

MEMORANDUM

To: UDOT Region One
From: Avenue Consultants
Date: February 20, 2019
Subject: Legacy Parkway Restrictions Study

1 EXECUTIVE SUMMARY

Beginning in 2020, legislation prohibiting heavy trucks on Legacy Parkway will expire as will the legal agreement that required a 55 MPH speed limit. As such, there is a possibility that the speed limit could be raised and trucks allowed on Legacy Parkway. To understand the impact these changes might have on traffic volumes and traffic operations, UDOT requested Avenue Consultants perform an evaluation into these two scenarios: Legacy Parkway with an increased speed limit and Legacy Parkway with an increased speed limit and no restriction on truck usage. The evaluation of these two scenarios included a review of four different aspects of Legacy Parkway and I-15: the existing traffic trends, shift in traffic volumes for each scenario, and the operational effects of this shift in traffic. The key findings from each of these are summarized below:

Existing Traffic Trends on Legacy Parkway

- Legacy Parkway is very much a commuter corridor with AM and PM peak hour volumes that are significantly higher (up to 400% higher) than other periods.

Shift in Traffic Volumes for Each Scenario

- Daily traffic volumes increase by nearly 50% with a higher speed limit (from 32,000 to 48,000) with most of the growth during the off-peak hours and in the off-peak direction when there is excess capacity. In the peak direction during the peak hours, the volume increase was less than 10% with just the speed limit increase.
- If heavy trucks were allowed, the peak direction during the peak hours would not experience as much volume growth in the AM peak and a decrease in the PM peak volumes. This is due to the fact that heavy trucks consume more roadway capacity than cars. With trucks on Legacy Parkway there is less capacity available for other vehicles which would make them more likely to use I-15

Operational Analysis of Legacy Parkway and Southbound I-15

- Despite the worse congestion that would occur at select locations, overall travel times would decrease on Legacy Parkway with an increase in the speed limit with or without heavy trucks.
- In the AM peak on Legacy Parkway, the LOS at the southbound Parrish Lane on-ramp merge would degrade from LOS D to LOS E with the speed change and to LOS F with heavy trucks.
- In the PM peak on Legacy Parkway, the LOS at the northbound 500 South on-ramp merge would go from LOS E to LOS F with or without heavy trucks.
- Operations on I-15 would improve in both scenarios with the 2600 South off-ramp diverge and segment between the 2600 South ramps going from LOS D to LOS C and the 2600 South on-ramp merge going from LOS F to LOS D.



2 INTRODUCTION

Part of an agreement in 2005 that led to the construction of Legacy Parkway, a freeway connection between I-215 and I-15 in Davis County, included a restriction that the speed limit could not exceed 55 MPH. There was also legislation that prohibited heavy trucks from using the facility. Both of these restrictions are set to expire in 2020, at which point it would be possible to raise the speed limit or allow heavy trucks on Legacy Parkway. To determine how these potential changes would impact traffic on both Legacy Parkway and I-15, UDOT requested that Avenue Consultants evaluate the potential shift in traffic volumes and subsequent changes to traffic operations.

This memo outlines the study process and reports the results of the analysis, including reviewing the amount of traffic volume that is likely to shift with these changes and the operational impacts of this shift. The study area for this project includes all of Legacy Parkway and the adjacent segments of I-15 as shown in Figure 1.

3 METHODOLOGY

The analysis for this study used collected traffic count data, the WFRC/MAG travel demand model (TDM), and Vissim microsimulation software to determine the impact on traffic volumes and operational performance for both Legacy Parkway and I-15 with the increased speed limit on Legacy Parkway and with and without the removal of the truck restriction.

3.1 Data Collection

Traffic volume data were collected from a variety of sources for mainline Legacy Parkway, I-15, I-215, and US-89 as well as for a number of freeway ramps in the study area. The purpose for the Legacy Parkway counts were to understand existing traffic patterns and traffic operations. The counts on I-15 and other nearby freeways were used to understand existing truck traffic in the study area that might choose to use Legacy Parkway and for traffic operations analysis.

Surrounding mainline freeway traffic volumes were collected for six hours of the day (three hours each in the AM peak and PM peak) at four locations (shown in Figure 1):

- I-15 south of the I-215 and I-15 junction between the Warm Springs Rd interchange ramps
- I-15 north of the Legacy Parkway and I-15 junction by the Shepard Lane grade separated crossing of I-15
- I-215 between the Redwood Rd interchange and the I-15 junction
- US-89 north of the Park Lane interchange and south of Shepard Lane

Traffic at these locations was video recorded and then manually counted to improve the vehicle classification accuracy. Heavy vehicles were classified as single unit or combo trucks.

Mainline volumes for Legacy Parkway came from two UDOT continuous count stations, which are located on Legacy Parkway, one at the north near the I-15/US-89 interchange and the other at the south near the I-215 interchange (as shown in Figure 1). These data were used to determine the peak period traffic volumes as well as the daily and seasonal distribution of Legacy Parkway traffic volumes.

