



RESEARCH

2007-21

Evaluating the Effectiveness of the Minnesota Speed Management Program



Office of Traffic, Security and Operations

Take the



steps...

Research...Knowledge...Innovative Solutions!

Transportation Research

Technical Report Documentation Page

1. Report No. MN/RC-2007-21	2.	3. Recipients Accession No.	
4. Title and Subtitle Evaluating the Effectiveness of the Minnesota Speed Management Program		5. Report Date May 2007	
7. Author(s) Kathleen A. Harder, Ph.D. and John R. Bloomfield, Ph.D.		6.	
9. Performing Organization Name and Address Center for Human Factors Systems Research and Design College of Design University of Minnesota Suite 225 1425 University Ave. S.E. Minneapolis, MN 55414		8. Performing Organization Report No.	
12. Sponsoring Organization Name and Address Minnesota Department of Transportation 395 John Ireland Boulevard Mail Stop 330 St. Paul, Minnesota 55155		10. Project/Task/Work Unit No.	
		11. Contract (C) or Grant (G) No. (c)81655 (wo) 199	
15. Supplementary Notes http://www.lrrb.org/PDF/200721.pdf		13. Type of Report and Period Covered Final Report	
		14. Sponsoring Agency Code	
16. Abstract (Limit: 200 words)			
<p>The Minnesota Speed Management Program (MSMP), a cooperative project between the Minnesota Department of Transportation and the Minnesota Department of Public Safety, was developed within the framework of the Minnesota Comprehensive Highway Safety Plan. The overall goal was to reduce the number of fatal and life-changing crashes on Minnesota highways. The MSMP involved a speed limit adjustment—on 850 miles of Minnesota’s 55 mph highways the speed limit was increased to 60 mph. It involved increased speed enforcement—by State Patrol, county sheriffs, and local law enforcement—on selected highways. There were four waves of <i>Enhanced</i> Enforcement (one of six weeks, three of eight weeks) each followed by four weeks of <i>Regular</i> Enforcement. The MSMP involved extensive public education, organized by the Office of Traffic Safety, with approximately 10,000 public service messages presented on the radio.</p> <p>Two evaluation efforts were conducted. The University of Minnesota compared travel speed data and crash data obtained during the MSMP with historical data. Throughout the MSMP, there were decreases in the number of drivers traveling at least 10 mph above the speed limits—decreases of -28.7% on 2-Lane/2-Way Highways; -28.7% on 4-Lane Divided Highways; -42.9% on Rural Freeways; and -11.2% mph on Urban Freeways. The University’s evaluation also showed there were reductions in the numbers of fatal and life-changing crashes during the MSMP. MarketLine Research conducted the second evaluation, using telephone surveys, and found nine in ten drivers support the speed limit increase from 55 mph to 60 mph in both Metro and Greater Minnesota. The MSMP, in concert with other efforts that are part of the Minnesota Comprehensive Highway Safety Plan, resulted in reductions in the number of speeders on Minnesota Highways and reductions in the number of fatal and life-changing crashes—making Minnesota’s roads safer.</p>			
17. Document Analysis/Descriptors Speed management; Speed data Speed limit changes Crash data Enhanced speed enforcement		18. Availability Statement No restrictions. Document available from: National Technical Information Services, Springfield, Virginia 22161	
19. Security Class (this report) Unclassified	20. Security Class (this page) Unclassified	21. No. of Pages 68	22. Price

**Evaluating the Effectiveness of the
Minnesota Speed Management Project**

Final Report

Prepared by:

Kathleen A. Harder, Ph.D.
John R. Bloomfield, Ph.D.
Center for Human Factors Systems Research and Design
University of Minnesota

March 2007

Published by
Minnesota Department of Transportation
Office of Research Services
Mail Stop 330
395 John Ireland Boulevard
St. Paul, Minnesota 55155-1899

This report represents the results of research conducted by the authors and does not necessarily represent the view or policy of the Minnesota Department of Transportation and/or the Center for Transportation Studies. This report does not contain a standard or specified technique.

