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MEMORANDUM

DATE: July 23, 2020
TO: Andrew Cannon
CC: Luis Diaz
FROM: JD Allen
RE: RGVMPO 2045 MTP – Roadway Analysis

Introduction

The roadway deficiencies analysis provides policy makers and the public with a better understanding of how the roadway network will be impacted by changes in the region over time if no improvements are made to the existing transportation system.

This memo looks at three aspects of roadway performance. Existing roadway performance is examined using the National Performance Management Research Data Set (NPMRDS). Transportation system performance over time is examined using the RGVMPO Travel Demand Model (TDM) results from the base year, milestone year and the 2045 horizon year to report anticipated trends in roadway performance across the life of the MTP. And third, the TDM is used to perform a capacity deficiencies analysis of anticipated 2045 transportation system performance.

The transportation system scenario used for the deficiencies analysis is the 2019 roadway network with the addition of existing plus committed (E+C) projects. To conduct the analysis the forecast year (2045) demographics are used to produce future trips that are loaded onto the E+C network to identify segments on the 2045 roadway network that are anticipated to experience level of service delivery failures if no further action is taken beyond what is already committed today.

In addition to identifying issues that need to be addressed, the results of the 2045 E+C scenario deficiencies analysis can be compared to the results for 2045 Build scenarios to measure the transportation system benefit obtained from the 2045 Build scenarios and/or the alternative growth scenarios. The level to which each scenario is anticipated to improve future transportation system conditions over the E+C system performance can be used by RGVMPO to prioritize policies and projects for implementation.

Methods

The following section identifies the data sources and describes the various methods and tools used to complete the roadway needs assessment.

National Performance Management Research Data Set Measures

In order to ensure a) a complete understanding of existing conditions on the RGVMPO roadway network and b) a federally compliant MTP, the 2045 MTP project team used FHWA's NPMRDS to calculate

roadway performance measures for the existing system. These values were aggregated from the NPMRDS and joined to the NPMRDS Texas roadway network to spatially analyze and target areas of concern. The results of this analysis provide the RGVMPO with quantitative values for performance measures for use in the evaluation and prioritization of transportation investments. The mobility measures used in the analysis include:

- *National Performance Management Measures for System Performance*
    - Level of Travel Time Reliability (LOTTR)
    - Percent of person-miles traveled on interstate segments that are reliable
    - Percent of person-miles traveled on non-interstate NHS segments that are reliable

RGVMPO Travel Demand Model

E+C Network

TDM outputs for the milestone (2019) and forecast (2045) years were compared using the E+C network to highlight areas that may experience a substantial increase in deficiencies or become new congestion points in the future. The E+C network includes the RGVMAB's existing roadways as of 2019 plus projects that are underway or are guaranteed funding/implementation in the near-term. The definition of the E+C network was accomplished through analysis of previous/existing TIPs and close coordination with RGVMPO staff and planning partners to identify obligated projects.

This system "snapshot" was then used as the network layer in an E+C Scenario TDM run using 2045 demographics. The resulting 2045 E+C scenario outputs provide performance measures that display areas of strain within the region if no additional improvements are made over the MTP forecast horizon. The comparison of 2019 and 2045 no-build outputs is the basis for regional trend analysis on congestion as well as the system deficiencies analysis.

TDM Outputs

A large portion of the roadway needs assessment is based on TDM forecasts. Travel demand forecasting quantifies the existing and future interaction between supply and demand on the transportation system. The supply of transportation is represented by the characteristics of the roadway network (e.g. roadway classification, roadway capacity, etc.), while the demand for transportation is created by the separation and intensity of urban activities. The service characteristics of the roadway and land use forecasts are direct inputs to the TDM.

A TDM previously developed for the Lower Rio Grande Valley (LRGV) in 2017 was used for the RGVMPO needs assessment. It estimates travel demand for a base year of 2014, a 2019 milestone year and for a forecast year of 2045. The TDM output produces a defined roadway network for the RGVMAB with congestion measures such as Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), Vehicle Hours of Delay, Volume-to-Capacity (V/C) ratio, and Travel Time Index (TTI) that help quantify system deficiencies at the segment and regional level to gain full perspective of the existing roadway system's performance.[1] These measures were quantified to visualize existing conditions and no-build forecast year outputs, creating a base to compare to TDM scenarios including additional projects resulting from this MTP update.

[1] Centroid connectors were not included for this roadway needs assessment.

Segment level analysis was also conducted to visualize congestion level-of-service (LOS) on the RGVMAB roadway network. LOS is an indicator of congestion on a scale from A to F, where A represents free flow traffic and F represents severe congestion. LOS was derived from RGVMPO TDM V/C ratios. The following ranges were used to generate roadway segment LOS values, and are based on TxDOT's Transportation Planning and Programming (TPP) division resources:

- LOS A: Less than 0.33
- LOS B: 0.33 to 0.55
- LOS C: 0.55 to 0.75
- LOS D: 0.75 to 0.90
- LOS E: 0.90 to 1.00
- LOS F: Greater than 1.00

Outputs for this assessment were initially analyzed for AM and PM peak periods to understand roadway conditions at their highest points of stress. These values were then averaged to create overall peak period values for analysis.

Analysis Results

The following sections detail findings from analyses based on FHWA's NPMRDS and the RGVMPO TDM to create a robust understanding of existing and future roadway conditions.

