Rail, Governmental Affairs, Traffic Safety) was held on February 1, 2024, where the study team presented and introduced this traffic study including team members, study limits, rail crossing locations, high-level crash analysis, existing operations, scope, and schedule. A Social Pinpoint virtual engagement page was created to gather comments from the attendees related to safety concerns, operational issues, evacuation issues, congestion, and noted growth areas could be labeled with detail. The traffic study team reviewed these comments.

Social Pinpoint Summary:

- Comments from the Austin District included heavy growth along the US 290 corridor mentioning schematics for FM 973 being developed and the need for grade separation within the area of US 290.
- At SH 95 in Elgin, potential growth and the need for additional capacity at turn lanes.
- In Giddings, there are issues with ponding during rain events and the number of at-grade crossings necessitates a large number of resources during evacuations.
- In Burton, potential safety projects are being looked at for FM 390 and SP 125.
- In Brenham, potential safety projects are being considered to address concerns at Wonder Hill.
- In Chappell Hill, potential projects are being considered to address safety concerns at FM 2447 and Bluebonnet Drive.
- The Bryan and Houston Districts are installing near- and long-term improvements near FM 1155 east of Chappell Hill including restricting median openings and widening.

In May 2024, the study team coordinated with H-GAC to discuss available hurricane evacuation models and other additional helpful information. No models were available. The study team was informed that the evacuation “Zip-Zone” is expected to be updated later this year.

A traffic study update presentation to the TxDOT Districts and Divisions of existing conditions, traffic projections, and methodology for hurricane evacuation operational analysis was presented on May 10, 2024.

The US 290 Traffic Study also coordinated with the relevant TxDOT Districts (Austin, Yoakum, Bryan, Houston) to gather input and share findings. These Districts have reviewed the study findings and proposed options and provided feedback. All feedback and comments from Districts have been incorporated in this study.

10. Planned Improvements

The Unified Transportation Program (UTP) is a 10-year plan that directs the development of transportation projects throughout Texas. It details the available funding as well as gaps in funding for various projects and serves as a roadmap for TxDOT to allocate resources and implement these projects. This ensures that transportation investments are strategically aligned with the state's long-term goals and priorities.

TXDOT has been actively working on US 290 to enhance the mobility, safety, and resilience of US 290 infrastructure. As shown in **Figure 27**, approximately 97 projects have been identified from the TxDOT project tracker. More than half of those projects are maintenance-related projects, aimed at extending the lifespan and resilience of US 290. Most projects are located within the Houston District.

The highlighted projects are below:

- US 290 Improvement Project - FM 1155 Intersection Study.
- US 290 at SH 36 interchange improvement project.
- US 290 Giddings Mobility Study.