Acknowledgements

We would like to thank the following individuals and organizations for their contributions to this project:

Sue Groth, Assistant State Traffic Engineer, Minnesota Department of Transportation

Daniel Brannan, Traffic Safety Specialist, Minnesota Department of Transportation

Nathan Drews, Minnesota Department of Transportation

Xi Zou, Graduate Research Assistant, University of Minnesota

Table of Contents

	<u>Page</u>
Chapter 1. Introduction.....	1
1.1. Minnesota Speed Management Program (MSMP).....	1
1.2. Background	1
1.3. Effects of the 1997 Increases in Speed Limits.....	2
1.4. Scope of the MSMP	3
1.5. Components of the MSMP	3
1.6. Costs of the MSMP.....	5
1.7. Purpose of this Report	5
Chapter 2. Summary of Findings during the MSMP:	
Objective Speed and Crash Data	7
2.1. Method	7
2.2. Travel Speeds on 2-Lane/2-Way Highways	8
2.3. Crash Data for 2-Lane/2-Way Highways	15
2.4. Travel Speeds on 4-Lane Divided Highways	17
2.5. Crash Data for 4-Lane Divided Highways	24
2.6. Travel Speeds on Rural Freeway	25
2.7. Crash Data for Rural Freeways	32
2.8. Travel Speeds on Urban Freeways	33
2.9. Crash Data for Urban Freeways	37
2.10. Note on Statistical Significance of Crash Data.....	39
2.11. Citation Data.....	39
Chapter 3. Summary of Findings during the MSMP: Driver Perceptions.....	43
3.1. Introduction	43
3.2. Sampling Techniques	43
3.3. Survey Objectives	43
3.4. Survey Findings	44
Chapter 4. Conclusions and Recommendations	47
References	51

List of Tables

	<u>Page</u>
Table 1.1: Enforcement Status During the MSMP	4
Table 2.1: Details of the ATRs Located on 2-Lane/2-Way Highways.....	8
Table 2.2 (a): 2-Lane/2-Way Highways <i>Within</i> Enhancement Zones— Mean Travel Speed and 85 th Percentile in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	11
Table 2.2 (b): 2-Lane/2-Way Highways <i>Within</i> Enhancement Zones— Percent of Vehicles in 10 mph Pace in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	11
Table 2.3 (a): 2-Lane/2-Way Highways <i>Outside</i> Enhancement Zones— Mean Travel Speed and 85 th Percentile in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	14
Table 2.3 (b): 2-Lane/2-Way Highways <i>Outside</i> Enhancement Zones— Percent of Vehicles in 10 mph Pace in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	15
Table 2.4: Crash Data during the MSMP Compared to Average Crash Data for the Prior 5 Years, for 2-Lane/2-Way Highways on which the Speed Limit Was Increased, from 55 mph to 60 mph, and that Were <i>Within</i> the Enhanced Enforcement Zones	16
Table 2.5: Crash Data during the MSMP Compared to Average Crash Data for the Prior 5 Years, for 2-Lane/2-Way Highways on which the Speed Limit Was Unchanged, at 55 mph, and that Were <i>Outside</i> the Enhanced Enforcement Zones	16
Table 2.6: Crash Data during the MSMP Compared to Average Crash Data for the Prior 5 Years, for 2-Lane/2-Way Highways for which the Speed Limit Was Increased, from 55 mph to 60 mph, and that Were <i>Outside</i> the Enhanced Enforcement Zones.....	17
Table 2.7: Details of the ATRs on 4-Lane Divided Highways	18
Table 2.8 (a): 4-Lane Divided Highways <i>Within</i> Enhancement Zones— Mean Travel Speed and 85 th Percentile in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	20
Table 2.8 (b): 4-Lane Divided Highways <i>Within</i> Enhancement Zones— Percent of Vehicles in 10 mph Pace, in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	20
Table 2.9 (a): Data for One 4-Lane Divided Highway <i>Outside</i> the Enhancement Zones—Mean Travel Speed and 85 th Percentile in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	23
Table 2.9 (b): Data for One 4-Lane Divided Highways <i>Outside</i> the Enhancement Zones—Percent of Vehicles in 10 mph Pace, in Eight Test Periods <i>During</i> and <i>Before</i> the MSMP	23
Table 2.10: Crash Data for 4-Lane Divided Highways that Were <i>Within</i> the Enhanced Enforcement Zones during the MSMP	24
Table 2.11: Crash Data for 4-Lane Divided Highways that Were <i>Outside</i> the Enhanced Enforcement Zones during the MSMP	25