National Performance Metrics

System Performance

Travel time reliability is a measure of "the consistency or dependability of travel times from day to day or across different times of day" for a given roadway.[2] While congestion typically focuses on the average roadway conditions in terms of delay, travel time reliability indicates the level to which traffic or roadway conditions can be anticipated for travelers to plan around expected delays. Reliability of the roadway network is important because it allows travelers to reach their destinations at their planned time.

Level of Travel Time Reliability (LOTTR) is calculated using a ratio of the 50th and 80th percentile travel time for all vehicles traveling a given roadway segment. Travel time data is provided as part of FHWA's NPMRDS. For the RGVMAB, 2019 travel time data was used for the defined RGVMPO NPMRDS roadway network. Using LOTTR data for the 2019 travel time data, the study team identified unreliable roadway segments (i.e. LOTTR ratio greater than 1.5) for interstate and non-interstate NHS roadways, shown in **Figure 1** through **Figure 5**Error! Reference source not found.. In this case, unreliable means that travelers of a roadway segment cannot reasonably predict the time it would take to travel the roadway during certain time periods.

Per the 2019 NPMRDS, the current system reports 93.7% percent of person-miles traveled on interstate segments that are reliable. This achieves the target of greater than or equal to 90% of the system containing a LOTTR less than 1.50. The current system further reports 88.4% percent of person-miles

[2]Source: FHWA; *National Performance Measures for Congestion, Reliability, and Freight, and CMAQ Traffic Congestion – General Guidance and Step-by-Step Metric Calculation Procedures;* https://fhwa.dot.gov/tpm/guidance/hif18040.pdf

traveled on non-interstate NHS segments that are reliable. This comes short of the 90% reliability target, which will help inform planning decisions moving forward.

Figure 1: RGVMAB Interstate and Non-Interstate NHS Segments – 2019 LOTTR > 1.5

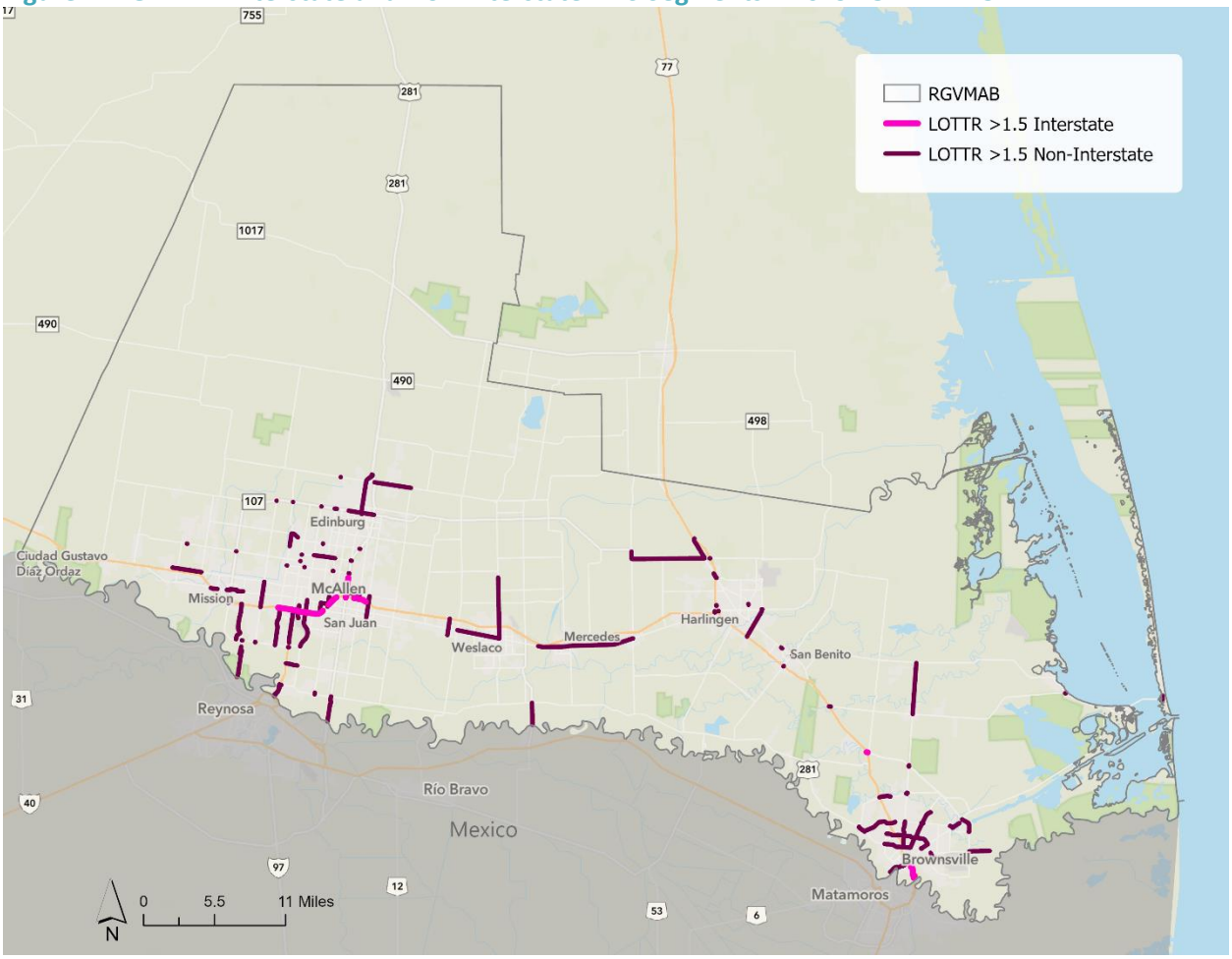


Figure 1 displays segments at the RGVMAB level for Interstate and non-interstate NHS facilities with an LOTTR greater than 1.5. Accordingly, contiguous segments with poor LOTTR exist on I-2, I-69C, and I-69E. Non-interstate NHS segments are dispersed throughout the region and will be further discussed below.

