

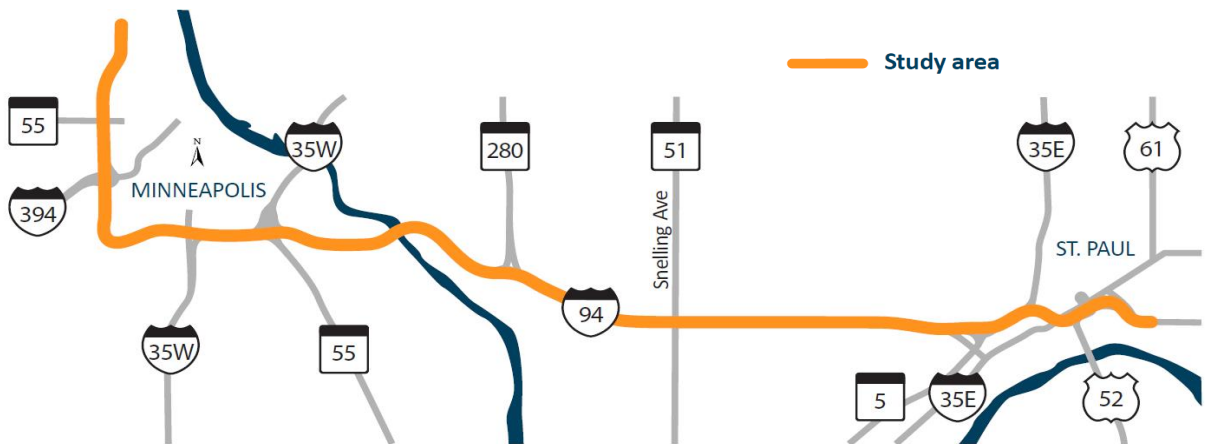
t2

Geometric and Traffic Conditions Summary

APPENDIX T2 – GEOMETRIC AND TRAFFIC CONDITIONS SUMMARY

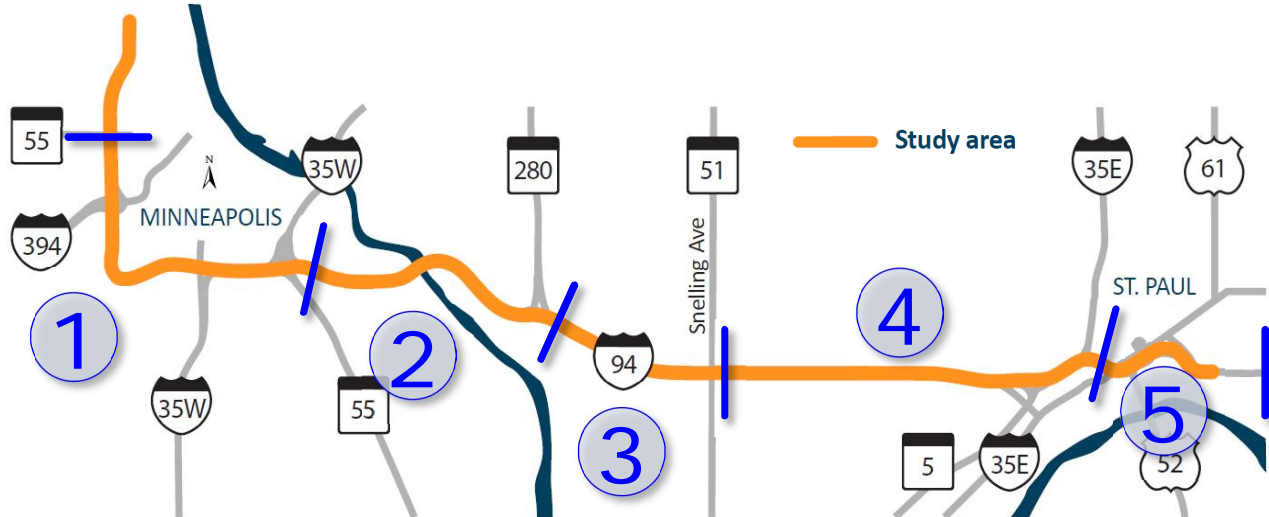
Introduction

This memorandum summarizes the geometric and traffic conditions within the Rethinking I-94 study area, which is shown in the figure below. The information was originally series of “one-pagers” that were released in December 2016 and summarized both the traffic and asset conditions within the study area. This document presents the traffic-related portion of these “one-pagers” describing the corridor’s geometric attributes, congestion and origin-destination data. Unless specified otherwise, standards cited below are from the MnDOT Road Design Manual (RDM) and applicable Technical Memoranda.



GEOMETRIC ATTRIBUTES

The Rethinking I-94 study area was reviewed in five segments for this summary of geometric attributes, as shown on the figure below.