List of Tables (Continued)

	<u>Page</u>
Table 2.12: Details of the ATRs on Rural Freeways	26
Table 2.13 (a): Rural Freeways <i>Within</i> Enhancement Zones—Mean Travel Speed and 85 th Percentile in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	28
Table 2.13 (b): Rural Freeways <i>Within</i> Enhancement Zones—Percent of Vehicles in 10 mph Pace in Eight Test Periods <i>During</i> and <i>Before</i> the MSMP	28
Table 2.14 (a): Data for One Rural Freeways <i>Outside</i> the Enhancement Zones— Mean Travel speed and 85 th Percentile in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	31
Table 2.14 (b): Data for One Rural Freeways <i>Outside</i> the Enhancement Zones—Percent of Vehicles in 10 mph Pace, in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	31
Table 2.15: Crash Data for Rural Freeways that Were <i>Within</i> the Enhanced Enforcement Zones during the MSMP	32
Table 2.16: Crash Data for Rural Freeways that Were <i>Outside</i> the Enhanced Enforcement Zones during the MSMP	33
Table 2.17: Details of the ATRs on Urban Freeways	34
Table 2.18 (a): Urban Freeways <i>Within</i> Enhancement Zones—Mean Travel speed and 85 th Percentile in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	36
Table 2.18 (a): Urban Freeways <i>Within</i> Enhancement Zones— Percent of Vehicles in 10 mph Pace, in Eight Time Periods <i>During</i> and <i>Before</i> the MSMP	36
Table 2.20: Crash Data for Urban Freeways for which the Speed Limit Was Increased, from 55 mph to 60 mph, and that Were <i>Within</i> the Enhanced Enforcement Zones during the MSMP	38
Table 2.21: Crash Data for Urban Freeways for which the Speed Limit Was Unchanged, at 55 mph, and that Were <i>Outside</i> the Enhanced Enforcement Zones during the MSMP	38
Table 2.22: Citation Data in First Enhanced Enforcement Period—for the Four Types of Highways on Which ATRs Were Located	40
Table 2.23: Citation Data for the Second Enhanced Enforcement Period —for the Four Types of Highways on Which ATRs Were Located	40
Table 2.24: Citation Data for the Third Enhanced Enforcement Period —for the Four Types of Highways on Which ATRs Were Located	41
Table 2.25: Citation Data for the Fourth Enhanced Enforcement Period —for the Four Types of Highways on Which ATRs Were Located	41
Table 2.26: Summary of All Citation Data	42
Table 4.1: Summary of the effect of the MSMP on Travel Speeds and Serious Injury Crashes	47

List of Figures

	<u>Page</u>
Figure 1.1: A New 60 mph Speed Limit Sign Uncovered at the Start of the MSMP	1
Figure 2.1: Map of Minnesota Showing the Seven ATRs Located of on 2-Lane/2-Way Highways	9
Figure 2.2: 2-Lane/2-Way Highways <i>Within</i> the Enhanced Enforcement Zones—Percent Decrease when the Number of Drivers Traveling at 70 mph or More <i>During</i> the MSMP (when the speed limit was raised to 60 mph) is compared to the Number of Drivers Traveling at 70 mph or More <i>Before</i> the MSMP (when the speed limit was 55 mph), for both the <i>Enhanced</i> Enforcement and <i>Regular</i> Enforcement periods	10
Figure 2.3: 2-Lane/2-Way Highways <i>Outside</i> the Enhanced Enforcement Zones—Percent Increase in the Number of Drivers Traveling at 70 mph or More <i>During</i> the MSMP compared to <i>Before</i> the MSMP, for the equivalent <i>Enhanced</i> Enforcement and <i>Regular</i> Enforcement periods	13
Figure 2.4: Map of Minnesota Showing Five ATRs Located on 4-Lane Divided Highways	18
Figure 2.5: 4-Lane Divided Highways <i>Within</i> the Enhanced Enforcement Zones—Percent Decrease in the Number of Drivers Traveling at 75 mph or More <i>During</i> the MSMP compared to <i>Before</i> the MSMP, for both the <i>Enhanced</i> Enforcement and <i>Regular</i> Enforcement periods	19
Figure 2.6: One 4-Lane Highway <i>Outside</i> the Enhanced Enforcement Zones—Percent Decrease in the Number of Drivers Traveling at 75 mph or More <i>During</i> the MSMP compared to <i>Before</i> the MSMP, for the equivalent <i>Enhanced</i> Enforcement and <i>Regular</i> Enforcement periods	22
Figure 2.7: Map of Minnesota Showing ATRs Located of on Rural Freeways	26
Figure 2.8: Rural Freeways <i>Within</i> the Enhanced Enforcement Zones—Percent Decrease in the Number of Drivers Traveling at 80 mph or More <i>During</i> the MSMP compared to <i>Before</i> the MSMP for the equivalent <i>Enhanced</i> Enforcement and <i>Regular</i> Enforcement periods	27
Figure 2.9: One Rural Freeway located <i>Outside</i> the Enhanced Enforcement Zones— Percent Decrease in the Number of Drivers Traveling at 80 mph or More <i>During</i> the MSMP compared to <i>Before</i> the MSMP, for the equivalent <i>Enhanced</i> Enforcement and <i>Regular</i> Enforcement periods	30
Figure 2.10: Map of the Twin Cities Showing the Three ATR Locations on Urban Freeways	34