Figure 2: McAllen/Edinburg Area Interstate and Non-Interstate NHS Segments – 2019 LOTTR > 1.5

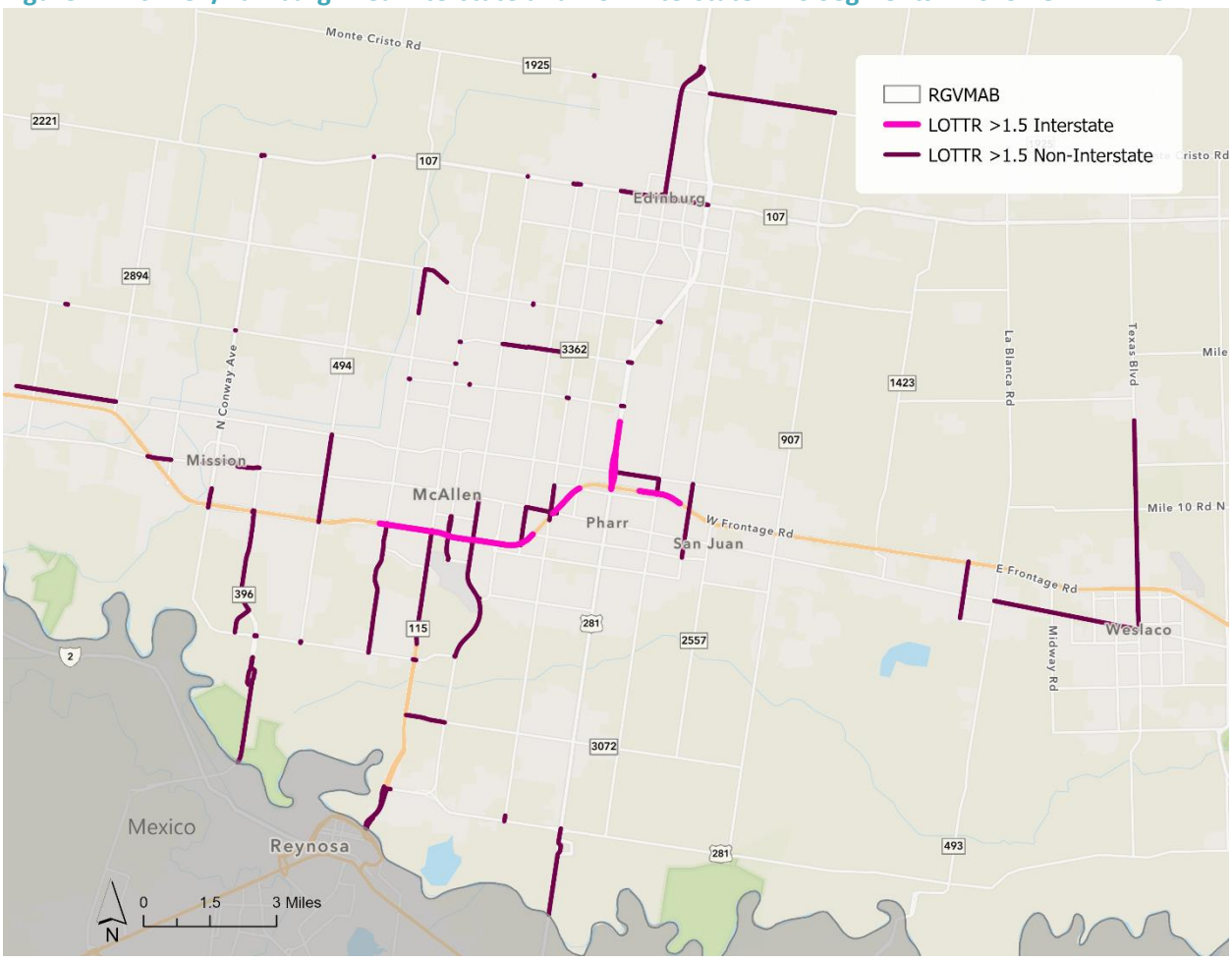


Figure 2 displays unreliable roadway segments for the McAllen/Edinburg area, showing several stretches of both interstate and non-interstate NHS segments to contain unreliable delays. While the I-2/I-69C junction near McAllen and Pharr suggests potential delay issues, several major arterials also contain LOTTR values above 1.5. These include: FM 396, FM 494, S. Ware Rd., FM 115, FM 336, S. 19th St. (Entry to McAllen-Miller International Airport), US-281 through the Hidalgo border crossing, US-281 through the Pharr-Reynosa border crossing, US-281 in Edinburg, W. University Dr., FM 1915, and US-83 in Weslaco.

Figure 3: Weslaco Interstate and Non-Interstate NHS Segments – 2019 LOTTR > 1.5

Figure 3 displays unreliable roadway segments occurring along critical non-interstate NHS roadway infrastructure. This includes US-83 in Weslaco and Mercedes, FM 1015 through the Progreso International Bridge, and N. Texas Blvd.

