

The Tipping Point: What COVID Travel Reductions Tell Us About Effective Congestion Relief

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APRIL 2022

Research Report
Final Report 2022-09

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Technical Report Documentation Page

1. Report No. MN 2022-09		2.		3. Recipients Accession No.	
4. Title and Subtitle The Tipping Point: What COVID-19 Travel Reduction Tells Us About Effective Congestion Relief				5. Report Date April 2022	
				6.	
7. Author(s) Paul Morris, SRF Consulting Group Gordon Parikh, SRF Consulting Group				8. Performing Organization Report No.	
9. Performing Organization Name and Address SRF Consulting Group 3701 Wayzata Blvd. Suite 100 Minneapolis, MN 55416				10. Project/Task/Work Unit No.	
				11. Contract (C) or Grant (G) No. (c) 1045129	
12. Sponsoring Organization Name and Address Minnesota Department of Transportation Office of Research & Innovation 395 John Ireland Boulevard, MS 330 St. Paul, Minnesota 55155-1899				13. Type of Report and Period Covered Final Report	
				14. Sponsoring Agency Code	
15. Supplementary Notes https://www.mndot.gov/research/reports/2022/202209.pdf					
16. Abstract (Limit: 250 words) <i>The Tipping Point – What COVID-19 Travel Reduction Tells Us About Effective Congestion Relief</i> uses observed data collected before and during the COVID-19 pandemic in the Twin Cities metropolitan area to answer a question with important implications for highway investment planning and travel demand management: At what level of vehicle miles traveled (VMT) does congestion significantly decline or disappear? The study pursues this question through a series of statistical analyses identifying inflection points in the relationship between regional VMT and congestion. The study also looks at the relationship between VMT and congestion at the corridor level to assess the sensitivity of congestion on specific roadways to changes in travel demand. This analysis categorizes Twin Cities freeways based on congestion frequency, highlighting the corridors expected to become congestion free as VMT declines and the corridors expected to remain congested.					
17. Document Analysis/Descriptors Traffic congestion, Travel demand management, COVID-19, Vehicle miles of travel				18. Availability Statement No restrictions. Document available from: National Technical Information Services, Alexandria, Virginia 22312	
19. Security Class (this report) Unclassified		20. Security Class (this page) Unclassified		21. No. of Pages 61	22. Price

The Tipping Point: What COVID-19 Travel Reduction Tells Us About Effective Congestion Relief

FINAL REPORT

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April 2022

Published by:

Minnesota Department of Transportation
Office of Research & Innovation
395 John Ireland Boulevard, MS 330
St. Paul, Minnesota 55155-1899

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ACKNOWLEDGMENTS

The report authors would like to recognize the contributions of Technical Advisory Panel members to this study. The individuals listed below provided valuable feedback and direction at multiple stages during the study's development.

- Kory Andersen, MnDOT (state technical liaison)
- Brad Utecht, MnDOT (state technical liaison)
- Paul Czech, MnDOT
- Jonathan Ehrlich, Metropolitan Council
- Jim Henricksen, MnDOT
- Michael Iacono, MnDOT
- Brian Kary, MnDOT
- Philip Schaffner, MnDOT
- John Zehnder, MnDOT

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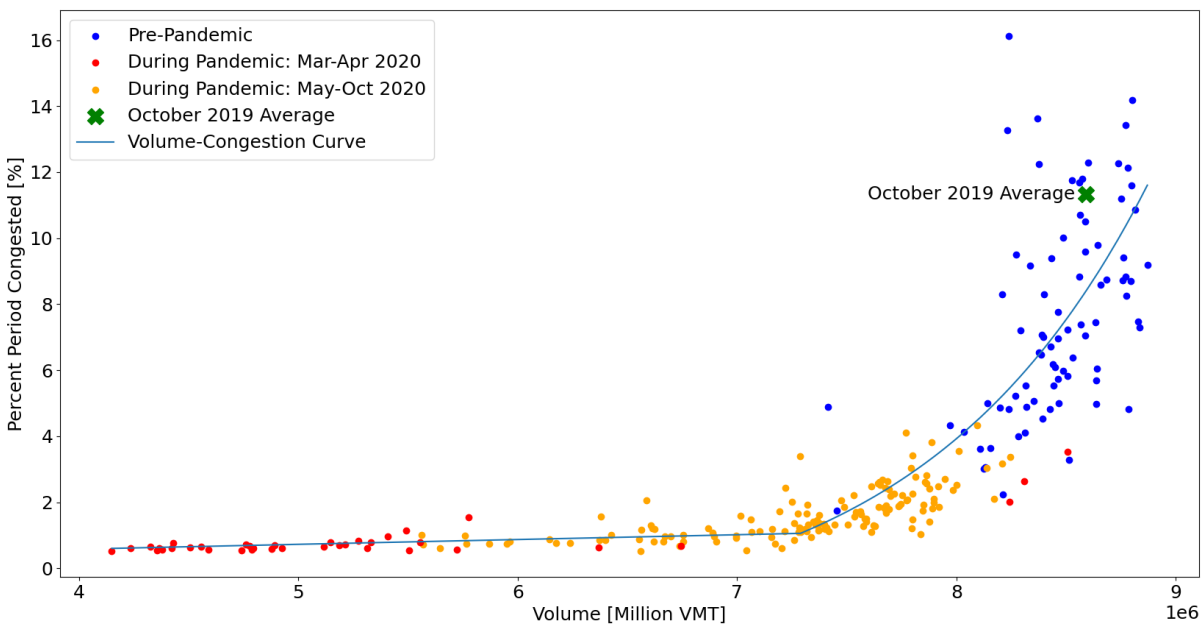
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EXECUTIVE SUMMARY

This study uses observed data collected before and during the COVID-19 pandemic to examine how changes in travel volume affect highway congestion in the Twin Cities metropolitan area. As indicated by its title, the study seeks to identify the region’s congestion “tipping points” — the points at which incremental changes in regional vehicle miles traveled (VMT) produce inflection points in traffic congestion growth rates — and explore the implications of these tipping points for travel demand management (TDM) and other congestion relief strategies.

Data were collected from detectors on mainline freeway segments in the Twin Cities area, totaling roughly 1,500 stations and 4,400 individual detectors, Mondays through Fridays, from October 2019 to November 2020. Thirty-second volume, occupancy, and speed measurements were aggregated to five-minute intervals to reduce noise that can result from sensor errors and natural variability in traffic flow. Congestion duration was calculated by summing the number of five-minute periods with an average speed at or below 45 mph in a spatial and temporal period of interest divided by the total number of five-minute periods in that same period.

The study produced a scatterplot showing the relationship between traffic volume and congestion on the regional freeway system during the PM peak period. This scatterplot indicates a strong correlation between regional VMT and congestion until peak period VMT hits approximately 8.5 million and congestion hits about 8 percent of freeway segments congested. At these levels, the VMT-congestion relationship became unreliable. The study concluded that 8 percent congested constitutes the freeway system’s PM peak period tipping point. The study observed similar phenomena in the AM peak but used PM peak period data to support tipping point analyses.

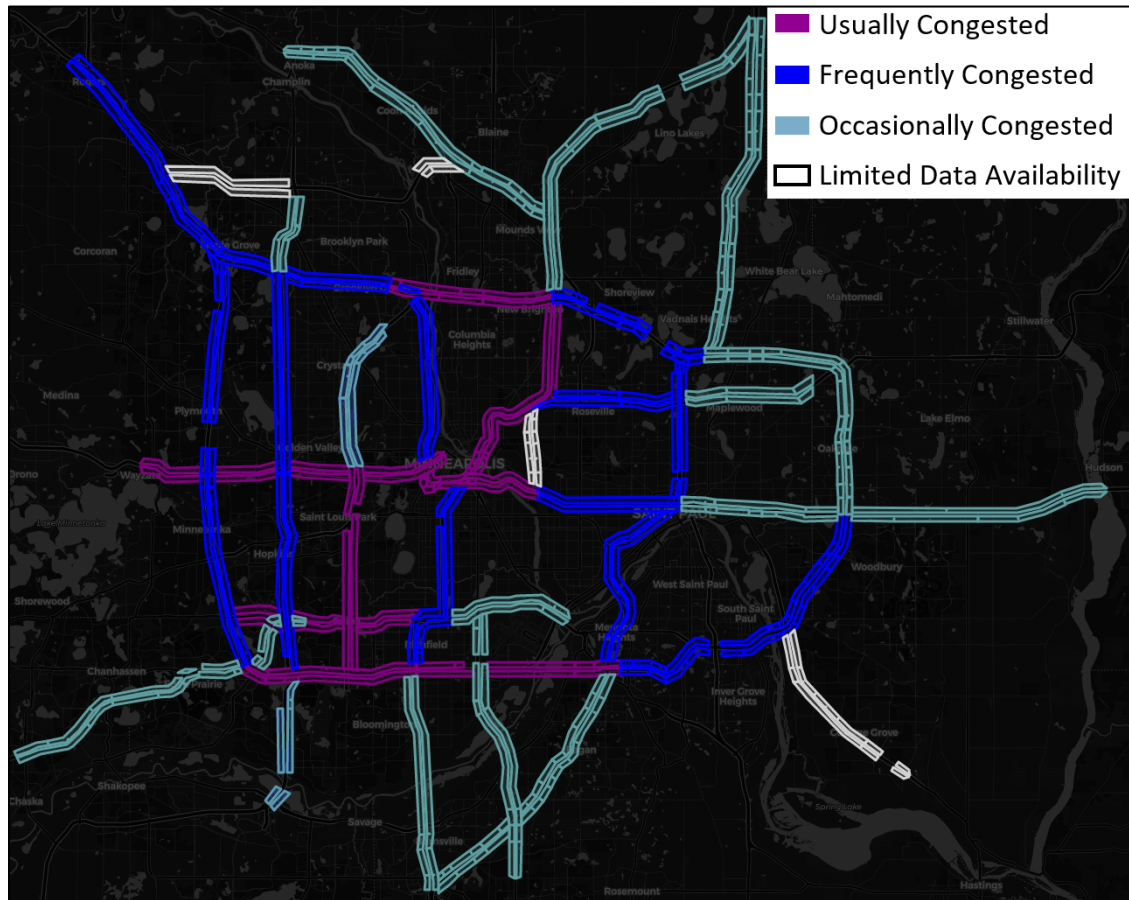


Regional congestion vs. VMT – PM Peak

Congestion tipping point in relation to regional VMT and congestion in October 2019

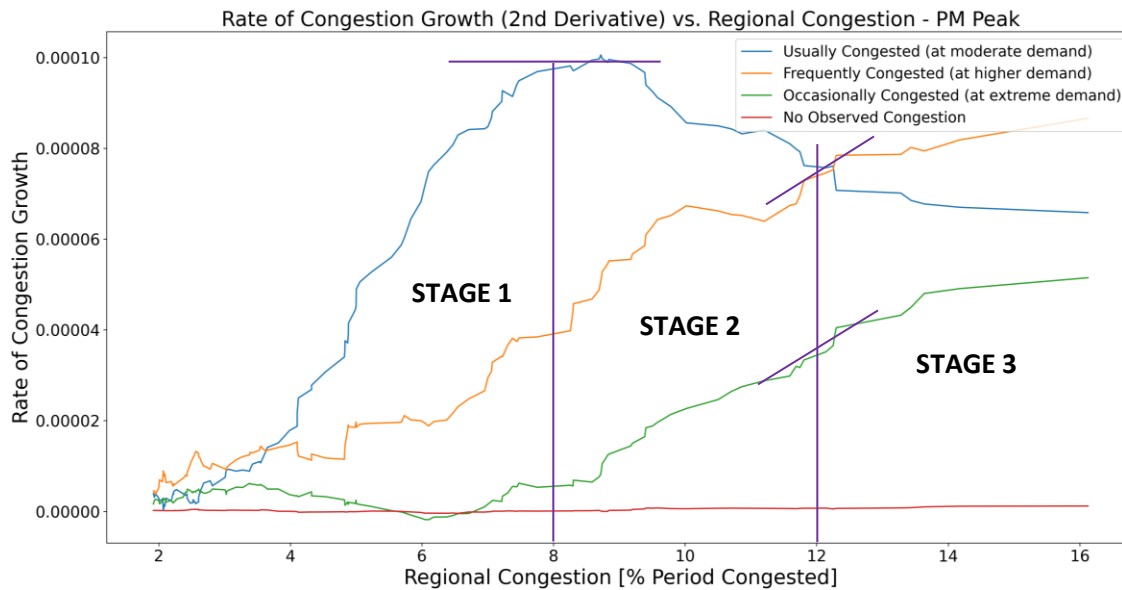
PM Peak Period	
Regional VMT	8.5 million
Relative to Oct. 2019 VMT	Down 4 percent
Regional Congestion	8 percent
Relative to Oct. 2019 Congestion	Down 35 percent

The study also explored how congestion performance differed across corridor segments on the freeway system. Freeway facilities were segmented into shorter segments and evaluated individually to establish the relationship between corridor-level congestion and regional VMT. This comparison demonstrated that corridor segments could be categorized into three categories of congestion frequency: usually congested, frequently congested, and occasionally congested.



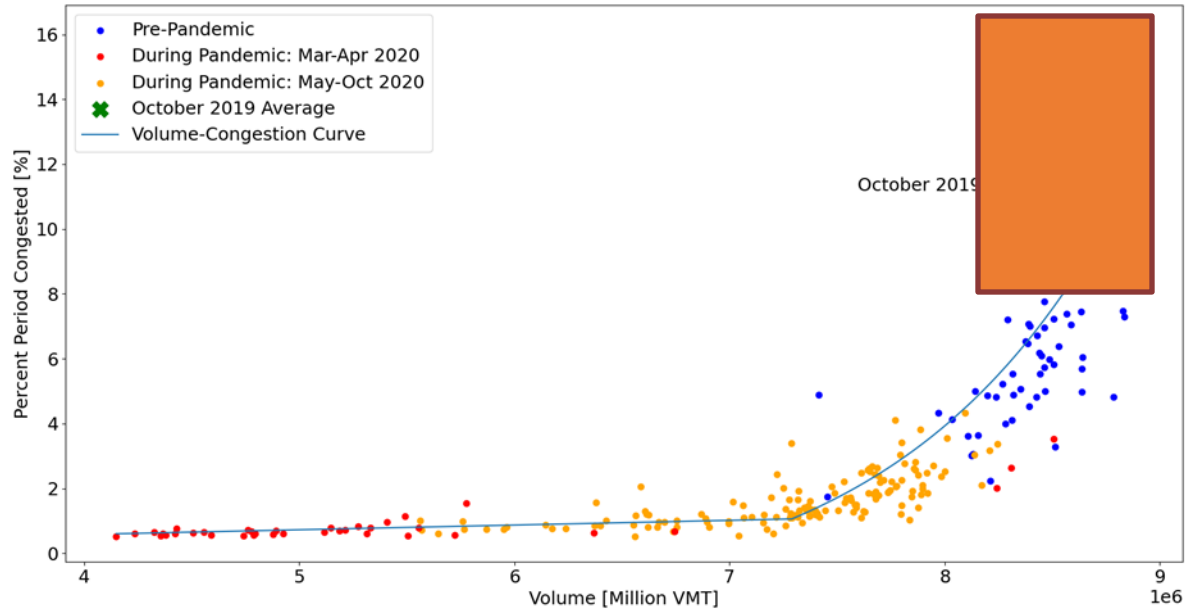
Map of corridor segment groups

The study then compared the rate of growth in congestion on usually, frequently, and occasionally congested corridors. This analysis found three stages of regional congestion. The first stage was dominated by rapid growth in congestion among usually congested corridor segments. The transition to the second stage occurred when congestion growth on usually congested segments peaked and began to decline, and congestion growth on frequently and occasionally congested corridors accelerated. The third stage of congestion growth began at the point where the rate of growth in congestion on usually congested segments was lower than the rate of growth in congestion on frequently congested segments, and there was a marked uptick in congestion on both frequently and occasionally congested corridor segments. The chart below visually depicts these stages.



Stages of congestion growth -- PM peak

Finally, the study applies findings from the corridor-level analysis to the regional VMT and congestion scatterplot presented above. For the PM peak, stage 1 in the growth of regional congestion — the stage marked by rapid increases in congestion on usually congested corridors — occurs between 7.5 and 8.5 million VMT. There is then a tipping point at which congestion becomes highly unstable, jumping to between 3 and 15 percent of the freeway system being congested with little relationship to VMT. This dynamic corresponds to the stages of regional congestion growth in which congestion on frequently and occasionally congested corridors accelerates. The observed break between reliable and unreliable congestion provides a data-driven rationale for a VMT target of 8.5 million VMT and a congestion target of about 8 percent for the PM peak period.



Congestion tipping point – PM peak

CHAPTER 1: INTRODUCTION

This study uses observed data collected before and during the COVID-19 pandemic to examine how changes in travel volume affect highway congestion in the Twin Cities metropolitan area. The study seeks to identify the region’s congestion “tipping points” — the points at which incremental changes in regional vehicle miles traveled (VMT) produce inflection points in traffic congestion growth rates. The study also explores the implications of these tipping points for travel demand management (TDM) and other congestion relief strategies.

The primary motivation for the study was a desire to understand and estimate the congestion benefits of VMT reduction. MnDOT commissioned the study during a period in 2020 when COVID-19 stay-at-home orders and other restrictions produced near congestion-free travel conditions. As traffic increased and congestion began to return to pre-pandemic levels, MnDOT identified an opportunity to measure congestion on a fixed system with a fixed population at different levels of VMT. These real-world measurements have provided insight into the congestion relief that may be possible if MnDOT and regional partners were to aggressively implement TDM.

Congestion tipping points are also an important consideration in policy and investment discussions around state and regional VMT reduction goals. Understanding how congestion decreases with declines in regional VMT opens new possibilities to express VMT reduction in terms of travel time savings, travel time reliability, and access to destinations. Identifying specific tipping point values also allows analysts and policymakers to compare potential VMT reduction goals to the VMT reduction needed to reduce or substantially eliminate regional congestion.

1.1 ABOUT THIS REPORT

This report explores the relationship between Twin Cities regional VMT and Twin Cities regional congestion along four paths of inquiry. These paths of inquiry are as follows:

1. How does regional congestion change with incremental changes in regional VMT?
2. Which corridors are usually congested, frequently congested, and occasionally congested?
3. As regional travel demand increases, how does congestion change on signalized arterials?
4. What are the equity implications of changes in regional travel demand?

Sources and methods used to advance each path of inquiry are discussed in Chapter 2. This study analyzes data collected between October 2019 and November 2020, a sample that includes pre-pandemic data, data collected during COVID-19 stay-at-home restrictions, and data collected throughout the summer and fall of 2020 when restrictions were relaxed and traffic increased. Chapter 3 analyses the relationship between congestion and regional VMT at the regional level, corridor level, and for signalized arterials. Chapter 3 also includes analysis of user impacts for essential workers and environmental justice populations. Chapter 4 summarizes conclusions and applications.

CHAPTER 2: SOURCES AND METHODS

This chapter describes data sources and methods used to support the paths of inquiry introduced above. The chapter has three sections. Section 1 describes the data and methods used to calculate traffic volume and speed on Twin Cities freeways. Section 2 explains how the study estimated traffic speeds on signalized arterials and assessed the relationship between signalized arterial congestion and regional VMT. Section 3 presents the data and methods used to assess travel times for targeted user groups and the relationship between user group travel time and regional congestion.

2.1 TRAFFIC VOLUME AND SPEED ON FREEWAYS

2.1.1 Instrumented freeways in the Twin Cities metropolitan area

Most freeways in the Twin Cities metropolitan area are instrumented with a mix of magnetic loop detectors and radar sensors, as shown in Figure 1, that provide lane-by-lane measurements of volume, occupancy, and, in some cases, speed. These detectors are located at approximately half-mile increments and produce measurements in 30-second intervals, providing high-resolution traffic data for both real-time operations and historical studies. In addition, this data is made available to researchers and other users via a publicly accessible application programming interface (API) known as TrafDat, allowing for easy access to large amounts of data.