List of Figures (Continued)

Page

Figure 2.11: Urban Freeways *Within* the Enhanced Enforcement Zones—
Percent Reduction when the Number of Drivers Traveling at
70 mph or More *During* the MSMP (when the speed limit was
raised to 60 mph) Is Compared to the Number of Drivers
Traveling at 70 mph or More *Before* the MSMP (when the speed
limit was 55 mph) for both the *Enhanced* Enforcement and
Regular Enforcement periods35

EXECUTIVE SUMMARY

1. Introduction

The Minnesota Speed Management Program (MSMP)—also known as HEAT (Highway Enforcement of Aggressive Traffic)—was a cooperative project between the Minnesota Department of Transportation (Mn/DOT) and the Minnesota Department of Public Safety (DPS). The program began on September 26, 2005.



A New 60 mph Speed Limit Sign Uncovered at the Start of the MSMP

The MSMP was developed within the framework of the Minnesota Comprehensive Highway Safety Plan (CHSP). It was an extensive speed control project that included speed limit studies, speed limit adjustment, increased speed enforcement, education, and an evaluation of the effectiveness of this comprehensive approach. The overall goal of the program was to reduce the number of fatal and life-changing crashes on Minnesota highways.

Travel speeds on Minnesota roads are excessive, with most drivers ignoring posted speed limits and travel speeds increasing each year. This is the context within which the Minnesota legislature has considered bills aimed at raising speed limits on all 2-Lane/2-Way highways with 55 mph speed limits. Mn/DOT and DPS do not believe a comprehensive increase in speed limits is advisable. However, they consider that speeds might be safely increased on some highways with 55 mph limits—specifically those where the increased limits would match the design standards of the highways—under certain conditions. These conditions are that there should be sufficient resources for law enforcement to ensure that drivers remain strictly within the speed limits and public education that helps motorists understand that the posted speed limit is the true speed limit.

2. Background

The National Maximum Speed Limit law was repealed in 1995. In 1997 speed limits were increased to 70 mph on rural interstates and to 65 mph on some highways in

Minnesota. These changes were reported by the media, but not accompanied by speed enforcement or education efforts. In 2005, Mn/DOT conducted a review of crash data obtained in the five years before and the five years after the 1997 speed limit changes. This review indicated that there was— (1) a 93% increase in fatalities on 4-Lane Divided Highways on which speed limits increased to 65 mph; (2) a 70% increase in fatalities on Rural Freeways on which speed limits increased to 70 mph. Mn/DOT and DPS believe problems occurred because the changes in speed limits were made without accompanying efforts to educate the public or to increase enforcement. The MSMP was carefully designed as a response to these problems.

3. The MSMP

The MSMP focused on (1) highways on which speed limits were increased in 1997, and (2) 55-mph highways on which speed limits could be raised bringing them into closer alignment with the highways' design speed (a rational speed limit). There were the 900 miles of interstates and 970 miles of expressways on which speed limits were increased in 1997. The MSMP aimed to increase law enforcement on the fastest of these roads, to reduce the speeds of the faster drivers and to reduce the number of fatal and life-changing crashes related to excessive driving speeds.