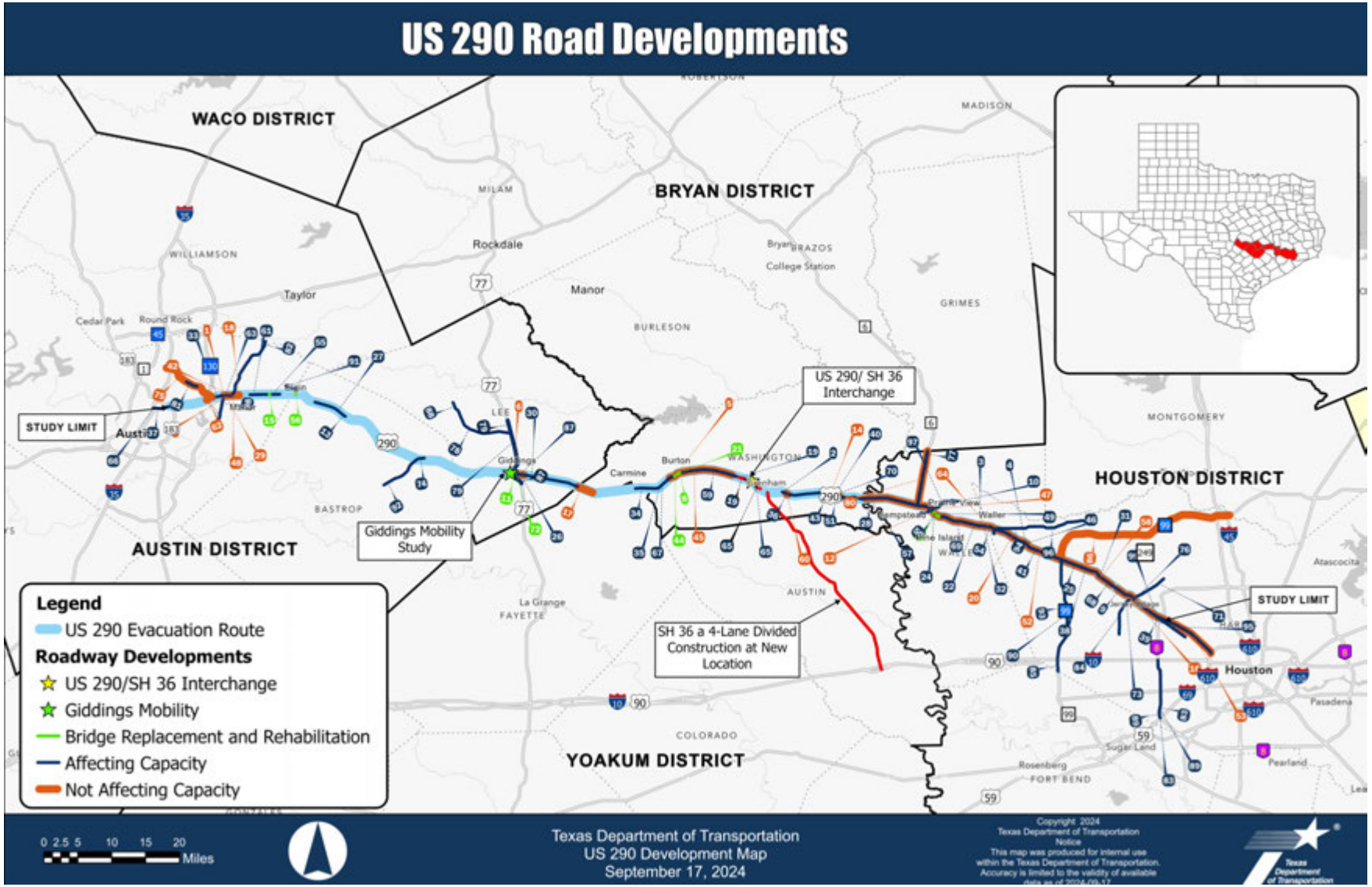


Figure 27. US 290 Project Tracker Map

11. Summary of Findings

The US 290 Traffic Study was conducted to address the 88th Texas Legislature's mandate to evaluate traffic congestion and evacuation routes along the corridor. The study encompassed a comprehensive analysis of existing conditions and projected conditions, focusing on various aspects such as safety, travel patterns, operational analysis, hurricane evacuation assessment, and the impact of the at-grade railroad crossing in Giddings. This section summarizes the findings derived from this study, as summarized below:

