Summary Report 1999-32

Research

Metropolitan Freeway System Congestion Summary Report

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16. Abstract (Limit: 200 words)

The annual Congestion Study is a geographical illustration of the metropolitan freeway system's traffic performance. It portrays time and areas of congested traffic flow during the A.M. and P.M. peak periods.

Congested areas are determined from data gathered by traffic management sensor arrays. The data, five-minute volumes and lane occupancy values, provide input into the determination of the average five-minute running speeds per lane.

This report is a summary of the time a freeway operates below 45 miles per hour. Freeway system field observations indicate that under this condition, shock waves develop in the traffic flow. Our working definition of congestion is then traffic flow below 45 miles per hour. The data summary compares the traffic during the month of October in each of the years. This is done to minimize the effects of construction and maintenance-induced congestion and to account for school-induced traffic loads. The study uses 1993 as a base year, the first year the report was done.

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METROPOLITAN FREEWAY SYSTEM CONGESTION SUMMARY REPORT

Summary Report

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Summary

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Congested areas are determined from data gathered by traffic management sensor arrays. The data, five-minute volumes and lane occupancy values, provide input into the determination of the average five-minute running speeds per lane.

This report is a summary of the time a freeway operates below 45 miles per hour. Freeway system field observations indicate that under this condition, shock waves develop in the traffic flow. Our working definition of congestion is then traffic flow below 45 miles per hour. The data summary compares the traffic during the month of October in each of the years. This is done to minimize the effects of construction and maintenance-induced congestion and to account for school-induced traffic loads.

The study uses 1993 as a base year, the first year the report was done. The 1994 congestion data, by comparison, shows a slight increase in the congested freeway miles (see figure 1). In 1995 the affected mileage returned to the 1993 values, and again declined in 1996. The following year, 1997, congested levels rose slightly, though still below the 1993 levels. In 1998 the levels rose to values above those of the base year, showing the largest change of any previous year.

In 1998 during the AM peak period (6:00 to 9:00), 123 miles of the 500 directional miles of freeway, twenty five percent, had some degree of congestion. The PM peak period (3:00 to 7:00) had 115 miles or twenty three percent of the directional mileage in a congested state.

Metropolitian Freeway System

Summary of Road Congestion

Directional Miles of Congested Roadway

	1993	*1994*	*1995*	*1996*	*1997*	*1998*
AM	91	100	86	72	73	123
PM	88	91	87	71	83	115

Base Mileage 500

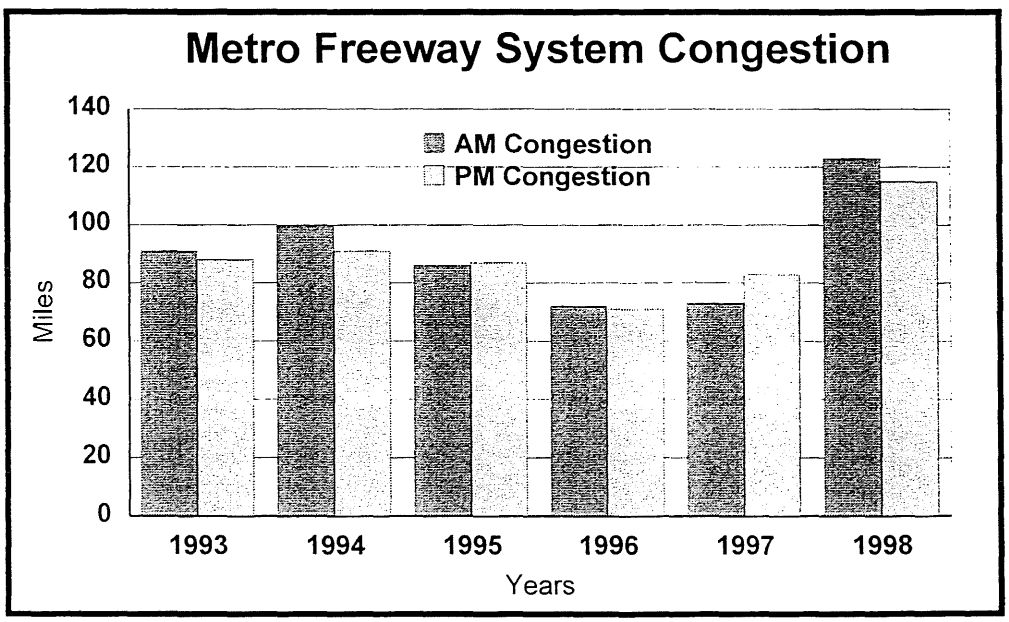

Figure 1

Congestion

Fourteen principal roadways make up the metropolitan freeway network. Four of these roads contributed significantly to the congestion increase I-35W, I-94, I-494, and TH-169. The following discussion identifies areas where significant increases in traffic congestion have occurred.

I-35 W

Morning Peak Period

Traffic on the northern portion of I-35W near Lexington Avenue in Blaine has experienced a 30 % growth in the Annual Average Daily Traffic (AADT) since 1992 with a 7.5% increase in 1998.[1] This growth is a key factor in the increased duration and length of roadway affected by congestion on I-35W south bound from Lexington Avenue to County Road E. Changes in road geometry and a new junction with TH-10 will cause further deterioration in this area.

Traffic on I-35W near the junction with County Road 46 in Lakeville has shown a 43% increase in the AADT since 1993 and a 17.9 % growth in 1998.[2] This significant growth in the northbound traffic flow from outside the traffic management system has led to a marked decline in traffic performance from County Road 42 to I-494.

Evening peak period

The I-35W northbound junction with I-694 has a heavy weave between the middle ramps of the cloverleaf interchange. The weave reduces flow and induces shock wave activity across all lanes of northbound I-35W traffic. This congestion is closely linked to the congestion on EB I-694 in the Interchange area.

I-35W north and southbound south of the Minneapolis CBD to the junction with TH-62 has increased the congestion time span during the evening peak period. Field observations show congested flows several days a week beginning at 1:00 PM, well outside the evening peak period.

I-94

Morning Peak Period

I-94, like I-35W, has had a marked increase in the AADT out side of the traffic management system. A 29% increase since 1993 and a 1998 annual 8.5% increase has occurred on I-94 at County Road 30 in Maple Grove.[3]

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[1] MnDOT Traffic Forecast and Analysis Section, Automated Traffic Recorder Report 1998 , p. 41
[2] Ibid. , p. 33
[3] Ibid. , p. 44

A four-to-two-lane traffic compression eastbound at Hemlock Lane in Maple Grove produces a daily standing traffic queue. Downstream, the traffic flow, at near capacity, breaks down again with the additional traffic from County Road 81, sending shock waves upstream in the traffic flow. Attempts at additional flow increases on this roadway cannot be accommodated. It will only produce a further reduction in mainline traffic flow.

