Rio Grande Valley
Metropolitan Planning Organization

CONGESTION AND DELAY STUDY
TIER 2 - OPERATIONS
EXECUTIVE SUMMARY
2023

Prepared for:

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Rio Grande Valley
Metropolitan Planning
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EXECUTIVE SUMMARY

The Rio Grande Valley Metropolitan Planning Organization (MPO) has an established congestion management process (CMP) to monitor the transportation network. The goal of the monitoring system is to ensure optimal performance of the transportation system by identifying congested areas and related transportation deficiencies.

Traffic studies are conducted each year, rotating among the seasons. In 2022, the Spring season was studied. Past CMP studies include Spring 2001, Fall 2002, Summer 2003, Spring 2004, Winter 2005, Fall 2006, Spring 2007, Winter 2008/2009, Summer 2009, Fall 2010, Spring 2013, Winter 2015, and Winter 2019.

The purpose of this years' study and routes shown in **Figures E-1** and **E-2**, which covered 1,415 directional miles within the region, was to identify problem areas using travel time studies and to prepare recommendations to improve the traffic flow on the transportation system as a whole and on specific corridors. The results of this study can be used as factors in prioritizing needed improvements.

Over the years, the majority of the recommended mitigation for the "congested" arterial segments was to optimize and coordinate the arterial signal system to provide more consistent travel speeds along major corridors and avoid frequent stopping at most signals. These conditions are being highlighted in this update cycle to differentiate between "congestion" and "delay". As illustrated in **Figure E-3**, the most common situation that results in a congested result is travel unconstrained for most of the link at or above posted speed, but the driver is forced to stop at the downstream intersection long enough to bring the average speed from center of upstream intersection until passing through the downstream intersection down to a point that results in a longer travel time to traverse the segment and thus a lower average speed. This condition will be referred to as "delay" instead of "congestion"… a small but very important distinction. To mitigate "delay", it will more commonly be a local intersection or corridor signal system operational issue, thus much lower capital cost vs. "congestion" that may more typically be a capacity issue with a large required investment.

Another signal system component that contributes greatly to unnecessary delay is the condition of the vehicle detection equipment. As summarized in **Table E-1**, recent assessments around the region have shown percentages as high as 97% of the areas intersections had inoperable detection.

Table E-1 - Summary of Regional Traffic Signal Detection

	McAllen	Mission	Pharr	Edinburg	Harlingen	Brownsville	Overall
Included Intersections	7	16	34	62	8	37	164
Intersections w/ bad Detection (Veh or Ped)	3	11	25	38	6	36	119
Avg.	43%	69%	74%	61%	75%	97%	73%