- **Field Visit Observation:**
    - Motorists operated above the speed limit across various sections of US 290.
    - Abrupt speed changes near urbanized sections: Giddings and Carmine.
    - Austin, Yoakum, and Bryan District rural sections lack illumination.
    - Manor: a significant amount of traffic turned to/from US 290 mainlanes via closely spaced intersections and driveways and interrupted traffic flow in US 290 mainlanes.
    - Giddings: train crossings caused traffic congestion and queues on both the east and west sides of the at-grade railroad crossing.
- **Safety Analysis:**
    - Crash numbers gradually increased from 2,550 in 2019 to the highest of 2,830 in 2023, despite the decline in 2020 caused by COVID-19 pandemic and stay-at-home conditions.
    - All urban segments indicated lower crash rates compared to the urban statewide average crash rate, while rural segments in the Austin District and Bryan District exhibited slightly higher crash rates than the rural statewide average crash rate.
- **Traffic Projections:**
    - Based on historical traffic counts and travel demand models, projected growth rates are 3.4%, 3.6%, and 2.7% for the Austin area, non-metro area, and Houston area, respectively, for the period from 2024 to 2029.
- **Travel Patterns:**
    - *Traffic volume:* The highest traffic volumes are near the metropolitan areas of Austin and Houston, with noticeable traffic peaks observed around Giddings and Brenham.
    - *Origin-Destination Analysis:* Most trips in Austin and Houston are internal within the metropolitan areas.
    - *Historical Hurricane Evacuation Pattern:* approximately 15% of evacuees are expected to use US 290 as an evacuation route during a hurricane event.

- *Railroad Crossings:* There are several railroad crossings along US 290, with the only at-grade crossing located in Giddings. The at-grade crossing causes substantial delays and studies are ongoing to improve emergency access.

- **Normal Condition Traffic Operation:**
  - Based on the eastbound and westbound comparison of capacity, traffic demand, and V/C ratios, US 290 demonstrates sufficient capacity to accommodate existing 2024 and projected 2029 traffic demands in most of the study sections.
  - The highest traffic demand in the Houston sections is expected to be accommodated by the corresponding highest capacity due to the recently completed US 290 widening projects ranging from IH 610 to FM 2920.
  - The second-highest traffic demand in Austin/Manor exceeds the 2024 and 2029 capacity and causes substantial congestion.
  - In Giddings, the US 290 section can still handle projected 2029 moderate traffic demand.
  - The existing partial cloverleaf one-lane ramps near Brenham have a V/C exceeding the limit in 2024 but are expected to be addressed in 2029 by the completion of the US 290 and SH 36 interchange improvements.
- **Hurricane Evacuation Assessment:**
  - Volume-to-capacity (V/C) ratios are used to assess existing roadway efficiency during evacuations, identifying critical bottlenecks and congestion areas.
  - In the event of hurricane evacuations, the existing EvacuLane and especially Contraflow systems aid in evacuation but face challenges due to factors such as the at-grade railroad crossing in Giddings.
- **Study Coordination**
  - Coordinated with TxDOT Districts and Divisions to gather comments and input through presentations, a Social Pinpoint virtual engagement page, and providing study updates.
  - Coordinated with the Austin, Bryan, and Houston Districts to obtain the latest signal timing plans and hurricane evacuation Contraflow plans.
  - Coordinated with H-GAC regarding hurricane evacuation models, hurricane Zip-Zone updates, and hurricane evacuation assessment methodology.
  - Coordinated with the Giddings Mobility Study team.
- **Planned Improvements**
  - Reviewed and incorporated UTP projects and funds available for US 290.
  - Identified and summarized US 290 roadway improvements from the TxDOT Project Tracker.

12. Potential Options for Reducing Traffic Congestion (Unfunded)

This section discusses the potential options for reducing traffic congestion as part of this study to alleviate the safety, mobility, and operational concerns under normal conditions and hurricane evacuation scenarios**.** Potential options for reducing traffic congestion are categorized into short-term (1 to 4 years) and mid-term (5 to 10 years). At this time, there is no dedicated funding or commitment by TxDOT to implement these improvement options.