DESIGN SPEED

Design speed is a selected speed used to determine the various geometric design features of the roadway. For this study, historical plan sets indicate that a 50 mph design speed was originally used. Current MnDOT guidance indicate that urban freeways should be designed at 50 mph or higher. Higher design speeds may facilitate better operations or capacity. However, careful analysis should be conducted so that the facility is not over designed. For the purposes of this assessment, geometric attributes related to speed are assessed against design standards for a 50 mph design speed.

HORIZONTAL ALIGNMENT

This I-94 corridor has several sharp curves, particularly within the downtown St. Paul commons, near TH280, over the Mississippi River, along I-35W commons, and by the Lowry Hill Tunnel. These sharp curves have a design speed below 50 mph. This means that even without the presence of heavy traffic volume, motorists may be forced to slow down due to the geometric limitations which may result in a breakdown in capacity. Sharp curvatures may also result in sightline restrictions which may impact both capacity and safety.

| Segment | Horizontal Alignment | | |
|---------|----------------------|---------------------------------------|--------------------------------|
| | # of Curves | % Curve length vs. length of corridor | % Curves meeting 50 mph design |
| 1 | 7 | 5.0 % | 57 % |
| 2 | 5 | 6.8 % | 100 % |
| 3 | 2 | 2.2 % | 100 % |
| 4 | 6 | 2.8 % | 83 % |
| 5 | 5 | 4.1 % | 100 % |
| Total | 25 | 21.0 % | 84 % |

VERTICAL ALIGNMENT

Vertical alignment also has a corresponding impediment like horizontal curvatures. Providing and maintaining a flatter profile grade enhances a more uniform traffic flow. Steeper grades have pronounced impacts especially to trucks and other heavy equipment vehicles. A typical maximum grade for a freeway is 3%. Highway grades in this corridor range between 0% and 4.4%, with approximately 24% of the corridor exceeding the typical maximum grade.

| Seg. | Vertical Alignment | |
|-------|--------------------------|---------------|
| | Hwy length of grade > 3% | % length > 3% |
| 1 | 4,800 | 34% |
| 2 | 3,650 | 28% |
| 3 | 500 | 7% |
| 4 | 1,800 | 10% |
| 5 | 5,250 | 35% |
| Total | 16,000 | 24% |

CROSS SECTION

The cross section of a roadway facility describes the allocation of the width of the travelled way for shoulders, median, and lanes. Allocation of cross sectional space is typically driven by the number of lanes needed for the corridor design traffic volumes and the provision for left and right shoulders for general recovery areas, maintenance, traffic enforcement, incident management, and transit (such as bus shoulder usage). Minimum desired design widths for this facility are 10' shoulders and 12' lanes. Within the study area, lane widths generally meet standards; however, shoulder widths are much more variable and often don't meet standards (see table below).

Average Cross Section Widths by Segment

| Seg. | Left Shoulder | | Travel Lanes | | Right Shoulder | |
|---------|---------------|------------------|--------------|------------------|----------------|------------------|
| | Ft. | % meets standard | Ft. | % meets standard | Ft. | % meets standard |
| 1 | 8.7 | 21 % | 12.0 | 100 % | 9.8 | 65 % |
| 2 | 4.3 | 0 % | 11.6 | 11 % | 5.7 | 11 % |
| 3 | 7.8 | 0 % | 12.0 | 100 % | 9.0 | 0 % |
| 4 | 7.4 | 27 % | 12.0 | 100 % | 9.8 | 79 % |
| 5 | 10.2 | 75 % | 12.0 | 100 % | 10.0 | 100 % |
| Overall | 7.8 | 28 % | 11.9 | 84 % | 9.0 | 58 % |

A review of the number lanes available to accommodate existing traffic volumes (2014 Annual Average Daily Traffic (AADT)) indicated that overall the number of lanes was sufficient to meet general capacity guidelines. However, actual traffic conditions on a given segment (volume by time of day, weaving, etc. also must be considered).

Number of Lanes

| Seg. | AADT | Ave # of Lanes | Min # of lanes per AADT |
|------|---------|----------------|-------------------------|
| 1 | 179,000 | 8.8 | 8.2 |
| 2 | 158,000 | 7.2 | 7.3 |
| 3 | 159,000 | 7.7 | 7.3 |
| 4 | 154,000 | 7.9 | 7.1 |
| 5 | 152,000 | 10.0 | 7.0 |