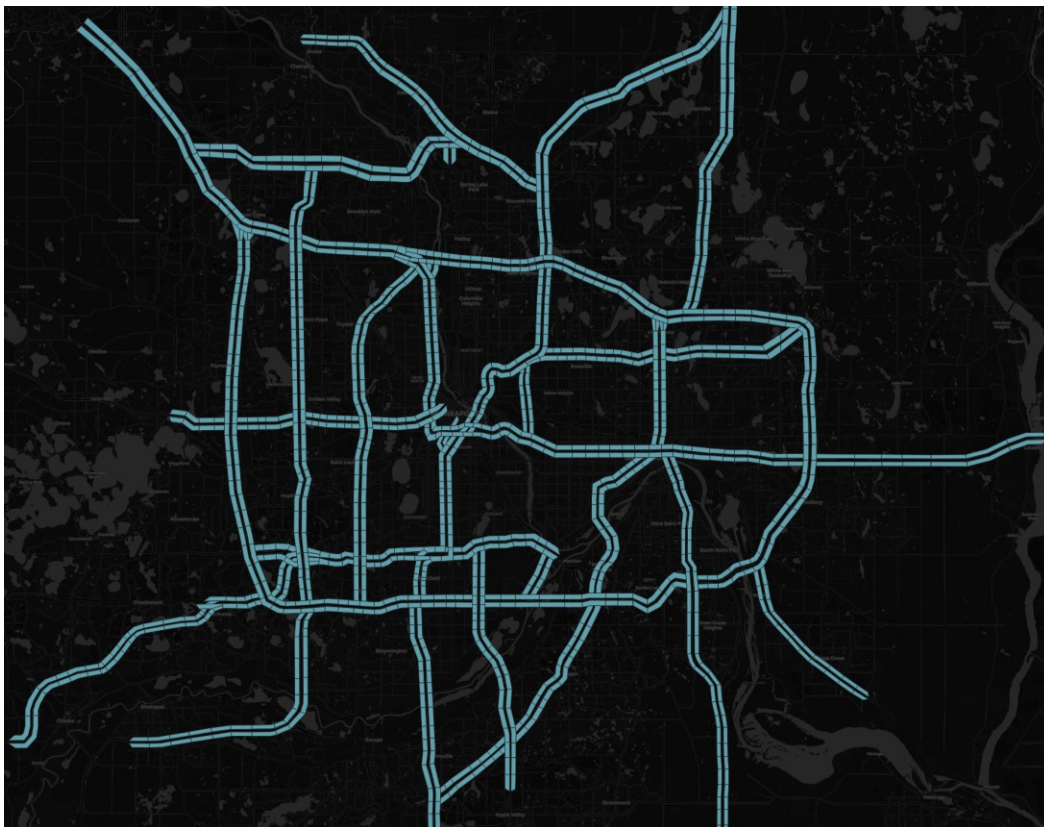


Figure 1. Instrumented freeway system in the Twin Cities metropolitan area.

2.1.2 Loop detector data collection and processing

Data from loop detectors (and radar) was collected from the TrafDat API using custom-developed software that facilitated unattended downloading. The data collected included all detectors on mainline freeway segments (i.e., excluding entrance/exit ramps, collector-distributor roads, etc.), totaling roughly 1500 stations and 4400 individual detectors, and covered Mondays through Fridays from October 2019 to November 2020. A few dates were also excluded from the analysis to account for holidays and days with significant snowfall.

Thirty-second volume and occupancy measurements were obtained for each detector using direct speed measurements when available and volume and occupancy-based estimates when not. These values were then aggregated to 5-minute intervals to reduce noise that can result from sensor errors and natural variability in traffic flow.

At approximately 846,000 data points per day, the entire study period comprised over 225 million data points, consuming 421 GB of raw (30-second) detector data, and more than 200 GB additional data for aggregations and calculated metrics.

2.1.3 Congestion metrics

For this study, freeway congestion was defined as a five-minute average speed at or below 45 miles per hour (mph). This matches the methodology used by MnDOT in its annual *Metropolitan Freeway System Congestion Report*, allowing for comparison with past conditions. Congestion duration was calculated by summing the number of five-minute periods with an average speed at or below 45 mph in a spatial and temporal period of interest divided by the total number of five-minute periods in that same period.

The study also measured vehicle miles traveled (VMT). This was calculated by multiplying volume measurements for each detector-interval by the length of the segment covered by the detector. Detector segments were defined to match those used by the *Congestion Report* to compare to past conditions.

2.2 TRAFFIC SPEEDS ON SIGNALIZED ARTERIALS

This study also explored the relationship between regional VMT and congestion on signalized arterials. To support exploration of this relationship, the study:

- 1.) Identified a source of traffic speed data on signalized arterials
- 2.) Defined a subset of signalized arterials in the Twin Cities for study
- 3.) Selected specific dates before and during the pandemic on which to compare arterial congestion and regional VMT
- 4.) Referenced a congestion threshold methodology for use in measuring arterial congestion

2.2.1 Source of traffic speed data

Average and free-flow traffic speeds on signalized arterials in the Twin Cities metropolitan area were calculated using traffic data obtained from ClearGuide, a proprietary platform that provides mobility information generated using Global Positioning System (GPS) probes and other mobile technologies. ClearGuide data was analyzed on selected corridors at a granularity of five-minute intervals, with average and free-flow speeds established for each direction. Once average speeds were identified, they were then compared against the free-flow speeds to identify the congestion threshold. The number of intervals where the average speed was less than congestion threshold was identified and produced as a percentage.

2.2.2 Selected arterials

Figure 2 shows the signalized arterials chosen to develop congestion analysis. The corridors are:

1. MN 47 – Between Lowry Ave and I-94
2. MN 65 – Between Viking Blvd and TH 610
3. MN 62 – Between I-494 and TH 55
4. MN 7 – between TH 100 and I-494

These corridors were selected to represent a good sample of the signalized arterials in the metro region.

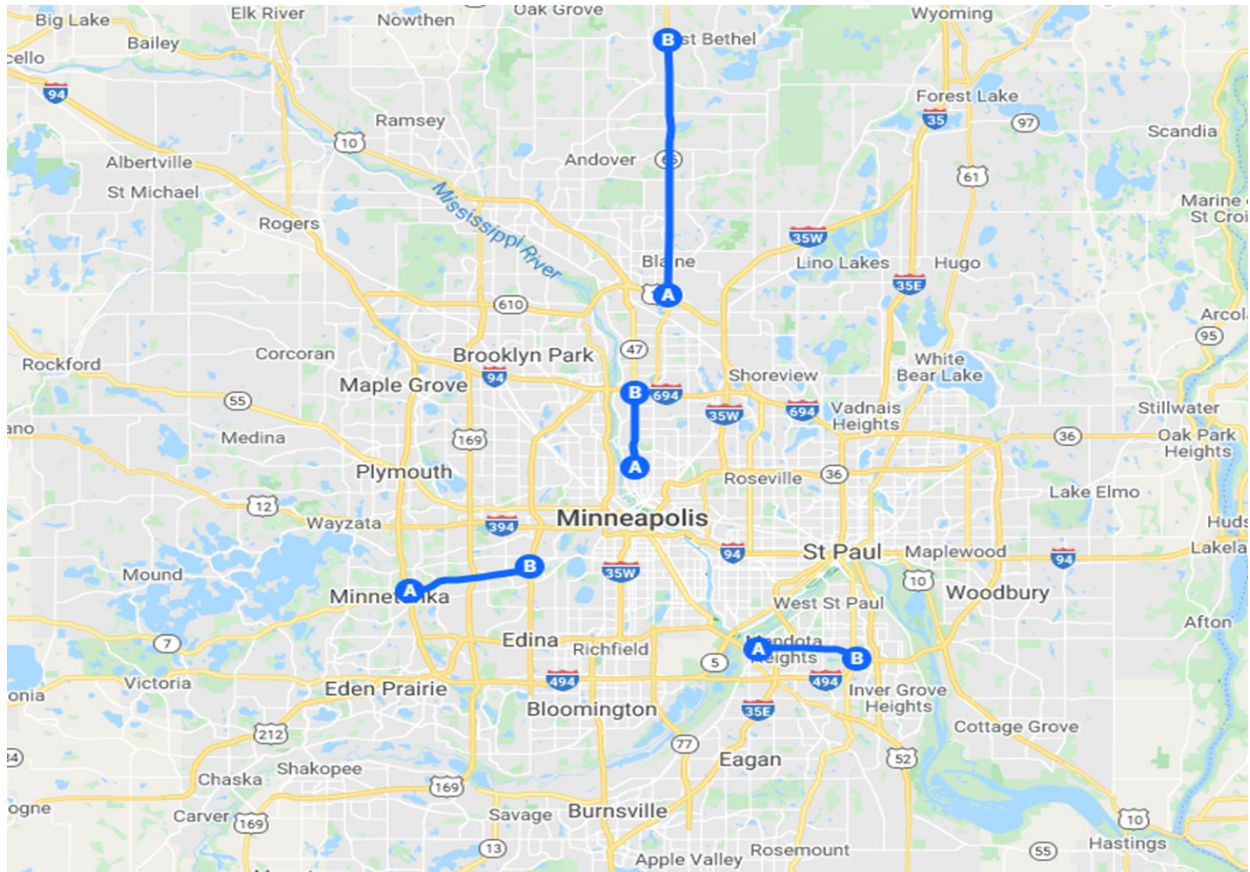


Figure 2. Signalized Corridors selected for congestion evaluation.

2.2.3 Dates of analysis

A series of 25 dates were selected to represent pre-Covid and during Covid conditions. These dates were selected to represent a distribution of VMT and congestion levels on the freeway system at the regional level, allowing an analysis of the relationship between freeway VMT and congestion with VMT and congestion off the freeway system. Using freeway congestion and VMT measures calculated as described in Section 2.1 and elaborated in Chapter 3, these dates were selected based on how closely the congestion or VMT conditions on those days matched the average for a given range of VMT or congestion values. This allowed comparing the ranges of regional values on the freeway system to the arterial system, where the data sources available make obtaining the same amount of data less feasible.

The following dates were used for AM Peak period (5 AM – 10 AM):

- April 3, 2020
- April 16, 2020
- May 8, 2020
- May 19, 2020
- June 22, 2020
- August 19, 2020

- January 3, 2020
- February 14, 2020
- January 31, 2020
- February 3, 2020
- February 26, 2020
- October 16, 2019
- October 8, 2019

The following dates were used for PM Peak period (2 PM – 7 PM):

- April 9, 2020
- March 23, 2020
- March 20, 2020
- May 1, 2020
- May 15, 2020
- June 4, 2020
- July 1, 2020
- August 28, 2020
- November 11, 2019
- January 28, 2020
- March 3, 2020
- December 19, 2019

2.2.4 Congestion thresholds

This study defined congestion on signalized arterials in relation to free flow speed using a methodology established for MnDOT’s *Congestion Management Safety Plan Phase IV* (2018). For arterials with a free flow speed below 40 mph, a congestion threshold was set at 10 mph less than free-flow speed. For arterials with free-flow speeds between 40 mph and 60 mph, the study used a congestion threshold of 0.75 times the free-flow speed. For arterials with a free-flow speed more than 60 mph, the study used a fixed congestion threshold of 45 mph which is used for all freeway facilities. This methodology is illustrated in on the next page. Table 1 provides the congestion threshold calculated for each arterial used in the study.

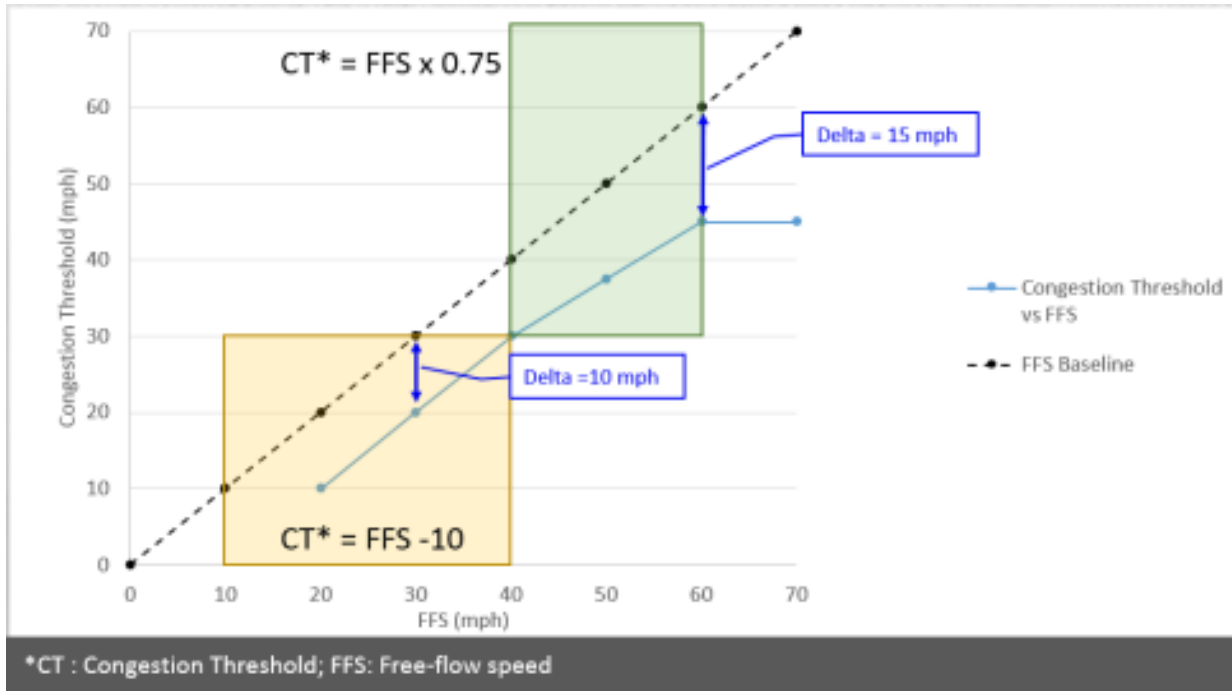


Figure 3. Congestion threshold methodology

Table 1. Congestion thresholds on signalized arterials

Corridor	Characteristic	Free Flow Speed	Congestion Threshold
MN 7	Radial / Parallel	50 mph	36 mph
MN 62	Circumferential / Parallel	55 mph	40 mph
MN 65	Radial / Isolated	60 mph	45 mph
TH 47	Radial / Parallel (Urban)	40 mph	30 mph

2.3 ORIGIN-DESTINATION ANALYSIS

User group travel times were explored using travel time data obtained from StreetLight. This data was collected and processed to conduct origin-destination analyses on the 25 dates used to assess congestion on signalized arterials (see Section 2.2.3). As with the congestion analyses, the study's OD analyses compared regional VMT and user group travel times to see how changes in travel demand impact user group mobility.

2.3.1 User groups

The study examined the travel times of two user groups:

- **Essential workers.** For the study's origin-destination analysis, essential workers were represented by Twin Cities residents commuting to a regional hospital.
- **Environmental Justice populations.** For the study's origin-destination analysis, EJ populations were represented by ACP50 residents commuting to regional employment clusters.

The term ACP50 refers to Areas of Concentrated Poverty in which most residents are non-white. Historically, the Metropolitan Council has used the classification to assess the impacts of policies and programs on low-wealth communities and communities of color. However, there is increasing recognition that combining low-wealth and non-white classifications reinforces negative, deficit-based stereotypes about communities of color. The classification also obscures that most people in poverty in the Twin Cities are white.

When this study was initiated, it was acceptable practice to use ACP50s to represent concentrations of low-wealth and historically marginalized populations. For this reason, the study uses ACP50s as trip origins in its evaluation of how regional VMT impacts the travel times of these groups. Future iterations of this analysis should replace ACP50s with distinct trip origins for low-wealth and historically marginalized populations.

2.3.2 Origins and destinations

2.3.2.1 Essential workers

Essential worker travel times were calculated from an OD analysis that used Thrive MSP 2040 community designations for trip origins and 10 regional hospitals for trip destinations. These trip origins and destinations are shown in Figure 4. The Thrive MSP 2040 community designations used in analysis are Urban/Urban Center, Suburban, and Suburban Edge. The following 10 hospitals are shown on the map.

- Abbot/Children's Hospital
- Fairview Southdale Hospital
- Hennepin County Medical Center
- Mercy Hospital

- North Memorial Medical Center
- Park Nicollet Methodist
- Regions Hospital
- United Hospital - St. Paul
- University of Minnesota Health Center
- Regency Hospital

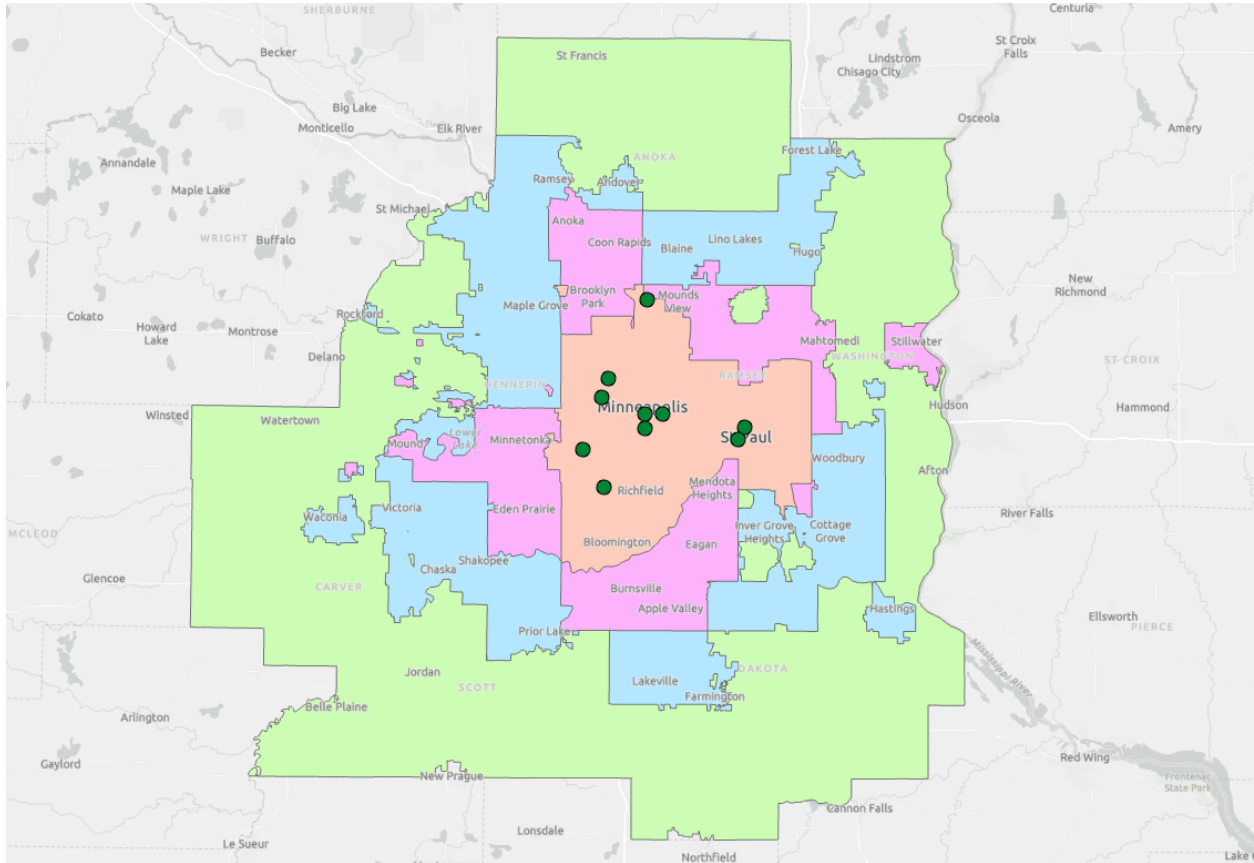


Figure 4. Thrive MSP 2040 community designations and regional hospitals

2.3.2.2 Environmental Justice Populations

Environmental Justice population travel times were calculated from an OD analysis that used ACP50 for trip origins and regional employment clusters for trip destinations. These trip origins and destinations are shown in Figure 5. ACP50s are shown in red; regional employment clusters in green.