In the eastern metropolitan area, I –94, westbound has a lane reduction at Century Ave in Maple Wood which produces a daily standing queue of traffic. Closer to St. Paul's CBD the lane configuration refereed to as the Commons produces another standing queue of traffic.

Evening Peak Period

I-94 evening peak period traffic westbound in Brooklyn Park from TH-152 to Hemlock lane exihibit the same traffic characteristics as the eastbound morning traffic. Again, the four to two lane compression of traffic produces a daily one-mile standing four-lane traffic queue.

The section of I-94 from the junction of TH-280 through the Lowery Hill Tunnel is another area of growing congestion. Left lane entries and exits, a series of complex weave patterns and unexpected shock-wave activity produce a high number of crashes. In 1996 this 4.2 mile section of roadway in 1996 produced 683 reported crashes or 1.9 crashes per day[4].

The St. Paul Commons area in an eastbound direction is a growing area of congestion. Shock waves propagating back from the bottleneck area on northbound I-35E. This has produced a decline in traffic flow performance in this zone.

I-494

Morning Peak Period

There has been a marked decline in the performance on I-494 South Bound in the Maple Grove area. The four to two lane traffic compression prior to Bass Lake Road creates a daily standing queue of traffic on the mainline.

The section of I-494 westbound in Bloomington just prior to TH-77 and continuing through the TH-100 interchange has shown an increase in the time the road is congested.

Evening Peak Period

The eastbound section of I-494 from TH-212 to TH-169 in Eden Prairie has shown a modest increase in congestion levels. This has been influenced by ongoing construction in and around TH-169. In both east and westbound directions from TH-169 to I-35W, I-494 has shown a steady decline in performance over the last three-year period.

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[4] MnDOT Freeway Operations Section, Freeway Volume-Accident Summary, p.7

TH-169

Morning Peak Period

TH-169 southbound from I-94 to immediately past I-394 has shown a substantial traffic flow increase from outside the current freeway management system. This has placed considerable strain on the ability to manage congestion. Ramp volumes at 63 Rd Avenue have been reduced significantly to compensate for this increase.

Evening Peak Period

Northbound traffic during the evening peak period has deteriorated from TH-62 to just north of Plymouth Avenue.

Findings

- The reported information shows that the freeway system ability to carry the peak period traffic is being challenged. The peak period has grown in time to a total of seven hours a day. Some roads exhibit near peak period flows for eleven hours.

- A significant portion of the growth in traffic demand is occurring outside the current traffic management system and that presents challenges both inside and outside of the managed freeway system.

- Under heavy peak period flows some geometric configurations show inherent weaknesses. These designs induce congestion.

  Four-to-two lane compression induce merge components in high volume traffic flows this causes major congestion. The attendant shock waves increase the probability of crashes.

  Left lane entrances and exits induce merge and diverge components in the most productive peak period lane. This produces congestion on otherwise free flowing roads.

- Several of the " Commons " designs force complex weaving patterns and couple those with random shock waves. These areas produce increased levels of congestion and very high crash rates.