Short Term (1 to 4 years)

- Perform a Road Safety Audit (RSA) on rural segments in the Austin and Bryan Districts with crash rates are higher than the statewide average crash rate.
- Provide illumination for the rural sections that lack lighting and exhibit a high percentage of "Dark, Not Lighted" crashes.
- Perform a speed study near urbanized towns within rural sections and provide additional warning signage to alleviate the drastic speed changes.
- Evaluate the impact of major driveways and crossovers on corridor mobility and safety in the Manor and Elgin sections.
- Perform a traffic signal timing optimization review to evaluate the traffic progression along US 290 in the Manor and Elgin sections.
- Extend the Contraflow limit from Field Store Road to SH 99.
- TxDOT continues collaborating with law enforcement to assist traffic controls for the at-grade railroad crossing in Giddings during hurricane evacuations.
- Improve roadway conditions, signage, and pavement markings along US 290 enhance hurricane route visibility:

Mid Term (5 to 10 years)

- Maintain and enhance pavement markings (including edge line rumble strips) and signage (including radar speed signs) to assist traffic in lane-keeping and speed management.
- Provide railroad preemption to the Giddings at-grade crossing to improve operations. Include a track clearance phase to clear traffic queue and exit phase after the train passes.
- Provide an end-of-queue warning system to alert approaching drivers of slow or stopped traffic ahead caused by train crossings and mitigate potential rear-end crashes.
- Complete US 290 and SH 36 interchange improvements and update Contraflow plan after completion.
- Expand and Diversify Evacuation Routes: Extend the Hurricane Evacuation Route network to include SH 249 (Aggie Expressway), SH 36 (Brenham), and potential Westpark Toll Road to provide more alternative routes for evacuees and alleviate the burden on US 290.
- Provide adequate Dynamic Message Signs along US 290 evacuation routes.

Appendix A. Long-term (2050) Traffic Projection and Analysis

Based on the House Bill 1 Rider 50 legislative text, this study is to evaluate options for reducing traffic congestion, considering projected traffic and usage patterns, and projected usage during disasters. The study team discussed analysis time periods that would respond to the legislation request. The audiences of this study are expected to be legislators and the public who focus more on near-term issues and solutions instead of the typical 20 plus year planning effort. Also, transportation studies and projects typically use opening year (approximately 5 years) for evaluation and reporting near-term results. Therefore, the study team adopted the existing year 2024 to look at existing operational conditions and the analysis year 2029 for near-term future needs.

However, long-term (20+ years) projections to identify the areas with long-term mobility improvement needs for the year 2050 were developed based on 2024 volumes and proposed annual growth rates. The demand versus capacity and volume-to-capacity (V/C) ratio figures for US 290 eastbound and westbound are shown below in **Figure A-1** through **Figure A-4**.

In 2050, eastbound and westbound directions exhibit similar mobility patterns. The findings are summarized below:

- In Austin-Manor-Elgin, projected 2050 demand is expected to significantly surpass existing capacity (restricted by the signalized highway), continuing to worsen the already excessive congestion and delay in this US 290 section (with up to 2.5 V/C ratios in 2050).
- In downtown Giddings, it is expected that the active UPRR railroad at-grade crossing will still cause queues and delays without alternative improvements implemented from the US 290 Giddings Mobility Study. The peak V/Cs are expected to remain under 1.0 in the near-term year 2029 but exceed by 2050.
- In Brenham, the US 290 and SH 36 interchange bottleneck is anticipated to be addressed by 2029 with the proposed improvement. However, the overall Brenham area will still need more capacity to handle traffic growth and local traffic demand by 2050.
- In Houston, the highest capacity still can accommodate 2029 traffic demand, but it is not sufficient for 2050 traffic demand and congestion and delay are expected without additional capacity or alternative solutions.

Furthermore, based on the US 290 Traffic Study findings, additional comprehensive studies should be performed for more specific and smaller project limits following this 140+ mile planning level study to develop potential alternatives with detailed improvements addressing existing mobility and safety issues.