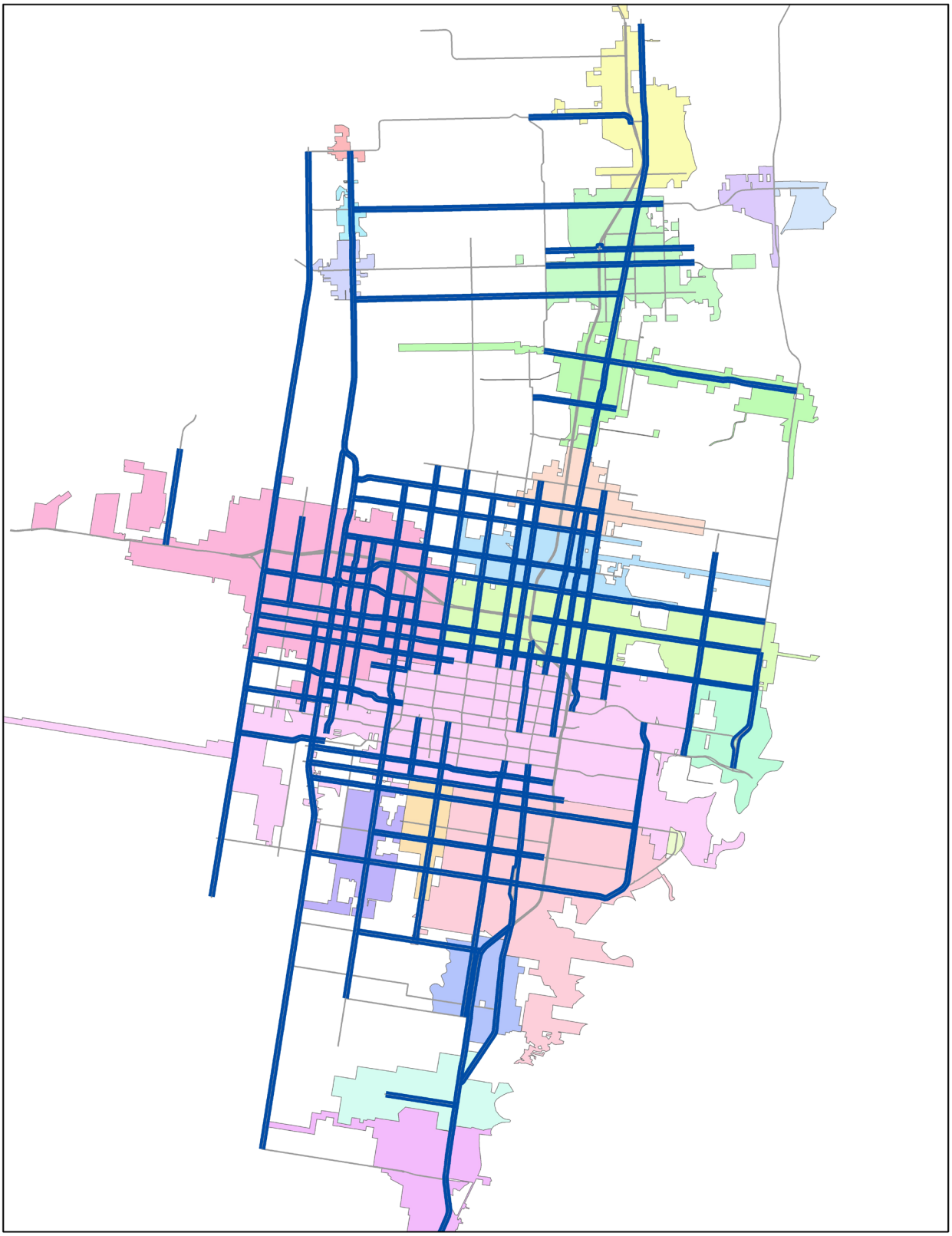

Figure E-1- Spring 2022 CMP Routes

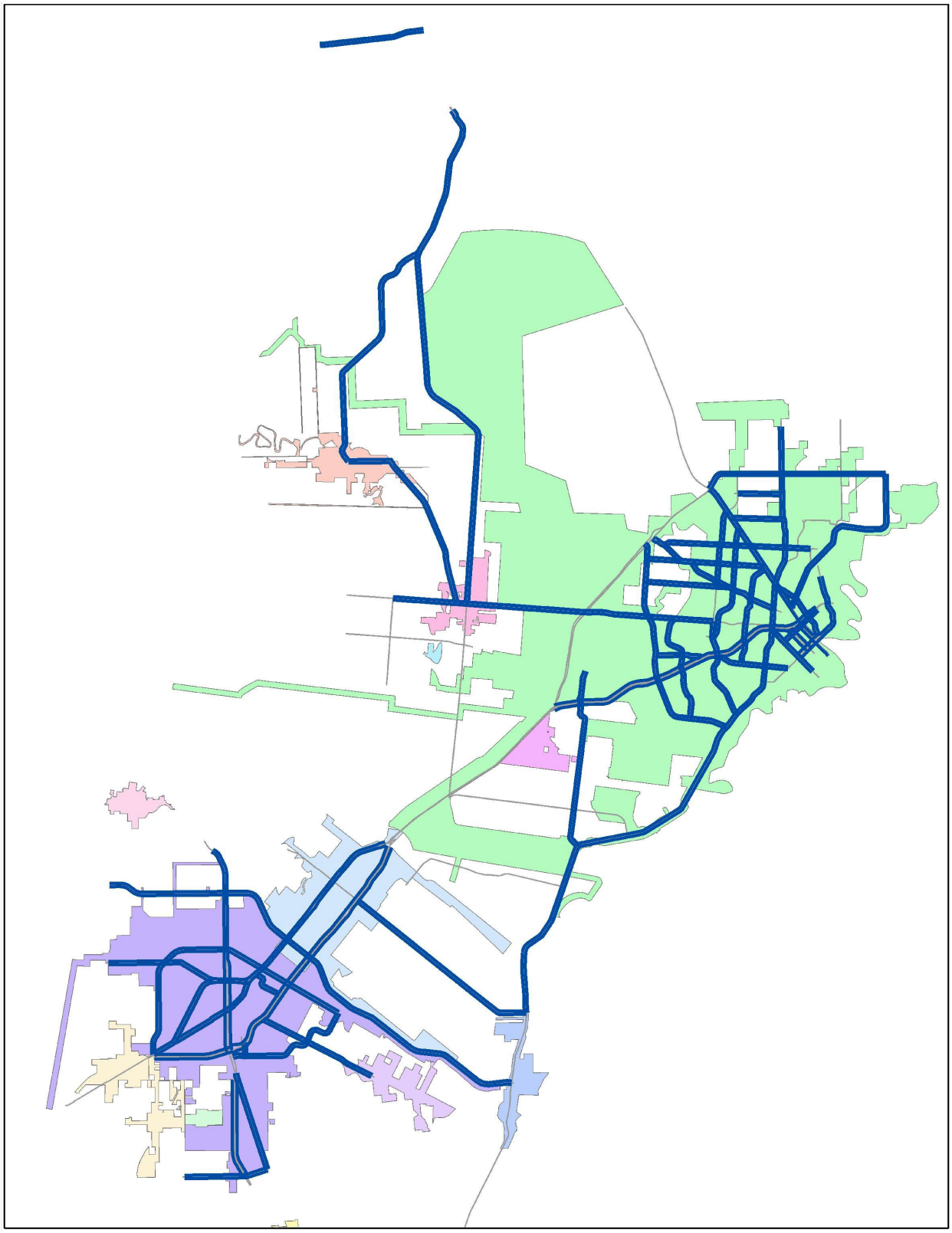

Figure E-2- Spring 2022 CMP Routes

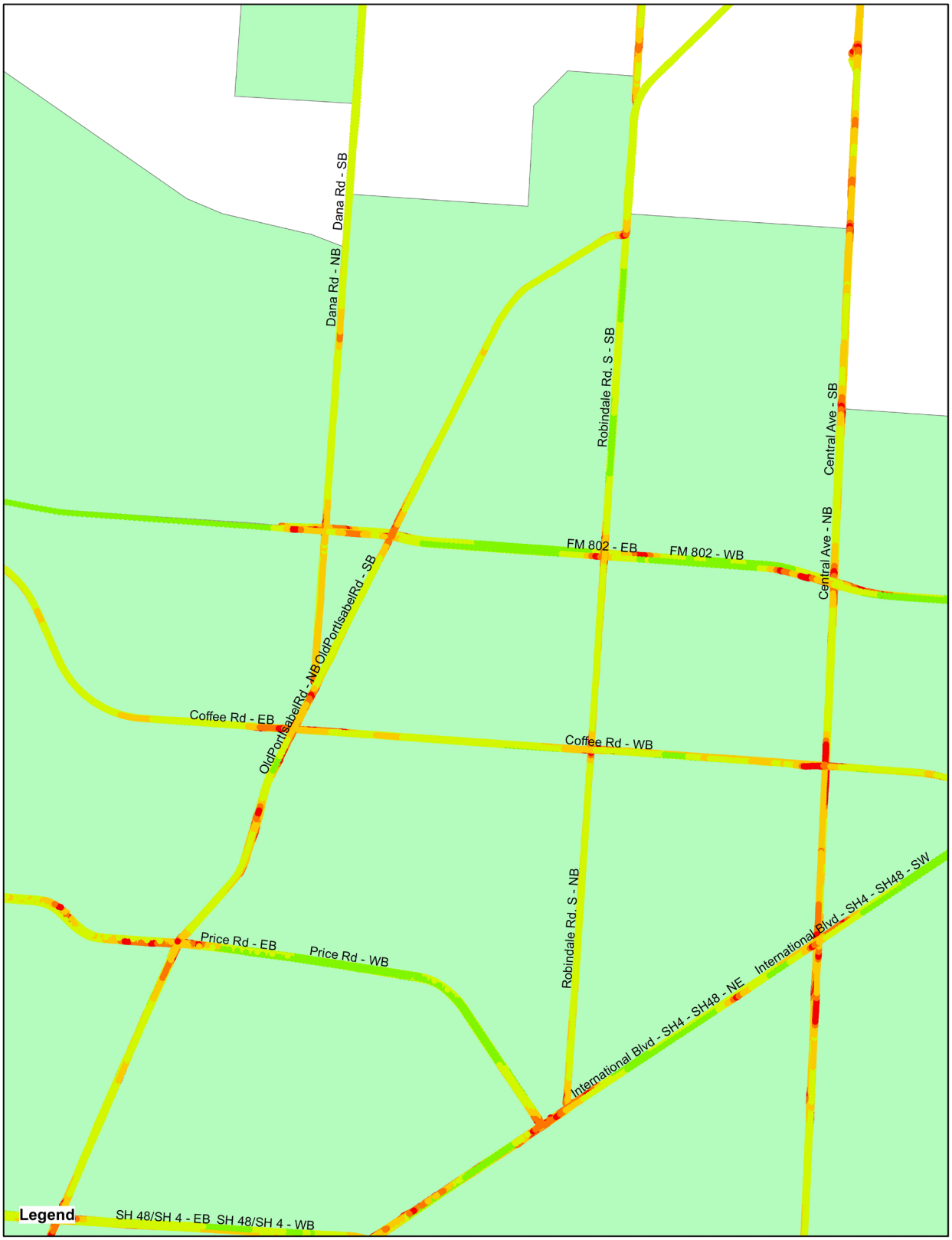

Figure E-3 – Example Raw 1-Second Travel Time Data

KEY FINDINGS

As shown in **Table E-2**, of the 1415.8 directional miles of roadways studied in Spring 2022, during the PM Peak Period, 214.0 miles were free-flow, 587.7 miles were stable, and 614.1 miles were congested. Therefore, for the Spring 2022 season, 56.6% of the roadways operated within an acceptable range during the PM Peak Period.

Table E-2 - Summary of Study Roadways in Terms of CI on Intersection Segments Congestion < 0.75

Season	Measure	Roadway Condition			Total
		Free Flow	Stable	Congested < 0.75	
Spring 2022	Number of Miles	214.0	587.7	614.1	1415.8
	Percentage of Miles	15.1%	41.5%	43.4%	100%

In working with the CMP sub-committee, 100 of the 164 intersections included in the field assessment were identified as having equipment that was able to support operating coordinated timing plans during the peak periods. Peak period traffic counts were collected in January 2023 to develop timing plans to replace the current "free" operations at most locations. When a traffic signal is running "free", it is meant to be responsive to vehicle calls from the detection. But, with a large number of intersections not having a complete working detection set-up, the signals will run very inefficiently and create delay that is not due to excessive volumes. By introducing coordinated signal timing during the peak periods, the signals at least are able to work together with common cycle lengths and anticipate traffic along the corridor. This keeps traffic moving and by not having random uncoordinated timings at each intersection.

While developing the signal timing, MPO staff requested recommendations of what equipment is needed to allow the signals to work better. This was perfect timing after completing the field assessment of 164 key intersections around the region. The Carbon Reduction Programs (CRP) had some funds available and applying approximately $2 million to traffic signals, as shown in **Table E-3**, will go a long way to improve not only local operations, but reduce regional delays.