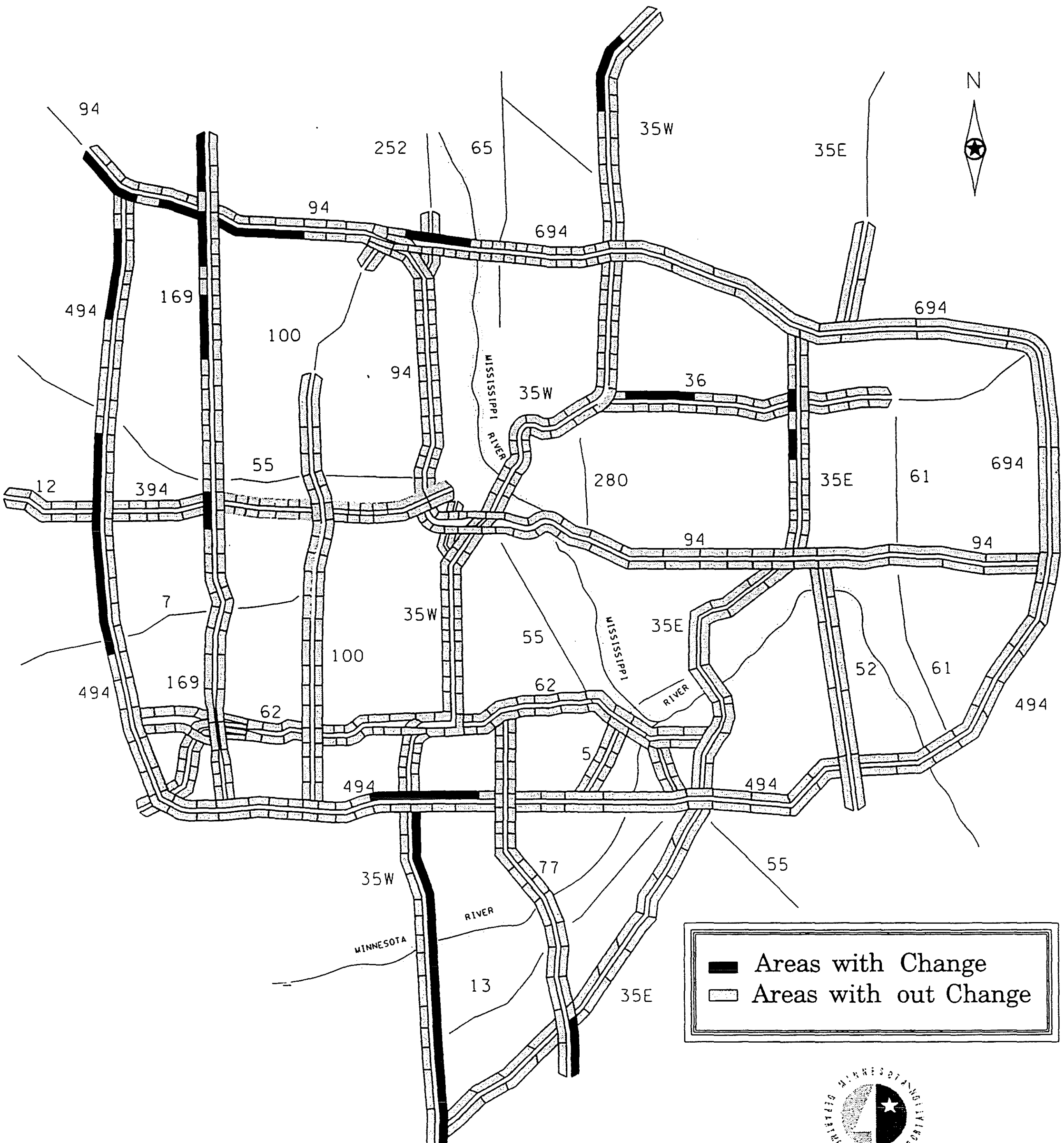
Appendix A

Areas of Annual Congestion Change Maps and Tables

Areas of Annual Congestion Change

1997 - 1998

AM



AM

Interstate Total # of Congested Miles

	1993	1994	1995	1996	1997	1998
I-35E SB	5.0	5.5	5.0	4.5	4.0	6.0
I-35E NB	1.0	1.0	1.0	1.0	1.0	1.5
I-35W SB	7.0	8.0	2.5	3.0	5.0	10.0
I-35W NB	12.5	12.5	7.5	6.0	6.0	14.5
I-94 EB	7.0	7.0	5.5	6.0	6.0	9.5
I-94 WB	5.0	5.0	6.0	6.0	4.5	7.5
I-394 EB	3.5	7.0	5.0	5.0	5.0	7.0
I-394 WB	2.0	2.0	1.5	1.0	0.0	1.5
I-494 EB	8.5	11.0	11.0	6.0	8.0	13.5
I-494 WB	4.0	3.5	4.5	4.0	4.5	9.5
I-694 EB	3.0	3.0	2.0	2.0	2.0	2.0
I-694 WB	5.0	4.5	4.5	2.0	2.0	4.0
Total	63.5	70.0	56.0	46.5	48.0	86.5

TH Total # of Congested Miles

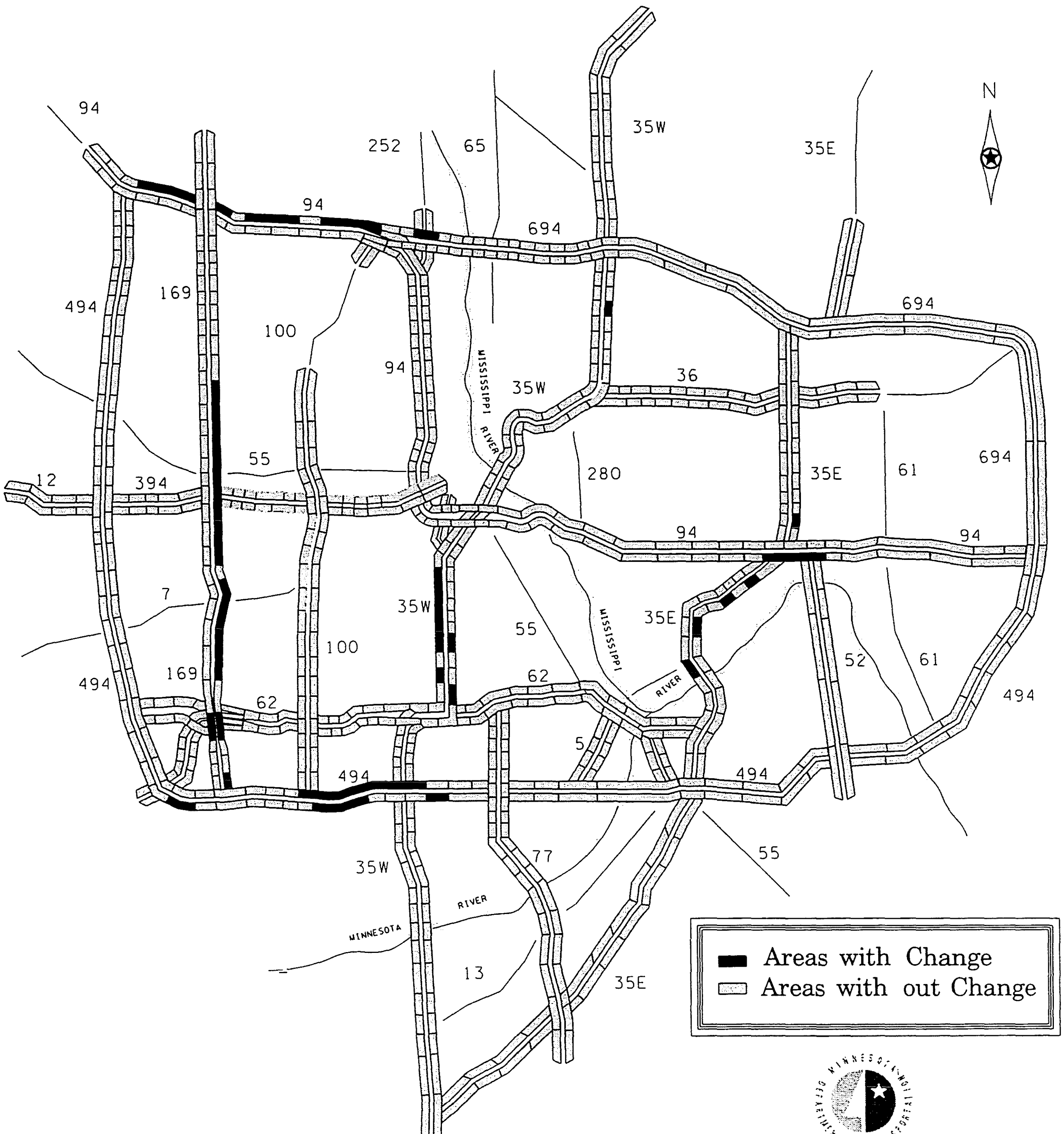
	1993	1994	1995	1996	1997	1998
TH 5 EB	0.0	0.0	0.0	0.0	0.0	0.0
TH 5 WB	0.0	0.0	0.0	0.0	0.0	0.0
TH 36 EB	0.0	0.0	0.0	0.0	0.0	0.0
TH 36 WB	3.5	2.0	2.5	1.0	1.0	4.0
TH 52 SB	0.0	0.0	0.0	0.0	0.0	0.0
TH 52 NB	1.0	1.0	1.0	1.0	1.0	1.0
TH 62 EB	2.0	2.0	2.5	2.5	3.5	4.5
TH 62 WB	6.5	5.0	5.0	4.5	5.0	6.0
TH 100 SB	3.0	3.0	2.5	3.5	3.0	3.0
TH 100 NB	1.0	1.0	1.5	1.5	1.5	2.0
TH 169 SB	7.5	9.0	9.5	7.0	7.0	11.0
TH 169 NB	1.0	3.0	1.0	0.0	0.0	2.0
TH 212 SB	0.0	0.0	0.0	0.0	0.0	0.0
TH 212 NB	0.0	0.0	0.0	0.0	0.0	0.0
TH 77 SB	0.0	0.0	0.0	0.0	0.0	0.0
TH 77 NB	2.0	4.0	4.0	3.0	3.0	3.0
Total	27.5	30.0	29.5	24.0	25.0	36.5