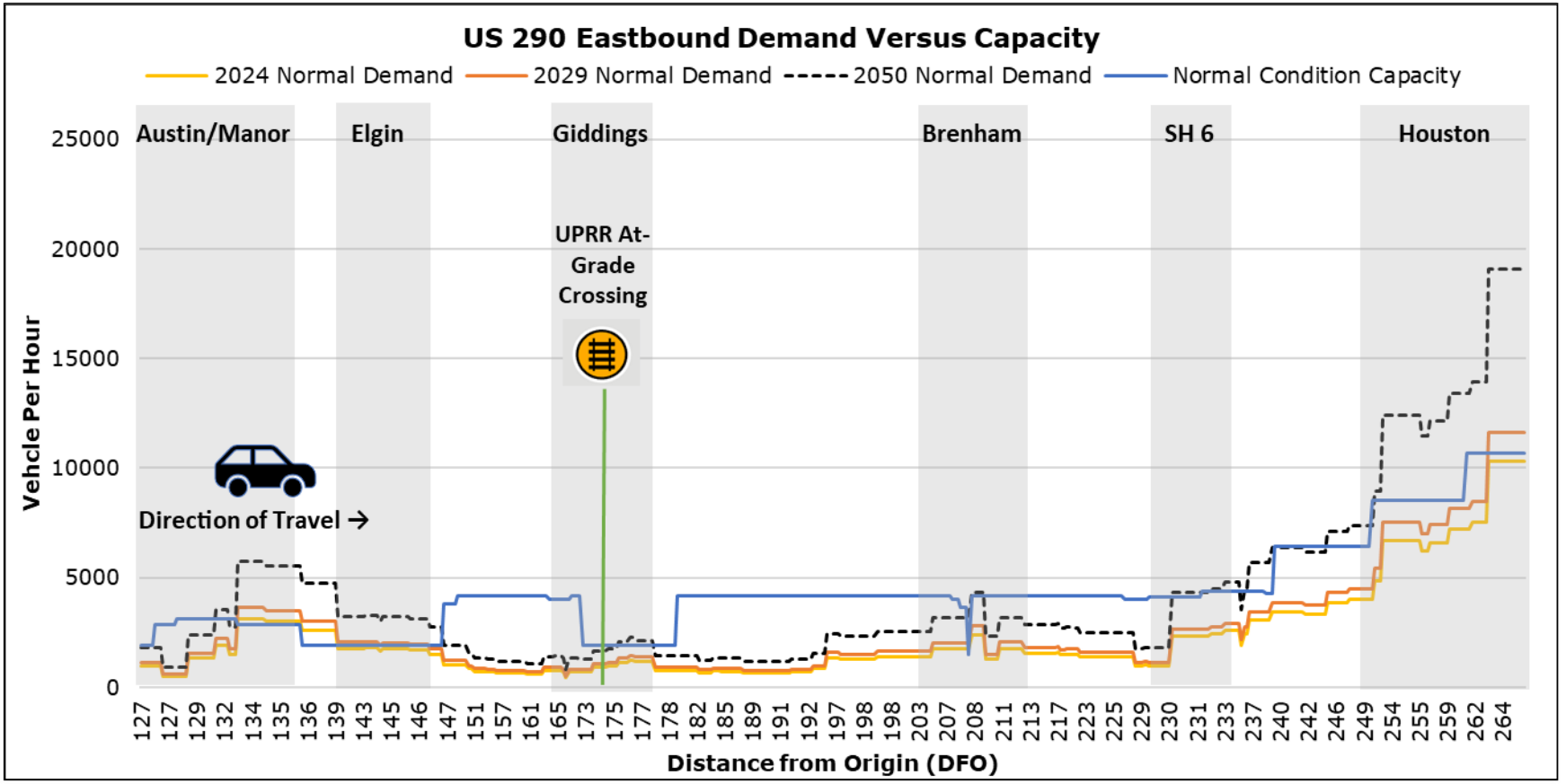


Figure A-1. US 290 Main Lane Eastbound Demand Versus Capacity (2050)