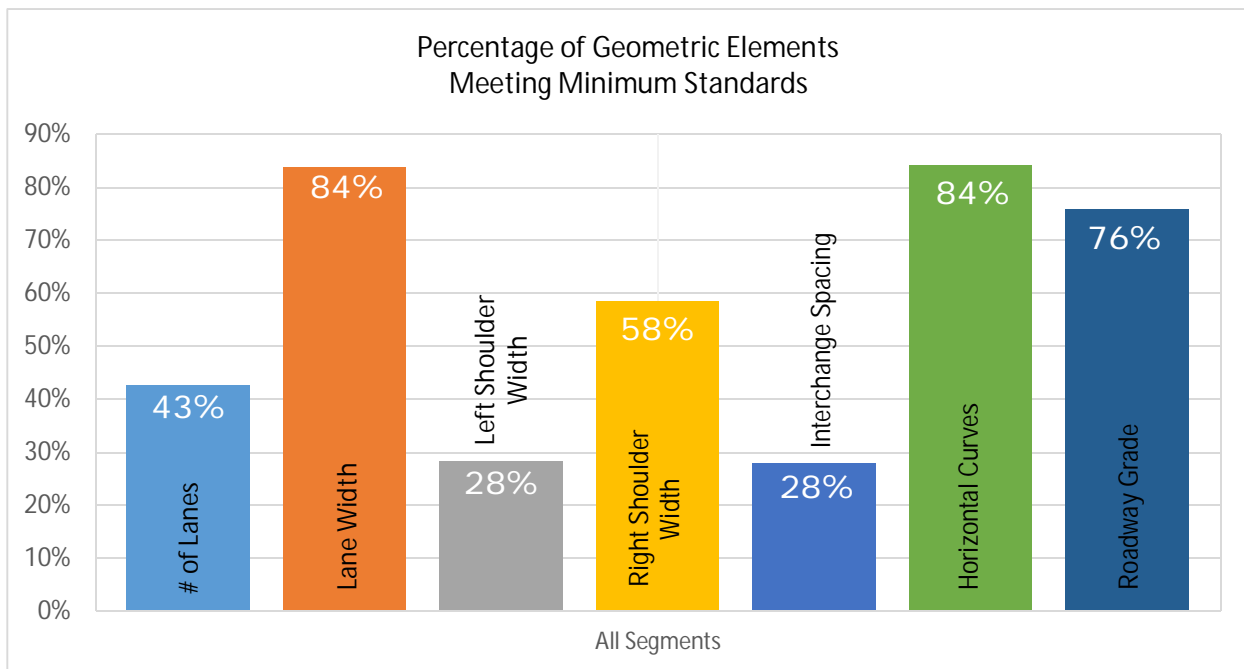
INTERCHANGE SPACING

Roadway functional classification reflects the function and strategic importance of a roadway. I-94 is classified as a Principal Arterial and is on the National Highway System (NHS). The minimum interchange spacing for this urban area of I-94 is 1 mile.

| Existing Access Spacing | |
|-------------------------|----------------|
| Less than 1 mile | 16 |
| Greater than 1 mile | 5 |
| Total | 21 |
| Average Spacing | 0.7 mi. |

OVERALL FINDINGS

The graph below summarizes the percentage of geometric elements in the study corridor meeting geometric standards.