Figure 4: Harlingen/San Benito Interstate and Non-Interstate NHS Segments – 2019 LOTTR > 1.5

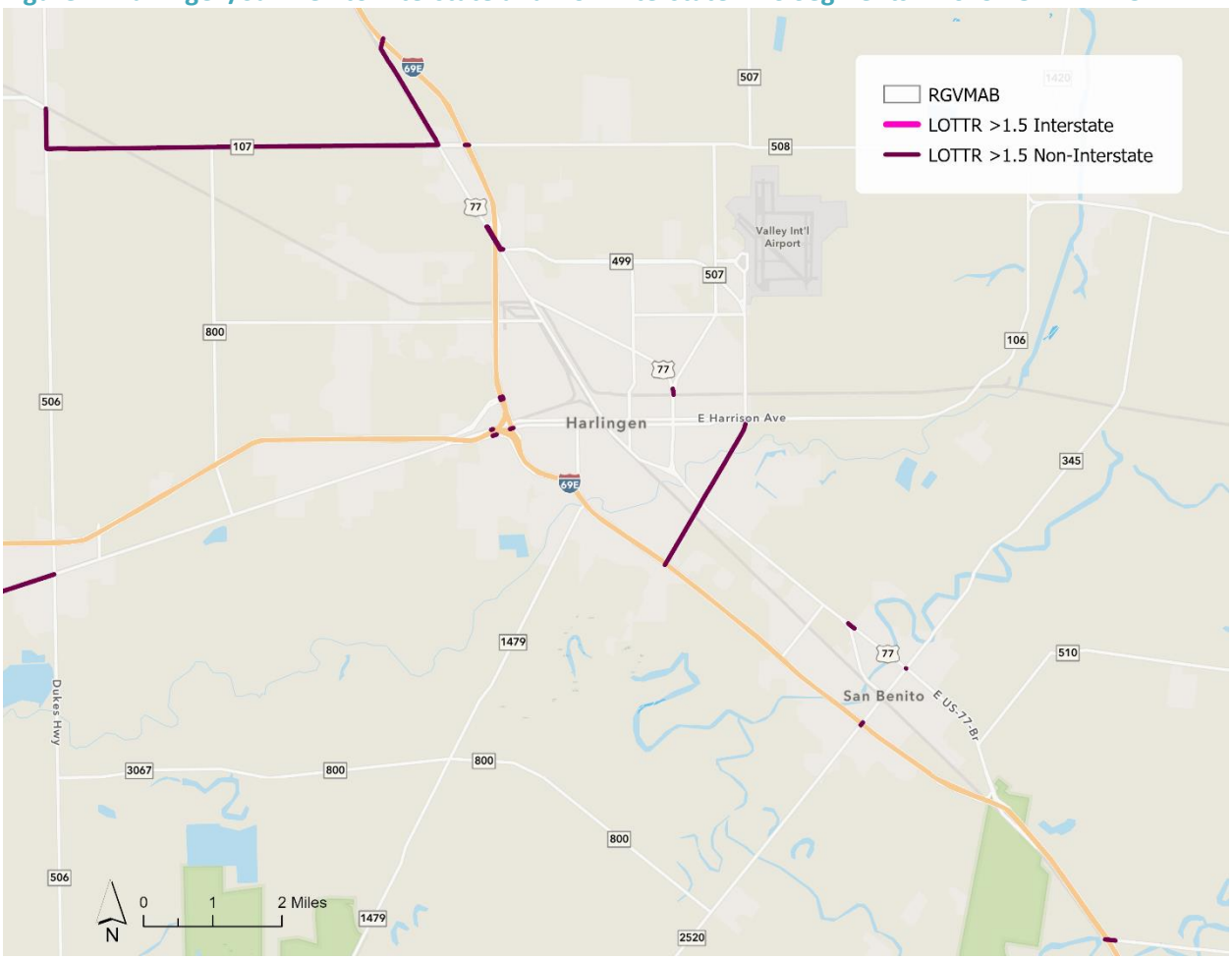


Figure 4 displays unreliable roadway segments in the Harlingen/San Benito area, largely on US-281, FM 107, US-77, and FM 499. Several intersections are also marked as unreliable, most notably near the I-2/I-69E junction in east Harlingen.

Figure 5: Brownsville/SPI Area Interstate and Non-Interstate NHS Segments – 2019 LOTTR > 1.5