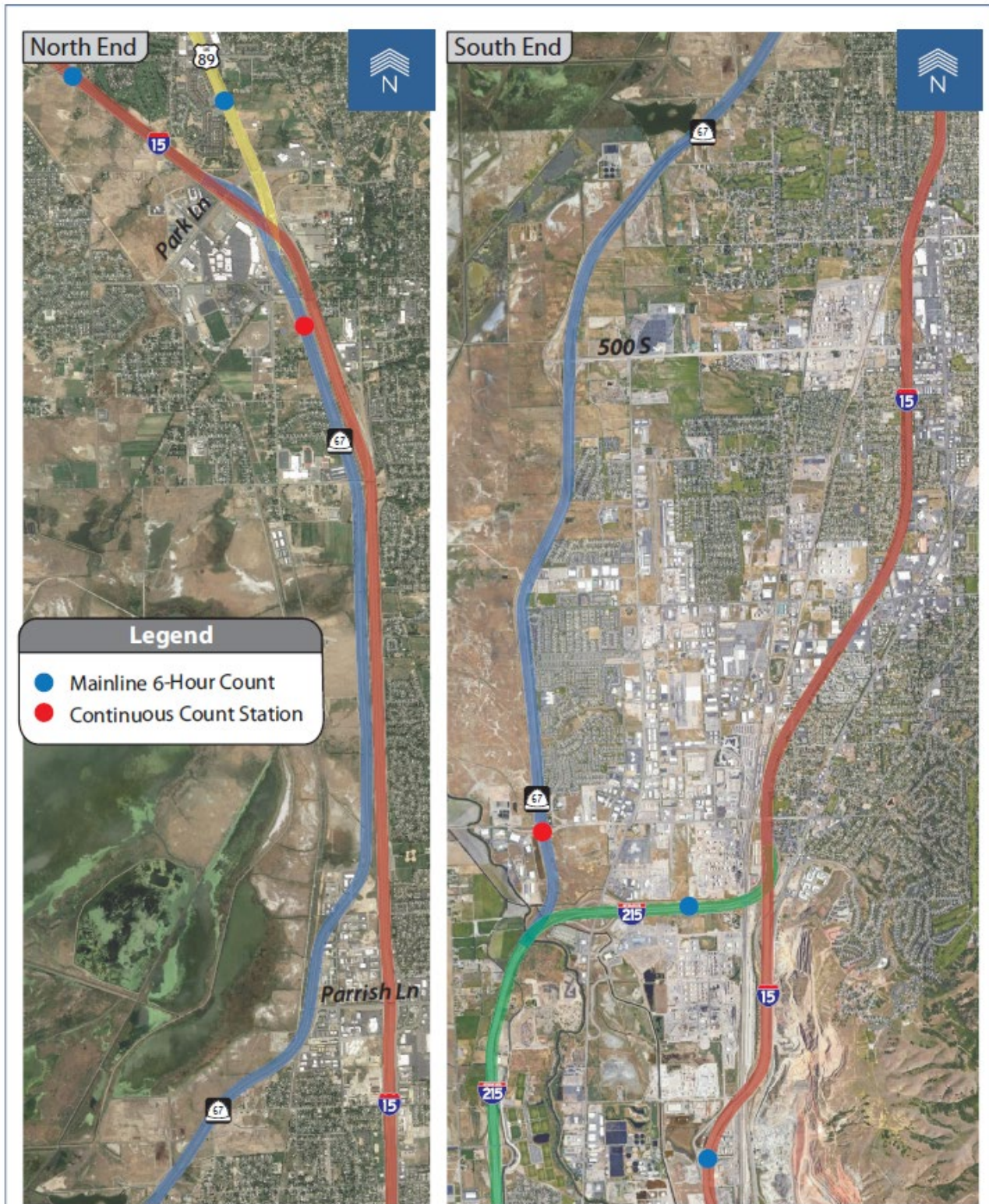


Figure 1: Study Area and Data Collection
Legacy Parkway Restrictions Study

Figure 1: Study Area and Data Collection Locations (Whole Page to be Replaced)

Freeway ramp volumes came from traffic counts performed for this project at both Legacy Parkway service interchanges and at select I-15 interchanges, recent traffic counts from another project on I-15, and PeMs counts. The counts for both this project and the recent project on I-15 included two hours in the AM peak and two hours in the PM peak. Trucks were also counted separately. PeMs data was used when traffic counts weren't available for ramps on I-15 in the study area. Where possible the vehicle lengths collected by PeMs were used to determine the number of trucks on each of the ramps.

3.2 Travel Demand Modeling

The WFRC/MAG travel demand model (TDM) is a tool used to predict future travel and traffic volumes for the Wasatch Front area. WFRC and MAG are the Metropolitan Planning Organizations for the Wasatch Front and are responsible for coordinating transportation planning in the region. MAG is responsible for Utah County and WFRC for Weber, Davis, and Salt Lake Counties. The version 8.3 draft of the travel demand model was used for this study.

The travel demand model has two primary inputs: land use data and transportation system data. The land use data consists of residential and employment information for the entire region. Using the land use and transportation system inputs, the travel model predicts how many trips will be generated in the region, where those trips are going, the mode by which they will be made, and the transportation facilities that will be used to get there. The most recent calibrated year (2015) was used to determine the shift in traffic due to changes in the restrictions on Legacy Parkway.

To prepare the model for use, vehicle speeds on Legacy Parkway were adjusted to better represent existing traffic volumes. Based on the difference between travel model volumes and count volumes, adjustment factors were developed by direction and time of day. To understand the shift in traffic volumes due to the removal of the restrictions on Legacy Parkway, the travel demand model was run for each scenario to which the adjustment factors were applied to estimate the new volumes for that scenarios.

3.3 Traffic Operations Analysis

The Vissim microsimulation software was selected for this study because it allows for the detailed evaluation of freeway operations, including the interaction between adjacent ramps. Vissim also allows for driving behaviors to be modified and travel times to be collected for user-specified segments, which collectively are used to calibrate the model to observed conditions.

3.3.1 Model Calibration

Vissim model calibration focused on matching observed congestion and driver behavior on southbound I-15 for the AM peak period and Legacy Parkway for both AM and PM peak periods. To match these observed conditions, changes were made to the Vissim parameters for the additive and multiplicative part of the safe driving distance and to the lane change distance used by vehicles in the model to determine they behave for lane changes and merging for on-ramps and lane drops.

As part of the calibration process the travel times collected by the Vissim model were compared to third-party GPS travel time data acquired by UDOT and hosted on the iPeMS website. The iPeMS data comes from a relatively small sample of vehicles traveling the roadway. As such, multiple days of data were aggregated to obtain a sufficiently large sample to be representative of typical conditions.

3.3.2 Measures of Effectiveness

For each scenario analyzed with Vissim analysis (i.e. existing conditions, increased speed limit on Legacy Parkway, increased speed limit and no truck restriction), the model was run 10 times and the results averaged. The main measure of effectiveness collected in the Vissim model was density of vehicles on the freeway. Density is used to determine a LOS for freeway segments based on the values shown in Table 1. This table includes the thresholds for basic freeway segments as well as those used for freeway diverge, merge, and weave segments.

Table 1: Basic and Merge/Diverge Freeway Segment Level of Service Criteria

Level of Service	Traffic Conditions	Average Basic Freeway Density (passenger car/ mile/lane)	Average Merge/Diverge Freeway Density (passenger car/ mile/lane)	Average Weave Freeway Density (passenger car/ mile/lane)
A	Free Flow Operations	$0 \leq 11.0$	$0 \leq 10.0$	$0 \leq 10.0$
B	Reasonable Free Flow Operations	> 11.0 and ≤ 18.0	> 10.0 and ≤ 20.0	> 10.0 and ≤ 20.0
C	Flow Speeds Near Free Flow Speeds	> 18.0 and ≤ 26.0	> 20.0 and ≤ 28.0	> 20.0 and ≤ 28.0
D	Flow Speeds Begin to Decline	> 26.0 and ≤ 35.0	> 28.0 and ≤ 35.0	> 28.0 and ≤ 35.0
E	Operation at Capacity	> 35.0 and ≤ 45.0	> 35.0 and ≤ 43.0	> 35.0 and ≤ 43.0
F	Unstable Flow	> 45.0	> 43.0	> 43.0

Source: Highway Capacity Manual 2010, Transportation Research Board National Research Council, Washington D.C

4 ANALYSIS RESULTS

The sections below outline the existing traffic patterns on Legacy Parkway, the shift in traffic volumes that will occur should the speed limit on Legacy Parkway be raised and with or without removing the truck restriction, and how this will affect the operations of Legacy Parkway and southbound I-15. Operations in the PM period on northbound I-15 was not evaluated because the majority of the study section, between I-215 and US-89, is normally in a free-flow condition. I-15 does experience PM peak congestion in the northbound direction through the study area, although there is regular congestion north and south of the study area.