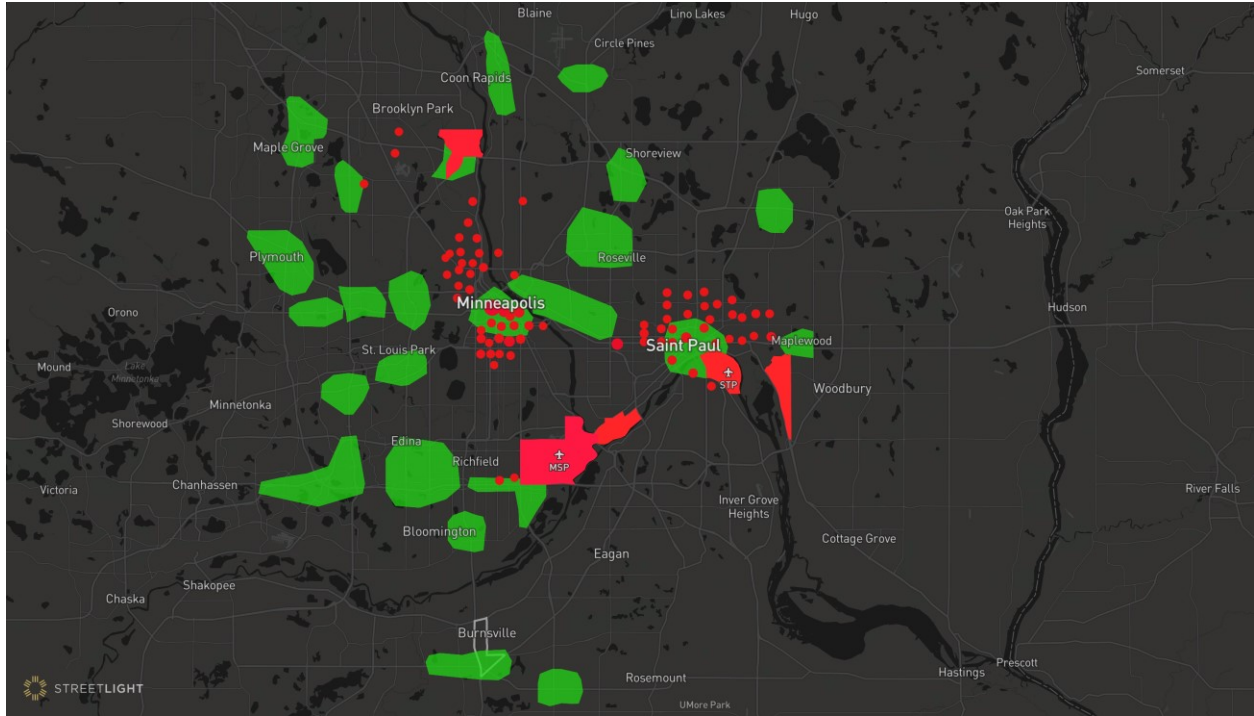


Figure 5. Locations of ACP50 and regional employment clusters in the Twin Cities

2.3.3 Travel time methodology

The study used a consistent methodology to calculate travel times for essential workers and environmental justice populations. This methodology used Streetlight data to generate average trip times for AM and PM peak periods across the 25 dates selected for analysis. In the case of essential workers, average trip times were calculated individually between each community designation and hospital. These averages were averaged again to produce the region's average essential worker travel time. Similarly, trip times were first calculated between each ACP50 area and regional employment cluster and then averaged to identify a typical AM and PM peak commute time for a person living in a neighborhood with a ACP50 designation.

CHAPTER 3: ANALYSIS

This chapter presents analysis conducted in response to the study's paths of inquiry using the sources and methods described in Chapter 2. By way of review, the study's paths of inquiry are as follows:

1. How does regional congestion change with incremental changes in regional VMT?
2. Which corridors are usually congested, frequently congested, and occasionally congested?
3. As regional VMT increases, how does congestion change on signalized arterials?
4. What are the equity implications of changes in regional VMT?

The chapter has six sections. Sections 1 – 3 focus on changes in regional VMT and congestion over the course of the pandemic. These sections shed light on path of inquiry #1: How does regional congestion change with incremental changes in regional VMT? Sections 4 and 5 present a corridor-level analysis that explores the sensitivity of corridor congestion to changes in regional VMT. These sections address the study's questions about congestion frequency and the impact of regional VMT and freeway congestion on signalized arterials. Finally, Section 6 presents the results of the study's OD analysis of essential worker and environmental justice population travel times.

3.1 REGIONAL VMT BEFORE AND DURING THE COVID-19 PANDEMIC

Figure 6 and Figure 7 on the next page show regional VMT over the course of the study period for AM and PM peak periods, respectively. As shown in the plot, regional VMT before the COVID-19 pandemic was relatively constant, with AM peak periods typically experiencing around 7 million VMT and PM Peak periods experiencing around 8.5 million VMT.

Following the World Health Organization (WHO) official declaration of the COVID-19 global pandemic on March 11, 2020, VMT in both AM and PM peak periods began to drop precipitously, with a further drop instigated by the closure of K-12 schools by the State of Minnesota on March 18, 2020, to around 4 million VMT in the AM peak and around 5 million in the PM peak. Another, smaller drop in VMT occurred following the beginning of Minnesota’s Stay at Home Order on March 27, 2020, bringing levels to their lowest point of around 3 million VMT in the AM peak and 4 million VMT in the PM peak in early April 2020. This indicates that, while the Stay-at-Home order did have an effect, people’s behavior had already significantly changed in response to the growing threat from the virus and decisions by businesses, matching many anecdotal observations of this period in time.

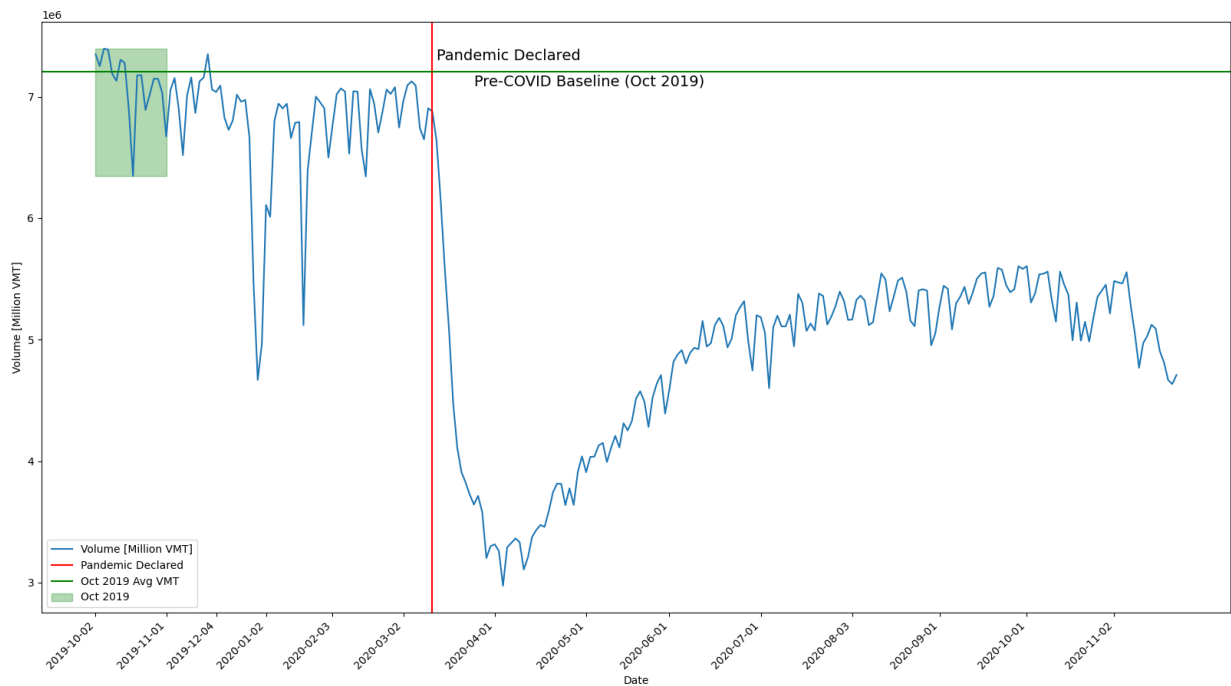


Figure 6. Regional VMT over the study period – AM Peak

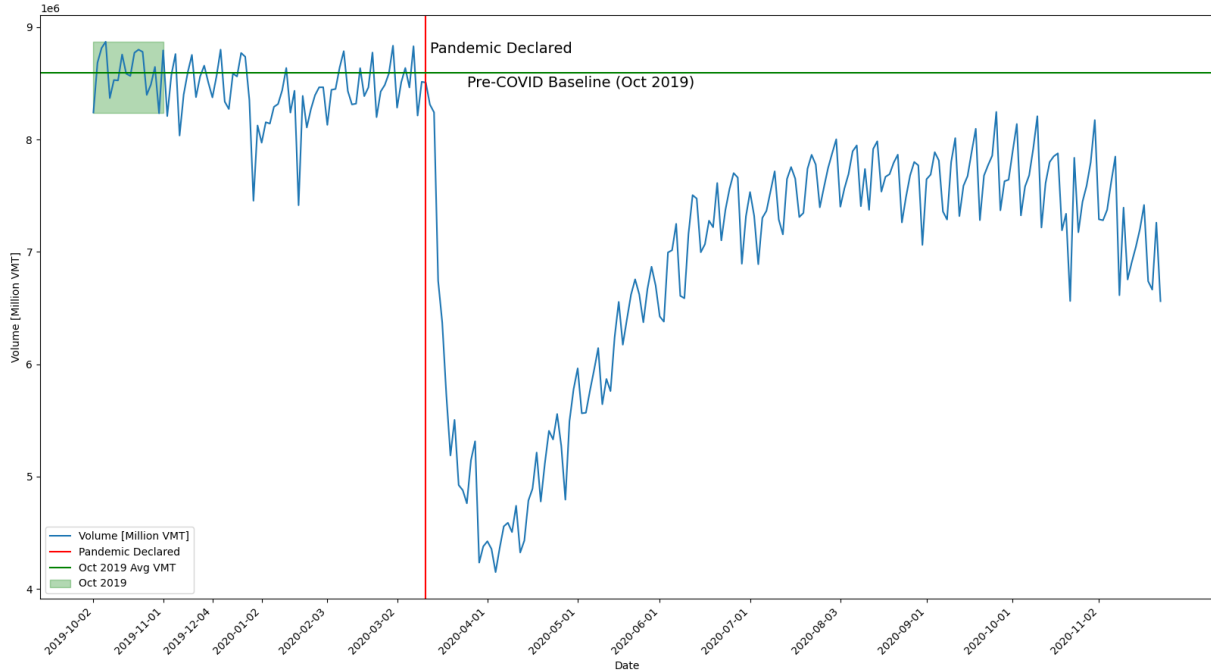


Figure 7. Regional VMT over the study period – PM Peak

Volume trends in the midday (10 AM – 2 PM), shown in Figure 8, and evening (7 PM – 12 AM), in Figure 9, off-peak periods showed a similar trend, with stability in the pre-pandemic period, a sharp drop in March 2020, and a rebound in the summer of 2020. Volumes during these periods are generally lower though, with pre-pandemic levels around 1 million VMT for both midday and evenings, a low of roughly 0.5 million VMT at the height of the stay-at-home order, and a rebound to near pre-pandemic levels following summer 2020.

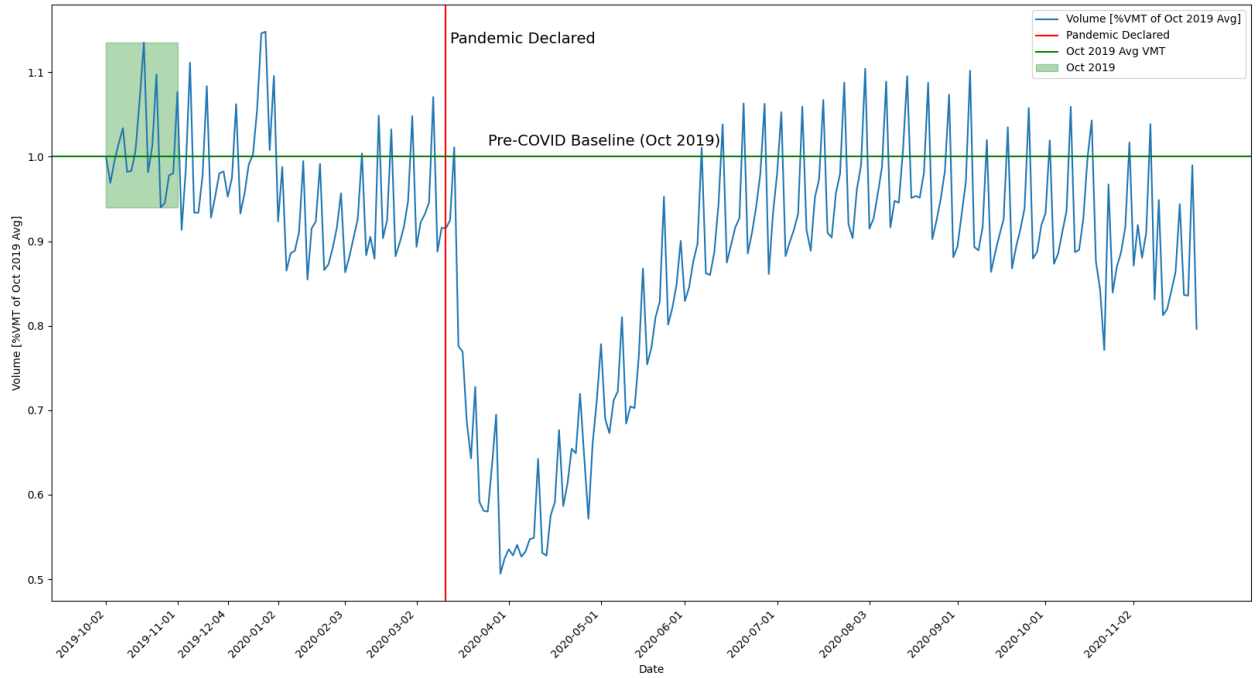


Figure 8. Regional VMT over the study period – Midday Off-Peak

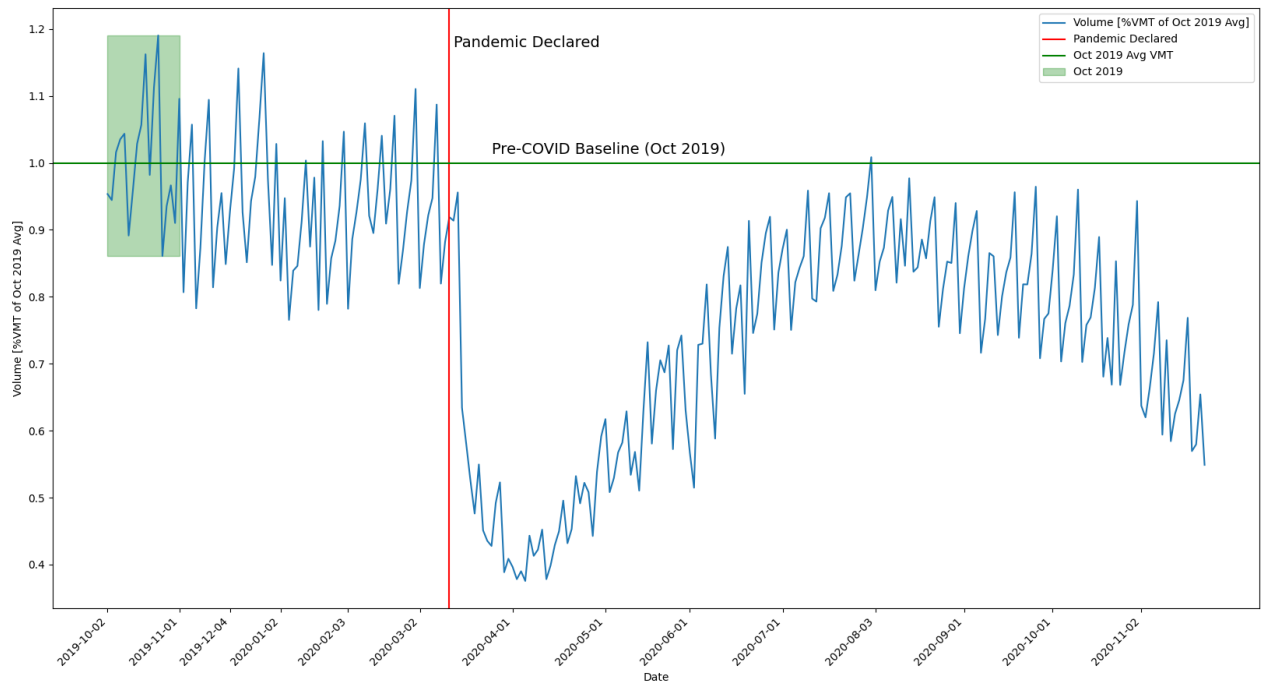


Figure 9. Regional VMT over the study period – Evening Off-Peak

3.2 REGIONAL CONGESTION BEFORE AND DURING THE COVID-19 PANDEMIC

Congestion patterns over the course of the study period demonstrated some similarities to the changes in VMT over the same period, though with some differences owing to the more complex relationship between volume and congestion.

For one, though the midday and evening periods, shown in Figure 10 and Figure 11, demonstrated a similar pattern in VMT change over time, there was very little congestion observed during these periods either before or after the pandemic. In the midday, congestion levels varied from around 1 percent to 2.5 percent congested before the pandemic, and between ~1 percent and 1.5 percent congested during the pandemic. In the evening, congestion levels were even lower, with values ranging from 0.5 - 1.0 percent pre-pandemic, and a slight drop to values ranging from 0.4 - 0.8 percent during the pandemic. In general, all these levels are low enough to produce very little observable congestion from the perspective of drivers.

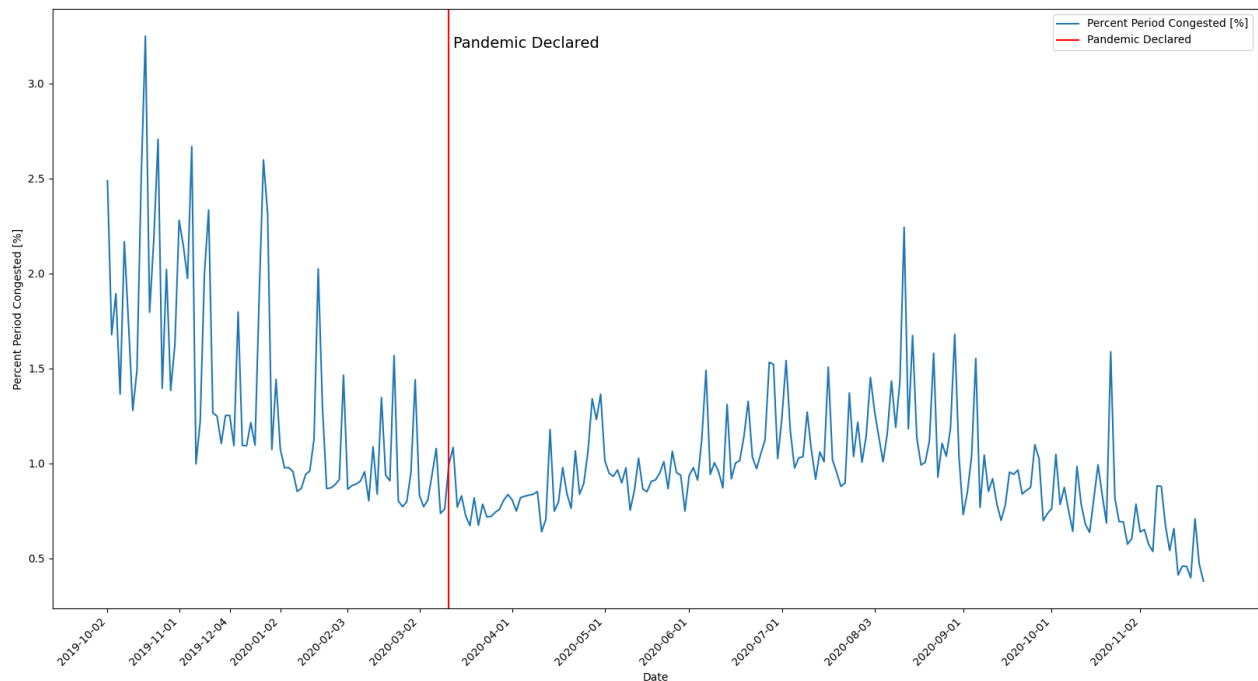


Figure 10. Regional Congestion over the study period – Midday Off-Peak

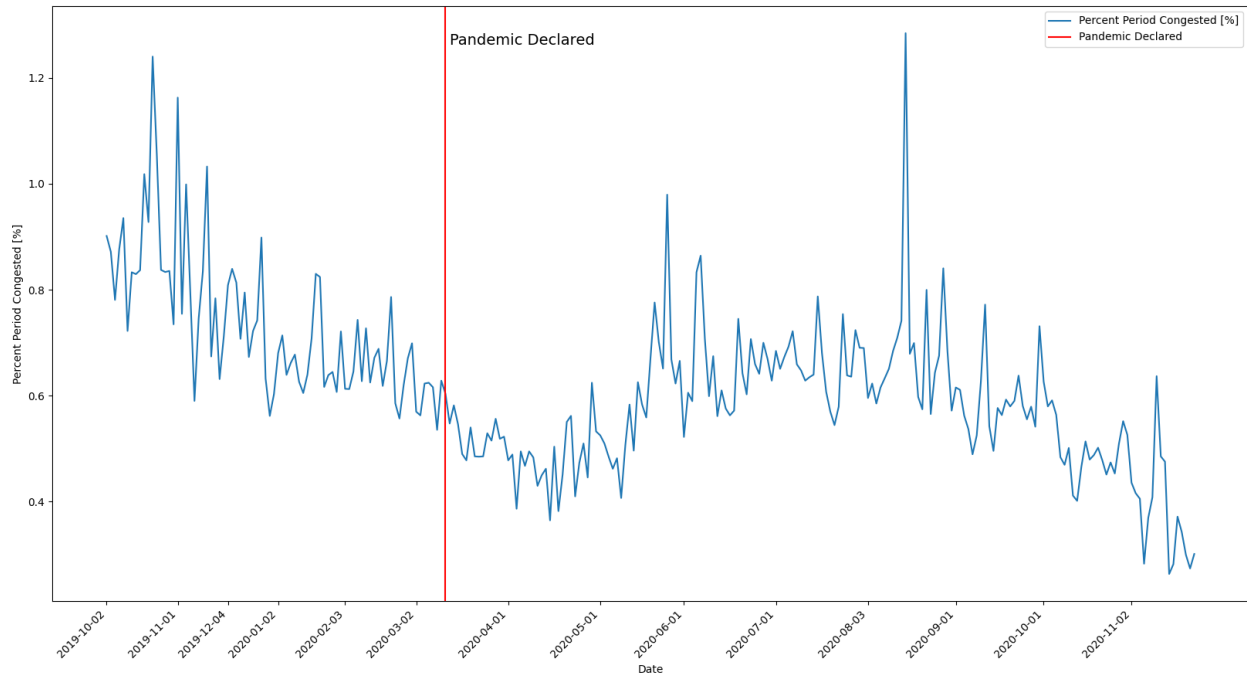


Figure 11. Regional Congestion over the study period – Evening Off-Peak

In the peak periods, by contrast, shown in Figure 12 and Figure 13, the differences between pre- and during-pandemic congestion levels were stark, as was obvious through anecdotal experience. In pre-pandemic AM peak conditions, congestion levels ranged from around 2 percent to up to 8 percent, with the average in October 2019 at about 6.8 percent. Pre-pandemic congestion in the PM peak ranged from around 4 percent to 14 percent, with an October 2019 average of around 11 percent.

