Twin Cities Ramp Meter Evaluation

Phase II – Interim Ramp Meter Strategy

Phase III – Plans for New Ramp Meter Strategy

executive summary

prepared for

Minnesota Department of Transportation

prepared by

Cambridge Systematics, Inc.

with

SRF Consulting Group, Inc.
N.K. Friedrichs Consulting, Inc.

November 27, 2001

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Introduction

As mandated by the Minnesota state legislature, Mn/DOT conducted a test of the impacts of shutting down the Twin Cities' ramp metering system in the fall of 2000. This test was conducted by an independent team of consultants directed by Cambridge Systematics, Inc. Traffic operations and accident data were examined for a pre-shutdown period between September 11 and October 15, and during the shutdown between October 16 and December 8. Market research to assess public opinion about the ramp metering system was also gathered during both periods.

The results of this study are documented in "Twin Cities Ramp Meter Evaluation," February 1, 2001. The major findings were that the ramp meter shutdown resulted in major degradation of freeway traffic operations and increases in the number of accidents. The market research findings documented considerable dissatisfaction with the ramp meter system – particularly in regard to queue length. However, the majority of respondents, during both phases of the study, favored continued modification of the ramp metering system rather than maintaining the pre-shutdown condition or shutting down the system permanently.

In light of these findings, Mn/DOT restored the operation of the ramp metering system on December 9, 2000 in a greatly modified fashion which featured a much more rapid green cycle. This system has remained in operation since that date. The Cambridge Systematics team was contracted to evaluate this interim system in the fall of 2001, replicating the timeframe and general methodology of the original study. This Executive Summary presents the findings of this third wave of evaluation of ramp metering in the Twin Cities. This study has helped to guide Mn/DOT's decision-making in regard to the future of the ramp metering system.