4.1 Existing Traffic Volumes

Using the UDOT Continuous Count Station the existing traffic patterns were reviewed to help identify when and how Legacy Parkway is currently being used. The data show that Legacy Parkway is very much a commuter corridor with high weekday peak hour volumes and low off-peak and weekend volumes.

The hourly traffic volume for an average weekday in the northbound and southbound directions and the combined volume are shown in Figure 2.

Legacy Parkway 2018 Average Hourly Weekday Traffic Volumes Between Parrish Lane & I-15/US-89

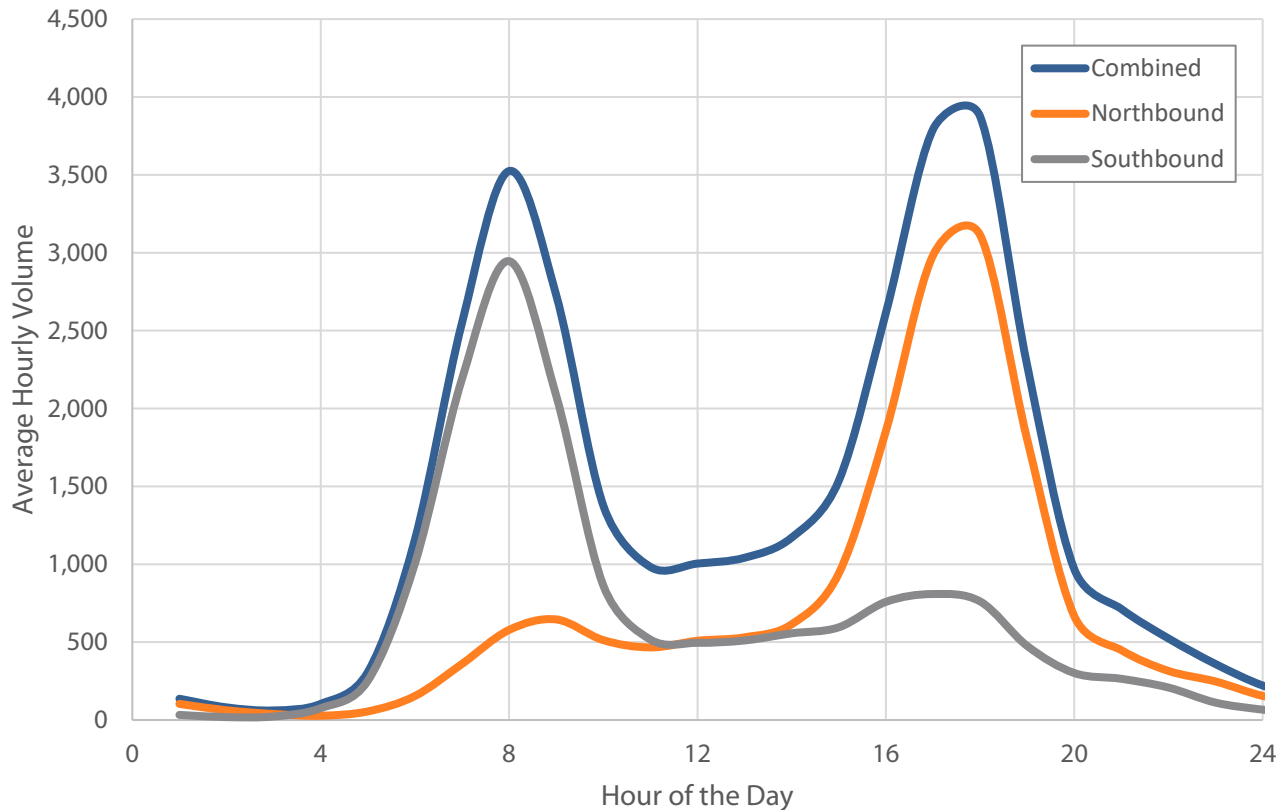


Figure 2: Legacy Parkway Hourly Weekday Traffic Volumes

The most significant traffic volumes on Legacy Parkway occur during the AM and PM peak periods with the volume on Legacy Parkway during the PM peak being up to four times higher than those during the middle of the day. The directional volumes also show that the majority of the volume during the peak times are headed in the peak direction, which is southbound in the AM and northbound in the PM.

The volume on Legacy Parkway also varies significantly between the weekdays and the weekend. During the weekend Legacy Parkway only carries a fraction of the traffic volumes that it does on weekdays. Both the hourly and daily variations show that the highest volumes on Legacy Parkway occur during periods with the most commuter vehicles, the AM and PM weekday peaks. This is also when I-15 is at its peak congestion.

The change in daily traffic volumes by month showed that volumes were fairly consistent throughout the year. The monthly variation ranged from 94% of the yearly average during January to 106% during August. The variation in traffic volume over the last five years was also reviewed and is shown in Figure 3. Traffic volumes on Legacy Parkway were at their peak in 2015, when I-15 was under construction and many people altered their travel patterns. However, traffic volumes are increasing and are nearly back to 2015 levels.