During the pandemic, however, congestion effectively disappeared. In the AM peak period, congestion dropped to below 1 percent, with values hovering around that point for the remainder of the study period. In the PM peak, a similar initial drop to around 1 percent was observed, though values up to 2 percent were observed starting in June 2020, and values up to 4 percent observed in late summer/early fall. Notably, even these highest levels of congestion in the PM peak during the pandemic barely reached the lowest levels of congestion in the pre-pandemic period, even though volume neared 90 percent of pre-pandemic levels.

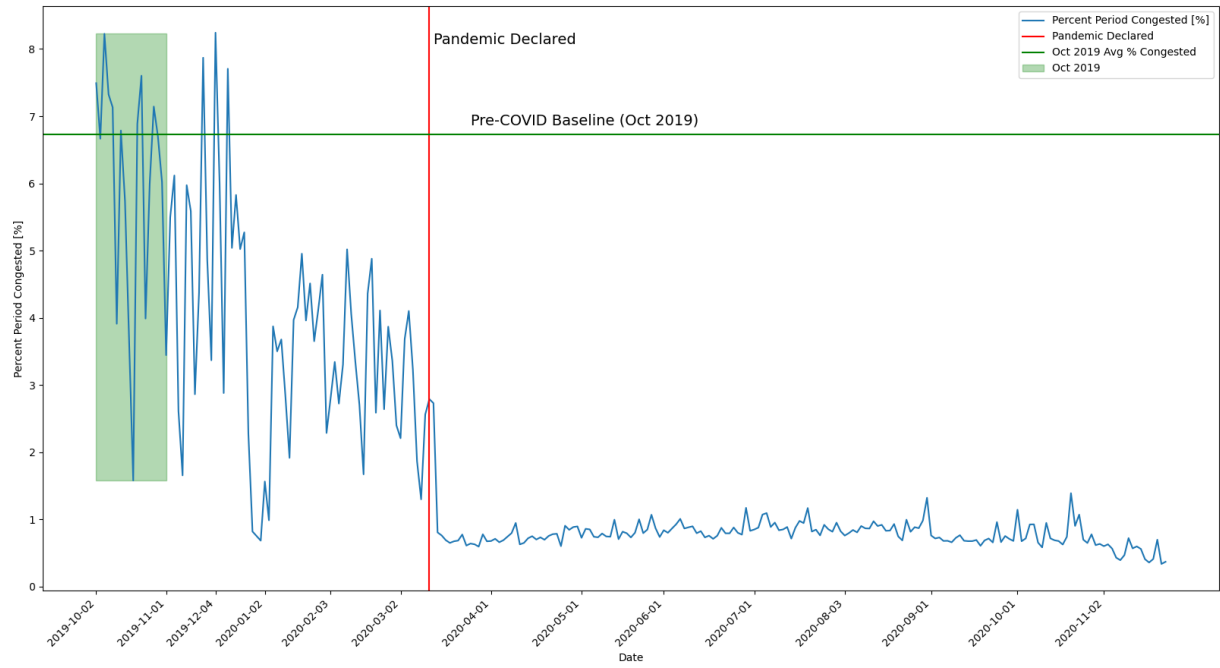


Figure 12. Regional Congestion over the study period – AM Peak

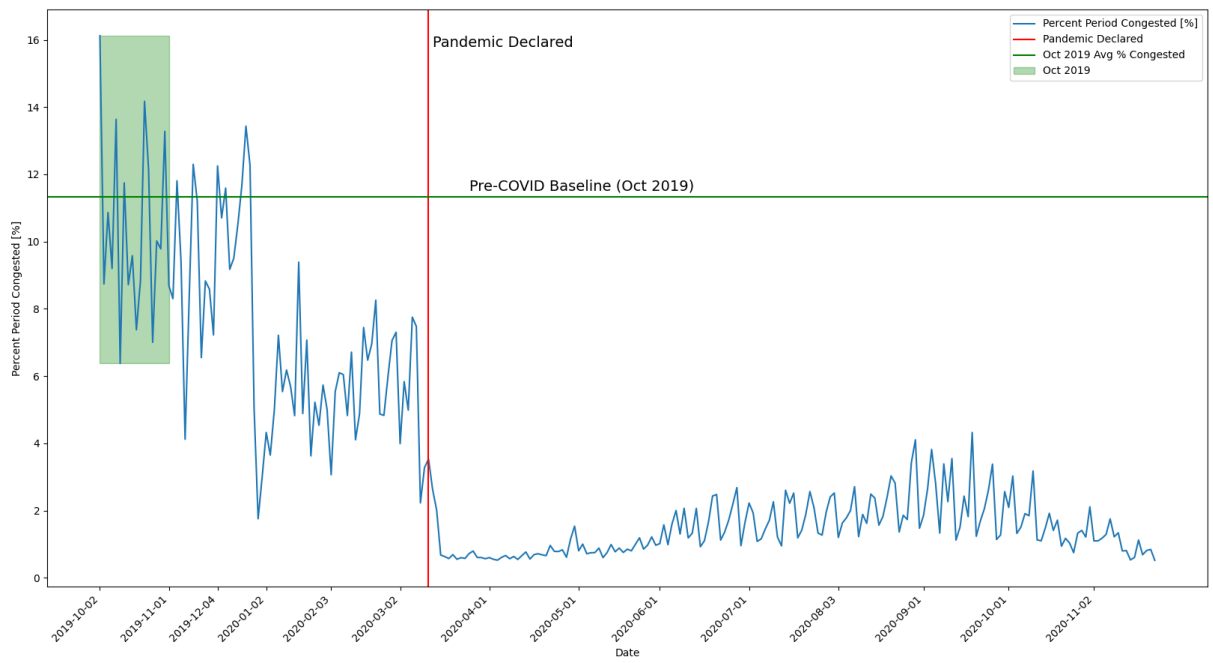


Figure 13. Regional congestion over the study period – PM Peak

3.3 TIPPING POINT ANALYSIS

3.3.1 Relationship between regional VMT and regional congestion

As alluded to above, the study observed a rebound in traffic volume following a drop at the beginning of the pandemic, but it did not observe a similarly sized increase in congestion. This is due to the nature of freeway operations. Freeways with sufficient capacity can accommodate increased traffic volumes with minimal declines in speed. This dynamic continues until high traffic densities exceed the freeway's capacity, resulting in the dramatic slowdowns that characterizes congestion.

While this may explain the general theory of why congestion levels behaved the way they did, more interesting is understanding how this phenomenon precisely affects the relationship between VMT and congestion. In this way, the pandemic represented something of a natural experiment, providing the opportunity to see how varied and prolonged changes in regional VMT affected actual congestion levels in the real world.

To examine this relationship, a plot of regional VMT vs. congestion over the entire study period (both pre- and during-pandemic) was created, and a curve was fitted to this data. From the PM peak period version of this plot, shown in Figure 14, two things can be noted. First, as indicated by the coloring of points, the data from the study period shows a consistent, overlapping trend in congestion levels before and during the pandemic. This indicates that the volume-to-congestion relationship was not fundamentally altered by pandemic changes in travel behavior.

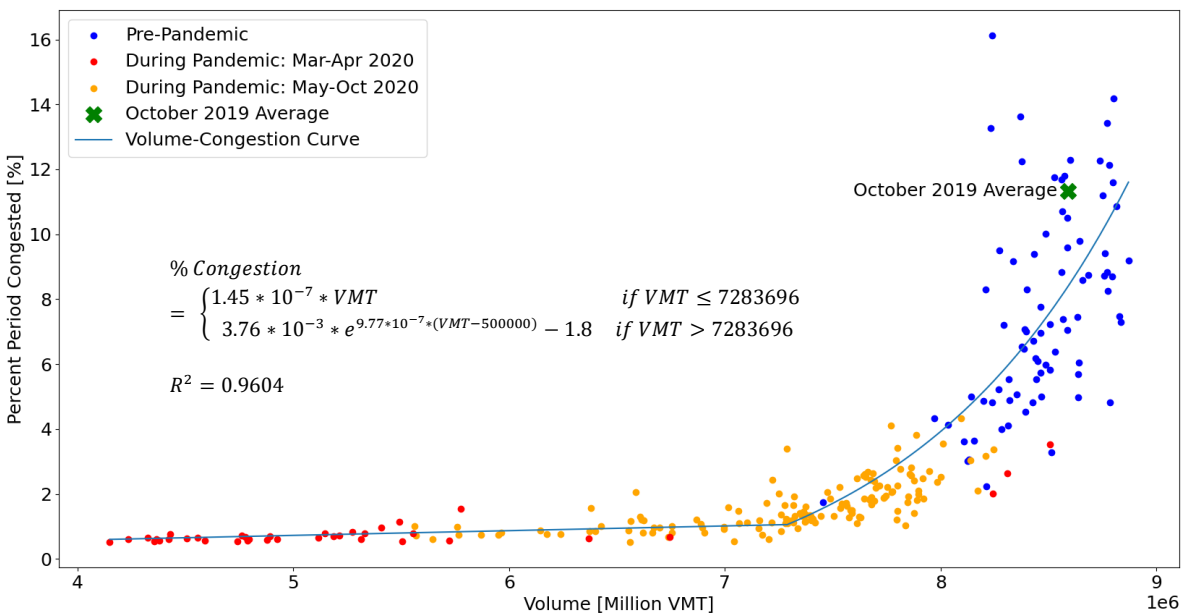


Figure 14. Regional congestion vs. VMT – PM Peak

Second, and most significantly, these data points exemplify the mechanism of congestion explained at the beginning of the section. At lower volumes, until around 7 million VMT, congestion behaves linearly.

Above that point, congestion becomes nonlinear, growing exponentially. This is demonstrated by the equation fitted to this data, where a piecewise linear/exponential function was found to best represent the relationship between VMT and congestion, compared to alternatives. Additionally, once in the exponential portion of the curve, there is an inflection point, around 8 million VMT, where congestion starts to show runaway growth. In fact, the increased dispersion in the data points above this level of VMT suggests even more variability than can be described by a single equation, illustrating the volatility that exists in highly congested systems.

Combining these two points, the mechanism behind the observations noted in the previous sections regarding the patterns of VMT and congestion over the course of the pandemic becomes clear. Despite the fact that volumes in the PM peak period approached 90 percent of those typical of pre-pandemic conditions, by largely staying below the 8 million VMT threshold, they remained below the inflection point past which runaway congestion begins. Because of this, any congestion that did appear was able to remain fairly localized and not spread throughout the network, as will be explored further in Section 3.4.

A similar trend was observed in the AM peak periods, shown in Figure 155, though there are some differences largely attributable to the difference in trip types that make up AM peak travel compared to PM peak travel. First, data from the pre- and during-pandemic periods did not overlap as much, showing the continued effect of remote work preferences throughout the study period. Second, as discussed in the previous sections, both VMT and congestion during these periods were reduced compared to PM peak periods, resulting in a shallower relationship between the two.

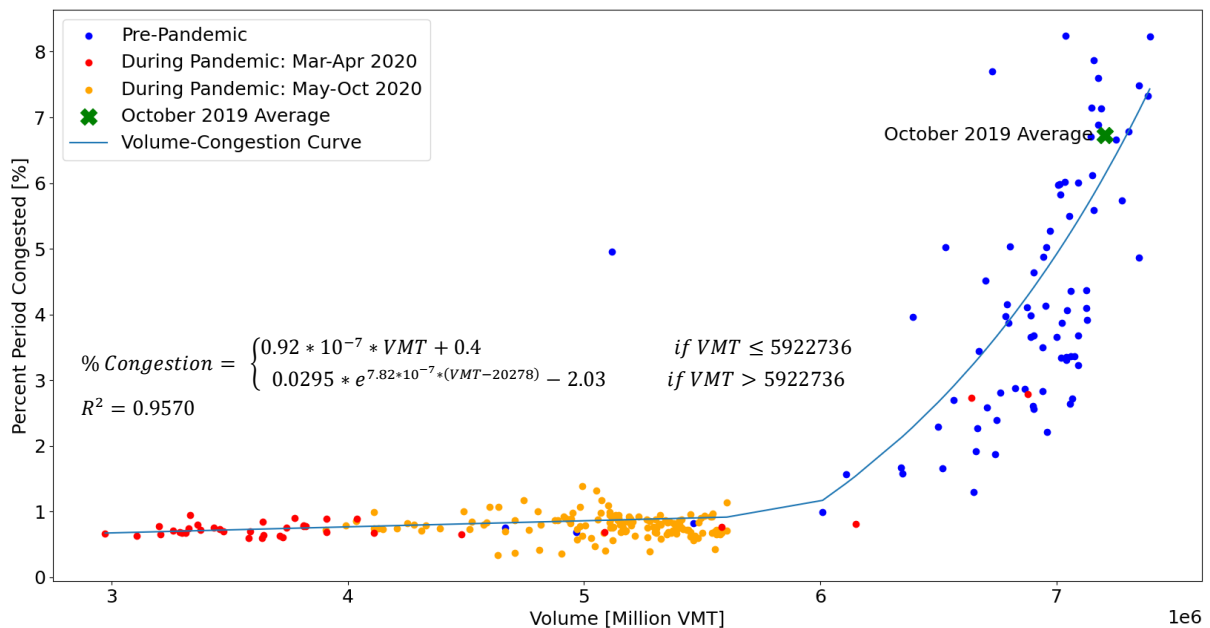


Figure 15. Regional congestion vs. VMT – AM Peak

3.3.2 Congestion benefits of VMT reduction

Given this relationship between VMT and congestion, it follows that there are significant benefits from reducing VMT at the regional level by even small amounts. Figure 16 shows the average congestion values in 100,000 VMT bins, along with the same function modeling PM peak VMT vs. congestion from Figure 14. Using this function, the expected congestion reduction for a range of VMT reductions compared to the October 2019 baseline was calculated, with these values indicated on the plot in red.

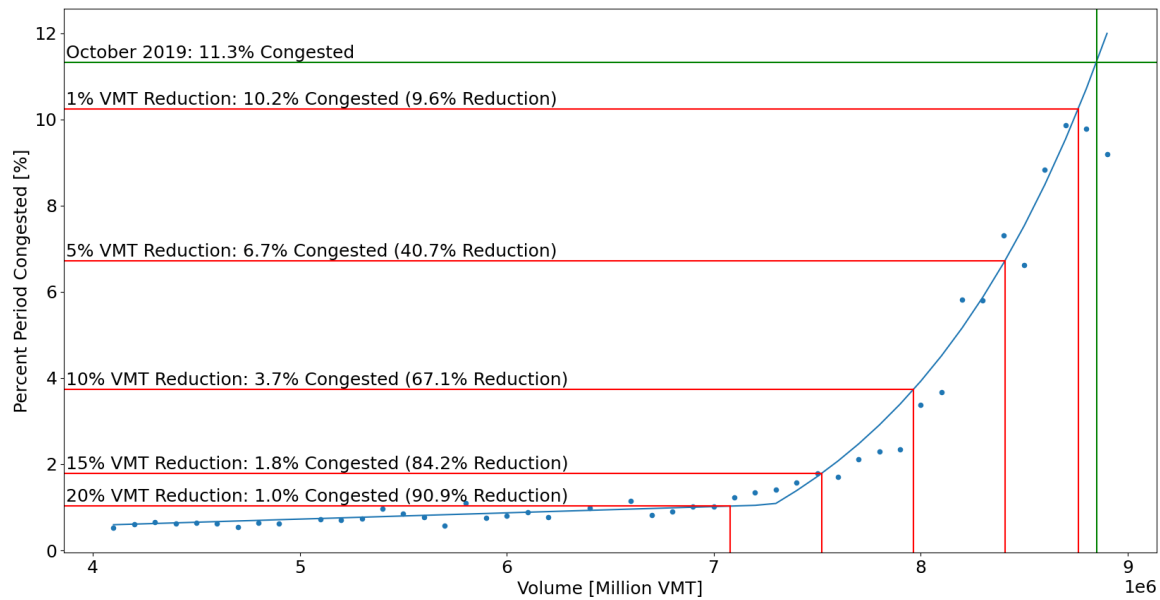


Figure 16. Congestion benefits of VMT reduction – PM Peak

Table 2. Congestion benefits of VMT reduction - PM Peak

Regional VMT (in millions)	Regional VMT (reduction from Oct. 2019 base)	Regional Congestion (share of freeway system < 45 mph)	Regional Congestion (reduction from Oct. 2019 base)
8.76	1%	10.2%	9.6%
8.41	5%	6.7%	40.7%
7.96	10%	3.7%	67.1%
7.52	15%	1.8%	84.2%
7.08	20%	1.0%	90.9%

Note: October 2019 base VMT calculated from October 2019 congestion to put congestion reductions in like terms. As a result, there is a slight difference between the October 2019 base VMT presented here and observed VMT.

As illustrated on the plot, even minor reductions in VMT produce significant reductions in congestion, with the steepest reduction in congestion, of about 40 percent compared to the baseline, occurring from only a 5 percent VMT reduction. A 10 percent VMT reduction puts the system into the range observed in the during-pandemic portion of the study period, with congestion decreasing by 2/3rd compared by the baseline.

At the most extreme, a 20 percent VMT reduction moves the system into the linear portion of the function, effectively eliminating all congestion. A similar trend is observed in the AM peak period, shown in Figure 17. While this is instructive, given the nature of the restrictions in place during this period, this likely represents the ceiling for the amount of congestion reduction that can be achieved through travel demand management strategies. Despite this, the nonlinear relationship between VMT and congestion at higher volumes still provides some lucrative opportunities for VMT reduction.