When many of Minnesota's 55 mph highways were constructed, they were engineered to meet a 60 mph (or higher) standard. However, since the mid-1970s they have operated with a 55-mph speed limit. Eight hundred and fifty miles of these highways were selected for inclusion in the MSMP—their speed limit was increased to 60 mph and there was increased law enforcement on these 850 miles.

The approximate costs of implementing the MSMP during FFY06 were \$3.0 million, with \$2.5 million for an increased presence of enforcement officers (Minnesota State Patrol, county sheriffs, and local law enforcement), \$349,700 for paid media (primarily radio), and \$150,300 in data collection, analysis and evaluation. In addition, both Mn/DOT and Minnesota State Patrol made significant in-kind contributions involving: project management, sign installation, speed detection equipment, traffic engineering reviews, vehicle costs, and fuel.

The MSMP had four main components—engineering, enforcement, education, and evaluation. In preliminary engineering efforts, highways that were candidates for increasing the speed limit were reviewed in order to ensure that those highways had the road geometry to support 60-mph speed limits and that they had six-foot shoulders at a minimum. The review also considered crash rates and connectivity to regional trade centers. There were Automatic Traffic Recorders (ATRs) on some of these highways—a number of the ATRs had been in place for several years; while others were installed shortly before the MSMP began. The ATRs were used to collect speed data in order to evaluate the effect of the MSMP on travel speeds.

With regard to Enforcement, throughout the MSMP, various law enforcement officers—State Patrol, county sheriffs, and local law enforcement—worked together. They made deployment decisions on the basis of the number of speeders traveling on the selected

highways prior to the MSMP and on the crash history of the highways, particularly with regard to fatal and life-changing crashes. During the MSMP, there were four waves of *Enhanced* Enforcement each followed by a period of *Regular* Enforcement. *Enhanced* Enforcement was scheduled for the first six weeks of the MSMP, beginning on 9/26/05. This was followed by four weeks of *Regular* Enforcement. Subsequently, there were three more periods of *Enhanced* Enforcement, each lasting eight weeks and each was followed by four weeks of *Regular* Enforcement. During the one six-week and three eight-week *Enhanced* Enforcement periods, each of the participating law enforcement officers kept a log of the number of hours they were on duty, and of the number of motorists they stopped and citations they issued.

There was an extensive public education effort throughout the MSMP. It was organized by the Office of Traffic Safety. Approximately 10,000 public service messages were presented on the radio—the messages grouped together and concentrated at the beginning and end of each of *Enhanced* Enforcement periods. Also, the Office of Traffic Safety took advantage of opportunities to focus media attention on the MSMP and its objectives of reducing both travel speeds and fatal and life-changing crashes.

During the four MSMP enforcement periods, travel speed data were collected on four types of roadway—(1) 2-Lane/2-Way Highways, on which the speed limits were raised from 55 mph to 60 mph; (2) 4-Lane Divided Highways, on which the speed limits remained at 65 mph; (3) Rural Freeways, on which the speed limits remained at 70 mph; and (4) Urban Freeways, on which the speed limits were raised from 55 mph to 60 mph.

In order to assess the effectiveness of the MSMP, two evaluation efforts were conducted. The University of Minnesota conducted the first of these evaluation efforts. This evaluation consisted of analyzing travel speed data and crash data—comparing both the speed and crash data obtained during the MSMP in both the *Enhanced* Enforcement and *Regular* Enforcement periods with the historical data from comparable time frames. We also reported law enforcement data obtained in the *Enhanced* Enforcement areas during the four *Enhanced* Enforcement periods. The second evaluation effort, conducted by MarketLine Research, involved two telephone surveys. These surveys, which sampled drivers' attitudes and their self-reported driving behavior, were conducted shortly before the MSMP began and soon after the fourth *Enhanced* Enforcement period finished. The results of both evaluations are presented below.

4. Results

In order to evaluate the effectiveness of the MSMP, speed and crash data were collected on four types of roadway—(1) 2-Lane/2-Way Highways, (2) 4-Lane Divided Highways, (3) Rural Freeways, and (4) Urban Freeways. The speed and crash data were analyzed by the University of Minnesota.