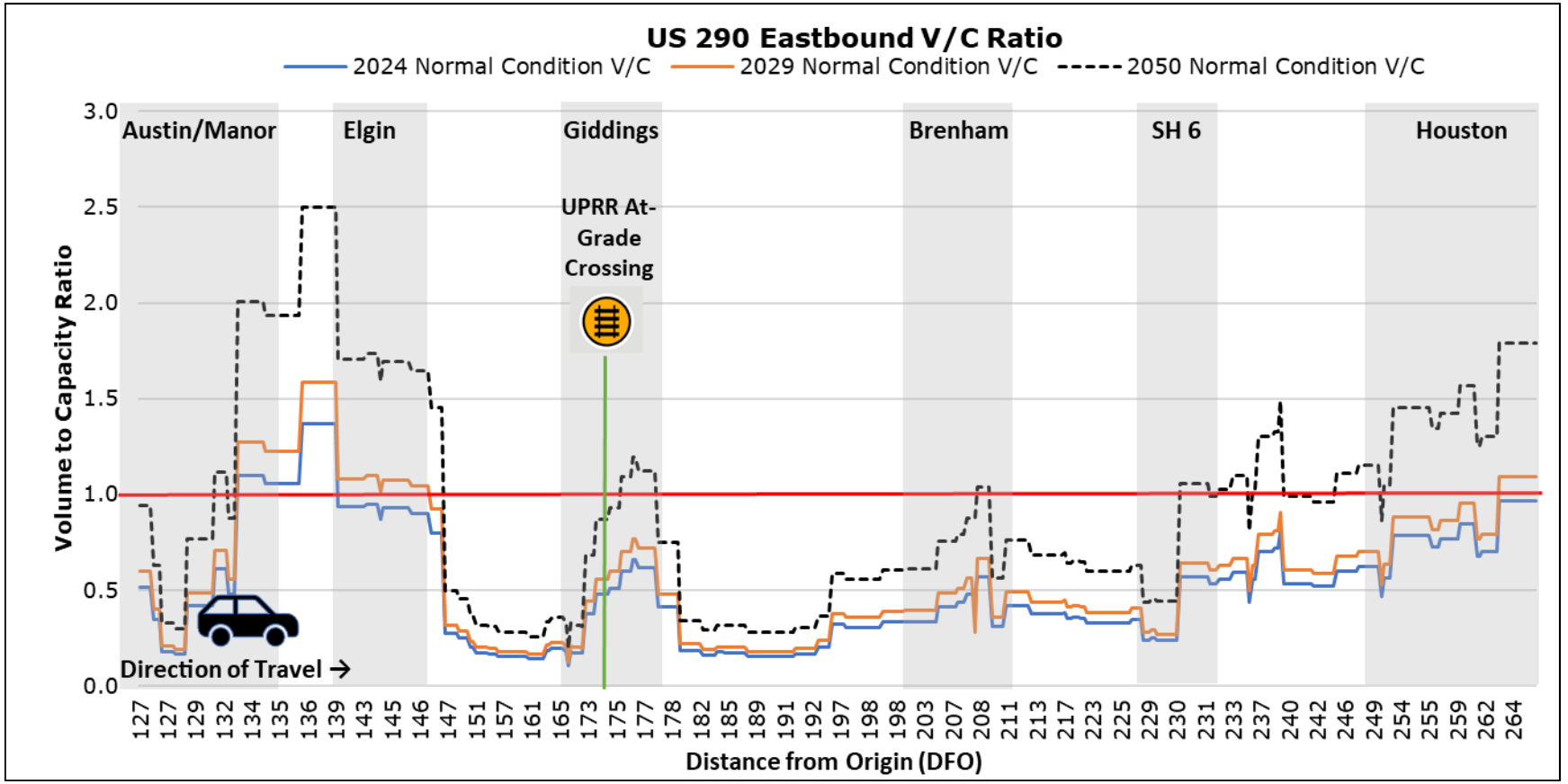


Figure A-2. US 290 Main Lane Eastbound V/C Ratio (2050)