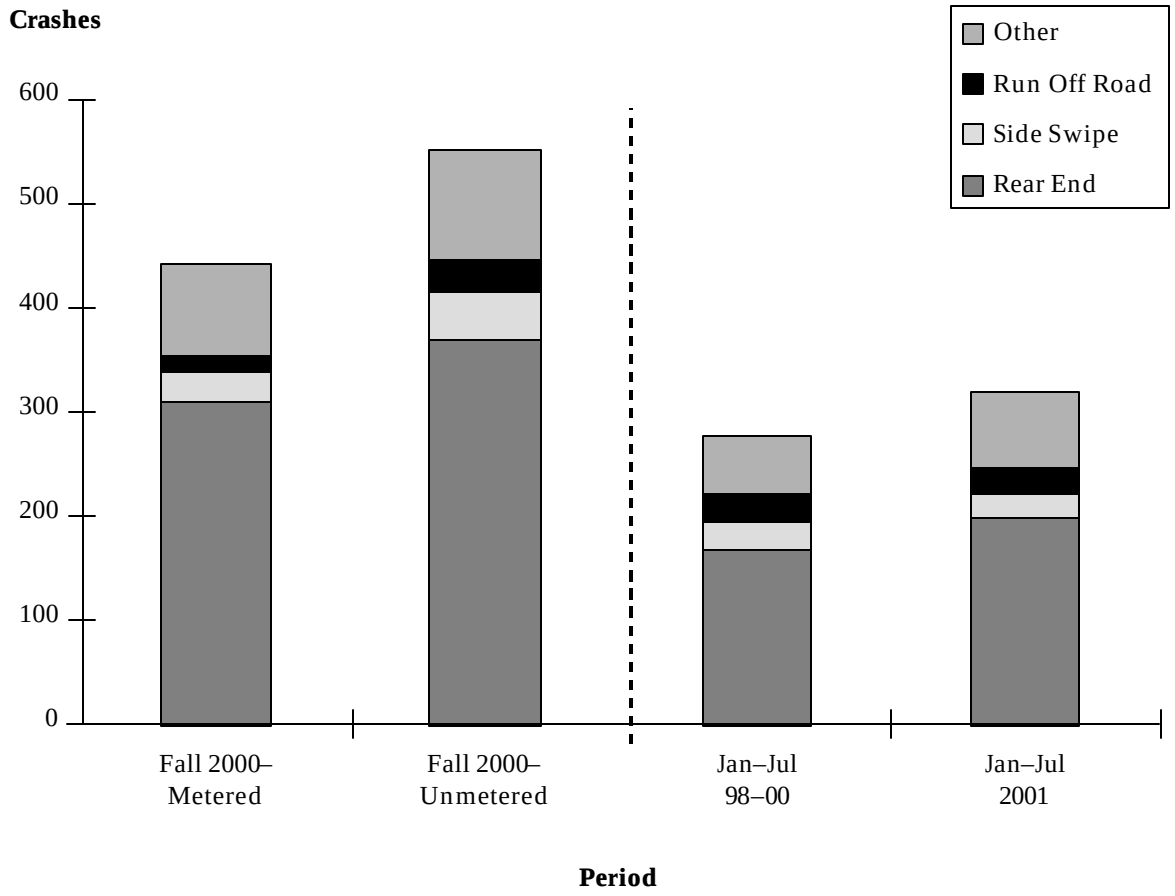
Crash Data Analysis

Cambridge Systematics conducted an analysis of crash data based on crash records received from the Department Public Safety. The objective of this analysis was to confirm if there is a continuation of the trend observed in the fall of 2000, relating to increased crash rates in the absence of ramp metering. The results of this analysis are summarized as follows:

- In the fall of 2000, crashes increased by 24 percent in the absence of metering. This analysis was based on five weeks of crash data. Comparing the first seven months of years 1998-2000 (fully metered) and year 2001 (interim metering operation), crash rates increased by 15 percent.

Figure ES.1 depicts the results of this comparison. After taking into account seasonal variations, January-July 2001 crashes on metered freeways were found to be higher than crashes in the same period in years 1998 through 2000. The data indicate that the absence of effective ramp metering has had a continued impact on crash rates.[1]

Figure ES.1 Crash Comparison by Type



[1] The 2000 data represents six weeks of data. The seven-month comparison for 1998-2001 represents an average of each month (slightly more than four weeks of data). This accounts for the difference in the overall number of accidents between the two comparison periods. If normalized for the same time period, the two sets of bars would be comparable to each other.