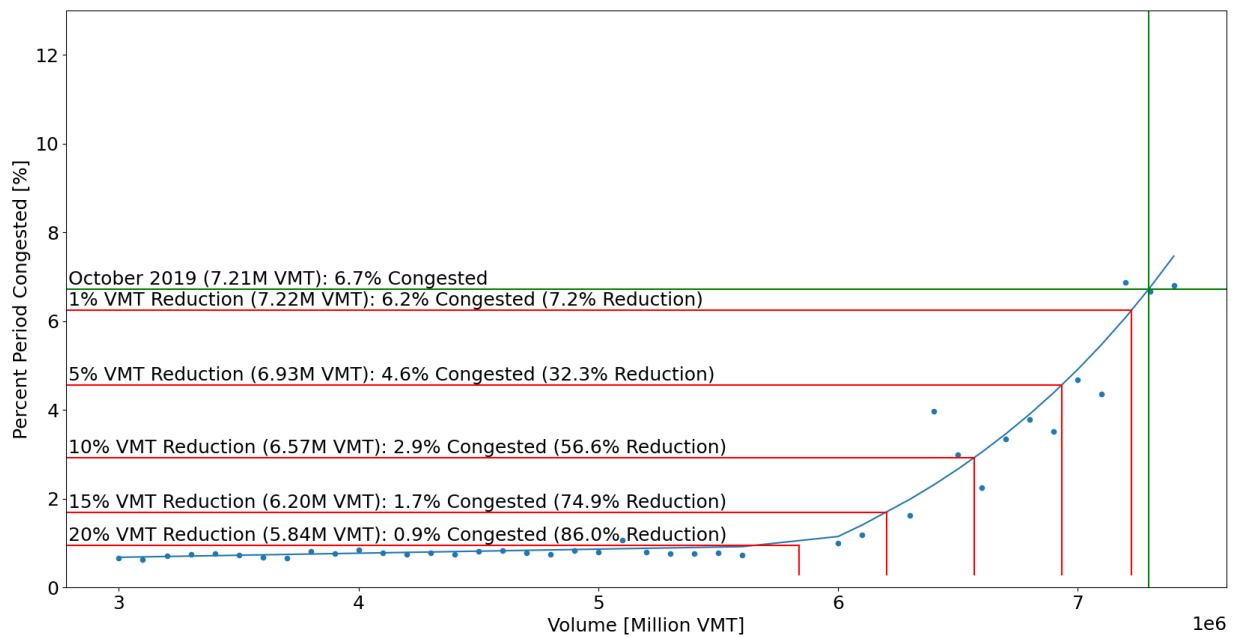


Figure 17: Congestion benefits of VMT reduction – AM Peak

Table 3. Congestion benefits of VMT reduction – AM Peak

Regional VMT (in millions)	Regional VMT (reduction from Oct. 2019 base)	Regional Congestion (share of freeway system < 45 mph)	Regional Congestion (reduction from Oct. 2019 base)
7.22	1%	6.2%	7.2%
6.93	5%	4.6%	32.3%
6.57	10%	2.9%	56.6%
6.20	15%	1.7%	74.9%
5.84	20%	0.9%	86.0%

Note: October 2019 base VMT calculated from October 2019 congestion to put congestion reductions in like terms. As a result, there is a slight difference between the October 2019 base VMT presented here and observed VMT.

3.4 REGIONAL VMT AND CONGESTION ON FREEWAY CORRIDORS

3.4.1 Segmentation of Twin Cities area freeways

The study also investigated the relationship between congestion at the regional level and congestion on individual corridors. The first step of this investigation divided freeways into major segments. Each freeway was divided into roughly equal-length segments, seen in the map in Figure 18, representing connections between interstates, or in a few cases other major trunk highways. Congestion data in these segments for each date was then compared to the corresponding congestion at the regional level. This portion of the analysis focused primarily on the PM peak period; however, a similar trend was observed in data from the AM peak period.

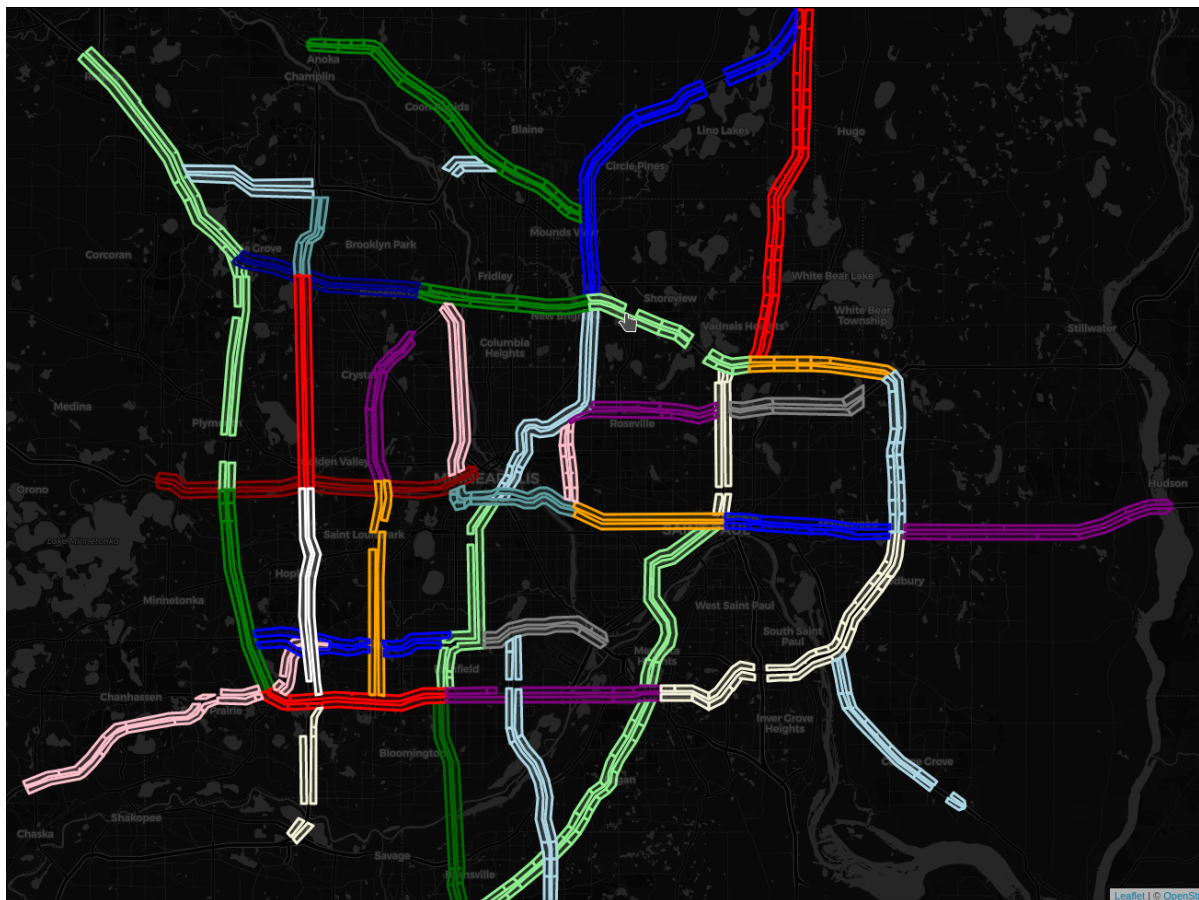


Figure 18. Map of corridor segments used for corridor-level analysis.

3.4.2 Comparison of regional and corridor-level congestion

To compare regional level congestion to corridor-level congestion, a series of plots were created to explore the variation in congestion in different corridor segments at varying levels of regional congestion. To account for the difference in magnitude between congestion at a corridor level compared to the regional level in these plots, congestion is expressed as a percentage of the maximum congestion experienced at the respective level.

Figure 19 shows congestion on the seven segments of I-94 in the Twin Cities metro area compared to congestion at the regional level, with a 1:1 line representing a baseline level of congestion where corridor-level congestion tracks with regional-level congestion. This plot illustrates a theme that is common among the primary freeway corridors in the Twin Cities region. As can be seen in the plot, the segment connecting I-394 with TH-280, one of the most heavily travelled corridors in the state, tends to exhibit congestion that rises both above the congestion observed in other segments of the same corridor, and congestion at the regional level. This is compared to the segment between TH-280 and I-35E, which, while more congested than other segments of I-94, tracks below the regional level of congestion. The other segments of the corridor, by comparison, do not exhibit significant levels of congestion until regional congestion reaches fairly high levels.

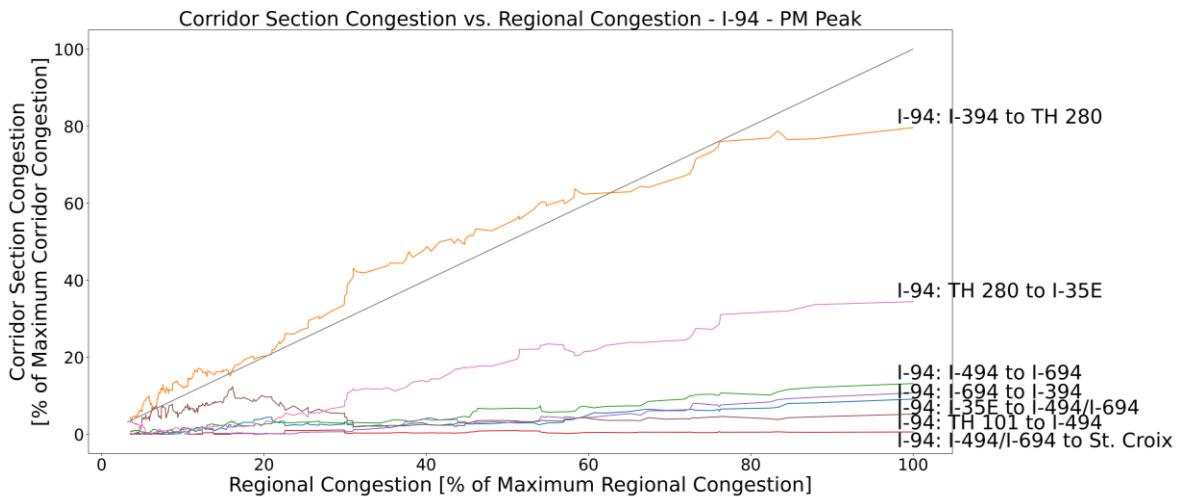


Figure 19. Corridor segment congestion vs. regional congestion for I-94 segments.

A similar trend is observed in Figure 20 (I-694), Figure 21 (I-494), and Figure 22 (I-35W), where one segment is close to or above the regional level of congestion, another set of segments follow regional congestion growth more slowly, and a third set exhibit very limited congestion until high levels of regional congestion. A similar pattern continues throughout most of the corridors in the Twin Cities metro area, though generally without the most highly congested segments exhibited by these major travel corridors.

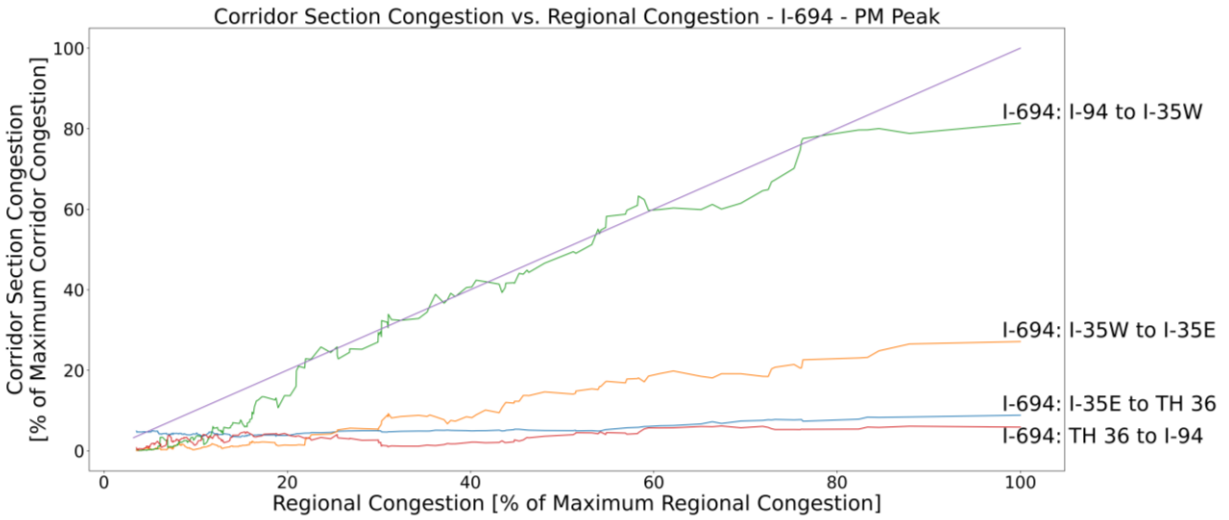


Figure 20. Corridor segment congestion vs. regional congestion for I-694 segments.

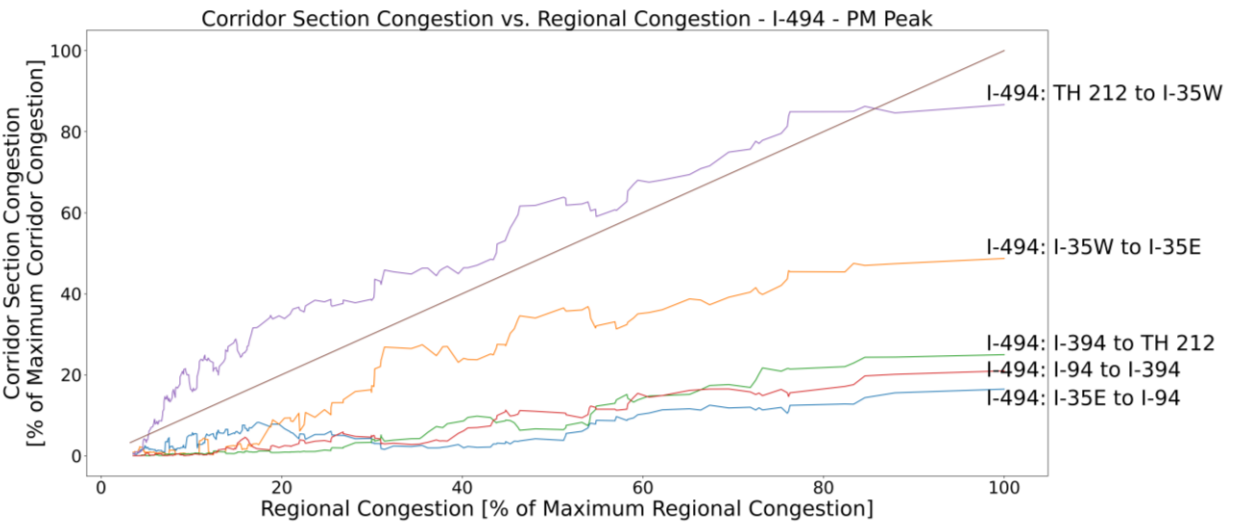


Figure 21. Corridor segment congestion vs. regional congestion for I-494 segments.

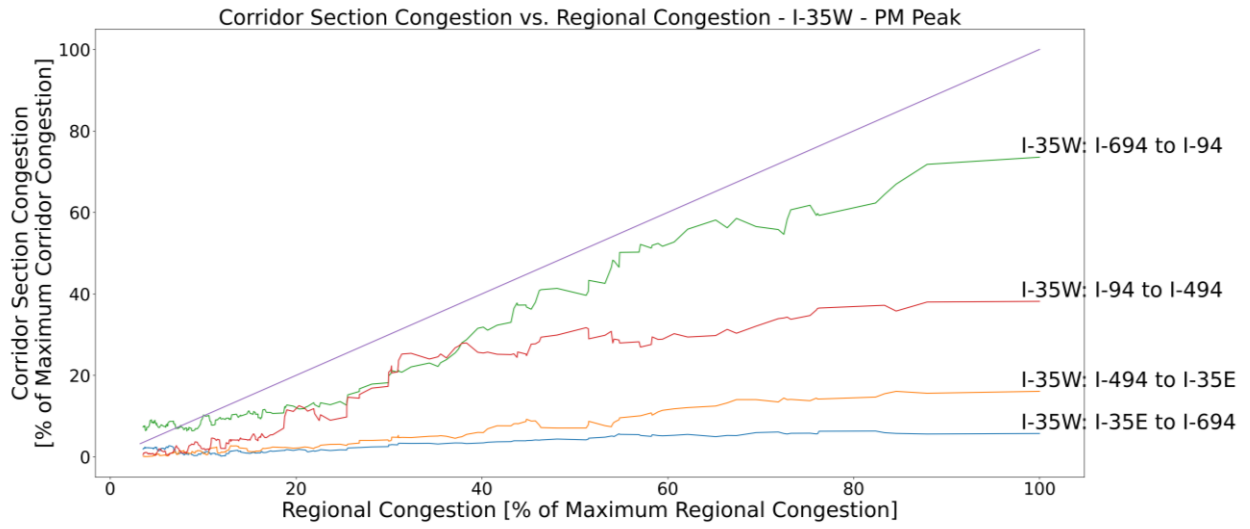


Figure 22. Corridor segment congestion vs. regional congestion for I-35W segments.

3.4.3 Categorization of corridors based on sensitivity of congestion to changes in VMT

When comparing all segments of freeway corridors throughout the metro area, some segments exhibit congestion that grows at or near the rate of regional congestion, others exhibit congestion that grows more slowly, and another group exhibits congestion that only becomes apparent at high levels of regional congestion. Based on these distinctions, the corridor segments were placed into the groups shown in Table 4.

Table 4. Corridor segment groups

Usually Congested at moderate demand levels	Frequently Congested at higher demand levels	Occasionally Congested at extreme demand levels	Limited data availability*
I-94: I-394 to TH 280 I-694: I-94 to I-35W I-494: TH 212 to I-35W I-35W: I-694 to I-94 I-394: All I-494: I-35W to I-35E TH 100: I-394 to I-494 TH 62: I-494 to I-35W	I-35E: I-94 to I-494 I-94: TH 280 to I-35E I-35W: I-94 to I-494 US 169: I-94 to I-394 I-35E: I-694 to I-94 TH 36: I-35W to I-35E I-94: I-694 to I-394 I-694: I-35W to I-35E I-94: TH 101 to I-494 US 169: I-394 to I-494 I-494: I-394 to TH 212 I-494: I-94 to I-394 I-94: I-494 to I-694 I-494: I-35E to I-94 TH 100: I-94 to I-394	TH 77: All TH 62: I-35W to MN River TH 10: All TH 212: All I-94: I-35E to I-494/I-694 I-35W: I-494 to I-35E I-694: I-35E to TH 36 I-35E: I-494 to I-35W I-35E: I-35W to I-694 I-694: TH 36 to I-94 I-35W: I-35E to I-694 I-94: I-494/I-694 to St. Croix US 169: TH 610 to I-94 TH 36: I-35E to I-694	TH 610: All TH 61: All TH 280: All

*Insufficient sample size to classify congestion frequency.

The first group consists of corridor segments that are usually congested at moderate levels of demand. These are critical connection points for major routes through the Twin Cities metro area and generally represent the most significant bottlenecks in the freeway system. The second group consists of segments that frequently become congested at higher demand levels, but typically only after the segments in the first group experience congestion. The third group consists of segments that become congested occasionally but only at extreme levels of demand. In addition to these main groups, there is also a fourth group of segments that did not demonstrate observed congestion, though it should be noted that this may result more from a lack of data available for these corridors, rather than their actual behavior. When displayed on a map, as in Figure 23, these corridor segment groups look like a map of typical PM peak congestion in the metro area.