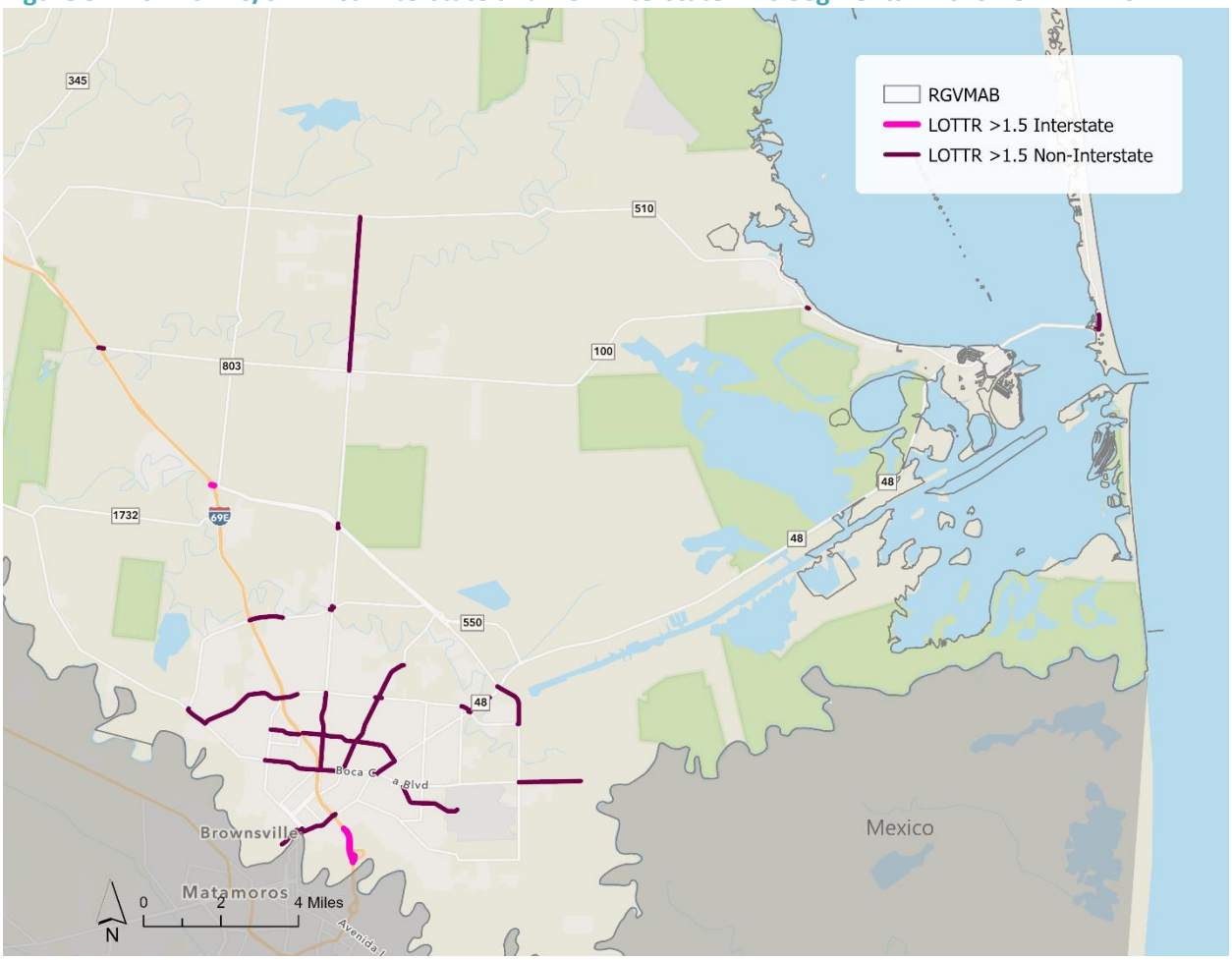


Figure 5 displays unreliable roadway segments in the Brownsville/South Padre Island area. The area experiences unreliable delay along I-69E, most notably as it transitions into US-83 approaching the Veterans International Bridge Los Tomates. Further, critical non-interstate NHS infrastructure of note includes SH 4 (both near the border and Brownsville – South Padre Island International Airport), FM 802, E. Price Rd., Old Port Isabel Rd., N. Indiana Ave. (adjacent to the Port of Brownsville), and Paredes Line Rd. extending north from Los Fresnos. The South Padre Island area experiences unreliable delay on SH 100 near Laguna Vista and at the SH 100/Padre Blvd. junction.

Regional Trends from RGVMPO TDM

To bolster the NPMRDS national performance measure information on existing conditions, separate congestion measures from the RGVMPO TDM outputs were analyzed for the 2019 milestone year. Current year (2019) outputs were then compared to the 2045 no-build outputs to emphasis potential future issues on the region's roadway infrastructure. Outputs were calculated to represent performance trends at a system and per capita level. The following measures were used to better understand the state of the RGVMPO transportation network:

- *Vehicle Miles Traveled (VMT)* – The amount of roadway miles traveled by vehicles within a specified segment for AM and PM peak period travel times.
    - This measure provides a sense of the overall level of vehicular traffic in the region and on individual roadways.
- *Vehicle Hours Traveled (VHT)* – Calculated from speed and miles traveled, VHT represents the number of hours traveled by vehicles within a specified segment for AM and PM peak period travel times.
    - This measure provides insight into the quality of service that the region's roadways provide, and feeds into other delay measures.
- *Vehicle Hours of Delay* – This represents additional hours spent in traffic due to congestion on the roadway network.
    - This measure indicates the amount of extra time it takes travelers to reach conditions compared to free-flow conditions.
- *Travel Time Index (TTI)* – The ratio of travel time during peak travel periods (congested time) required to make the same trip at free-flow speeds.
    - For example, a TTI of 1.2 indicates that a 10-minute free flow trip would take 12 minutes during peak congestion times.[3]

Table 1 presents the regional performance measures for the 2045 no-build scenario in comparison of 2019 regional performance measures. The table is meant to quantify the anticipated changes in traffic and congestion over time and provide a baseline for evaluating TDM scenarios that reflect the addition of transportation projects developed in this MTP.

Table 1: RGVMAB Traffic & Congestion Performance Measures; 2019 & 2045

Measure	2019 – Existing Conditions*			2045 –No Build			
	Interstate & Toll	Arterials	Total	Interstate & Toll	Arterials	Total	% Change for Totals
Daily VMT	1,252,706	3,658,447	4,911,153	2,030,436	6,500,916	8,531,352	74%
per person			3.44			3.69	7%
Daily VHT	28,422	124,215	152,637	70,253	763,769	834,022	446%
per person			0.11			0.36	237%
Annual Weekday Vehicle Hours of Delay	1,019,383	9,157,491	10,176,874	7,998,109	196,716,385	204,714,493	1912%

[3] Source: https://www.bts.dot.gov/bts/bts/content/travel-time-index

per person			7.13			88.53	1142%
Weighted Avg. TTI	1.17	1.61	1.39	1.84	6.79	4.32	211%

**2019 was used as stand in for current conditions because it is the most recent year for which complete data is available*

In comparison to the 2019 "existing conditions," the data in **Table 1** shows the 2045 No-Build transportation system to be severely inefficient based on TDM outputs. Each measure (regional and per capita) displays an increase in percent change over the forecast horizon. Delay measures suggest substantial increases over the 26-year period. The most notable indicator is annual weekday vehicle hours of delay, as the TDM projects this measure per person to increase by 1142%. TTI measures also display severely congested conditions in 2045. TTI outputs suggest peak hour trips will take over four times the normal free flow travel time for the same trip.