Legacy Parkway Traffic Volume Variation by Year
Average of 2013 through September 2018

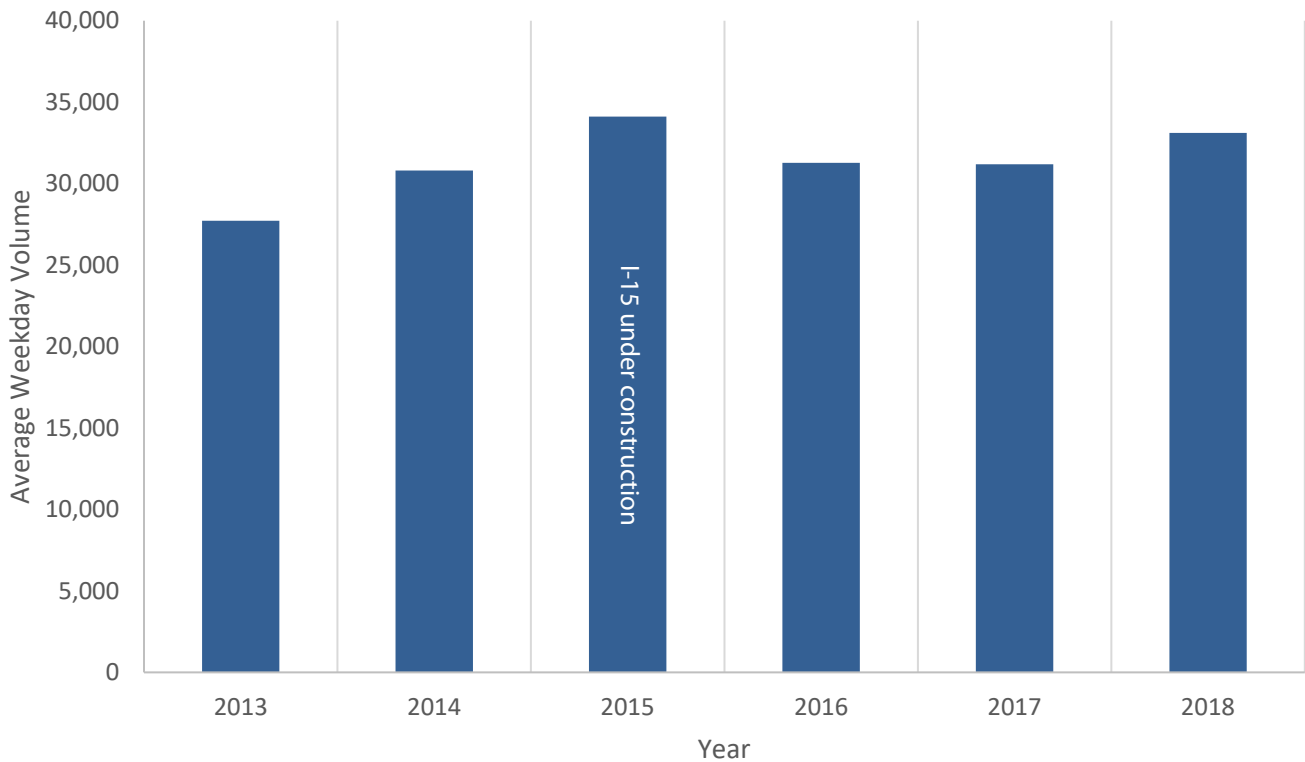


Figure 3: Legacy Parkway Yearly Traffic Volume Trends

4.2 Shifted Traffic Volumes

In evaluating the shift in traffic volumes on Legacy Parkway, both a daily shift and AM and PM 3-hour peak period shifts were analyzed. The traffic shifts for the 3-hour AM and PM peak periods are shown in Figure 4. The volume increases in the peak direction (southbound AM/northbound PM) are relatively modest at less than 10% for the increased speed limit scenario, while in the off-peak direction the AM volume increases by nearly 90% and the PM volumes by over 20%. Volume increases in the off-peak periods are much higher at 100% for the midday period and nearly 200% for the evening period. The detailed numbers can also be found in Table 2.

Figure 5 shows the total daily traffic volume increase on Legacy Parkway with both scenarios for passenger cars, single unit trucks and combo trucks. With the increased speed limit, the daily volume on Legacy Parkway is expected to increase from about 32,000 vehicles per day to nearly 48,000 vehicles per day, an increase of nearly 50%. If trucks were also allowed, the daily volume would increase to about 56,000 vehicles per day, with 6,500 heavy trucks; however, there would be fewer passenger vehicles because as some trucks shift from I-15 to Legacy, some cars would shift to I-15 to take their place.