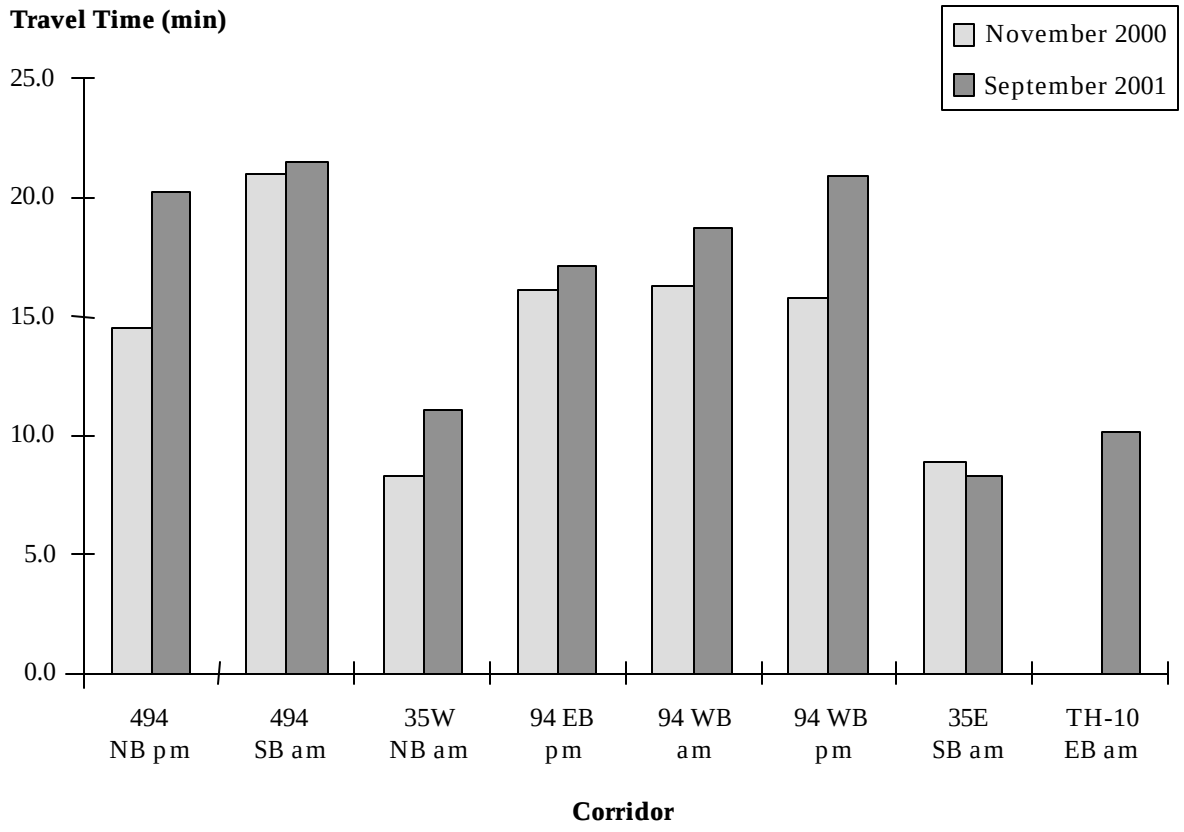
Traffic Data Analysis

Cambridge Systematics compared traffic volumes and speeds on metered freeways in September 2001 versus November 2000. The September 2001 field data were collected using TMC archived data. The November 2000 analysis had used a combination of TMC data and original field data collected by Cambridge Systematics. The results of this analysis are summarized as follows (in each case, the variance averages between five and 10 percent):

- Freeway speeds in 2001 are consistently slower than in 2000;
- Freeway travel times in 2001 are consistently longer than in 2000; and
- Freeway traffic volumes in 2001 are consistently lower than in 2000.

Figure ES.2 depicts the results of the travel time comparison. The data indicate that the absence of effective ramp metering has had a continued impact on freeway speeds, travel times and volumes.

Figure ES.2 Travel Time Comparison



Market Research

Cambridge Systematics conducted random telephone surveys of 500 commuters in the Twin Cities metropolitan area in September 2001. The purpose of the surveys was to assess the public's perception of the interim ramp metering system implemented in December 2000 following completion of the shutdown experiment. The survey design and sampling plan were similar to that used to gage public reaction to the old ramp metering system in September/October 2000, and to the ramp meter shutdown experiment in October/November 2000. The major difference was that previously a random survey of 250 commuters and four corridor-specific surveys (of 125 commuters each) were conducted, while this time a single random survey of 500 commuters was conducted. Since there were no significant differences in the findings of the earlier random survey versus the corridor-specific surveys, this change in approach (which saved time and budget) had no significant impact on the findings.

The major findings of this survey are as follows:

- Reported average travel times in the region have increased from 28 minutes under the old ramp metering system to 30 minutes under the current system, with freeway travel time showing the most significant increase from 20 to 24 minutes. This supports the findings of the traffic data that freeway operations have not returned to their pre-shutdown condition and continue to be degraded.

- Commuters' attitudes toward ramp meters are generally more positive than in the pre-shutdown condition. People are more satisfied with meters (6.1 versus 5.0 on a scale of 10 where 10 equals total satisfaction), and are less inclined to believe that waits are too long, that they wait even when traffic is moving smoothly, and that meters cause congestion on local streets. However, fewer commuters (5.6 versus 5.9 previously) believe that their travel time is predictable.

- Strong support (60 percent of commuters) was evidenced for continued modification of the ramp metering system. About one-quarter (26 percent) believe that the system should continue to operate as is, while 14 percent believe that the meters should be shutdown completely. These percentages are similar to those expressed during the pre-shutdown condition, except support for a complete shutdown has declined significantly from 21 percent previously.

- Support was expressed for a variety of new metering strategies including varying the hours of operation depending on congestion (7.7 out of 10) and setting the timing on freeway-to-freeway ramps so that waits are no longer than three minutes (7.1). Support was low (3.9) for setting the timing at local meters so that waits would be no longer than six minutes (the previously acceptable maximum wait time). Thus, the new metering system will be set to limit waits to no more than four minutes.

Implementation Plan for the New Ramp Metering System

Based on the market research and traffic data analysis conducted under contract with Cambridge Systematics, changes to Mn/DOT's ramp metering system will start to be implemented in late 2001 and become operational in stages in 2002. The new system implements several lessons learned over the past year since the official Ramp Meter Study was conducted.

The primary goals of the new ramp metering system are to:

- Reduce delays caused by congestion and crashes;
- Reduce the number of crashes caused by congestion;
- Provide travelers with more reliable travel times; and
- Manage ramp meter wait times.

These goals will be measured by the following performance standards:

- Delays will be less than four minutes per vehicle on local ramps and less than two minutes per vehicle on freeway to freeway ramps;
- Queues will be prevented from backing up into arterial intersections;
- Meter timing will vary depending on congestion levels on both freeways and ramps; and
- Meter start times and the duration of metering will vary in response to congestion levels.