	1993	1994	1995	1996	1997	1998
Grand Total	91	100	86	71	73	123

Areas of Annual Congestion Change

1997 – 1998

PM



PM

Interstate Total # of Congested Miles

	1993	1994	1995	1996	1997	1998
I-35E SB	0.5	0.5	0.5	1.0	1.0	1.5
I-35E NB	3.5	3.5	4.0	2.5	2.5	4.0
I-35W SB	10.0	10.0	6.0	4.5	6.0	9.5
I-35W NB	5.5	5.5	1.5	1.0	6.0	9.0
I-94 EB	4.5	4.5	7.0	5.0	7.5	10.5
I-94 WB	7.0	7.0	7.5	4.5	6.5	11.0
I-394 EB	2.5	3.0	3.5	3.0	5.0	5.5
I-394 WB	1.0	4.0	3.5	1.0	1.5	2.0
I-494 EB	5.0	5.0	5.5	5.5	6.5	8.5
I-494 WB	7.0	8.0	9.0	9.0	7.5	11.0
I-694 EB	2.0	2.0	2.0	2.0	3.5	3.5
I-694 WB	4.0	4.0	1.0	1.0	1.5	3.0
Total	52.5	57.0	51.0	40.0	55.0	79.0

TH Total # of Congested Miles

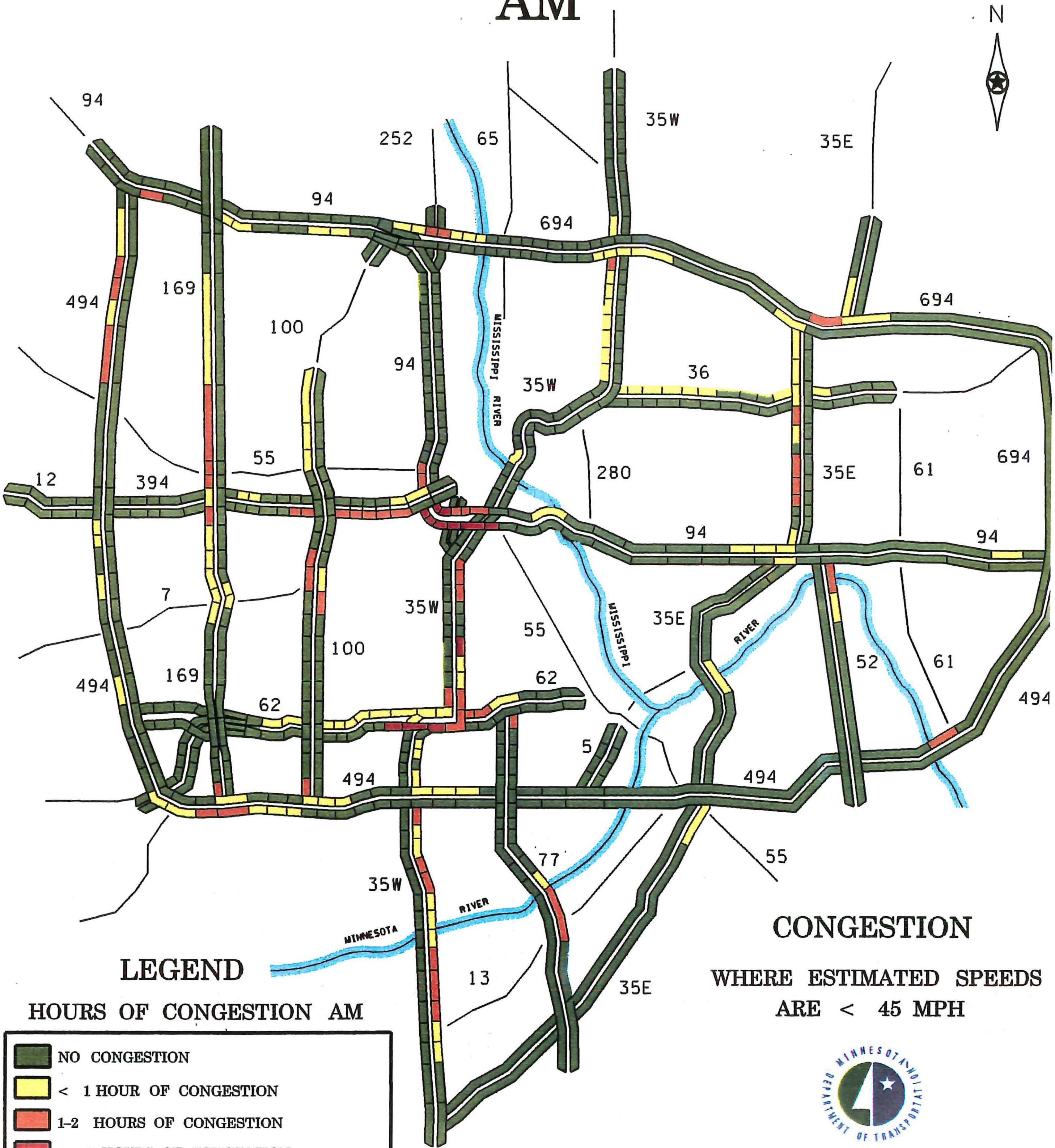
	1993	1994	1995	1996	1997	1998
TH 5 EB	0.0	0.0	0.0	0.0	0.0	0.0
TH 5 WB	0.0	0.0	0.0	0.0	0.0	0.0
TH 36 EB	4.0	0.0	1.5	0.0	0.0	0.5
TH 36 WB	0.0	0.0	0.0	0.0	0.0	0.0
TH 52 SB	0.0	0.0	0.5	0.5	0.5	0.5
TH 52 NB	0.5	0.5	0.5	0.5	0.5	0.5
TH 62 EB	8.0	8.0	6.0	5.0	5.5	6.0
TH 62 WB	3.0	1.5	1.0	1.0	4.5	5.5
TH 100 SB	2.0	2.0	3.0	2.5	2.0	2.0
TH 100 NB	4.0	4.0	4.0	2.5	3.5	4.5
TH 169 SB	0.0	1.0	2.5	1.5	1.0	2.0
TH 169 NB	11.0	13.0	13.0	13.5	7.0	11.0
TH 212 SB	0.0	0.0	0.0	0.0	0.0	0.0
TH 212 NB	0.0	0.0	0.0	0.0	0.0	0.0
TH 77 SB	2.0	3.0	3.0	3.0	3.0	2.5
TH 77 NB	1.0	1.0	0.5	0.0	0.5	0.5
Total	35.5	34.0	35.5	30.0	28.0	35.5