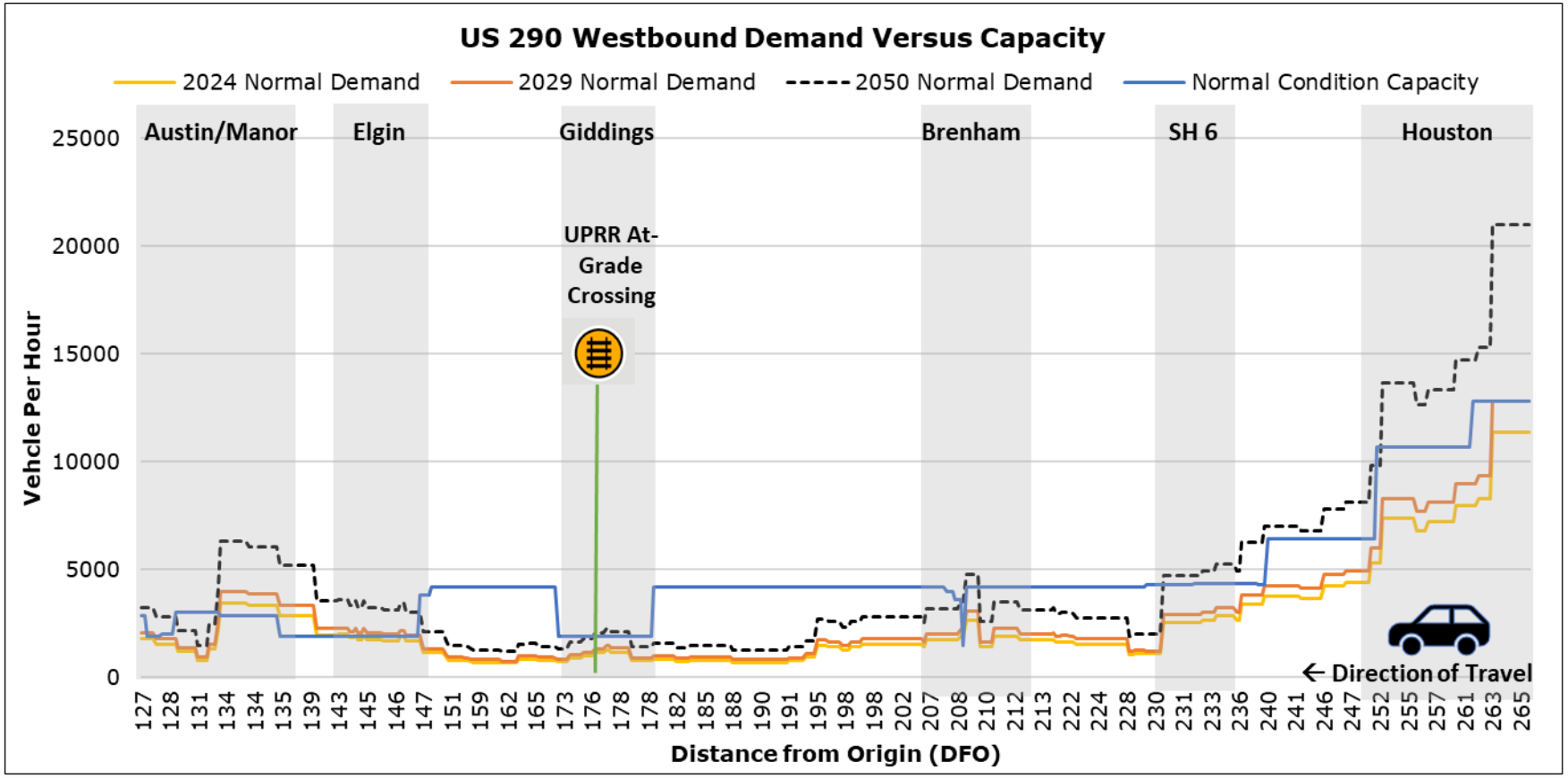


Figure A-3. US 290 Main Lane Westbound Demand Versus Capacity (2050)