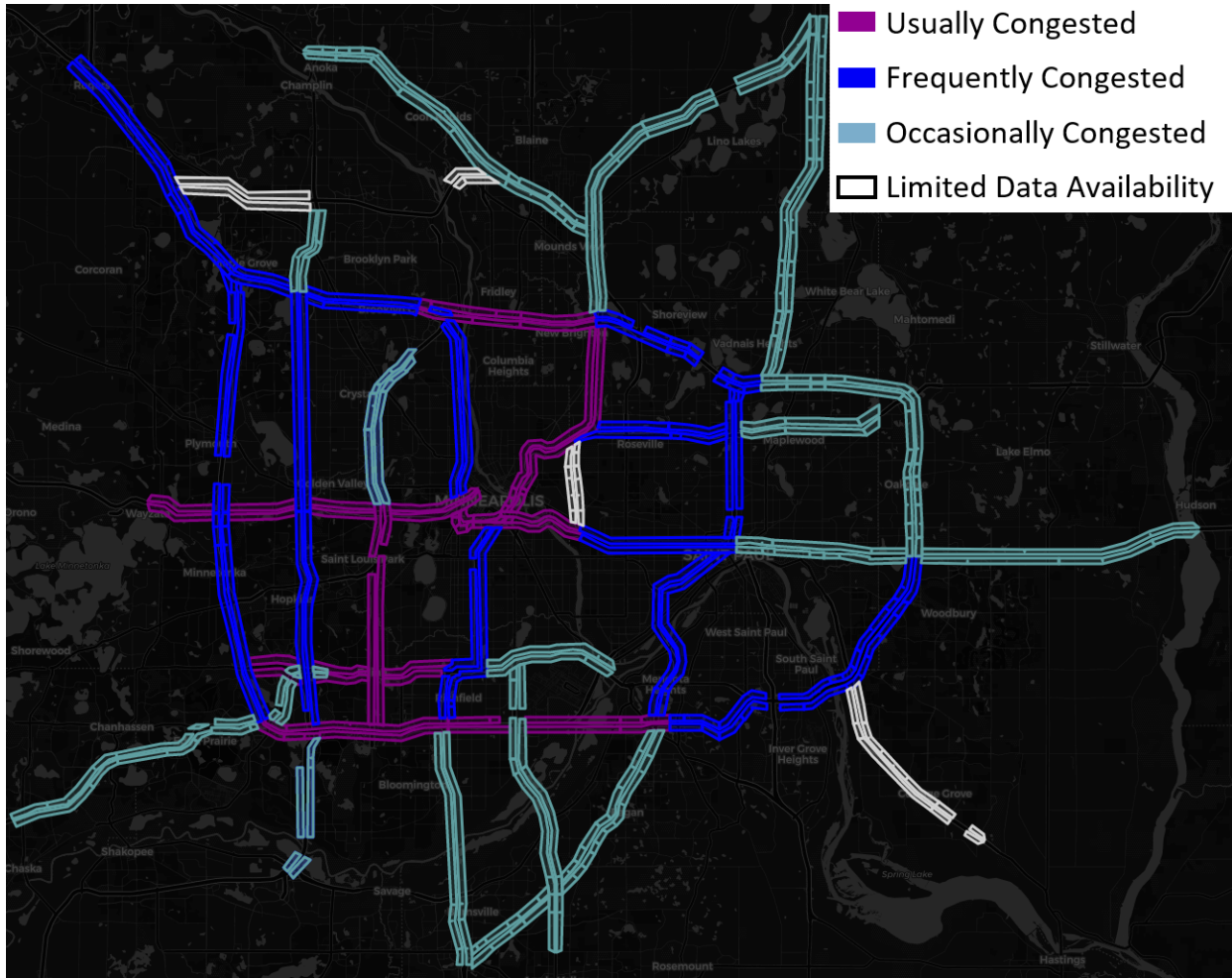


Figure 23. Map of corridor segment groups

Averaged together, these groups show a clear distinction from one another. Figure 24 shows the aggregated corridor-level congestion in these groups compared to regional VMT for the PM peak period (with some smoothing). As can be seen in the plot, the “usually congested” corridor segments demonstrate congestion that rises more rapidly and to a higher magnitude than the other two groups. In contrast, the “frequently congested” group shows a similar pattern but delayed and with a lower maximum. The “occasionally congested” group shows minor congestion at all but the highest levels of demand.

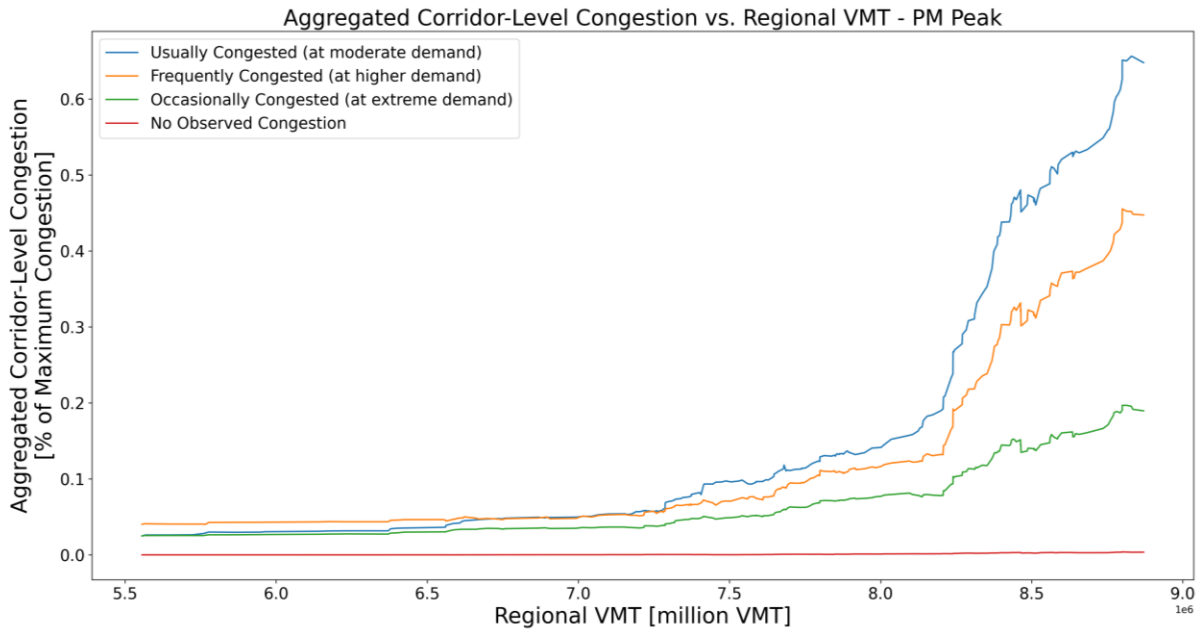


Figure 24. Aggregated corridor-level congestion vs. regional VMT – PM Peak

Figure 25 shows the rate of aggregated corridor-level congestion increase vs. regional congestion. This is essentially the second derivative of the data in Figure 244, representing the rate at which congestion at the corridor level is growing. Values higher on the Y axis of this plot indicate that congestion is increasing at an increasing rate, i.e. accelerating. As this plot shows, as congestion at the regional level increases, congestion in corridor segments in the “usually congested” group begins to increase at an increasing rate much earlier than segments in the other groups. This continues until regional congestion reaches about 8 percent, at which point the rate of increase of congestion in these segments begins to slow. At this point congestion is still increasing in these segments, but at a slower and decreasing rate.

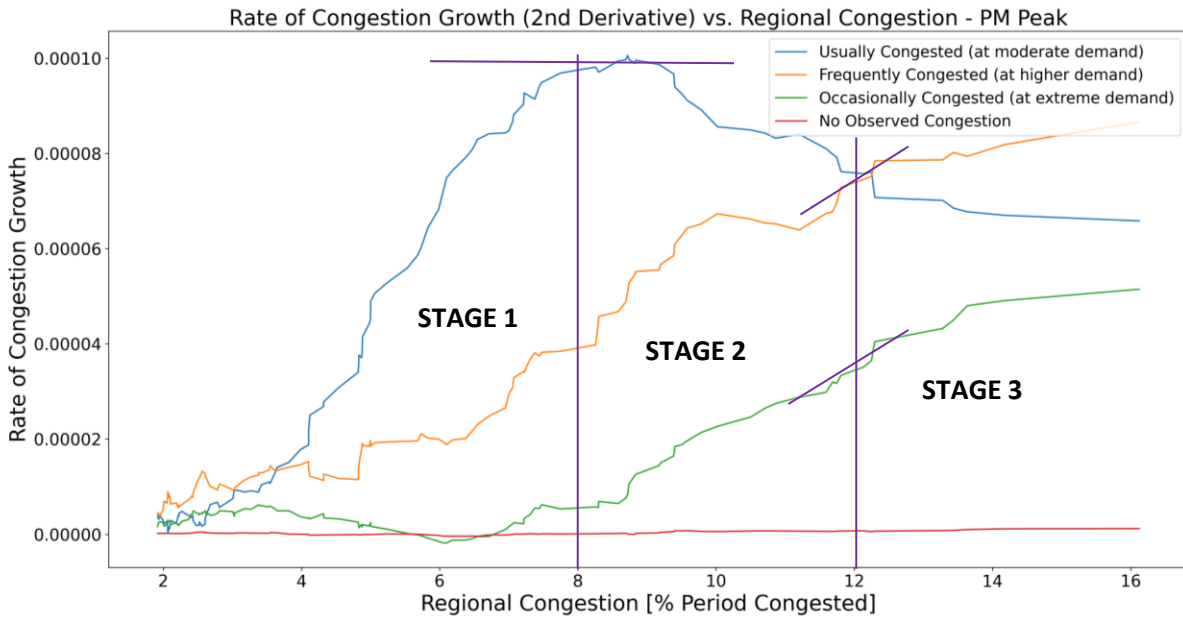


Figure 25. Stages of congestion growth -- PM peak

Meanwhile, the rate of congestion increase in the “frequently congested” group continues increasing. As regional congestion increases further, to around 12 percent, the rate of congestion increase in these segments then overtakes that of those in the “usually congested” group, indicating that congestion in these “frequently congested” segments is growing faster than that in the “usually congested” segments. This is likely because, at this level of regional demand/congestion, the “usually congested” segments have essentially reached their maximum capacity near jam density. At this point, there is effectively no more room on the roadway in these segments for any more vehicles, so congestion spills over into the less congested “frequently congested” segments.

In the third, “occasionally congested,” group, congestion is also increasing at an increasing rate, albeit slower than in the “frequently congested” group. However, one can imagine that, with further regional demand above that typically seen in the Twin Cities, a similar point would occur where the rate of congestion increase in the “frequently congested” group would slow down, allowing the rate of congestion increase in the “occasionally congested” group to overtake it, owing this time to segments in the “frequently congested” group reaching their capacity.

Looking at the congestion growth process from this perspective, some insights can be made into the dynamics of congestion at very high demand levels. Figure 26 shows the same plot of regional congestion vs. regional VMT shown in Figure 14, but with some additional annotations. The lower horizontal line indicates the general point at which the rate of congestion increase in the “usually congested” segments slows down. At this point, congestion becomes highly volatile, as can be observed in the highly dispersed points in the box just above this line. The upper horizontal line shows the point at which the rate of congestion increase in the “frequently congested” segments overtakes the rate in the “usually congested” segments, with points above this line showing similar variability.

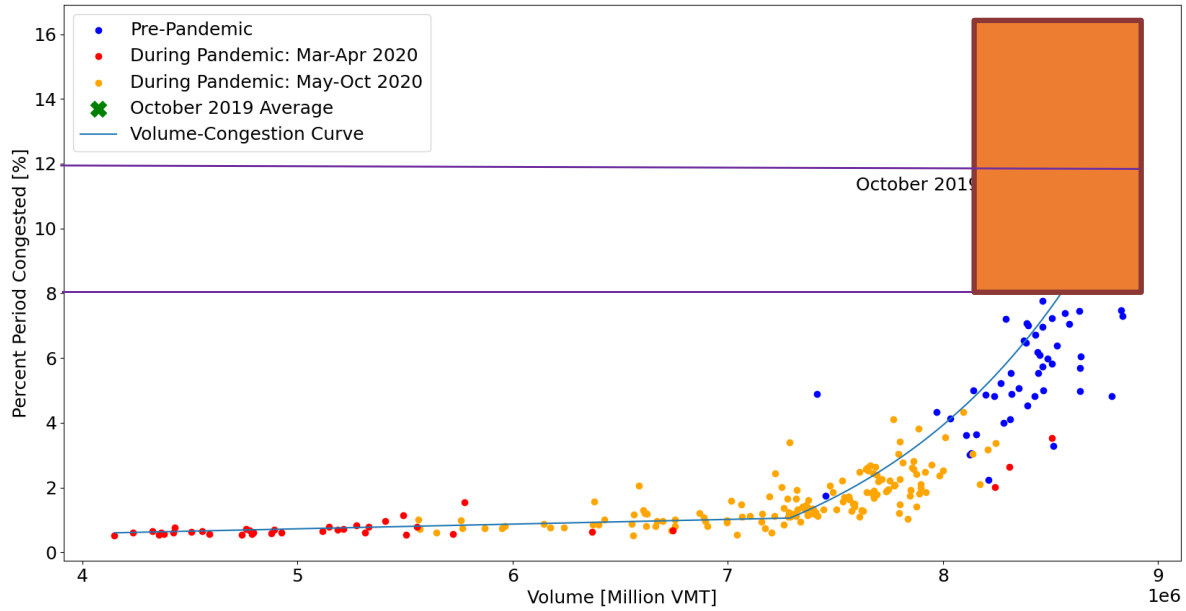


Figure 26. Congestion tipping point – PM peak

Above these lines, the smoother relationship between VMT and congestion that is observed at lower levels of regional demand/congestion breaks down, causing much less predictable congestion that can rise to extreme levels. However, the nature of congestion at the corridor level suggests some potential ability to control this, by keeping congestion in the key “usually congested” corridor segments below the point where it spills over into the less congested segments, for instance by targeting travel demand management strategies towards reducing travel in these particular segments or corridors.

3.5 REGIONAL TRAVEL DEMAND AND CONGESTION ON SIGNALIZED ARTERIALS

As described in Chapter 2 Sources and Methods, this study includes an analysis of how regional travel demand impacts congestion on signalized arterials. This analysis used ClearGuide speed data and arterial specific congestion thresholds to measure congestion on four Twin Cities arterials during AM and PM peak hours for 25 dates in late 2019 and 2020. The four arterials studied were MN 7 between MN 100 and I-494; MN 47 between Lowry Ave and I-94; MN 62 between I-494 and MN 55; and MN 65 between Viking Blvd and MN 610.

Results of the study's analysis of congestion on signalized arterials are presented in two parts. The first part charts the relationship between arterial congestion and regional VMT to see whether and how arterial congestion increases with incremental increases in regional VMT. The second part of the presentation charts the relationship between congestion on select arterials and the regional freeway system.

3.5.1 Regional VMT and congestion on signalized arterials

3.5.1.1 MN 7 between MN 100 and I-494

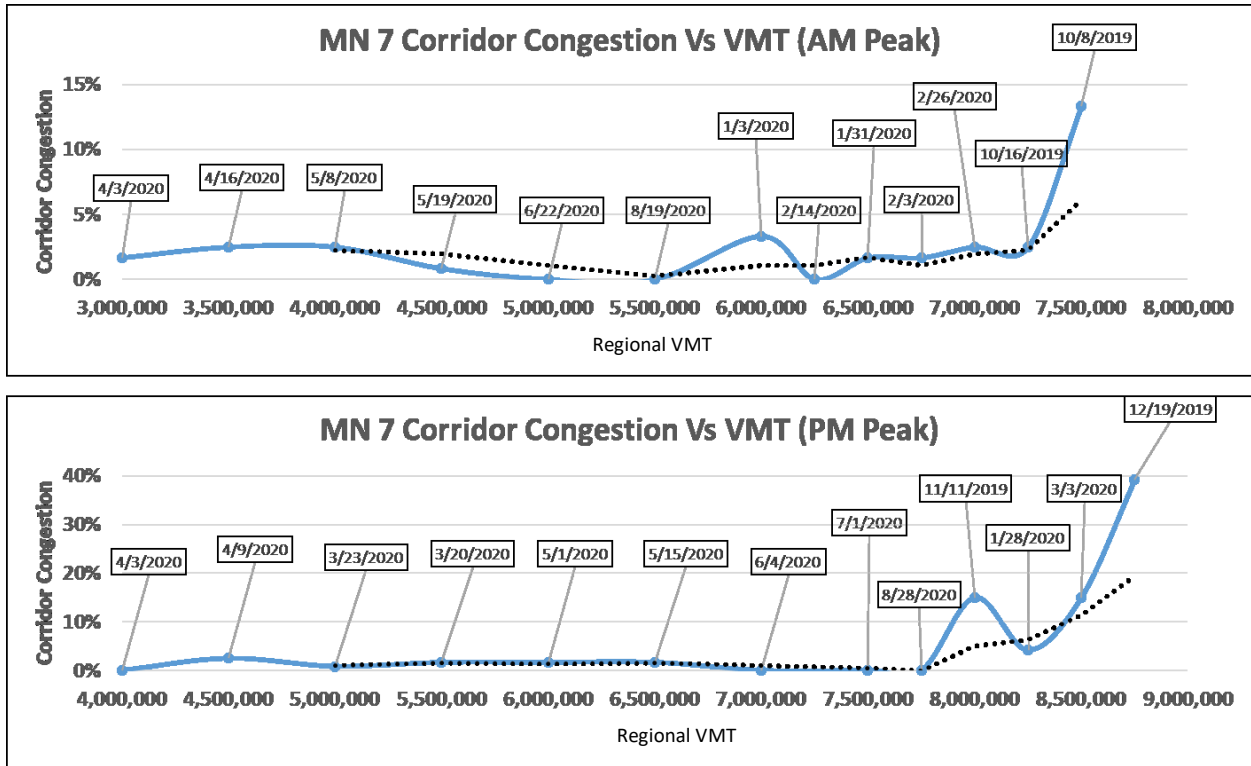


Figure 27. Relationship between congestion on MN 7 and regional VMT – AM and PM Peak

Analysis of regional VMT and AM congestion on MN 7 indicates corridor congestion remains between 0 – 5 percent until regional VMT during the AM peak period tops 7 million. Analysis of regional VMT and PM congestion on MN 7 indicates there is little to no congestion on the corridor until regional VMT during the PM peak period tops 8 million.

3.5.1.2 MN 47 between Lowry Ave and I-94

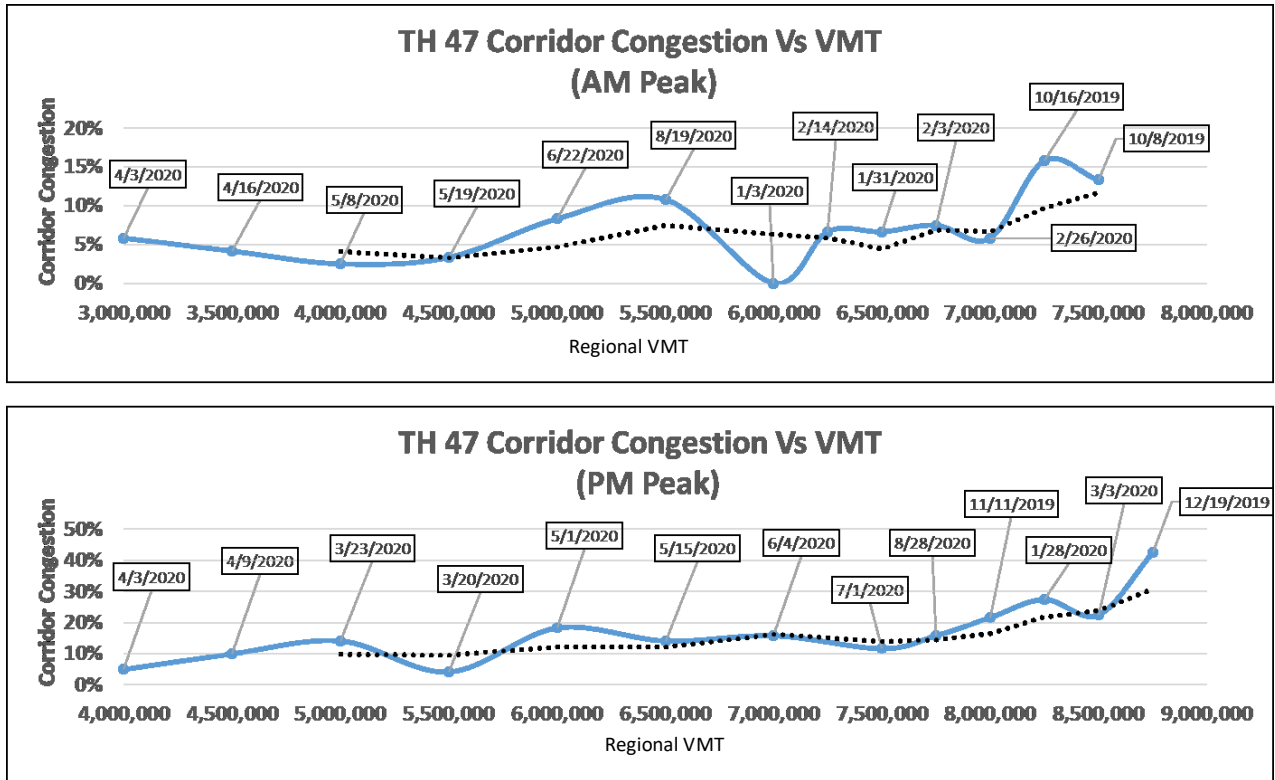


Figure 28. Relationship between congestion on MN 47 and regional VMT – AM and PM Peak

Analysis of regional VMT and AM congestion on MN 47 indicates corridor congestion remains between 0 – 10 percent until regional VMT during the AM peak period tops 7 million. Analysis of regional VMT and PM congestion on MN 47 indicates corridor congestion fluctuates between 5 – 20 percent on the corridor until regional VMT during the PM peak period tops 8 million.