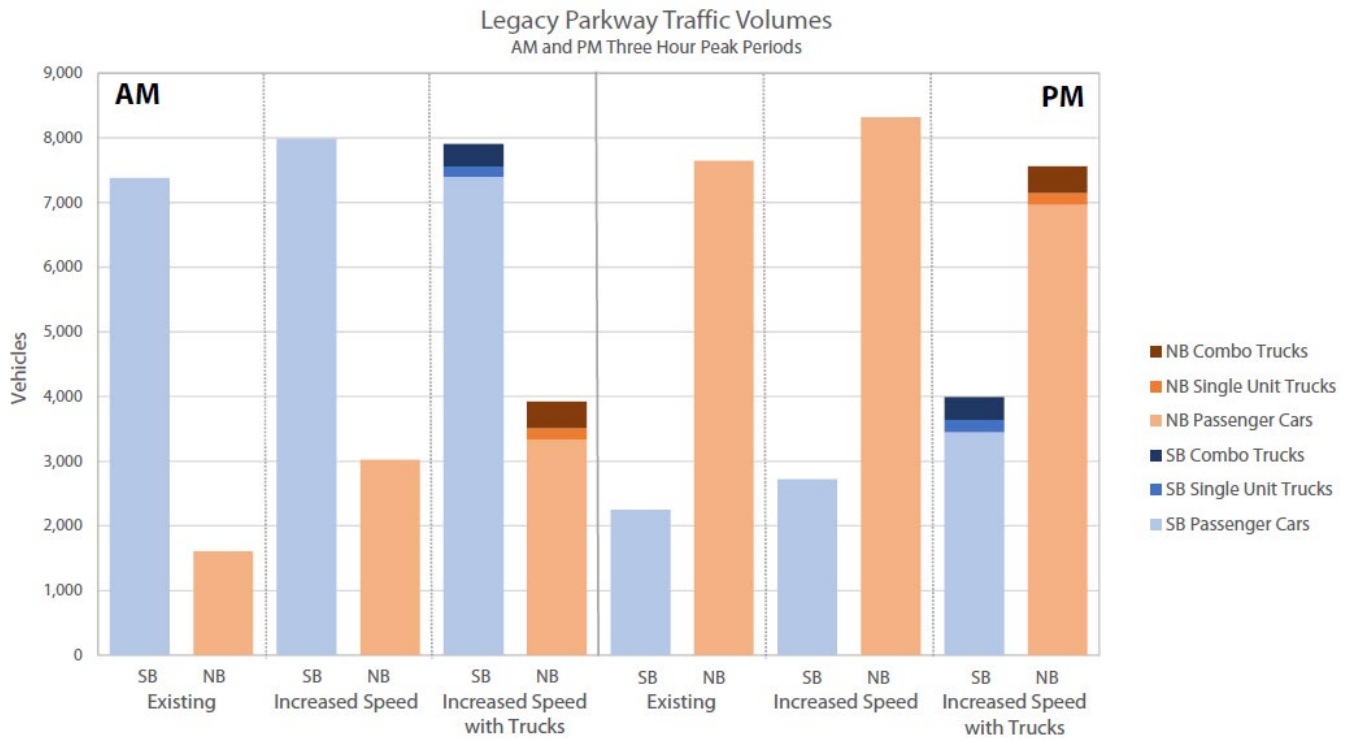


Figure 4: 3-Hour Peak Period Traffic Volumes on Legacy Parkway

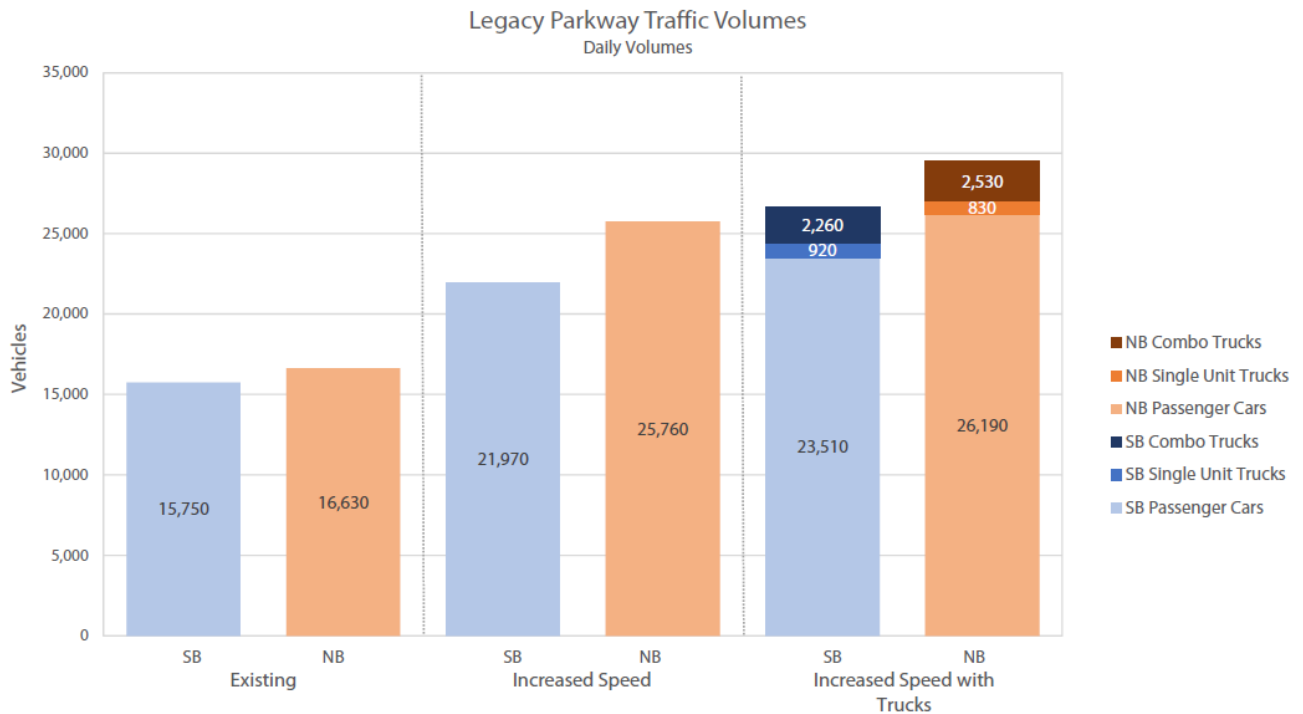


Figure 5: Daily Traffic Volumes on Legacy Parkway

Table 2: Legacy Parkway Peak and Daily Volume Changes

Vehicle Type	Southbound			Northbound			Total		
	Existing	Increased Speed	w/ Trucks	Existing	Increased Speed	w/ Trucks	Existing	Increased Speed	w/ Trucks
AM Peak (6 AM to 9 AM)									
Passenger Cars	7,380	7,990	7,400	1,610	3,020	3,340	8,990	11,010	10,730
Single Unit Trucks	0	0	160	0	0	170	0	0	330
Combo Trucks	0	0	350	0	0	410	0	0	770
Total	7,380	7,990	7,910	1,610	3,020	3,920	8,990	11,010	11,830
PM Peak (3 PM to 6 PM)									
Passenger Cars	2,250	2,720	3,450	7,650	8,320	6,970	9,900	11,040	10,390
Single Unit Trucks	0	0	190	0	0	180	0	0	380
Combo Trucks	0	0	350	0	0	410	0	0	770
Total	2,250	2,720	3,990	7,650	8,320	7,560	9,900	11,040	11,540
Daily									
Passenger Cars	15,750	21,970	23,510	16,630	25,760	26,190	32,380	47,730	49,670
Single Unit Trucks	0	0	920	0	0	830	0	0	1,750
Combo Trucks	0	0	2,260	0	0	2,530	0	0	4,810
Total	15,750	21,970	26,690	16,630	25,760	29,550	32,380	47,730	56,230

Allowing trucks to utilize Legacy Parkway limited the growth in total traffic volume in the dominant direction during the peak periods. In fact, during the PM peak period, northbound traffic volumes would decrease slightly with the removal of the truck restriction despite the increased speed limit. This is due to the fact that trucks use more roadway capacity than cars, so each truck that is added in the peak direction during the peak period either displaces one or more cars or degrades the performance of the road. Allowing trucks on Legacy Parkway will increase the daily volumes on Legacy Parkway but will restrict the shift in the peak direction during the most congested times. With or without removing the truck restriction, much of the volume growth would occur during the off-peak periods and during the peak period in the off-peak direction where vehicles can make use of the underutilized capacity on Legacy Parkway.

Using the existing daily distribution, the distribution with the increased volumes from the increased speed limit with and without trucks are shown in Figure 6. When combining both directions the traffic volumes would increase for all hours of the day. The northbound daily traffic volume distribution is shown in Figure 7. In the northbound direction the PM peak reduces with trucks but the width of the peak increases. Figure 8 shows the southbound daily traffic volume distribution.