Table E-3 – Carbon Reduction Program (CRP) Recommendations

		Loops		Cabinets		GPS	Sub-Totals	% of RGV
Cameron County	Brownsville	$690,000		$360,000		$8,000	$1,058,000	50.3%
	Harlingen	$0		$60,000		$500	$60,500	2.9%
Cameron County Totals		$690,000		$420,000		$8,500	$1,118,500	
Hidalgo County	Edinburg	$549,920		$160,000		$8,000	$717,920	34.1%
	McAllen	$0		$20,000		$500	$20,500	1.0%
	Mission	$53,360		$20,000		$5,500	$78,860	3.7%
	Pharr	$98,080		$60,000		$11,000	$169,080	8.0%
Hidalgo County Totals		$701,360		$260,000		$25,000	$986,360	
	RGV Totals	$1,391,360		$680,000		$33,500		
		$2,104,860						

COORDINATED TRAFFIC SIGNAL TIMINGS

Ahead of the improvements anticipated from the CRP, coordinated signal timings were installed into various corridors around the region. Those timings were developed while factoring in various local conditions. Those elements include the following:

- Volumes - Peak Turning Movements
- Distribution / Peak Directions
- Time of Day Variation - Plans
- Pedestrians
- Speed limits - School zones
- Intersection spacing distances
- # lanes
- Left turn bays
- Variable side street volumes along corridor – minor / major cross streets
- Detection - vehicle and peds
- Cabinet age
- Controller model and consistency
- GPS clock
- Coordinated phases
- Left turn controls - FYA, lead/lead, lead/lag
- Common Cycle length
- Offsets
- Directional Preferences

CoPLAN worked closely with each City to develop timing plans that factored in local preferences. The timings were installed by City staff while working with CoPLAN to train them on the details. In most cases, City staff have not worked with coordination previously. Making adjustments to the timings based on observations must be done carefully while factoring in the bigger picture of the corridor and can not be done in a vacuum of an isolated intersection.

One tool that is very helpful to visualize the corridor operations, is the use of time / space diagrams. **Figure E-4** shows the International corridor in Brownsville between McKenzie and Security. The right line is the “before” run from last years CMP travel time runs. That illustrates the results of driving the corridor during peak periods by with the signals running free and not coordinated. The line will be flat or horizontal when drivers are stopped at an intersection and not progressing down the corridor. The left thicker line is after the implementation of the peak period coordinated signal plans. The difference in travel time is 76% less with the coordinated plans. This is a substantial reduction in delays without any construction or impacts to the public during implementation.

Another corridor example from the project is **Figure E-5** highlights the before and after conditions for SH 107 during the AM period for those traveling eastbound. Travel time savings are substantial with a 41% reduction. Texas Transportation Institute (TTI) has researched and documents methods to determine the benefits of such projects. The factors that are considered include the following:

- Travel Time Savings
- Average Value of an Individuals Time
- Average Occupancy of the Vehicle
- Volume of Vehicles on Corridor that Experience the Time Savings
- Number of Time Periods in a Year

Based on those elements, signal timing projects produce some of the highest return on investment results for transportation projects. In addition to the direct time savings benefits, there are many other elements that contribute to even higher benefits including reduced stop/go traffic that leads to improved safety, air quality, and lower fuel consumption.

Only considering savings in travel time, return on investment (ROI) will vary by corridor given the local volume and specific travel time savings. Those results ranged from 26:1 to 74:1. Those benefits are substantial and are achieved with no construction or delays during such improvements.