Table 2 further demonstrates TDM outputs based on a separate quantitative analysis to pull the RGVMAB's top congested corridors. Results are the product of a weighted average rank which considers several delay measures. The top 5% of congested segments on the roadway network were pulled based on V/C ratio. Segments were then selected to create contiguous corridors experiencing severe congestion. Corridors were then ranked separately for each measure, which generated a final weighted average rank. This analysis helps highlight roadways more local and/or in nature, potentially suffering from congestion due to major roadways causing route deviations, traffic spillover, etc.

Table 2: RGVMAB Top 20 Most Congested Corridors – 2019 Existing Conditions

Roadway	Jurisdiction	From	To	V/C Ratio	TTI	Weekday Hours of Delay
Tom Gill Rd	Hidalgo County	Expy 83	FM 2221	1.85	3.18	169,036
Expy 83	La Joya/Palmview	Tom Gill Rd	.3 mi east	1.96	3.37	149,041
FM 2221	Citrus City	Tom Gill Rd	SH 107	1.91	3.43	384,454
W Monte Cristo Rd	Edinburg/Hidalgo County	FM 2993	N Depot Rd	1.78	3.24	96,379
US 281	Hidalgo County	FM 2557	.5 mi E of S Tower Rd	1.82	2.78	36,584
S FM 493	Donna	Stites Rd	Juarez Rd	1.89	3.00	31,937
FM 493	Edinburg	Davis Rd	FM 1925	1.86	3.26	23,059
Westgate Dr	Midway North/Oliverez	Mile 10 N	Roosevelt Rd	1.79	2.74	133,810
N Baseline Rd	Mercedes/Indian Hills	Mile 11 N	Mile 9 Rd	1.87	2.94	49,530
FM 752/FM 510	San Benito	Resaca Nueva Dr	San Jose Ranch Rd	1.82	3.19	334,201
Iowa Gardens Rd	San Benito	Bus 77	Nelson Rd	2.19	4.83	193,696
FM 510	San Benito	Line M Rd	Green Valley Dr	1.79	2.65	72,358
FM 106	Rio Hondo	Nelson Rd	E Brown Tract Rd	1.88	3.11	36,393
US 281	Brownsville	FM 1577	FM 1732	2.02	3.58	51,971
Cavazos-Olmito Rd/Naranjo Rd	Brownsville/Olmito	New Carmen Ave	Noble Pine Ln	1.79	2.72	57,307
FM 803	Brownsville	Olmito North Rd	FM 2893	1.90	3.68	77,100
Old Port Isabel Rd	Brownsville	SH 100	3.14 Mi S of SH 100	1.81	2.63	72,908
E University Blvd/East Ave	Brownsville	Lizka Ln	E 30th St	1.92	3.40	42,428
SH 107	Primera/Combes	FM 506	Tamm Ln	1.85	3.25	89,934
E Alberta Rd	Hidalgo County	FM 1423	N Tower Rd	1.96	3.30	132,489

Deficiencies Analysis

The TDM provides capacity outputs which create the base for the RGVMAB roadway system deficiencies analysis of anticipated 2045 transportation system performance. V/C Ratio was used to generate LOS values (refer to **TDM Outputs** above for LOS methods), and is defined below.

- *Volume Capacity (V/C) Ratio* – The ratio of traffic flow to maximum allowable traffic flow on a roadway segment, where a ratio of 1 represents a segment at full capacity and higher values indicate more severe congestion.
    - This measure is used to isolate specific locations where vehicular demand outstrips capacity of a roadway section.

Table 3 displays RGVMAB capacity measures. The 2045 average V/C ratio suggests that the roadway network will be roughly 26% above capacity during peak travel periods, increasing by 63% from 2019. The 2045 No-Build average V/C ratio falls within LOS F, which indicates severe congestion as the status quo for the RGVMAB.

Table 3: RGVMAB Capacity Measure Measures

Measure	2019 – Existing Conditions*			2045 –No Build			
	Interstate & Toll	Arterials	Total	Interstate & Toll	Arterials	Total	% Change for Totals
Avg. V/C Ratio	0.78	0.76	0.77	1.27	1.25	1.26	63%
% of Roadway Miles with Heavy Congestion			43%			80%	85%

**2019 was used as stand in for current conditions because it is the most recent year for which complete data is available*

Table 4 presents LOS totals for RGVMAB roadway segments falling within LOS categories A-D (low to moderate congestion) and LOS categories E-F (high to severe congestion). LOS measures show a shift in segment majority falling within LOS E-F categories by 2045. Further, when breaking down segment totals between E-F for the 2045 No-Build, 93% of the 4621 segments fall within LOS F, meaning 65% of the system's total segments fall within the most severe congestion category.