3.5.1.3 MN 62 between I-494 and MN 55

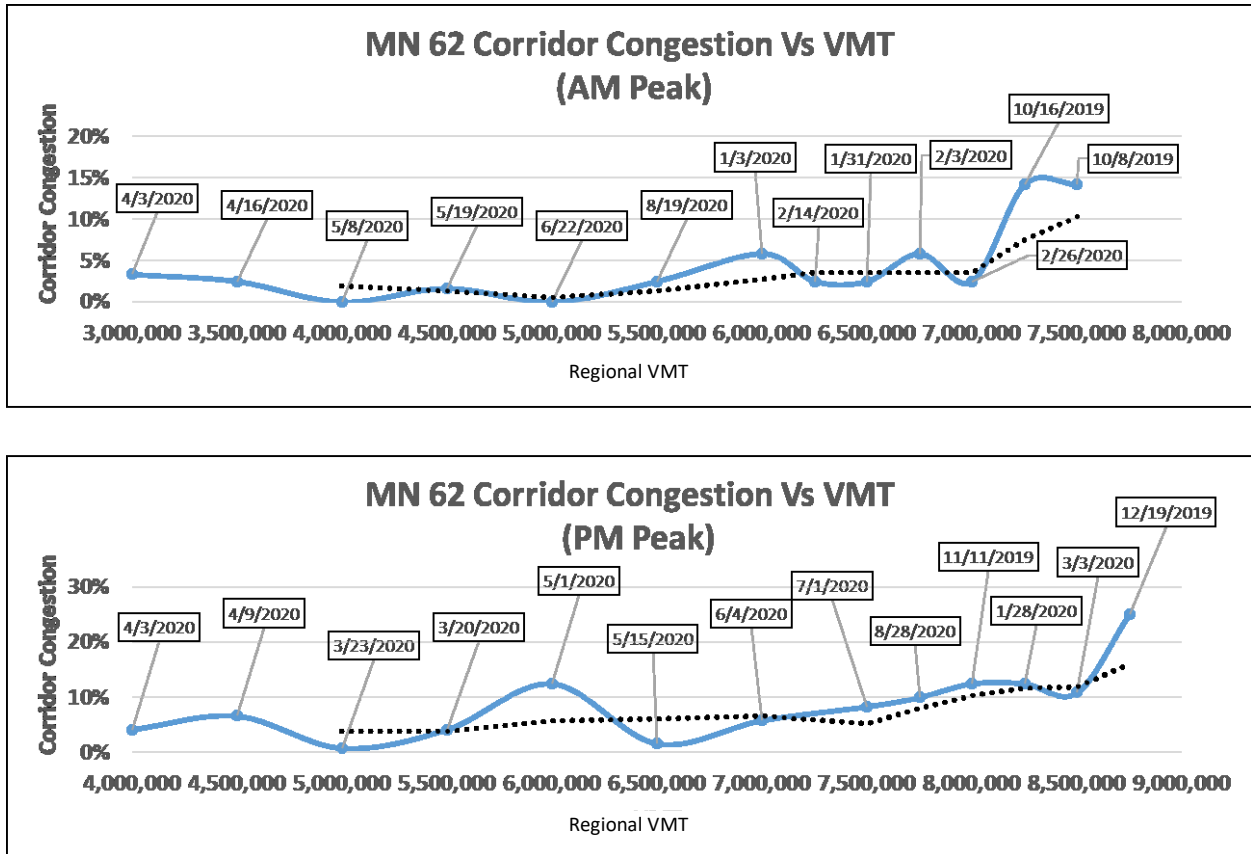


Figure 29. Relationship between congestion on MN 62 and regional VMT – AM and PM Peak

Analysis of regional VMT and AM congestion on MN 62 indicates corridor congestion remains between 0 – 10 percent until regional VMT during the AM peak period tops 7 million. Analysis of regional VMT and PM congestion on MN 62 indicates corridor congestion fluctuates between 0 – 10 percent on the corridor until regional VMT during the PM peak period tops 7.5 million.

3.5.1.4 MN 65 between Viking Blvd and MN 610

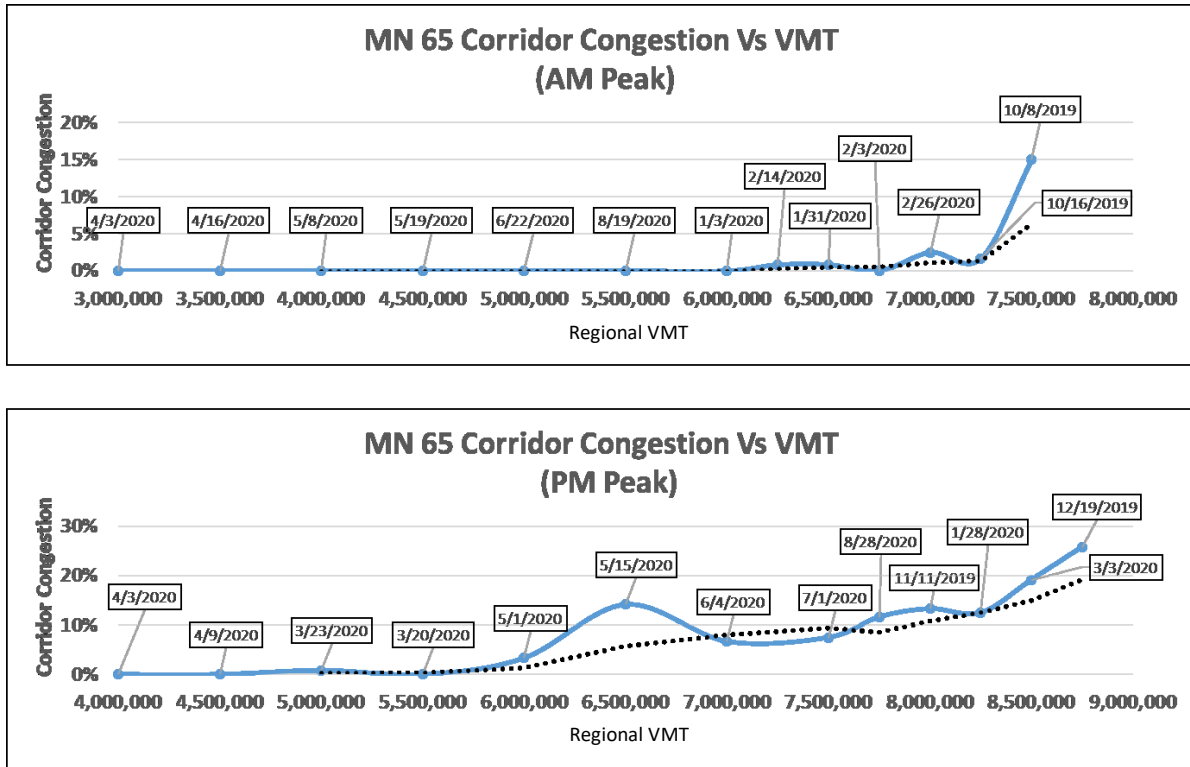


Figure 30. Relationship between congestion on MN 65 and regional VMT – AM and PM Peak

Analysis of regional VMT and AM congestion on MN 65 indicates little to no corridor congestion until regional VMT during the AM peak period tops 7 million. Analysis of regional VMT and PM congestion on MN 65 indicates corridor little to no corridor congestion until regional VMT during the PM peak period tops 5 million.

3.5.2 Regional congestion and congestion on signalized arterials

3.5.2.1 MN 7 between MN 100 and I-494

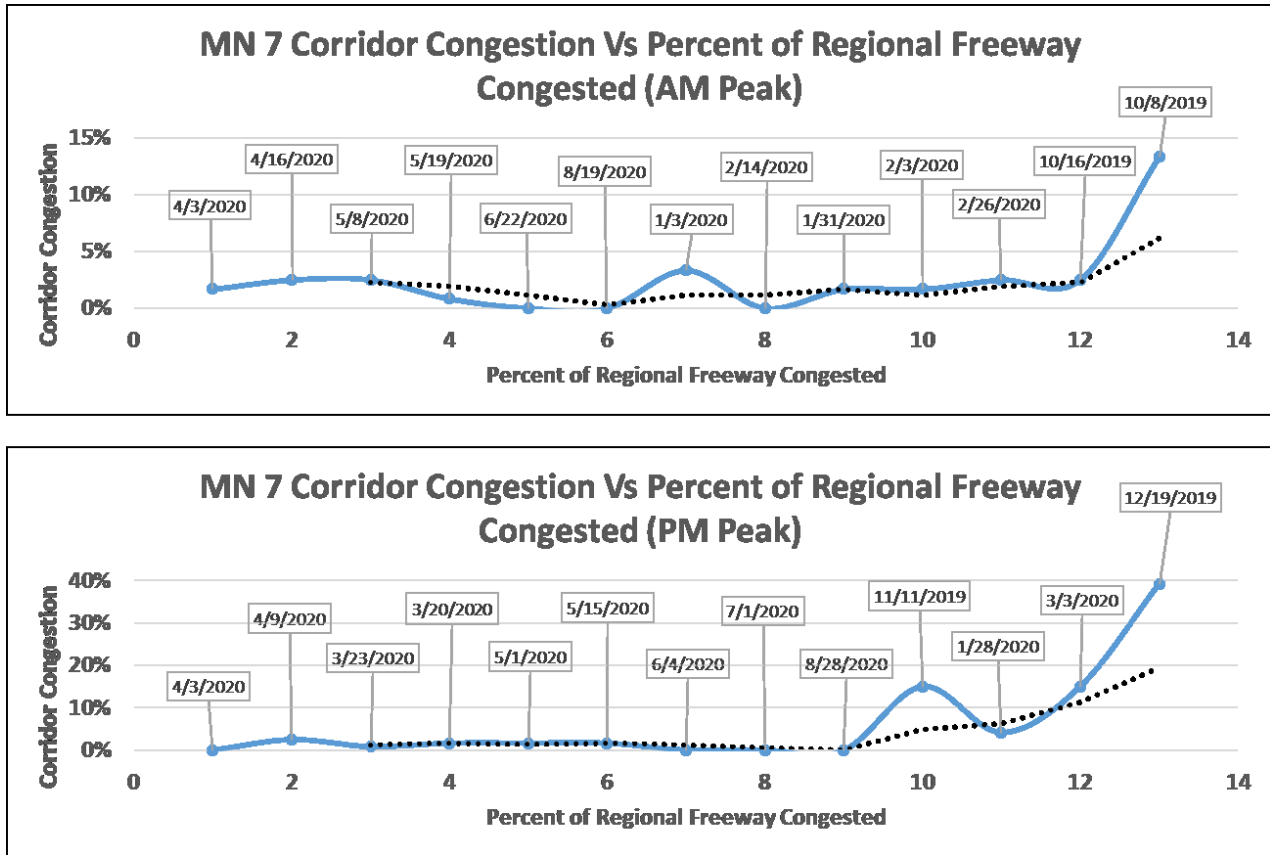


Figure 31. Relationship between congestion on MN 7 and regional congestion – AM and PM Peak

Analysis of regional congestion and congestion on MN 7 during the AM peak period indicates corridor congestion remains between 0 – 5 percent until regional congestion tops 12 percent. Analysis of regional congestion and congestion on MN 7 during the PM peak indicates there is little to no congestion on the corridor until regional congestion tops 10 percent.

3.5.2.2 MN 47 between Lowry Ave and I-94

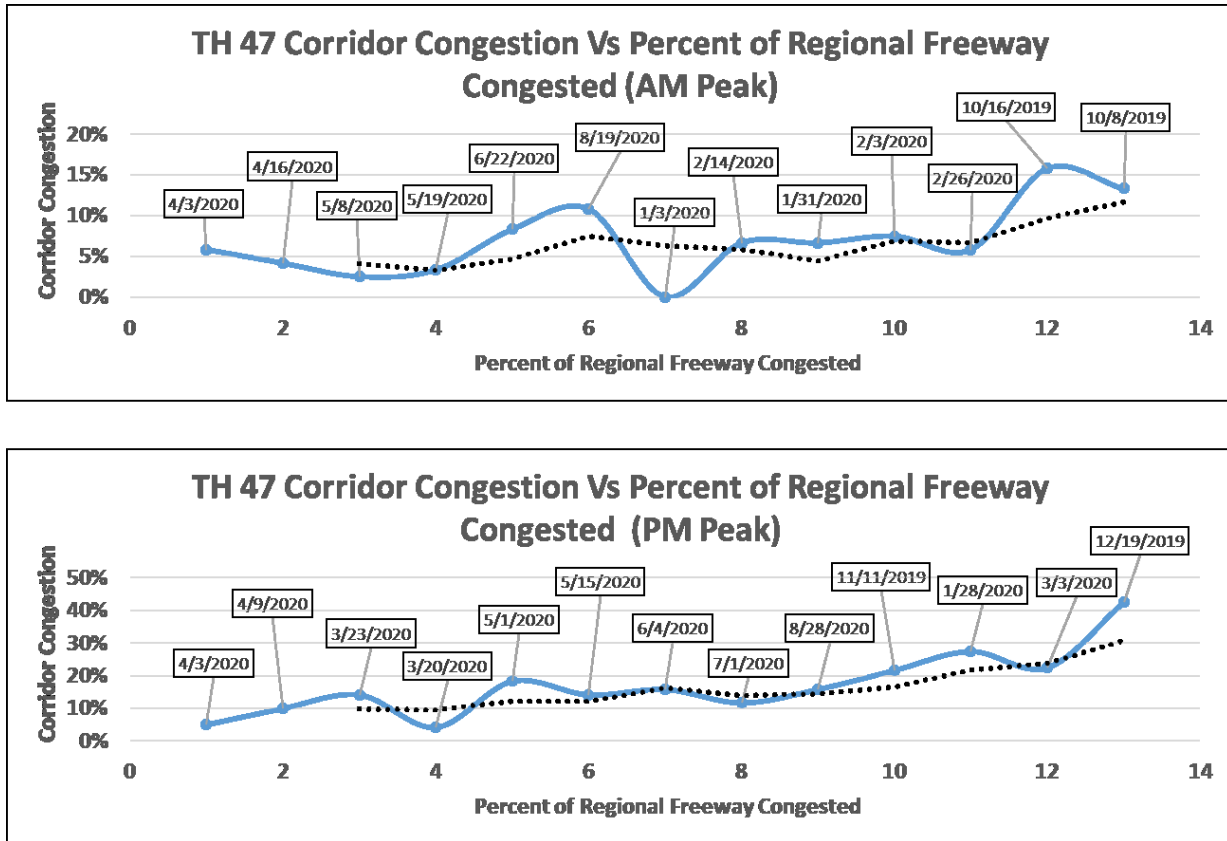


Figure 32. Relationship between congestion on MN 47 and regional congestion – AM and PM Peak

Analysis of regional congestion and congestion on MN 47 during the AM peak period indicates corridor congestion remains between 0 – 10 percent until regional congestion tops 12 percent. Analysis of regional congestion and congestion on MN 47 during the PM peak indicates corridor congestion fluctuates between 5 – 20 percent until regional congestion tops 8 percent.

3.5.2.3 MN 62 between Lowry Ave and I-94

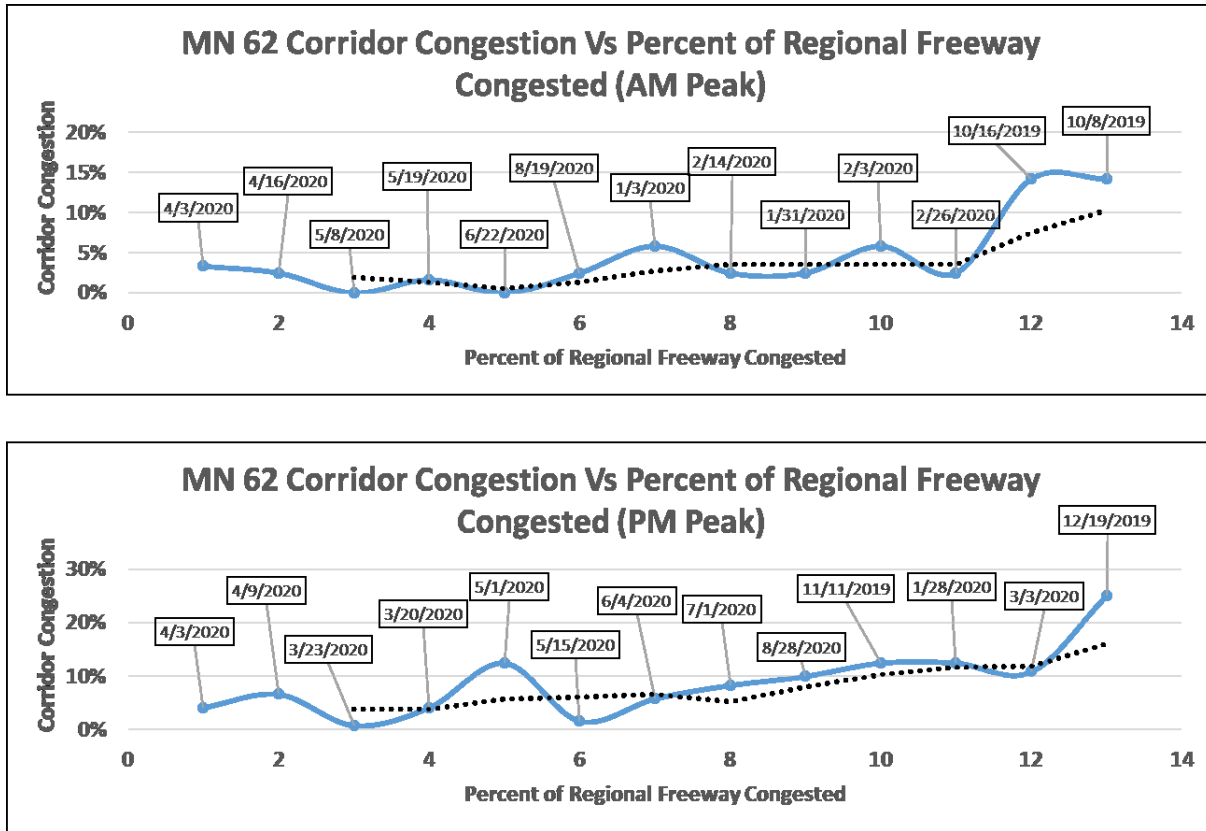


Figure 33. Relationship between congestion on MN 62 and regional congestion – AM and PM Peak

Analysis of regional congestion and congestion on MN 62 during the AM peak period indicates corridor congestion remains between 0 – 10 percent until regional congestion tops 12 percent. Analysis of regional congestion and congestion on MN 62 during the PM peak indicates corridor congestion fluctuates between 0 – 10 percent until regional congestion tops 8 percent.