	1993	1994	1995	1996	1997	1998
Grand Total	88	91	87	70	83	115

Appendix B
Congestion Maps

1993 Metro Freeway Congestion

AM



LEGEND

HOURS OF CONGESTION AM

- NO CONGESTION
- < 1 HOUR OF CONGESTION
- 1–2 HOURS OF CONGESTION
- > 2 HOURS OF CONGESTION

91 TOTAL MILES OF CONGESTION
500 TOTAL MILES OF FREEWAY

CONGESTION

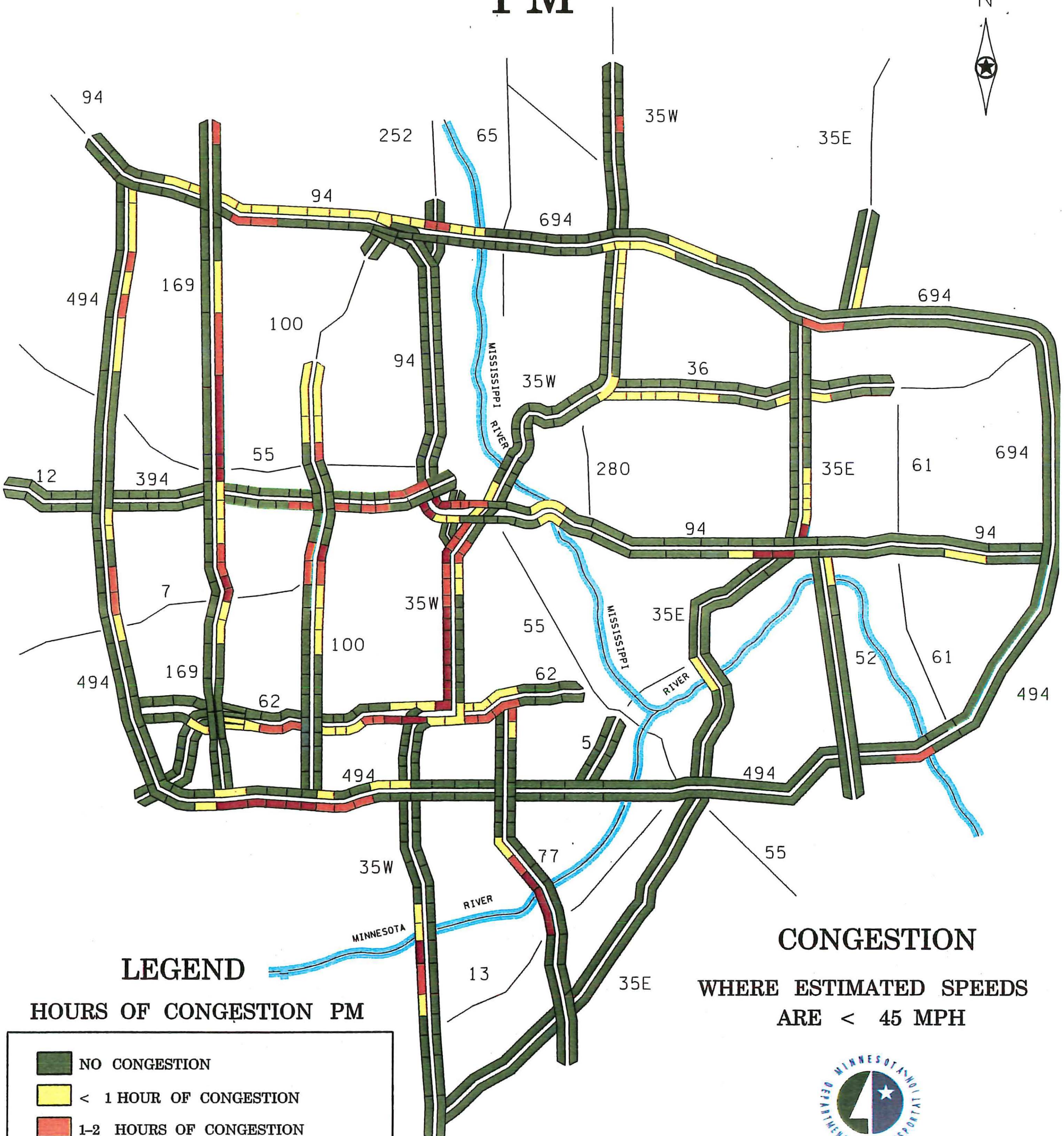
WHERE ESTIMATED SPEEDS ARE < 45 MPH

MINNESOTA DEPARTMENT OF TRANSPORTATION

TMC

1993 Metro Freeway Congestion

PM



LEGEND

HOURS OF CONGESTION PM

- NO CONGESTION
- < 1 HOUR OF CONGESTION
- 1–2 HOURS OF CONGESTION
- \> 2 HOURS OF CONGESTION

88 TOTAL MILES OF CONGESTION

500 TOTAL MILES OF FREEWAY

CONGESTION

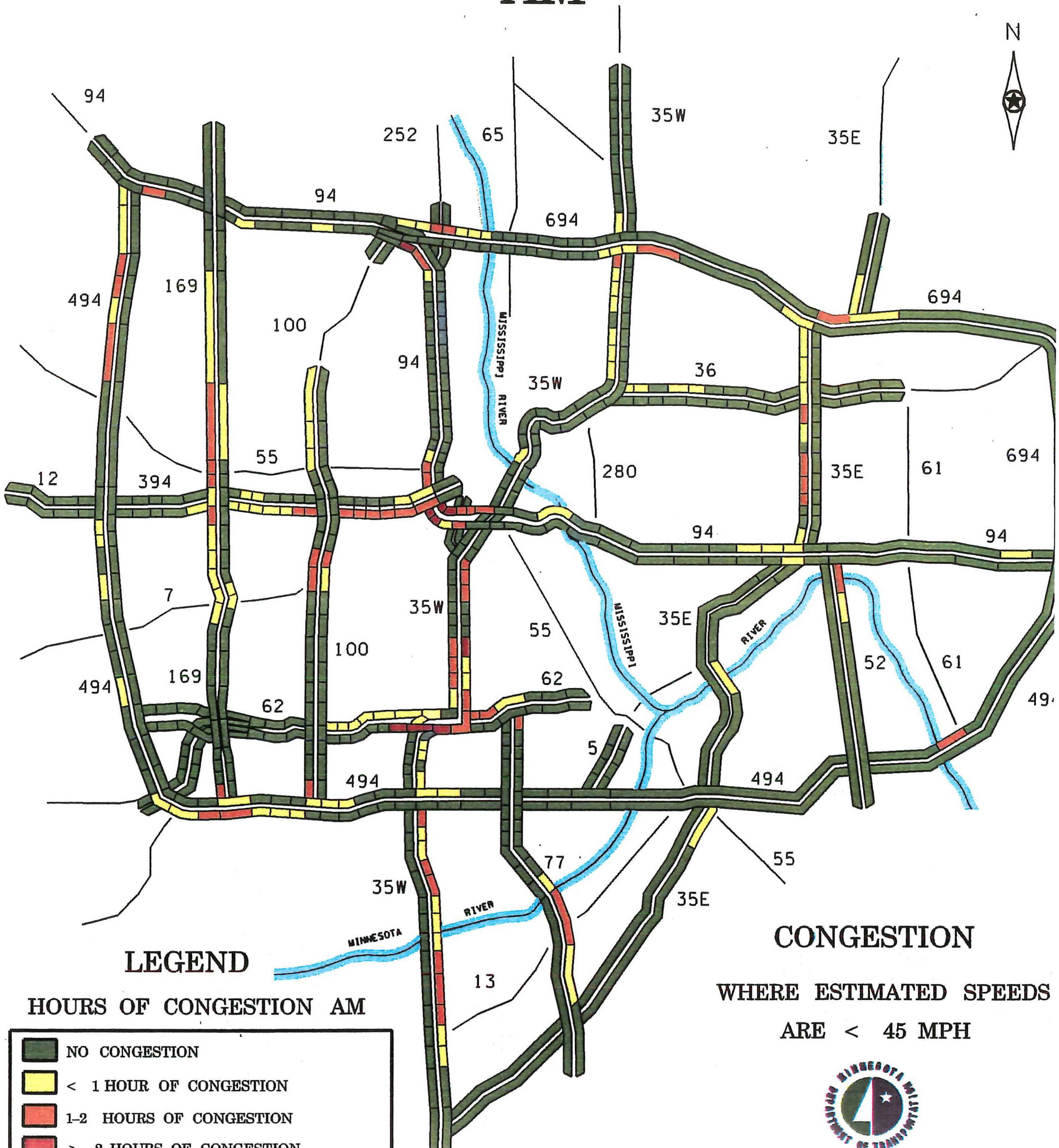
WHERE ESTIMATED SPEEDS ARE < 45 MPH

MINNESOTA DEPARTMENT OF TRANSPORTATION