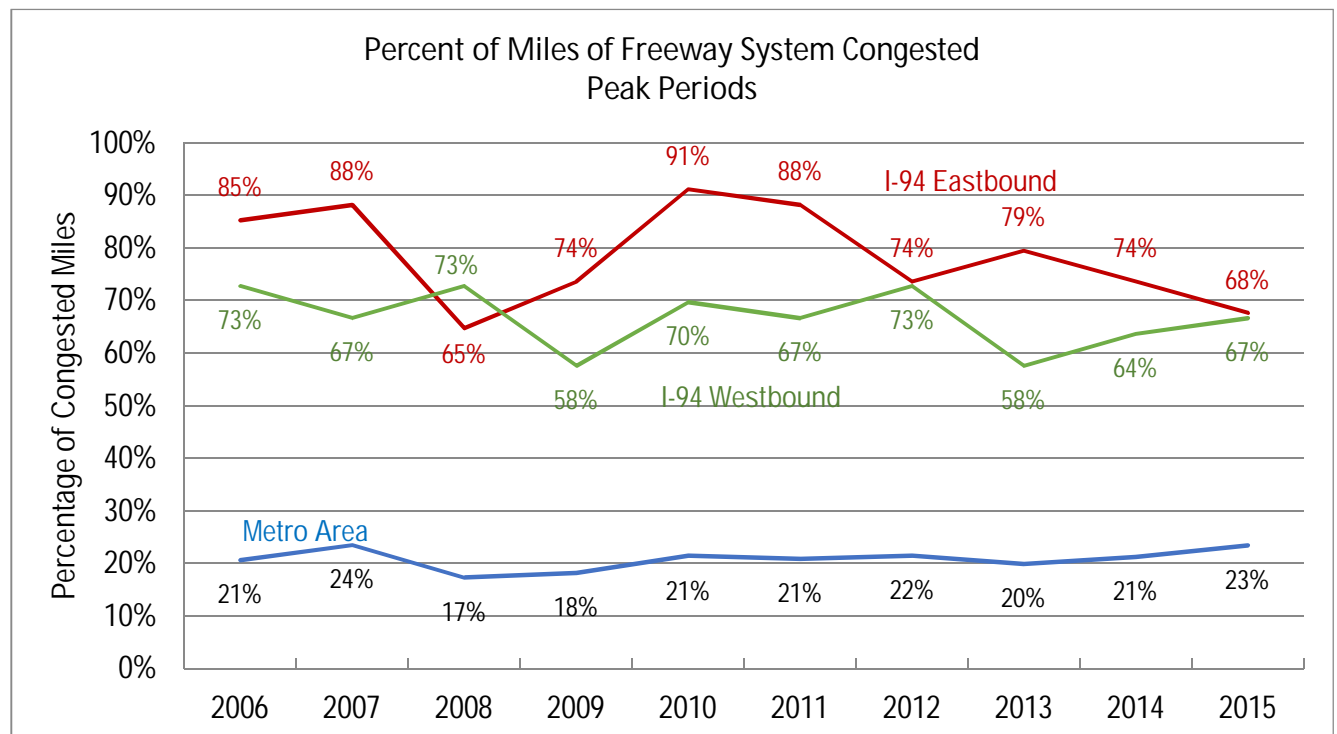


Congestion

Congestion on I-94 is one of the top transportation challenges in the I-94 corridor. The corridor has daily traffic levels over 160,000 vehicles at its busiest locations, making it the second most used highway in Minnesota, behind I-35W. Located in the central part of the Twin Cities, connecting to major job and entertainment centers, as well as shopping and homes for hundreds of thousands of people, this segment of I-94 experiences congestion severe enough to impact where people work, when they travel, and how much time they need to budget for trips.

The congestion on I-94 is substantially worse than overall congestion levels in the Twin Cities. MnDOT has been tracking congestion as a key performance measure for over a decade. The measure looks at each segment of freeway and determines if the segment experiences reoccurring congestion. Congestion is defined as when traffic speeds drop below 45 MPH.

The graph below compares the percentage of congested miles in the Metro Area against the I-94 study area over a 10-year period (2006-2015) for the combined AM and PM peak periods.

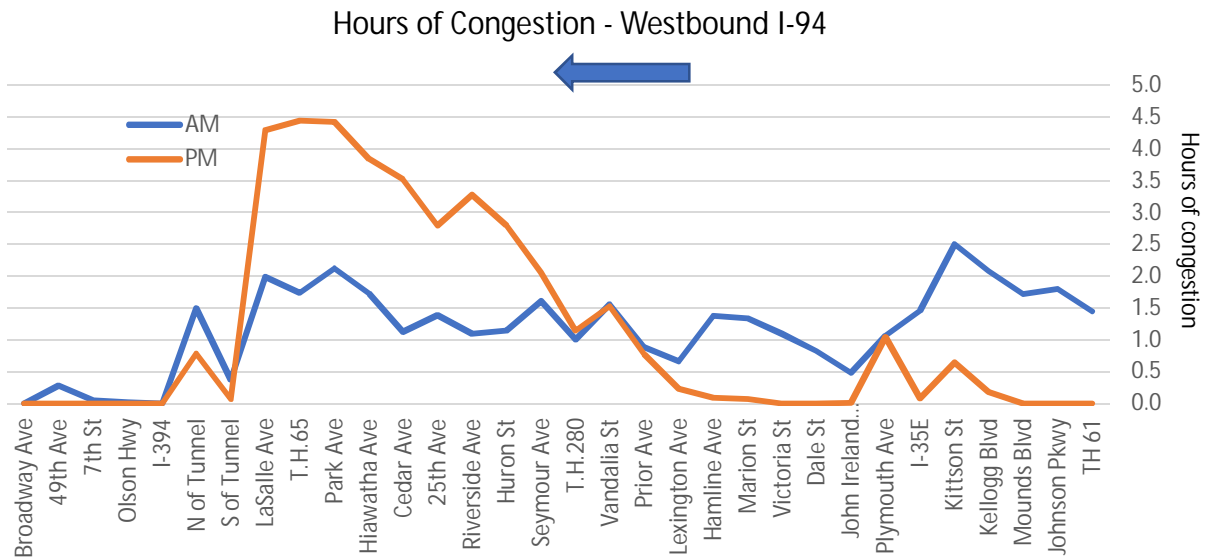


Overall, the percentage of congested miles in the Metro area has been steady, with an average of 21%. There was a minor dip in overall congestion in the 2008-2009 that mirrors national recession trends; however, congestion has since risen to pre-recession levels.