3.5.2.4 MN 65 between Viking Blvd and MN 610

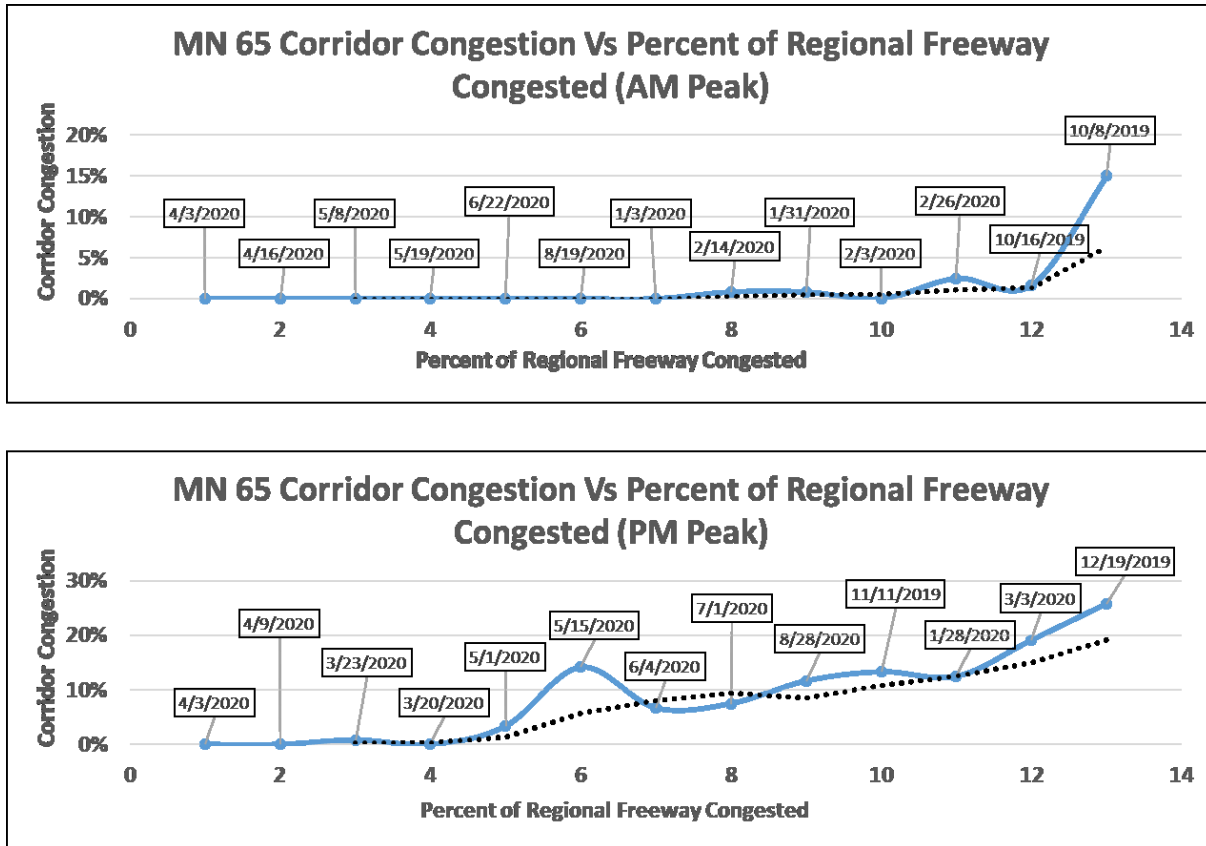


Figure 34. Relationship between congestion on MN 65 and regional congestion – AM and PM Peak

Analysis of regional congestion and congestion on MN 65 during the AM peak period indicates little to no congestion on the corridor until regional congestion tops 12 percent. Analysis of regional congestion and congestion on MN 65 during the PM peak indicates little to no corridor congestion until regional congestion 4 percent.

3.5.3 Findings related to congestion on signalized arterials

The previous pages provided an analysis of how regional travel demand before and during the COVID-19 pandemic impacted congestion on four signalized arterials in the Twin Cities region. The analysis's objective was to determine whether selected arterials were affected by the congestion "tipping points" observed on the regional freeway system. As noted in Section 3.3, these tipping points were observed at 6 and 7 million regional VMT during the AM peak period and between 7.5 and 8.5 million VMT in the PM peak period.

The study finds a correlation between congestion on signalized arterials and congestion tipping points on the regional freeway system. During the AM peak, congestion on signalized arterials is stable along a corridor baseline until regional VMT tops 7 million and freeway congestion tops 12 percent. During the PM peak, congestion on MN 7, MN 47, and MN 62 is largely stable until 7.5 to 8 million regional VMT, or 8 to 10 percent regional freeway system congestion. The region's PM peak period tipping point is not observed on MN 65, a frequently congested corridor that is highly sensitive to changes in demand for PM peak travel starting at about 5 million regional VMT.

3.6 REGIONAL VMT AND USER GROUP TRAVEL TIMES

The study also analyzes how regional travel demand impacts the travel times of two select user groups: essential workers and environmental justice (EJ) populations. Information about how the study analyzed essential worker and EJ population travel time is available in Chapter 2: Sources and Methods.

3.6.1 Essential worker travel time

Figure 35 presents the results of an origin-destination analysis measuring average travel time between Thrive MSP 2040 community designations (urban/urban center, suburban, and suburban edge) and the region’s 10 largest hospitals during AM and PM peak periods on 25 dates before and during the COVID pandemic. The figure plots average travel times in relation to regional VMT observed on the dates in question.

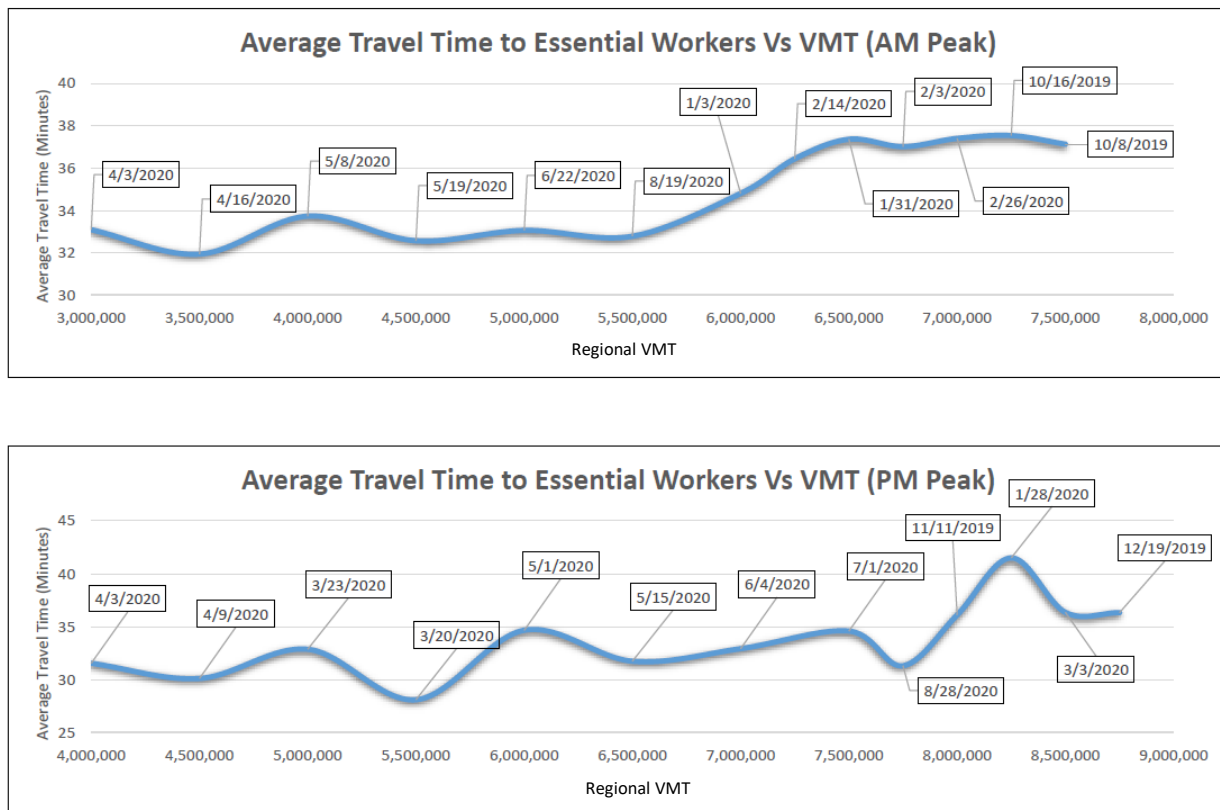


Figure 35. Average travel time for essential workers in relation to regional VMT – AM and PM Peak

Analysis of essential worker travel time during the AM peak period indicate travel times averaged between 32 and 34 minutes until regional VMT reached 5.5 million. Average travel times for essential workers during the AM peak period increased as regional VMT grew from 5.5 million to 6.5 million. From 6.5 to 7.5 million regional VMT, average travel times for essential workers during the AM peak was approximately 37 minutes.

Analysis of essential worker travel time during the PM peak period indicate travel times averaged between 28 and 35 minutes until regional VMT reached approximately 8.0 million. Average travel times for essential workers during the PM peak period increased sharply to over 40 minutes as regional VMT grew from 7.8 million to 8.2 million, however, this growth was the result of just two data points.

3.6.2 Travel times for Environmental Justice populations

Figure 36 presents the results of an origin-destination analysis measuring average travel time between transportation analysis zones with an ACP50 designation and regional employment centers. The figure plots average travel times in relation to regional VMT observed on the date in question.

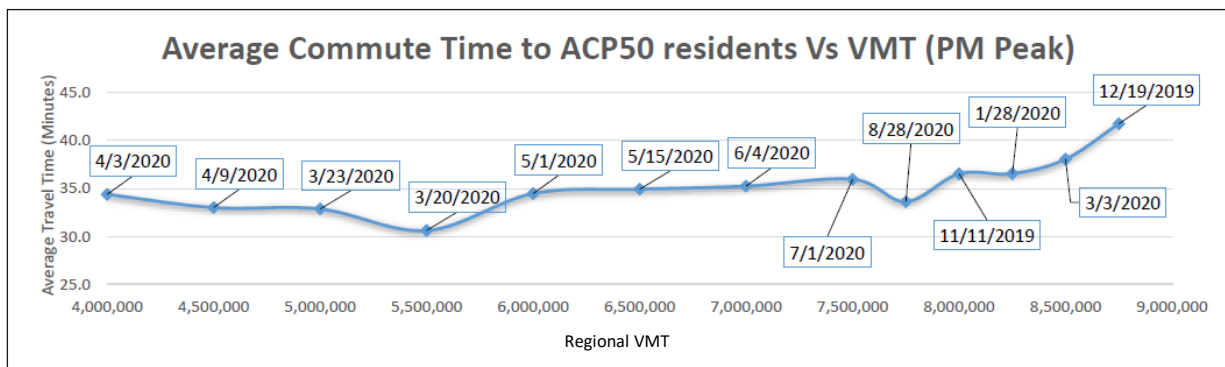
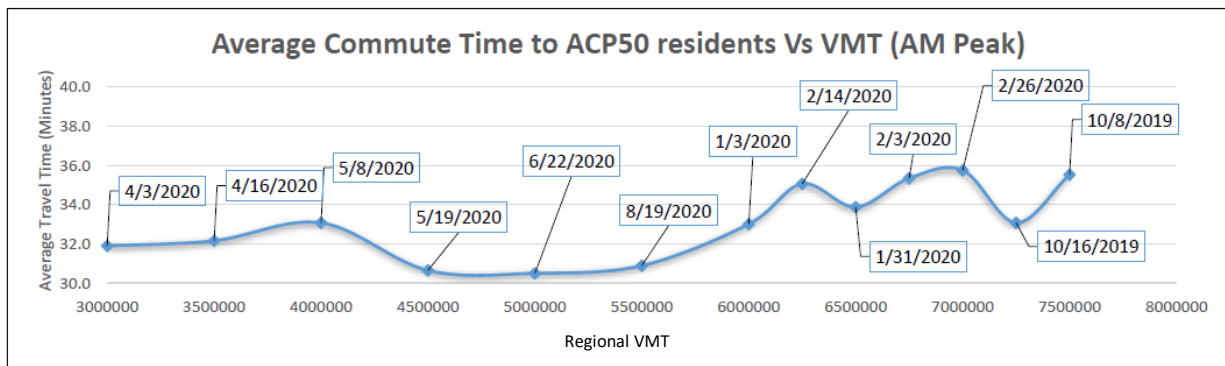


Figure 36. Average travel time for ACP50 residents in relation to regional VMT – AM and PM Peak

Analysis of EJ population travel time during the AM peak period indicate travel times averaged between 30 and 34 minutes until regional VMT reached 5.5 million. Average travel times for EJ populations during the AM peak period increased as regional VMT grew from 5.5 million to 6.3 million. From 6.3 to 7.5 million regional VMT, average travel times for EJ populations during the AM peak was between 33 and 36 minutes.

Analysis of EJ population travel time during the PM peak period indicate travel times averaged between 30 and 36 minutes until regional VMT reached approximately 8.0 million. Average travel times for EJ

populations during the PM peak period increased to over 40 minutes as regional VMT grew from 8.0 million to over 8.5 million.

3.6.3 Findings related to user group impacts

The study finds a correlation between regional travel demand and the travel times of essential workers and EJ populations. Furthermore, the congestion tipping points observed in this study's analysis of regional VMT and freeway congestion are reflected in the levels of regional VMT associated with increased essential worker and EJ population travel times.

During the AM peak, average travel times for essential workers and EJ populations remain stable until regional VMT tops 5.5 million. As noted in Section 3.3, freeway congestion begins to increase across the system at about 6 million regional VMT. This finding suggests that essential worker and EJ population travel times during the AM peak are disproportionately impacted by frequently congested freeways (those freeways that become congested at lower levels of regional travel demand). During the PM peak, average travel times for essential workers and EJ populations remain stable until regional VMT reaches 7.5 to 8.0 million. This is consistent with the study's finding that systemwide freeway congestion during the PM peak begins to increase steadily at about 7.5 million regional VMT.

CHAPTER 4: CONCLUSIONS AND APPLICATIONS

This study explored the relationship between regional VMT and regional congestion in the Twin Cities metropolitan area along the following four paths of inquiry.

1. How does regional congestion change with incremental changes in regional VMT?
2. Which corridors are usually congested, frequently congested, and occasionally congested?
3. As regional travel demand increases, how does congestion change on signalized arterials?
4. What are the equity implications of changes in regional travel demand?

The following chapter uses analysis presented in Chapter 3 to answer each question and to discuss potential applications of the study findings.

4.1 CONCLUSIONS

4.1.1 How does regional congestion change with incremental changes in regional VMT?

The study found the share of congested Twin Cities freeways increased with increases in regional VMT and the correlation between traffic volume and congestion was consistent among observations made before and during the pandemic. As discussed in Section 3.3, the study used a scatterplot to illustrate the relationship between regional VMT and congestion during the PM peak period. This scatterplot showed a strong correlation between VMT and congestion until peak period VMT hit approximately 8.5 million and congestion hit about 8 percent of freeway segments congested. At these levels, the VMT-congestion relationship became unreliable. The study concluded that 8 percent congested constitutes the freeway system's PM peak period tipping point. The study observed similar phenomena in the AM peak but used PM peak period data to support tipping point analyses.

Table 5 relates the PM peak period congestion tipping point to the level of regional VMT and congestion observed in October 2019. The table shows that the tipping point — the break between reliable congestion concentrated on usually congested corridors and unreliable congestion spread across the system — represents a 4 percent reduction in VMT and 35 percent reduction in congestion.

Table 5. Congestion tipping points in relation to regional VMT and congestion in October 2019

PM Peak Period	
Regional VMT	8.5 million
Relative to Oct. 2019 VMT	Down 4 percent
Regional Congestion	8 percent
Relative to Oct. 2019 Congestion	Down 35 percent

4.1.2 Which corridors are usually congested, frequently congested, and occasionally congested?

The study finds variation in congestion frequency among Twin Cities freeway corridors. This finding indicates that congestion on certain corridors is highly sensitive to regional VMT, while other corridors tend to be congested or uncongested within a broad range of regional VMT values. The study uses this finding to organize freeway corridors into three categories: usually congested, frequently congested, and occasionally congested.

- **Usually congested** corridors are those observed to be congested at low levels of regional VMT. These corridors include I-94 between I-394 and Hwy 280 and I-35W between I-694 and I-94.
- **Frequently congested** corridors are those observed to be uncongested at low levels of regional VMT and congested at higher levels of regional VMT. Corridors in this category are those that tend to tip regional congestion above its minimum level of congestion once regional VMT reach the observed tipping point. Corridors in this category include I-35E from I-94 to I-494.
- **Occasionally congested** corridors are those that are typically uncongested at all but the highest levels of regional VMT. Corridors in this category include all of US 212 and US 169 between MN 610 to I-94.

The full breakdown of Twin Cities freeway corridors into categories of congestion frequency is available in Table 4 and Figure 23 in Section 3.4.

4.1.3 As regional travel demand increases, how does congestion change on signalized arterials?

The study found congestion on signalized arterials to be sensitive to regional VMT and congestion. Among three of the four signalized arterials examined (MN 7, MN 47, and MN 62), PM peak period congestion remained stable at a corridor minimum until regional VMT approached the congestion tipping point observed on the regional freeway system. Once regional VMT and regional congestion hit the tipping point, corridor congestion on the signalized arterials increased significantly. On the fourth signalized arterial studied, MN 65, congestion appeared to have a linear relationship with travel demand starting at about 5 million regional VMT.

4.1.4 What are the equity implications of changes in regional travel demand?

The study found that congestion tipping points observed on the regional freeway system triggered increases in essential worker and EJ population travel times. In the case of the AM peak period, essential worker and EJ population travel times showed a notable increase starting at 5.5 million VMT, whereas regionwide freeway congestion began to increase at about 6 million regional VMT. This finding suggested that essential worker and EJ population travel times during the AM peak were disproportionately affected by usually congested freeways (those freeways that become congested at lower levels of regional travel demand).

4.2 APPLICATIONS

4.2.1 Tipping point research and travel demand management

The primary application of this study is to better understand and quantify the congestion benefits of travel demand management (TDM). In fitting curves to the regional volume-to-congestion relationship, this analysis shows the slope of the curve is steepest at higher volumes. As illustrated in Figure 16 and Figure 17 in Section 3.3, the slope of the curve means that as regional VMT are reduced from pre-pandemic levels, each percent decrease in VMT results in a higher percent decrease in regional congestion. This dynamic — VMT reduction resulting in a disproportionate reduction in regional congestion — continues along the volume-to-congestion curve as it moves from pre-pandemic VMT levels to the level of VMT observed at the height of pandemic travel restrictions in spring 2020. Assuming spring 2020 represents the ceiling of what may be possible through TDM, this study suggests that TDM incentives are highly unlikely to overshoot a point of diminishing returns for congestion reduction.

4.2.2 Corridor congestion and highway mobility strategies

The study's analysis of corridor congestion frequency and its relationship to regional VMT sheds light on the type of highway mobility strategies most appropriate for a given corridor. Usually congested corridors — those that are congested at almost any level of regional VMT — are likely to remain congested even under scenarios in which technology advancements, a shift to remote working, and TDM incentives increase telecommuting rates above current assumptions. These corridors are strong candidates for EZ-Pass and other mobility strategies designed to manage congested conditions. Frequently and occasionally congested corridors, by contrast, could be reliably uncongested in a future with increased telecommuting. These corridors are strong candidates for TDM incentives.

4.2.3 Peak period VMT reduction vs. overall VMT reduction

Another application of this study is to place potential reductions in peak period VMT in the context of state and regional goals to reduce overall VMT.

Table 6 shows the effect that a 5-percent, 10-percent, and 20-percent reduction in peak hour VMT from an October 2019 base would have on regional congestion and overall VMT. As shown in the table's top-right quadrant, a 5-percent reduction in peak hour VMT results in a 30-40 percent congestion reduction but only a 3.1 percent reduction in overall VMT. A peak period VMT reduction of 10 percent, shown in the table's bottom-left quadrant, results in a roughly 50-percent congestion reduction but only a 6.3-percent reduction in overall VMT. Even a 20-percent reduction of peak period VMT, which — as shown in the bottom-right quadrant — effectively eliminates all congestion, resulting in an overall VMT reduction of just 12.6 percent.

Table 6. Peak period vs. overall VMT reduction

October 2019 Base			~40% Congestion Reduction	
	Volume [Million VMT]	% of Total [%]	VMT Reduction [%]	Target Demand [Million VMT]
Early Morning	0.756	3.0%	0%	0.756
AM Peak	7.207	28.7%	-5%	6.847
Midday	5.232	20.8%	0%	5.232
PM Peak	8.592	34.2%	-5%	8.162
Evening	3.313	13.2%	0%	3.313
Total	25.1			24.310
Total % Reduction				3.1%
	~50% Congestion Reduction		~90% Congestion Reduction	
	VMT Reduction [%]	Target Demand [Million VMT]	VMT Reduction [%]	Target Demand [Million VMT]
Early Morning	0%	0.756	0%	0.756
AM Peak	-10%	6.486	-20%	5.766
Midday	0%	5.232	0%	5.232
PM Peak	-10%	7.733	-20%	6.874
Evening	0%	3.313	0%	3.313
Total		23.520		21.940
Total % Reduction		6.3%		12.6%

This analysis underscores the significant congestion benefits of VMT reduction. If the state were to pursue and achieve a 20-percent VMT reduction as recommended by the Sustainable Transportation Advisory Committee, such an achievement would essentially eliminate congestion on the Twin Cities freeway system, resulting in reduced and more reliable travel times throughout the region.

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