TMC

1994 Metro Freeway Congestion

AM



LEGEND

HOURS OF CONGESTION AM

- NO CONGESTION
- < 1 HOUR OF CONGESTION
- 1–2 HOURS OF CONGESTION
- > 2 HOURS OF CONGESTION

100 TOTAL MILES OF CONGESTION

500 TOTAL MILES OF FREEWAY

CONGESTION

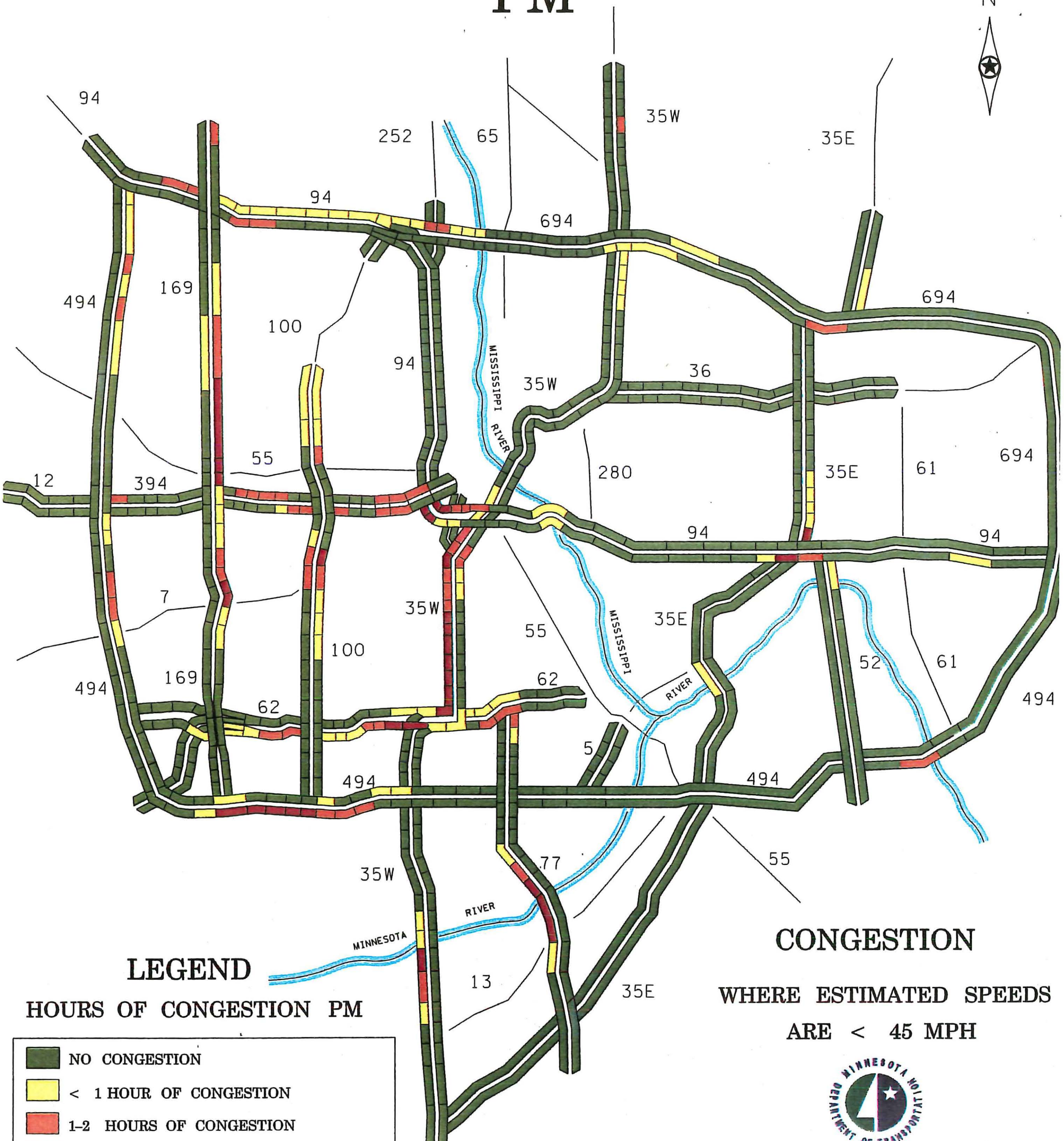
WHERE ESTIMATED SPEEDS ARE < 45 MPH

MINNESOTA DEPARTMENT OF TRANSPORTATION

TMC

1994 Metro Freeway Congestion

PM



LEGEND

HOURS OF CONGESTION PM

- NO CONGESTION
- < 1 HOUR OF CONGESTION
- 1–2 HOURS OF CONGESTION
- > 2 HOURS OF CONGESTION

91 TOTAL MILES OF CONGESTION

500 TOTAL MILES OF FREEWAY

CONGESTION

WHERE ESTIMATED SPEEDS ARE < 45 MPH

MINNESOTA DEPARTMENT OF TRANSPORTATION

TMC

1995 Metro Freeway Congestion

AM

LEGEND

HOURS OF CONGESTION AM

- No Congestion