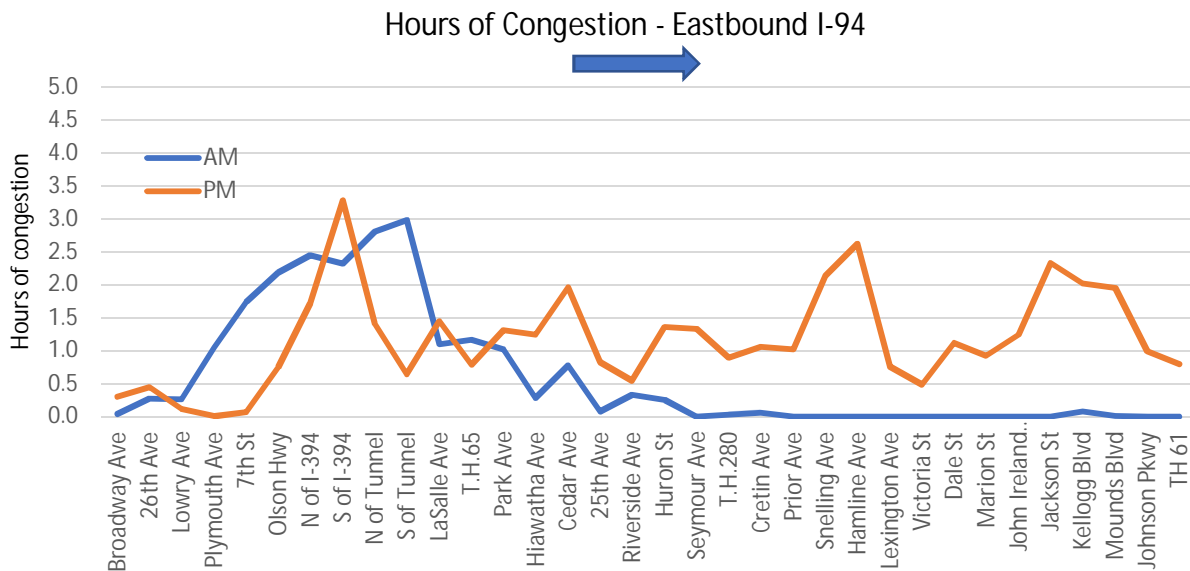
In contrast to the Metro Area, the percentage of congested miles along I-94 over the past 10 years averages 79% in the eastbound direction and 67% in the westbound direction.

HOURS AND DISTRIBUTION OF CONGESTION ALONG I-94

The distribution of congestion along I-94 and the durations of the congestion were reviewed based on available speed data for the 10-year period from 2006 to 2015. Congestion was assumed to be occurring when average highway speeds were below 45 mph. The AM peak period in this analysis is between 5am and 10am and the PM peak period is between 2pm and 7pm.



The primary location of congestion in both directions is upstream of the Lowry Tunnel, and spills back as far as Snelling Avenue to approximately 6 ½ miles to the east, with the PM peak period experiencing more than twice the congestion than the AM period at this location.



In the eastbound direction, the PM peak period experiences twice the amount of congestion than the AM peak period, on average over the length of the corridor. The Lowry tunnel is also a source of congestion for both periods, but that's where the similarity ends. In the PM period, congestion also spikes around Snelling Avenue and in the downtown St. Paul area associated with the back to back 35E system interchanges and US Route 52 (Lafayette Freeway).

Origin – Destination Data

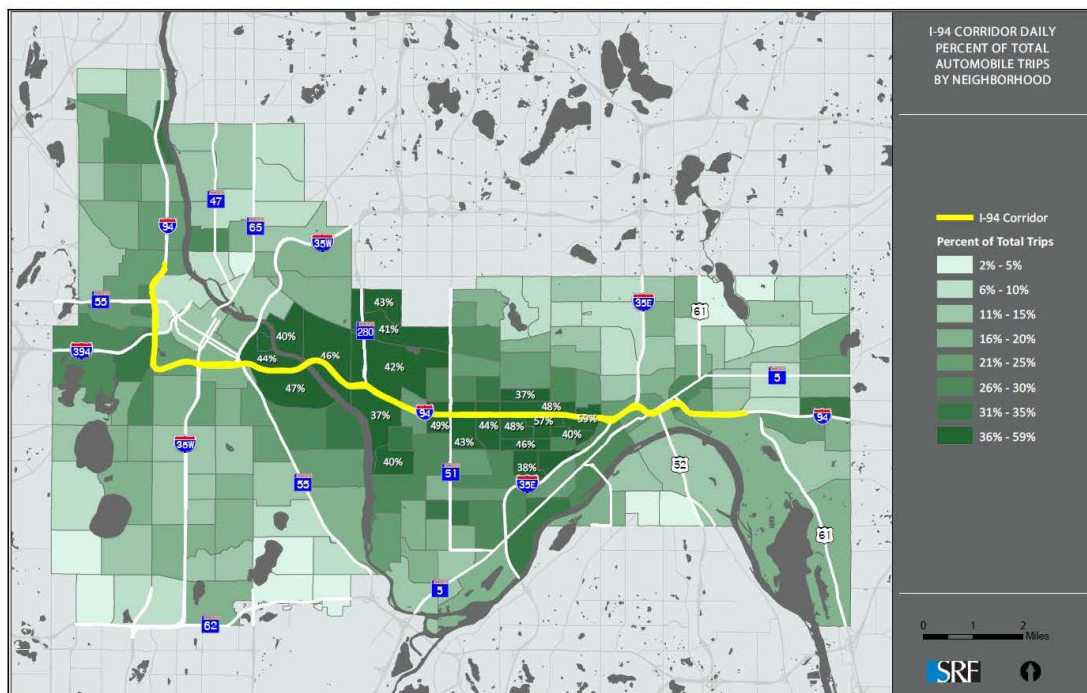
INRIX is a software/data company that provides historical and real-time traffic information, traffic forecasts, travel times and traffic counts. The origin-destination (OD) data provided by INRIX indicate real-world traffic patterns along the I-94 corridor.