The new system will be implemented in the following stages:

- Queue detection is being installed on ramps to provide real-time information about queue delays:
  - About 30 percent of ramps already have queue detectors. These meters are on the following corridors: 35W, 35E, 494, 94, 100, 169, 62 and 77.
  - 160 queue detectors will be installed in 2002 that will allow deployment of the new system to the rest of the currently metered corridors.
- New software is being created for implementation in March 2001 that:
  - Uses the queue detector information to adjust rates for real-time conditions;
  - Allows the system to operate efficiently even when there are detector malfunctions; and
  - Provides better information for monitoring system performance.
- Ramp Meter Removal – At least 24 current meter installations will be targeted for removal in 2002 including meters that are not currently used and for which there is no foreseeable need to meter in the next five years. Additional meters can be removed if

sufficient capacity improvements are made, or corridors cannot be effectively managed with meters.

- System Expansion – Installation of new meters will be considered only where recurring congestion exists and it can be assured that metering would have a positive influence on the corridor's operation.

Table ES.1 compares the three metering strategies – the original method, the current interim system, and the new method. Table ES.2 shows the locations and approximate operating times for the first round of queue detection. In this first round, 70 A.M. peak meters will have queue detection installed (28 percent of all A.M peak meters; and 85 P.M. peak meters (30 percent of the total) will be equipped with queue detection.

Table ES.1 Comparison of Metering Strategies

	Original Method	Current Method	New Method
Goal	Maximize bottleneck through-put and improve safety	Break-up platoons of vehicles entering freeway	Reduce delays caused by congestion and crashes while having acceptable queues
Traffic Responsive?	Yes, real-time for mainline conditions; Not real-time for queues	No, fixed time metering only	Yes, real time for mainline **and** ramp conditions
Time windows for metering	Up to four hours A.M. Up to five hours P.M. Start and end times determined by corridor traffic conditions	Two hours A.M. Two hours P.M. Fixed systemwide start and end times	Start and end times determined by corridor traffic conditions
Queues	15-minute maximum wait; Spill back to local streets allowed; No real time queue management	Currently no delays with a few exceptions	<four-minute maximum wait on local ramps; <two-minute maximum wait on freeway to freeway ramps; Delays tracked in real time; Delays shared across corridor ramps
Strengths	Maximizes mainline capacity and safety	No queues	Rates based on real time ramp demand; Safeguards in place against long queues; Safety and mainline capacity will improve over current method
Weaknesses	No real-time queue management; Queue wait too sensitive to incidents and hardware failures	Non-responsive to traffic conditions; Does not prevent congestion; Higher crash rate than original method	More congestion than original method

Table ES.2 First Stage of Corridor Deployment

A.M. Peak

Freeway	From	Through	Total Meters	Fwy to Fwy Mtrs	Approx. Start Time*	Approx. End Time*
NB 35W	CR 42	Cliff Road	5	0	6:15	8:15
NB 77	CR 38	TH 13	6	0	6:30	8:30
EB 10	Ferry Street	Hansen Blvd.	6	0	6:00	8:00
WB 94	Marion Street	TH 280	7	0	6:45	8:45
SB 494	Bass Lk Road	TH 7	10	2	6:00	8:00
SB 35E	Little Canada	Maryland	6	2	6:15	8:15
WB 494	24th Avenue	TH 100	12	5	6:30	8:30
WB 62	35W	TH 169	10	3	6:30	8:30
EB 62	TH 169	35W	9	4	6:30	8:30

* Start and End times subject to congestion and may vary over time.

P.M. Peak

Freeway	From	Through	Total Meters	Fwy to Fwy Mtrs	Approx. Start Time*	Approx. End Time*
NB 494	TH 62	Bass Lk Road	10	2	3:00	6:00
WB 94	Marion Street	TH 280	7	0	3:00	6:00
EB 494	E. Bush Lake	12th Avenue	10	2	3:00	6:00
WB 494	24th Avenue	TH 100	12	5	3:00	6:00
NB 169	Valley View	Plymouth Road	15	4	3:00	6:00
NB 100	77th Street	394	13	2	3:00	6:00
WB 62	35W	TH 169	9	3	3:00	6:00
EB 62	TH 169	35W	9	4	3:00	6:00

* Start and End times subject to congestion and may vary over time.