- < 1 Hour of Congestion
- 1-2 Hours of Congestion
- > 2 Hours of Congestion
- ROADWAYS
- Water.shp

MINNESOTA DEPARTMENT OF TRANSPORTATION

CONGESTION

WHERE ESTIMATED SPEEDS ARE < 45 MPH

86 Total Miles of Congestion

500 Total Miles of Freeway

1995 Metro Freeway Congestion

PM

LEGEND

HOURS OF CONGESTION PM

- No Congestion
- < 1 Hour of Congestion
- 1-2 Hours of Congestion
- > 2 Hours of Congestion
- ROADWAYS
- Water.shp

CONGESTION

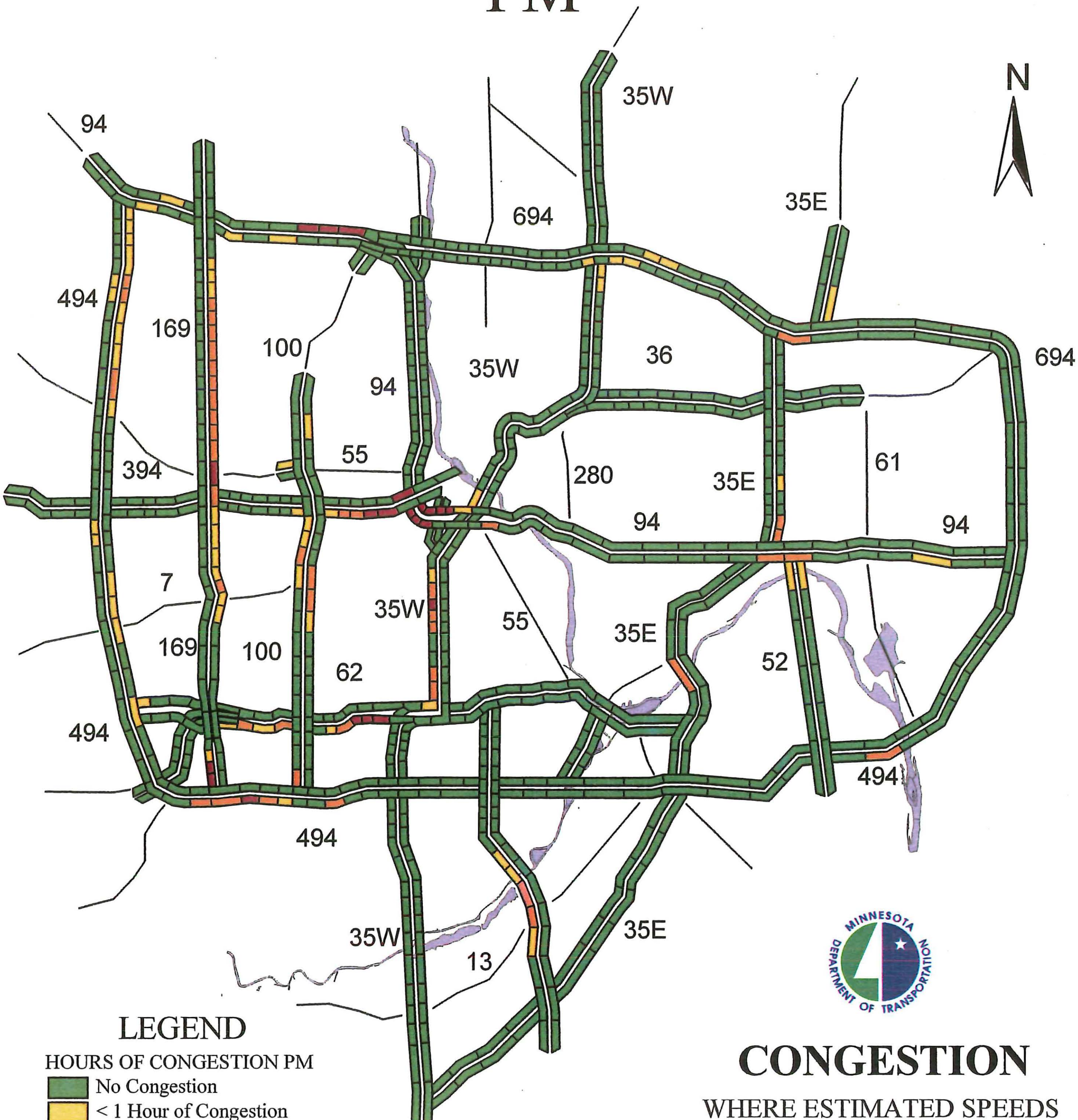
WHERE ESTIMATED SPEEDS ARE < 45 MPH

87 Total Miles of Congestion
500 Total Miles of Freeway

1996 Metro Freeway Congestion

1996 Metro Freeway Congestion

PM



LEGEND

HOURS OF CONGESTION PM

- No Congestion
- < 1 Hour of Congestion
- 1-2 Hours of Congestion
- > 2 Hours of Congestion
- ROADWAYS
- Water.shp