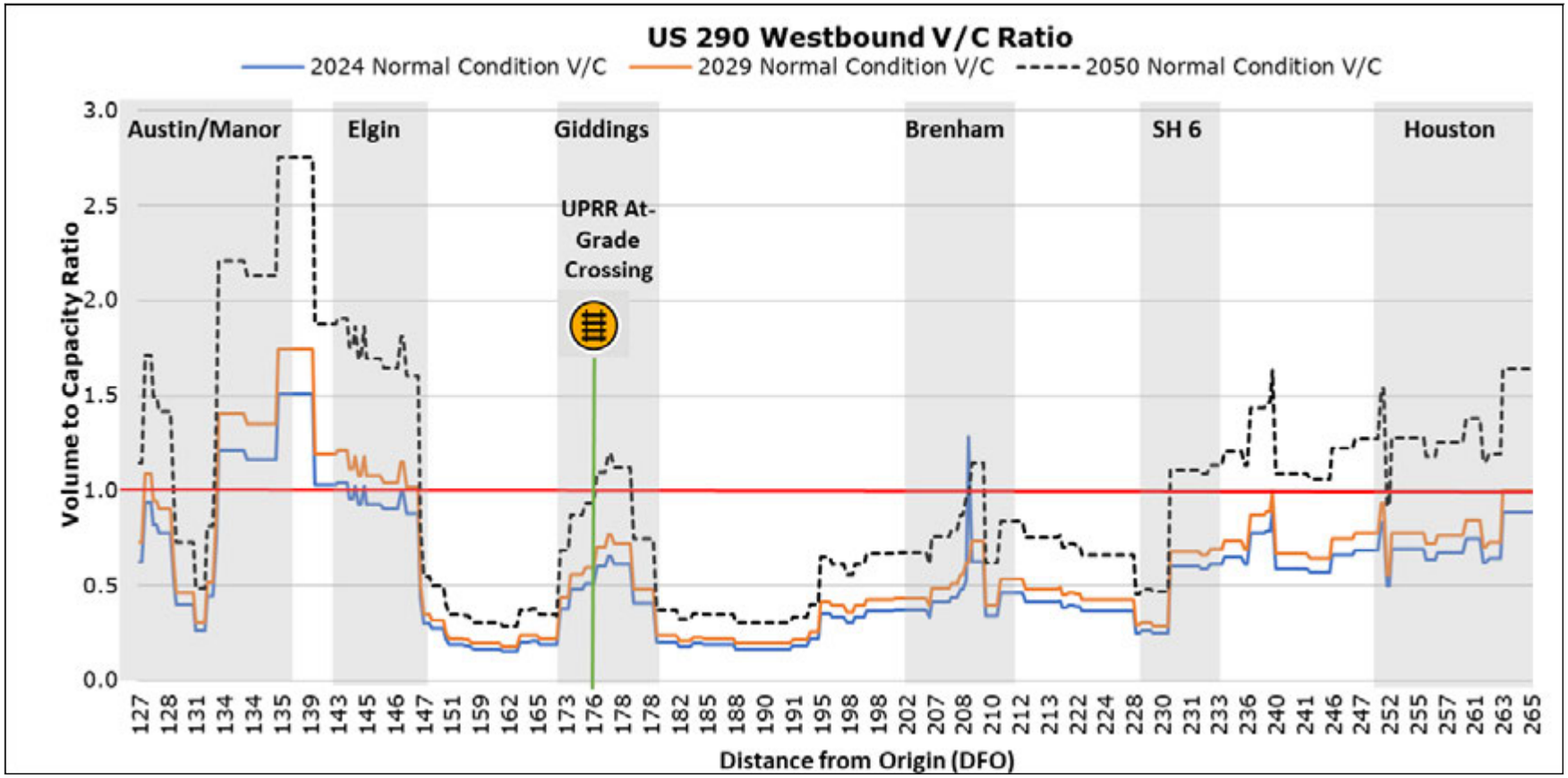


Figure A-4. US 290 Main Lane Westbound V/C Ratio (2050)

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