The time range of INRIX data used in this study is from September 2015 to November 2015 and covers the seven-county area surrounding Minneapolis. The trip dataset includes a total of 6.1 million records and the trip path dataset has over 513 million GPS location records. The data includes individual trip information such as providers, types of vehicle, trip origins, trip destinations, etc. In addition, the detailed trip path was provided in the format of XY coordinates and time. The time intervals were usually from 5 seconds to 3 minutes, giving detailed accounts of trip destinations and travel times. INRIX OD data is collected through their network of worldwide anonymized GPS data with coverage of over 250 million vehicle and devices probes.

INITIAL RESULTS

People Living and Working near I-94 Use I-94

The following graphic identifies the percent of total trips from each neighborhood that use I-94. Approximately 40 to 50 percent of all vehicle trips generated by the neighborhoods and precincts along I-94 between downtown Minneapolis and downtown Saint Paul use I-94.

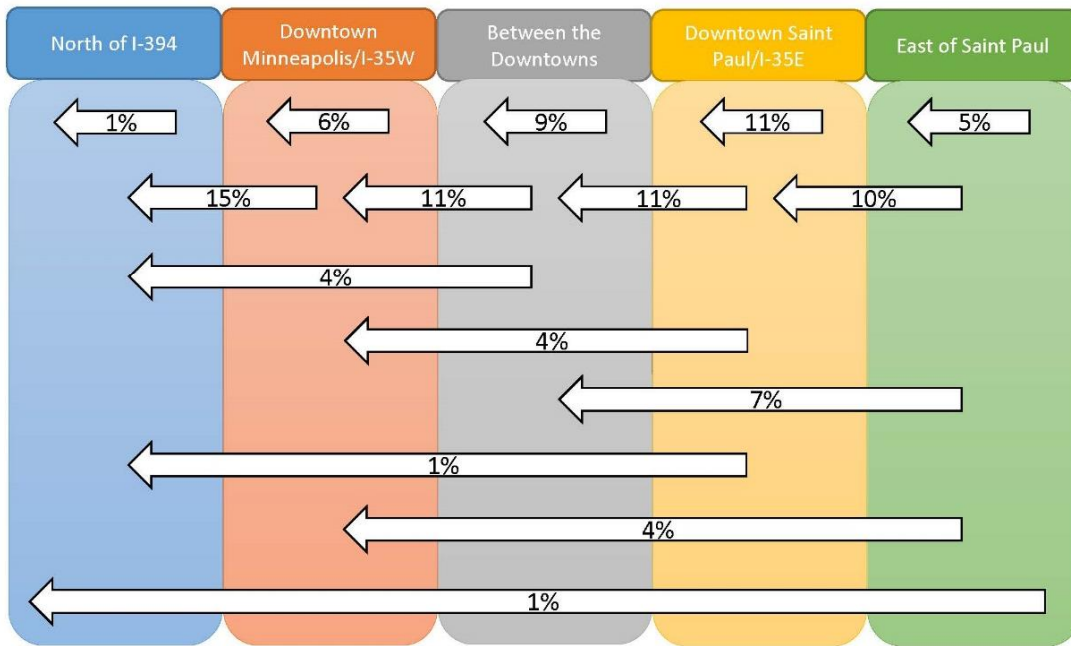


I-94 Users Not Just Passing Through

The following two graphics aggregate the neighborhood and precinct data into larger zones to better understand the general travel patterns along the corridor. The first graphic identifies daily traffic patterns on westbound I-94 and the second graphic identifies eastbound I-94 travel patterns. Overall, approximately 80 percent of all trips occur within a single zone or travel to the adjacent zone. Only about one percent of all study area trips pass from Broadway Avenue to Highway 61 along I-94.