CONGESTION

WHERE ESTIMATED SPEEDS ARE < 45 MPH

71 Total Miles of Congestion
500 Total Miles of Freeway

1997 Metro Freeway Congestion

AM

LEGEND

Hours of Congestion AM

- No Congestion
- < 1 Hour of Congestion
- 1-2 Hours of Congestion
- > 2 Hours of Congestion
- Water
- Roads

CONGESTION

WHERE ESTIMATED SPEEDS ARE < 45 MPH

73 Total Miles of Congestion
500 Total Miles of Freeway

1997 Metro Freeway Congestion

PM

LEGEND

Hours of Congestion PM

- No Congestion
- < 1 Hour of Congestion
- 1-2 Hours of Congestion
- > 2 Hours of Congestion
- Water
- Roads

MINNESOTA DEPARTMENT OF TRANSPORTATION

CONGESTION

WHERE ESTIMATED SPEEDS
ARE < 45 MPH

83 Total Miles of Congestion
500 Total Miles of Freeway

1998 Metro Freeway Congestion

AM

LEGEND
Hours of Congestion
- No Congestion
- < 1 Hour of Congestion
- 1-2 Hours of Congestion
- > 2 Hours of Congestion
- Water
- Roads

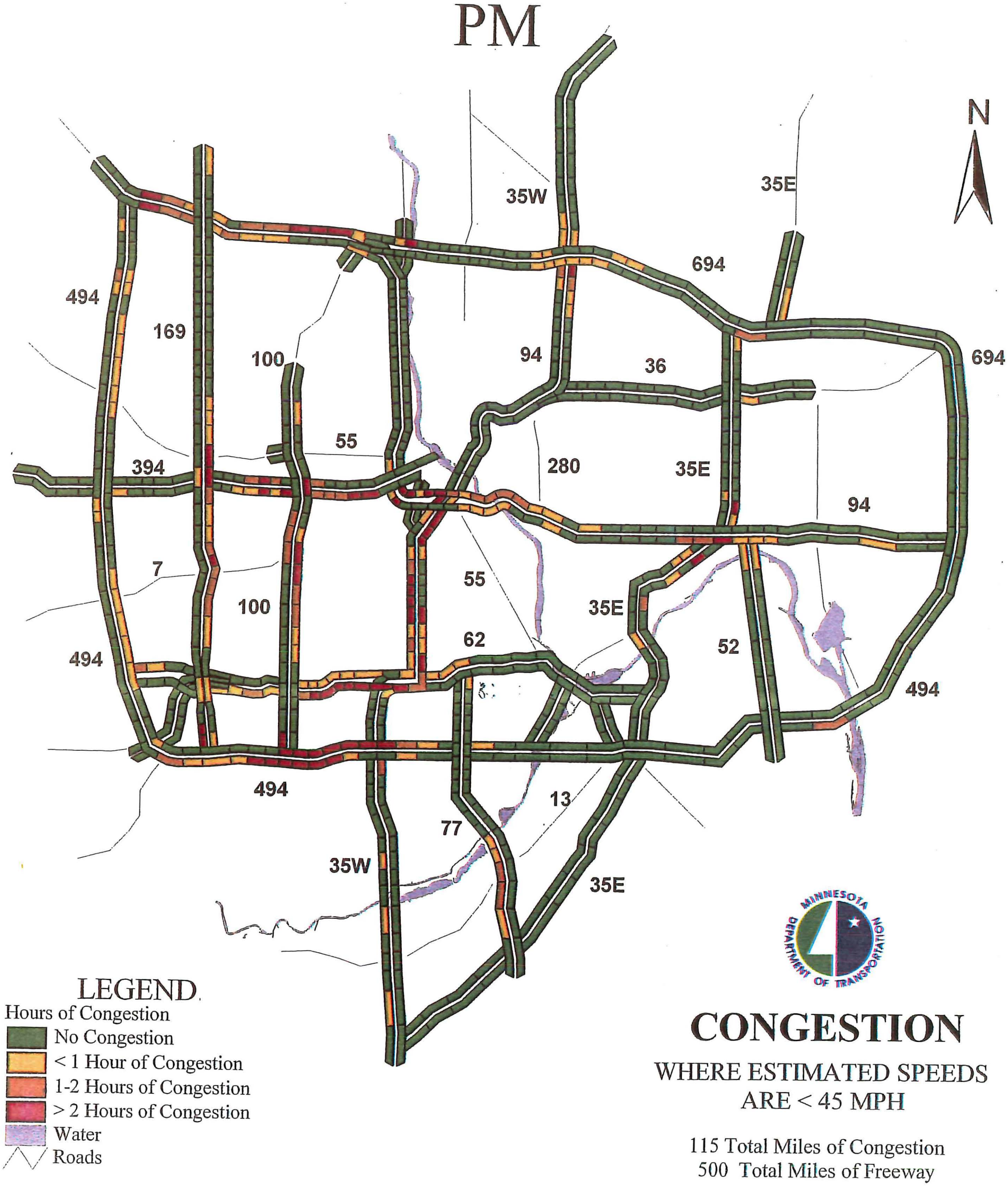
MINNESOTA DEPARTMENT OF TRANSPORTATION

CONGESTION

WHERE ESTIMATED SPEEDS ARE < 45 MPH

123 Total Miles of Congestion
500 Total Miles of Freeway

1998 Metro Freeway Congestion



MINNESOTA DEPARTMENT OF TRANSPORTATION

CONGESTION

WHERE ESTIMATED SPEEDS ARE < 45 MPH

115 Total Miles of Congestion
500 Total Miles of Freeway

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