4.1 Travel Speed Analysis

From the speed data obtained with the ATRs, we derived several speed measures for the *Enhanced* Enforcement and *Regular* Enforcement periods. The same measures were also derived from historical speed data obtained from the ATRs prior to the MSMP. To

compare the MSMP speed data with the historical data, we conducted a series of statistical tests. To test for differences in mean speed we used the procedure for comparing population means outlined by Kitchens (1987, p 369-373). To test for differences in the percentage of vehicles in the 10 mph pace and in the proportions of vehicle traveling at various speeds, we treated each distribution of speeds as a Bernoulli population, and then used the procedure for comparing population proportions described by Kitchens (1987, pages 400-404). The statistical tests were conducted in two ways— (1) the traditional way, using n -values equal to the number of vehicles that traveled past each ATRs; and (2) using an extremely conservative correction, with n -values equal to the number of hours in each test period (to correct for the fact that when traffic is congested, individual vehicles may not be independent of each other).

4.2 Travel Speed Results

To concisely convey evaluation findings, in this report we focus on drivers who were traveling at least 10 mph above the speed limit in the MSMP—i.e., on drivers who were traveling at 70 mph or more on 2-Lane/2-Way Highways; 75 mph or more on 4-Lane Divided Highways; 80 mph or more on Rural Freeways; and 70 mph or more on Urban Freeways. All the changes in the number of drivers traveling at least 10 mph above the speed limit are highly statistically significant.

Our evaluation showed that throughout the MSMP there was a decrease in the number of drivers who were traveling at excessive speeds. In particular, we found that there were large decreases in the number of drivers traveling at least 10 mph above the speed limit. There was a decrease (-28.7%) in the number of drivers traveling at 70 mph or more on 2-Lane/2-Way Highways (where the new speed limit was 60 mph); a decrease (also 28.7%) in the number of drivers traveling at 75 mph or more on 4-Lane Divided Highways (where the speed limit was 65 mph); a decrease (-42.9%) in the number of drivers traveling at 80 mph or more on Rural Freeways (where the speed limit was 70 mph); and a decrease (-11.2%) in the number of drivers traveling at 70 mph or more on Urban Freeways (where the new speed limit was 60 mph). Decreases were found with the speed data collected from ATRs located *within* the *Enhanced* Enforcement Zones and *outside* the *Enhanced* Enforcement Zones. The reductions in the number of drivers traveling at 10 mph over the speed limit *within* the *Enhanced* Enforcement Zones are very likely due to the increased presence of enforcement officers on those roads. And, the similar reductions from speed data collected at ATRs located *outside* the *Enhanced* Enforcement Zones are likely due to their close proximity to those *Enhanced* Enforcement Zones.

There was one exception in the speed reduction findings—there was a pronounced *increase* (+61.3%) in the number of drivers traveling at 70 mph or more on 2-Lane/2-Way Highways located *outside* the *Enhanced* Enforcement Zone. One ATR in particular was responsible for a large share of this increase: This ATR is located on MNTH 65, near Pliny, in Aitkin County. It should be noted that this ATR was located much further away from the *Enhanced* Enforcement Zones than any other ATR in this study.

The speed data are summarized along with the crash data in the Table 1 below.

Table 1: Summary of the effect of the MSMP on Travel Speeds and Serious Injury Crashes

			85 th Percentile		Mean Speed		Fatal and "A" Injury Crashes		ATRs Used*
			Before	During	Before	During	Before (5 yr Avg.)	During	
2-Way/2-Lane	Miles	Percent Change Drivers>70 mph							
Within EEZ (SL—55-60 mph)	317	-28.7%	65.9	65.1	61.2	61.0	16.8	13	3
Outside EEZ (SL—55-55 mph)	7,594	+61.3%	64.1	64.2	58.2	57.7	251.6	224	4
Outside EEZ (SL—55-60 mph)	475	N/A	N/A	N/A	N/A	N/A	12.8	6	0

			85 th Percentile		Mean Speed		Fatal and "A" Injury Crashes		ATRs Used*
			Before	During	Before	During	Before (5 yr Avg.)	During	
4-Lane Divided (SL—65 mph)	Miles	Percent Change Drivers>70 mph							
Within EEZ	52	-28.7%	73.2	72.0	67.4	65.8	8.2	5	4
Outside EEZ	550	-34.3%	73.5	72.9	68.2	67.3	49.6	38	1