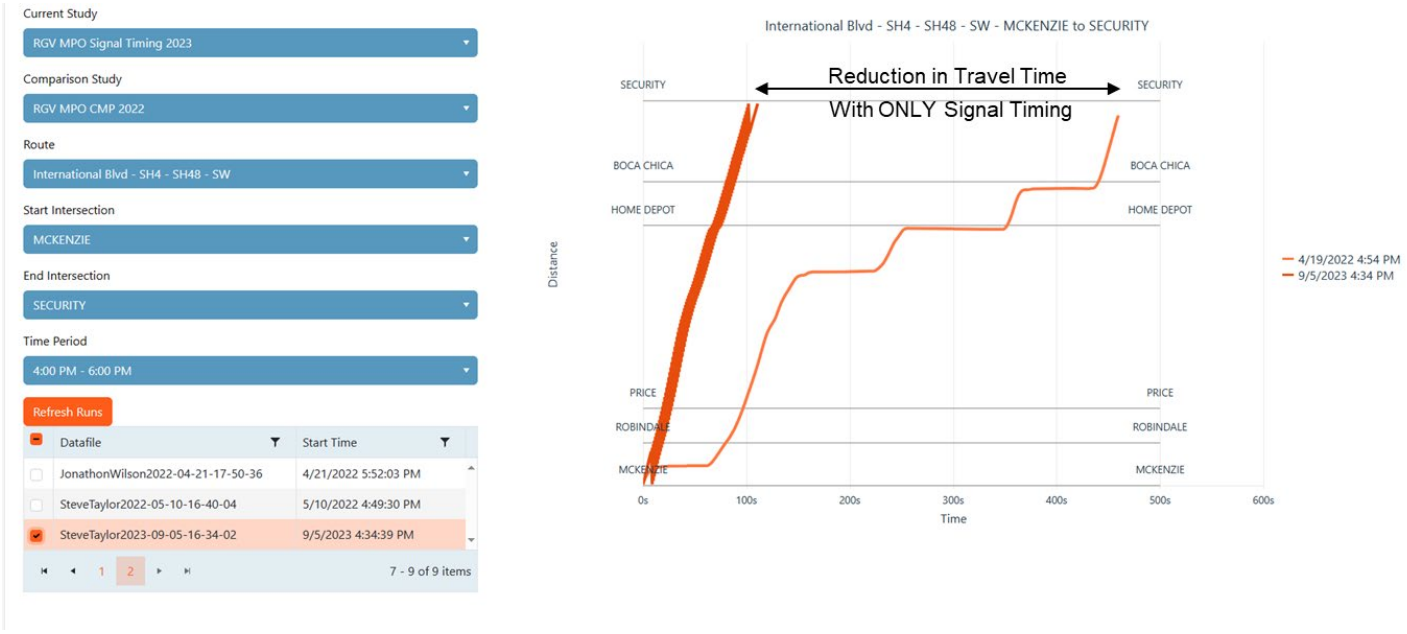

Figure E-4 – International Blvd Southwest Bound – PM

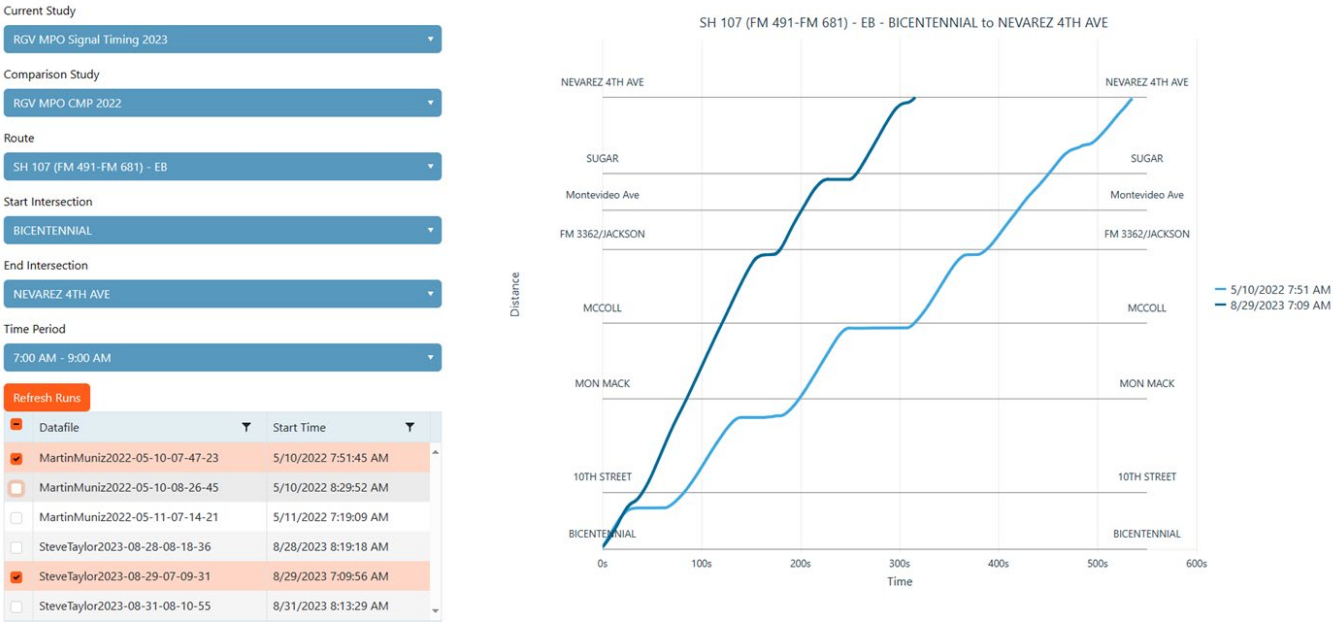

Figure E-5 – SH 107 Eastbound – AM

CONCLUSIONS

A large percentage (43.4%) of roadway intersection segments studied in Spring 2022 were operating under congested conditions. On many of the segments with CI in the congested range, the congestion occurred only near a stop sign or traffic signal and had acceptable conditions through the remainder of the segment.

This Tier 2 Operations study enabled CoPLAN to work with the respective cities that maintain the signals to coordinate selected corridors during peak periods. The benefits of such projects included travel time savings, reduced stop and go traffic, and reduced delays and apparent congestion. Prior to implementing the coordinated signal timing on the corridors, each signals hardware was evaluated and documented. In general, throughout the region, the vehicle detection systems are lacking in funding for maintenance. Ideally, a failure rate of 10% should be a goal for the city, but those rates are exceeding 40% and as high as 97%. That leads directly to delays and congestion that is avoidable at costs far less than widening the roadway.

Travel time savings for the corridors included in the project were reduced between 19%-75%. That range represents the difference between to local conditions along the corridors and the quality of the operations for the “before” condition. For those corridors that have been part of past signal timing improvements, the typical life before needing updates is 3 years, depending on volume changes and growth. In some cases, construction is completed, but signal optimization is still needed to maximize the efficiency of the new improvements.

The observed travel time saving produced a return on investment that exceeded 40:1 for the overall project. This far exceed any capital expansion projects while using far less funds while providing benefits to regional operations and not just local benefits.

RECOMMENDATIONS

The majority of the segments found to be congested would improve by optimizing and coordinating the signals along the corridors. In general, much of the study network would recognize substantially improved operations before warranting larger capital expenditures. Of the roadway segments that were congested, 59% would improve to acceptable levels with optimized and coordinated signal timing. The signals shown, are primarily those that are maintained by cities with population greater than 50,000. This threshold is the point where TxDOT turns over maintenance of on-system signals to the respective city. These signals are coupled with those that were recently optimized and coordinated through a City of McAllen funded effort. Leveraging that recent effort by continuing the coordination across city limit lines would allow the region to benefit from the combined effort.