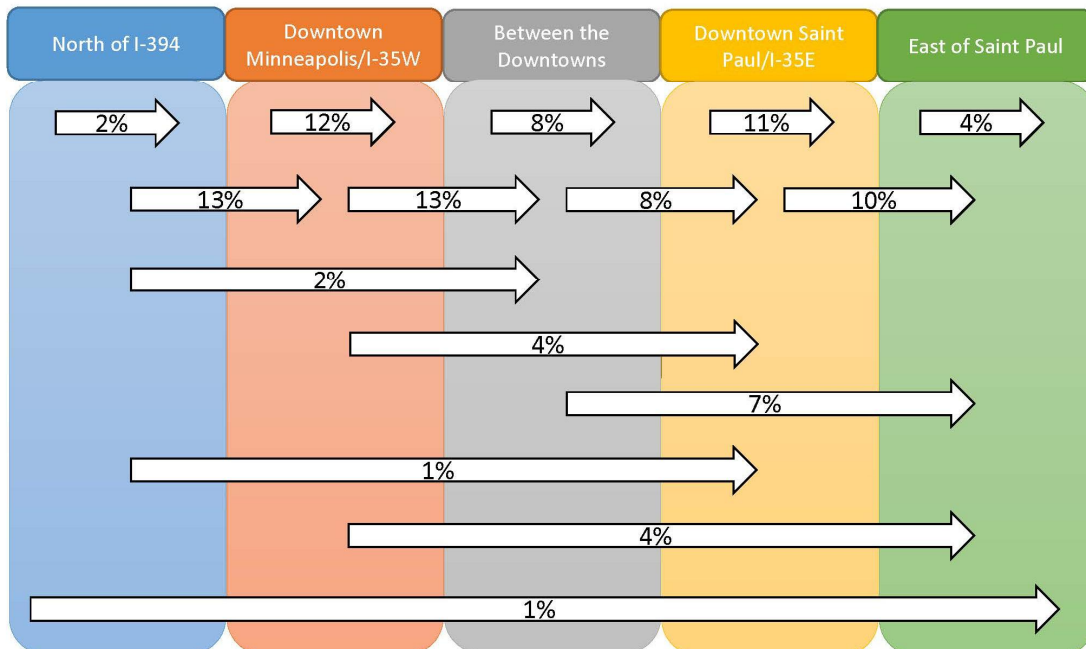
Westbound I-94 Zone Analysis

Percent of Total Trips between Highway 61 and Broadway Avenue



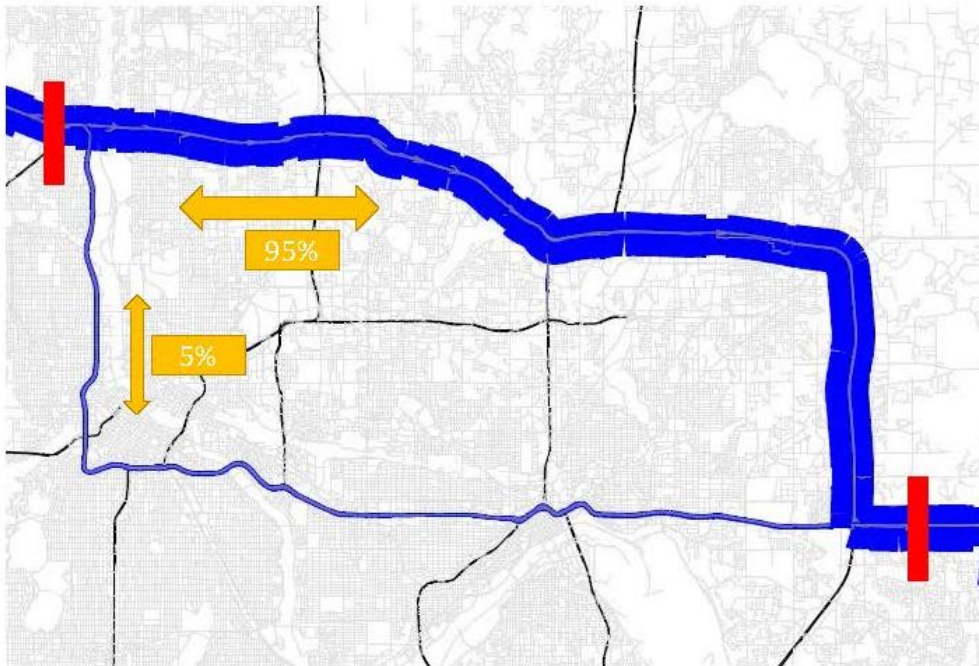
Eastbound I-94 Zone Analysis

Percent of Total Trips between Broadway Avenue and Highway 61



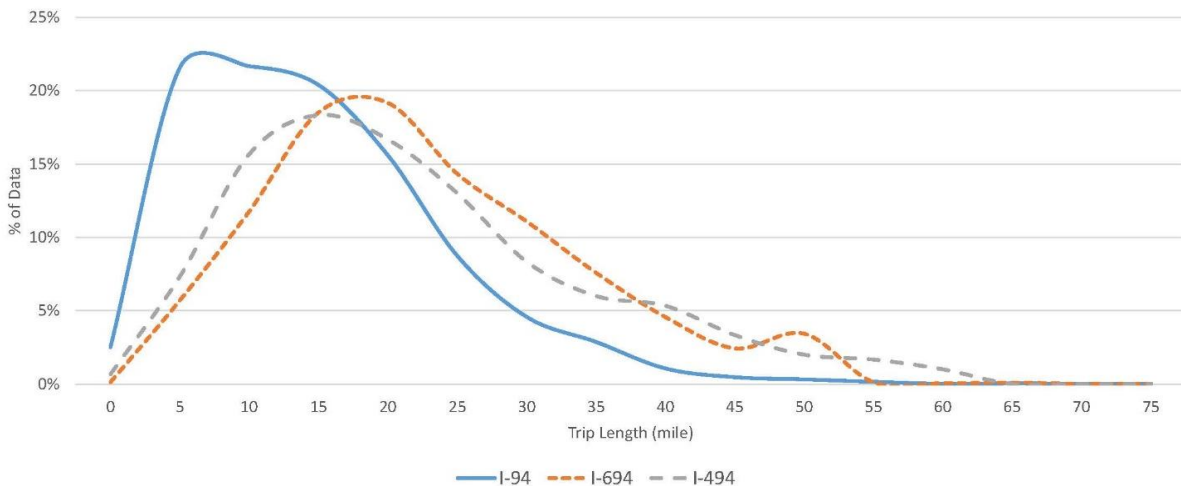
I-694 is Used as a Regional Connection

The following graphic identifies that approximately 95 percent of all regional trips that travel on I-94 through Brooklyn Center and I-94 in Woodbury use I-694 instead of I-94. Freight and passenger vehicles show similar travel patterns.



Trips on I-94 are Shorter than Beltway Trips