Table 4: RGVMAB LOS Totals

Measure	2019 – Existing Conditions*		2045 –No-Build	
	Segment Total	% of Total	Segment Total	% of Total
LOS A-D	4,359	61%	2,214	31%
LOS E-F	2,804	39%	4,949	69%
Total	7,163	100%	7,163	100%

**2019 was used as stand in for current conditions because it is the most recent year for which complete data is available*

Figure 6 and **Figure 7** display RGVMPO roadway network LOS values for 2019 and the 2045 No-Build to further illustrate potential roadway system deficiencies within the RGVMAB. TDM outputs forecast severe LOS conditions not only within major and minor municipalities, but similar conditions expanding throughout peripheral areas and rural highways. **Figure 6** displays existing RGVMPO LOS to be strained in most major urban areas. Contiguous LOS scores of E and F, suggesting heavy peak hour congestion, are seen in the following areas:

- Hidalgo County throughout the Mission/McAllen/Hidalgo/Edinburg area
- Municipalities along the I-2 corridor such as Donna, Weslaco, and Mercedes
- State highway infrastructure connecting the region east to west, such as SH 10 and US 281
- Corridors peripheral to the Harlingen and San Benito Central Business Districts (CBD), including infrastructure connecting to the Valley International Airport (VIA) and the Port of Harlingen
- Major Brownsville thoroughfares, such as US 281, I-69E, Paredes Line Road, and SH 48.
- SH 100/Queen Isabella Causeway which connects South Padre Island (SPI) to mainland Texas.

Figure 6: RGVMPO Level-of-Service – 2019 Existing Conditions

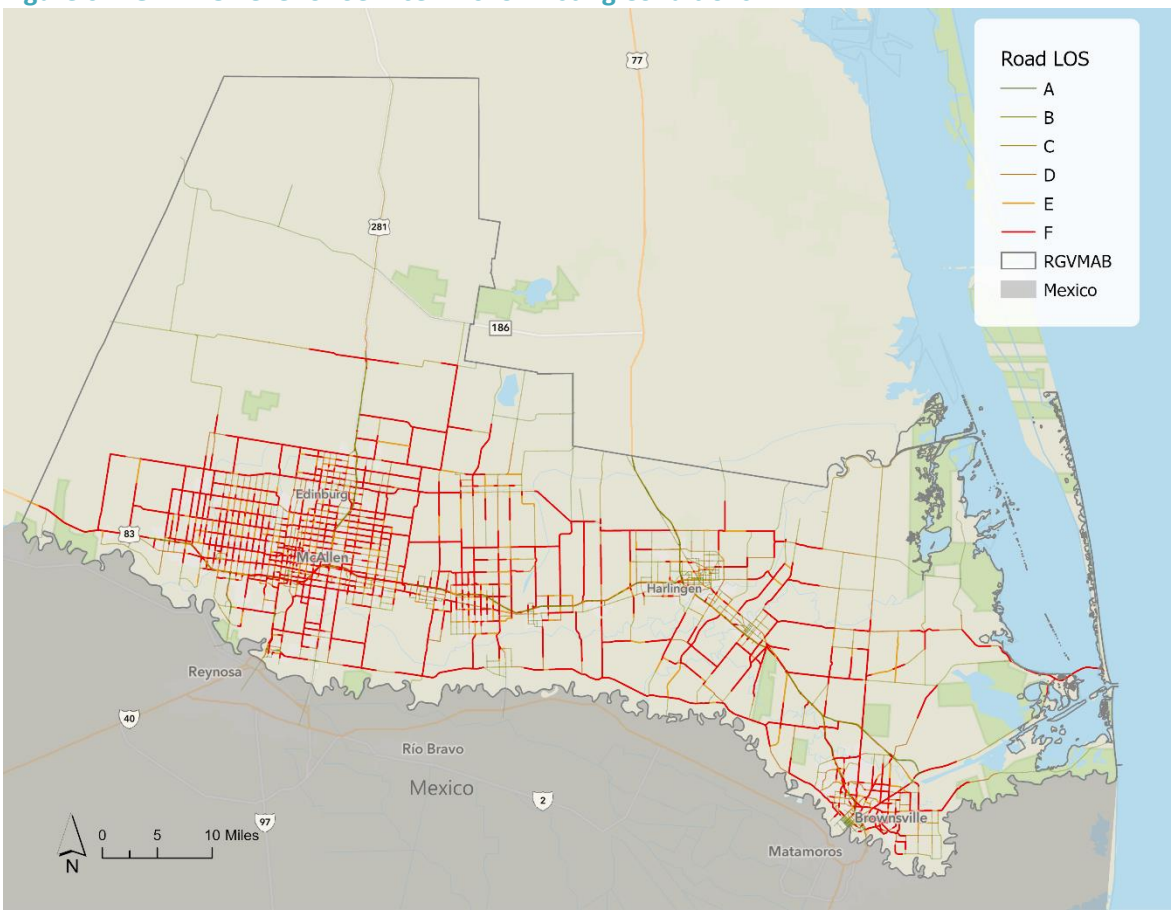
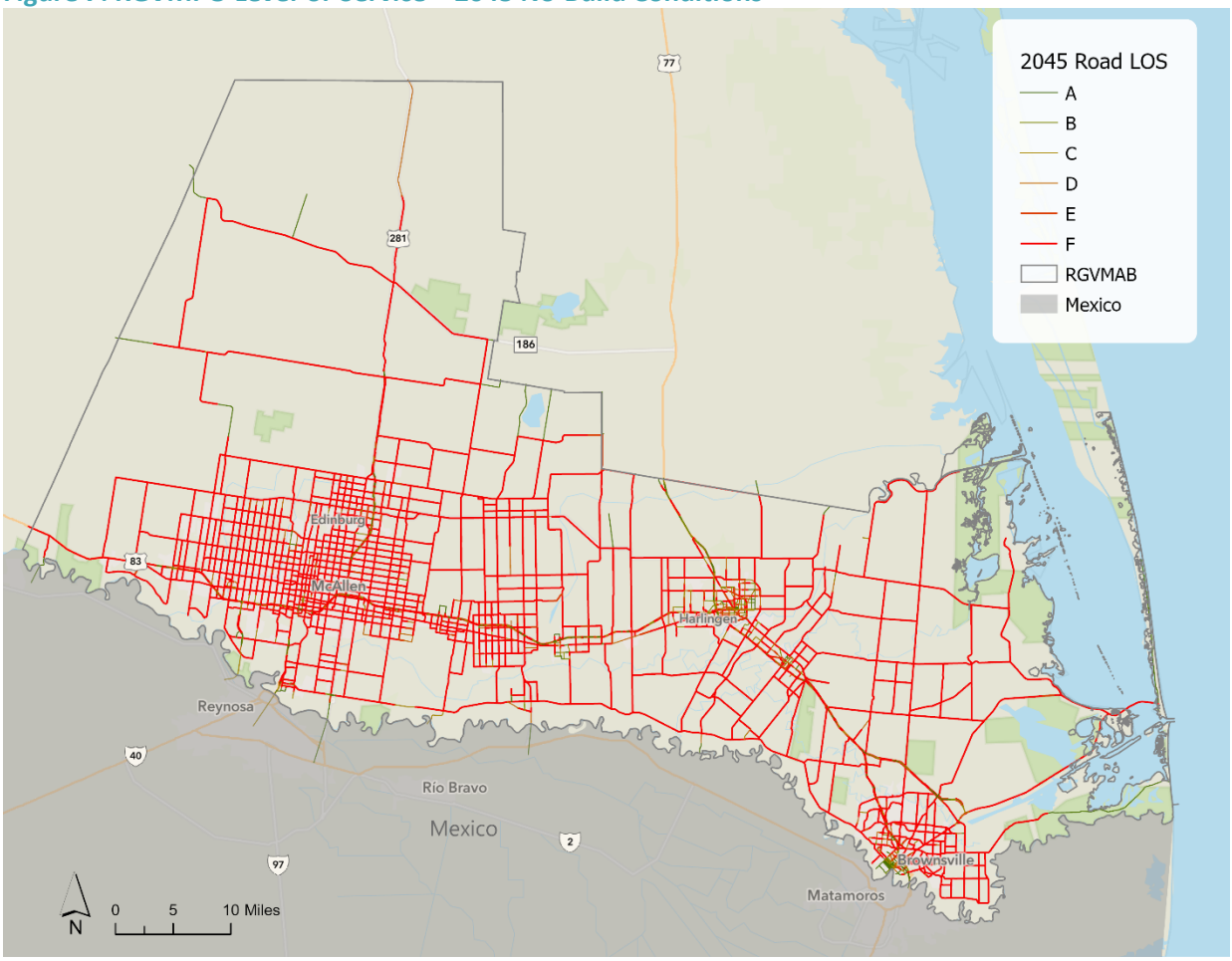