FHWA provides guidance for appropriate funding for staffing and maintenance of traffic signals. The local funding for those areas have apparently been less than ideal. That has now led to signal systems around the region that are not operating well and therefore are contributing to the delays observed. Traffic signals include computers that have the functionality to move traffic with less delays than those experienced in the Valley.

Signal timing continues to be an area that deserves attention within the region to allow maximum efficiency of the existing system before costly widening to add capacity. Signal timing optimization and coordination facilitate smoother operations, less stops, less delay, improved fuel economy, lower vehicle emissions, and less headaches for drivers. The cost / benefit of signal timing projects far

exceeds projects 100 times as expensive and can be accomplished in far less time and much less impact to drivers and property owners to endure roadway construction.

Signal timing improvements are a relatively inexpensive way to make significant improvements on a transportation network. Improved signal timing can decrease delay by appropriately allocating green time among competing phases. This allows more traffic to pass through the signal with less delay. By adjusting cycle lengths and offsets, drivers can travel longer distances along a corridor before having to stop for a red light. This decreases travel time and improves air quality. Both signal timing optimization and traffic signal progression are low-cost improvements to make the best use of existing capacity and optimize allocation of funding. The cost for a signal timing improvement project varies depending on the number of traffic signals, the controller capabilities, vehicle detection condition, the location of the traffic signals and adjacent signals, the number of timing plans required, and implementation and fine-tuning needs. The results will be very evident as has been demonstrated previously with localized projects. A regional perspective would produce consistent travel time runs even when crossing from one city / agency to another.

Also, research has shown that coordinated signal timing will not only reduce delay and gas consumption but will also improve safety by reducing stop and go traffic. This will in turn reduce rear end crashes.