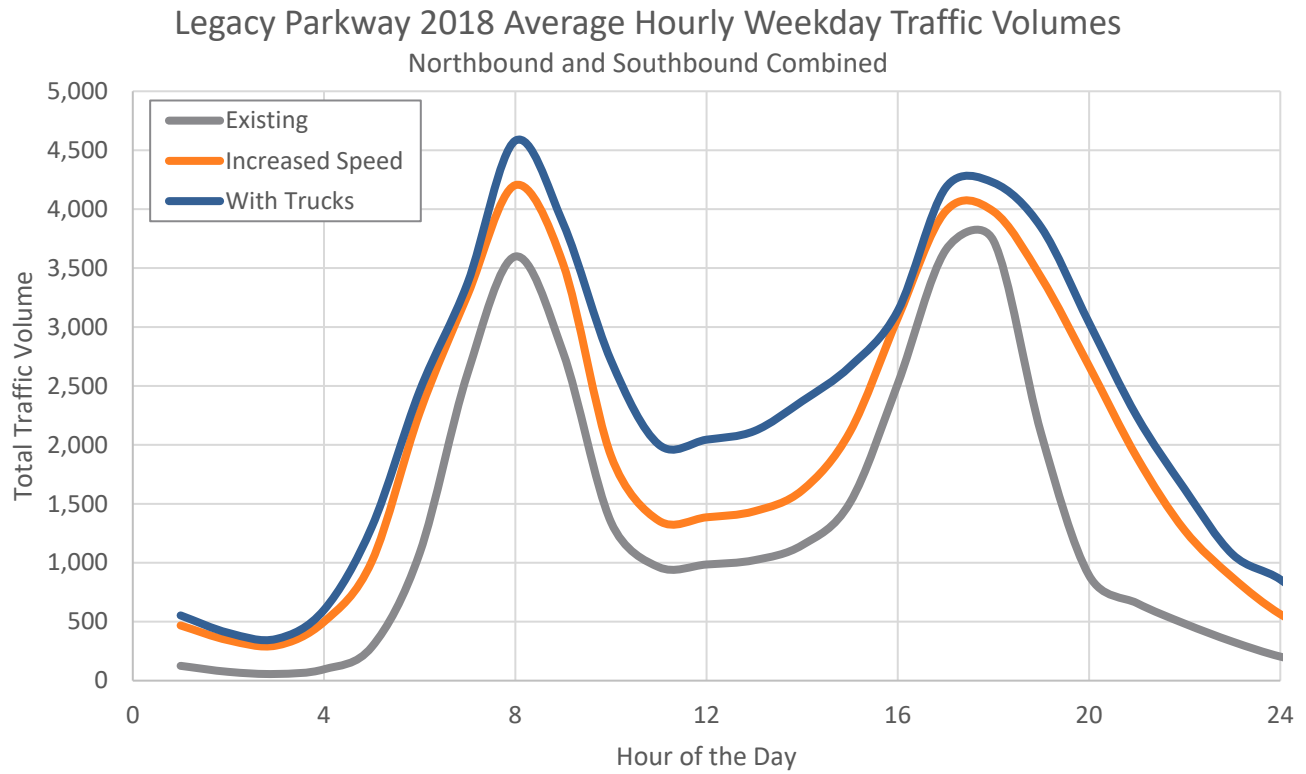


Figure 6: Combined Daily Distribution of Scenario Traffic Volumes

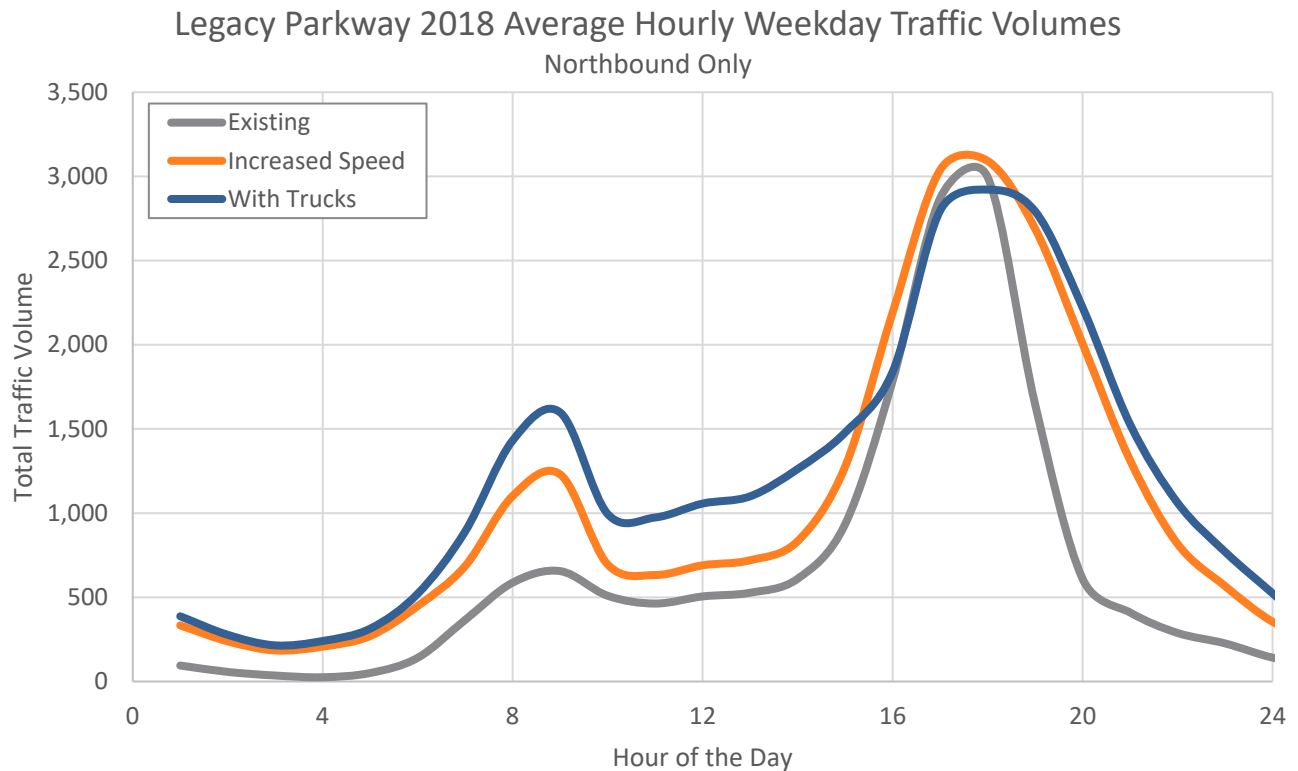


Figure 7: Northbound Daily Distribution of Scenario Traffic Volumes

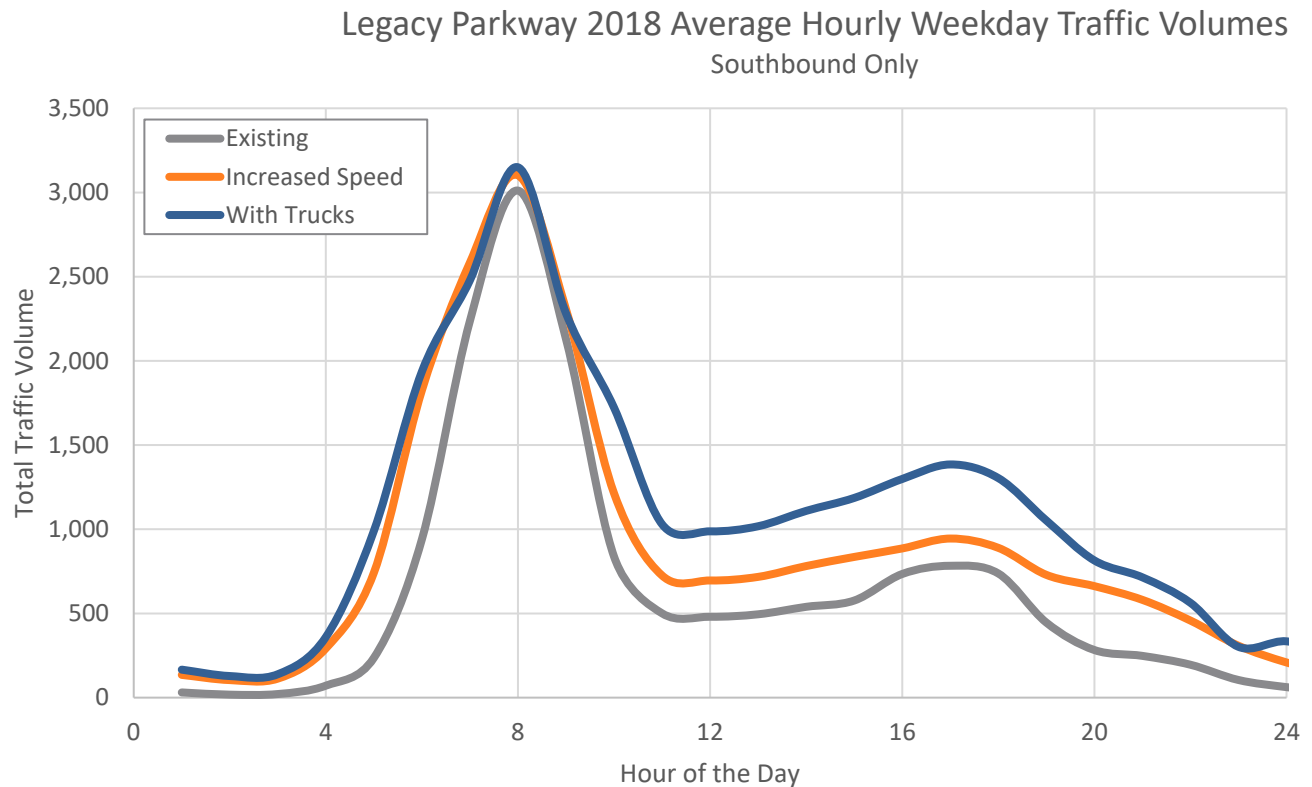


Figure 8: Southbound Daily Distribution of Scenario Traffic Volumes

4.3 Operations Analysis

The LOS was calculated along each segment on Legacy Parkway and Southbound I-15 in the study area. The LOS is shown in Figure 6 for the AM peak in the southbound direction and PM peak in the northbound direction, the off-peak direction was under capacity with all sections at least LOS C. As shown in the figure, the shift in traffic volumes would worsen the operations on Legacy Parkway while improving conditions on I-15 in the southbound direction. Northbound I-15 typically operates with free-flow conditions from I-215 to Farmington, hence reducing the volumes due to a traffic shift onto Legacy Parkway would have virtually no impact on traffic northbound traffic operations.

While the shift in traffic degrades the LOS along sections of Legacy Parkway, the increased speed limit still improves travel times due to the higher speeds on the uncongested sections. Table 3 shows a comparison of travel times between the different scenarios on Legacy Parkway and I-15. On Legacy Parkway the travel times decreased more when the heavy truck restriction was maintained with biggest difference being 54 seconds in the southbound direction during the AM peak. Travel times on I-15 in the southbound during the AM peak also improved by 30 seconds.