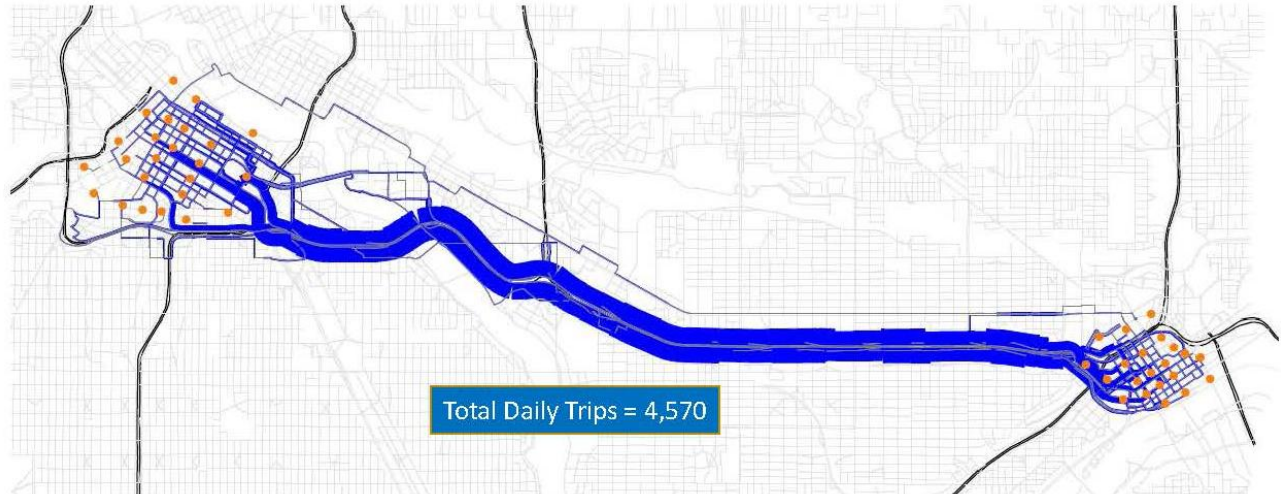
Trip length on I-94 are significantly shorter when compared to I-494 and I-694. The data presented in the graphic below supports this data.



*Note: Trip Length within the 7-County Model Coverage area.

I-94 Connects the Downtowns, but it's not a Common Trip

There are approximately 4,500 daily trips between downtown Minneapolis and downtown Saint Paul. This value represents about 3% of total trips on I-94 near Snelling Avenue. Based on recent transit ridership surveys, similar amounts of trips are being made (4,500) on the Green Line and bus route 94.



Prepared by: WSP, Community Design Group, and MnDOT