Figure 7 displays the RGVMPO roadway system almost entirely strained by congestion at peak hour travel times in the 2045 No-Build scenario. TDM outputs forecast severe LOS conditions not only within major and minor municipalities, but similar conditions expanding throughout peripheral areas and rural highways.

Figure 7: RGVMPO Level-of-Service – 2045 No-Build Conditions



Conclusion

Understanding the existing and 2045 No-Build RGVMAB roadway travel conditions is imperative for a successful MTP update and an informed project prioritization moving forward. Analysis focused on NPMRDS values for system reliability in conjunction with RGVMPO TDM outputs to generate this understanding. The following lists key findings from the roadway needs analysis:

- The roadway network contains unreliable segments on both the interstate and non-interstate NHS networks. The existing interstate network meets the system reliability target of 90% person-miles traveled on reliable segments. The non-interstate NHS network displays unreliable segments throughout the RGVMAB, and accordingly contains a percentage of person-miles traveled on reliable segments less than the target.
- The percentage of non-SOV travel on the NHS network suggests household and non-household travel leans towards SOV travel. These percentages can be used to set targets moving forward.
- TDM outputs show large increases in all congestion measures at the regional and per capita level between 2019 and a No-Build scenario. Similarly, Daily VMT and Annual Weekday Hours of Delay show the most substantial percentage increases between 2019 and the 2045 No-Build. Overall, the region would trend towards pervasive congestion during peak hour travel times (assuming no improvements are made).
- LOS measures derived from TDM V/C ratios further these claims, displaying existing peak hour congestion to be experienced throughout the region, extending into peripheral/rural regions. 2045 No-Build LOS measures display severe peak hour congestion on most roadway facilities.

Because the performance measures developed using the TDM are output and saved at the link level, these same measures can be used to quantify the benefit that the proposed MTP program of projects achieves in addressing the identified deficiencies. This approach not only satisfies the requirements to use quantitative methods to identify issues and an objective approach to devising solutions, but also gives the RGVMPO powerful analytical tools to help support an informed decision making process directed toward the selection, funding and implementation of an effective program of projects. The TDM deficiencies identified in this memo will be used to contrast the 2045 Build Scenario and provide a reference point for gauging expected impact of proposed projects through TDM outputs.