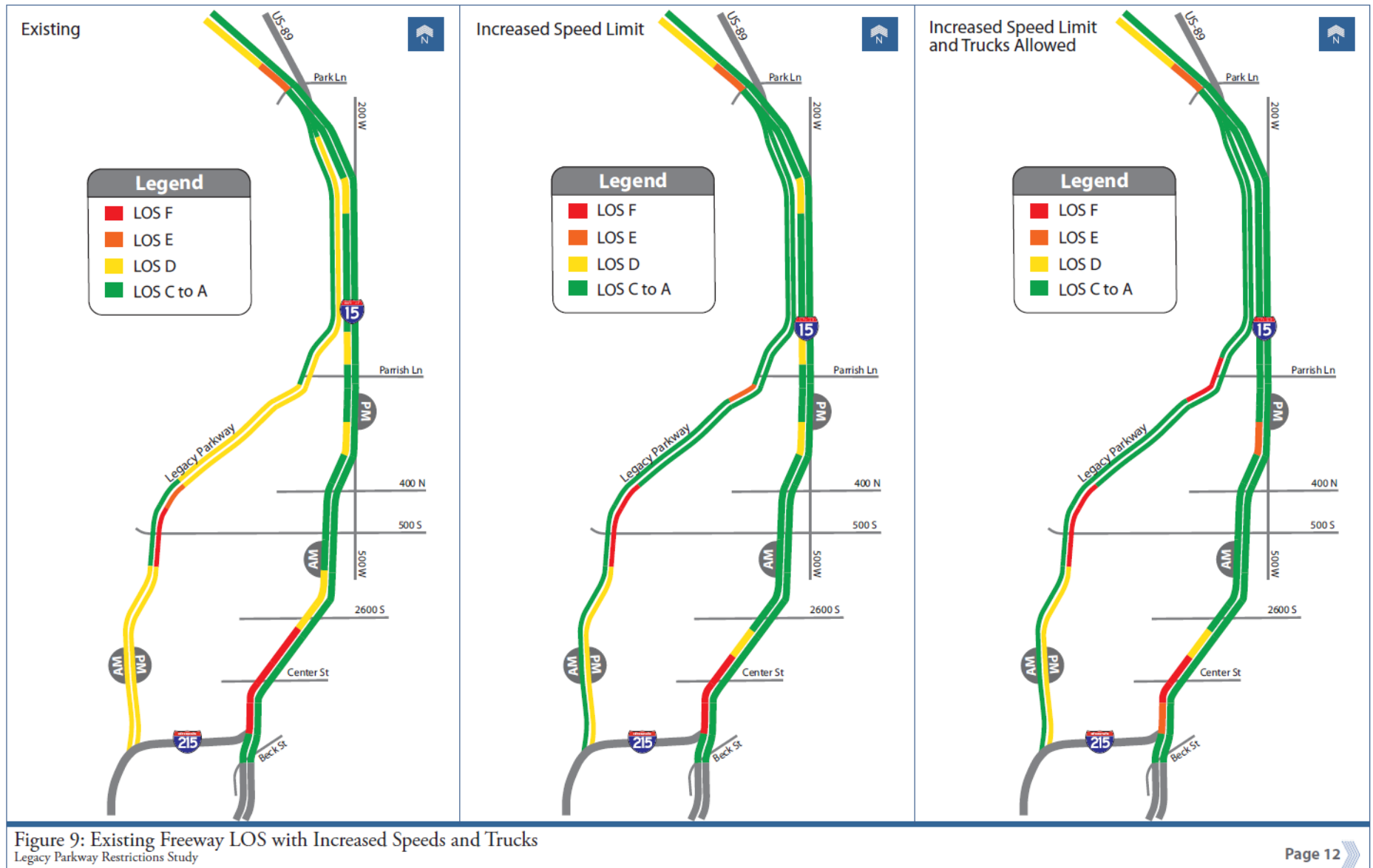


Figure 9: LOS Figure (whole page to be replaced)

Table 3: Travel Time Comparison

Time Period	Southbound Travel Times (Min)			Northbound Travel Times (Min)		
	Existing	Increased Speed Limit	Increased Speed Limit with Trucks	Existing	Increased Speed Limit	Increased Speed Limit with Trucks
Legacy Parkway (I-15 to I-215)						
AM	13.2	11.0	11.9	12.5	10.5	10.6
PM	12.4	10.3	10.5	14.3	12.9	13.4
I-15 (Legacy Parkway to I-215)						
AM	10.9	10.4	10.4	No Data		

4.3.1 Legacy Parkway Operations

On the Legacy Parkway, traffic operations would degrade along two segments, one in the AM and one in the PM. The first segment is at the Parrish Lane interchange in the southbound direction during the AM peak and the second is at the 500 South interchange in the northbound direction during the PM peak. Both of these locations have existing issues that would be exacerbated by the increase in traffic volumes.

The analysis during the AM peak shows the following for southbound Legacy Parkway in the Parrish Lane interchange area:

- Heavy trucks on Legacy Parkway would have a more substantial traffic impact with a LOS F than the increased speed limit with a LOS E at the Parrish Lane on-ramp merge area. Additionally, with trucks the congested LOS F section would extend further upstream than the congested LOS E section would extend under the increased speed scenario, extending to the Parrish Lane off-ramp diverge area.
- Worsening conditions at the Parrish Lane on-ramp merge area would create a metering effect that would actually improve the performance of downstream Legacy Parkway between Parrish Lane and 500 South from LOS D to LOS C, although the actual density of the improvement would only be of 3 or 4 fewer vehicles per mile per lane.

During the PM peak, Legacy Parkway is congested in the northbound direction around the 500 South on-ramp merge in all scenarios. The following are some differences between the scenarios for the Parrish Lane interchange area of Legacy Parkway:

- The presence of heavy trucks would not increase the density any more than the increased speed limit without heavy trucks.
- Even though the presence of heavy trucks would reduce the northbound volume during the PM peak it would still increase the density by 24 vehicles per mile per lane.
- Worsening conditions at the 500 South on-ramp merge would improve the performance of Legacy Parkway between 500 South and Parrish Lane from LOS D to LOS C by metering the upstream traffic.

4.3.2 I-15 Operations

On southbound I-15 during the AM peak, performance would improve due to a reduction in traffic in both scenarios. During the AM peak the most congested section of I-15 is between the 2600 South off-ramp and the I-215 off-ramp. The analysis for the AM peak show the following for southbound Legacy Parkway:

- Allowing heavy trucks on Legacy Parkway would improve operations on southbound I-15 at the I-215 off-ramp more than just increasing the speed limit. With heavy trucks on Legacy Parkway the density would improve to 40 vehicles per mile per lane compared to 49 vehicles per mile per lane in the existing.
- North of the Center Street off-ramp, the larger shift in vehicles that would come from just the increased speed limit without trucks would improve operations slightly more than with trucks allowed on Legacy Parkway.
- The most congested sections of I-15 (from the Center Street off-ramp to I-215) would only experience slight improvements in either scenario.

5 CONCLUSIONS

In 2020, when the legislation maintaining the speed limit on Legacy Parkway at 55 MPH and restricting heavy truck use of the facility ends they can expect to see an increase the traffic volumes on Legacy Parkway. Daily traffic volumes will increase by 50% or more with only a small amount of this growth occurring in the peak direction during the peak hours. The volume increases in the peak direction (southbound AM/northbound PM) are less than 10% for the increased speed limit scenario.

This growth in volume on Legacy Parkway would degrade the operational performance for the southbound in the AM peak and northbound in the PM peak. In the AM, the existing LOS D at the Parrish Lane onramp merge becomes a LOS E without trucks or LOS F with trucks. In the PM, the LOS for the 500 S merge would move to a LOS F from the existing LOS E. The vehicle speeds in the worst section would also be reduced due to the increase in congestion. However, due to the increased speed in the uncongested sections the travel time along Legacy Parkway would improve in both the AM and PM peaks. This improvement was larger when the heavy truck restriction remained.

This shift in traffic would also cause some improvement on the operational performance of southbound I-15 in the AM peak where the LOS F section north of the I-215 interchange doesn't extend as far north when comparing either of the scenarios to the existing conditions. At the 2600 S offramp and between the 2600 S ramps the LOS D would improve to LOS C in both scenarios. The 2600 S onramp section would go from LOS F to LOS D.