			85 th Percentile		Mean Speed		Fatal and "A" Injury Crashes		ATRs Used*
			Before	During	Before	During	Before (5 yr Avg.)	During	
Rural Freeway (SL—70mph)	Miles	Percent Change Drivers>70 mph							
Within EEZ	265	-42.9%	78.6	77.2	72.7	70.9	31.6	25	3
Outside EEZ	460	-71.1%	79.9	78.1	73.3	72.1	37.8	37	1

			85 th Percentile		Mean Speed		Fatal and "A" Injury Crashes		ATRs Used*
			Before	During	Before	During	Before (5 yr Avg.)	During	
Urban Freeway (SL—55-60mph)	Miles	Percent Change Drivers>70 mph							
Within EEZ	27	-11.2%	69.5	68.7	61.6	60.0	13.2	9	3
Outside EEZ	89	N/A	N/A	N/A	N/A	N/A	26.8	19	0

EEZ—Enhanced Enforcement Zones

N/A—Data Not Available

*ATRs Used—Automatic Traffic Recorders embedded in the roadway that record speed, class, and volume data

4.3 Crash Data Analysis

With regard to the crash data, this report deals with Fatal and 'A' Injury Crash data that were updated on November 21, 2006. The crash data obtained during the MSMP were compared with average crash data obtained during the five years prior to the MSMP. There were too few crashes to allow us to conduct meaningful statistical comparisons for the individual combinations of highway type, speed limit, and enforcement status. However, using the Sign Test (Siegel and Castellan, 1988, pp. 80-87), it was possible to consider all the combinations at the same time and determine whether there was an overall difference between the crash data for the MSMP time period and the average crash data from the five previous years for the same time period.

4.4 Crash Data Results

Our evaluation showed that during the MSMP there were reductions in the numbers of Fatal and “A” Injury Crashes. The results obtained using the Sign Test indicated that the reduction was statistically significant. The crash data are summarized along with the speed data in Table S.1, above.

4.7 Citation Data

The Citation Data obtained in the four *Enhanced Enforcement* periods in the MSMP is summarized in Table 2. [Please note, no comparisons with historical data were possible for the citation data.]

Table 2: Summary of all citation data

Violation	Number of Citations	Number of Warnings
Speed	33,686	45,672
Seatbelt	2,684	1,549
DAR/DAS	1,638	
Equipment	1,143	5,847
No Insurance	917	
Warrants	422	
Drugs	235	
DWI	136	
Child Restraint	101	57
Open Bottle	86	
Minor Consumption	34	
Vehicle Forfeiture	25	
Weapons	14	
Miscellaneous	6,459	16,402
Total Warnings		69,402
Total Citations	47,580	

Total Officers Involved	6,513
Total Vehicles Stopped	47,580

4.6 Driver Perceptions

Data relating to driver perceptions were obtained by MarketLine Research in two surveys. A 26-question survey instrument was used in pre-MSMP interviews that were conducted by telephone between August 15 and August 24, 2005. The same survey instrument was used to conduct post-MSMP telephone interviews between August 4 and August 29, 2006—the first of these post-MSMP interviews were conducted 19 days after the fourth *Enhanced Enforcement* period ended. In both the pre- and post-MSMP surveys, MarketLine Research obtained responses from 300 drivers statewide and from an additional 200 drivers who represented three specific samples: (1) a sample specific to *speed corridors*, involving drivers who traveled on highways which had an increase in the speed limit, but no change in enforcement levels; (2) a sample that was specific to *enforcement corridor*, involving drivers who traveled on highways which had enhanced enforcement, but did not have changes in the speed limit; and (3) a sample that was specific to drivers who traveled primarily on highways which had both enhanced enforcement and an increase in the speed limit.

MarketLine Research found that, after the MSMP, (1) nearly 9 in 10 drivers support the increase in speed limits on selected state freeways and highways; (2) significantly more

drivers feel the appropriate speed for their most frequented highway is equal to the posted speed limit—for drivers in corridors where the speed limit was increased from 55 mph to 60 mph, there was a 15% increase in post-MSMP respondents who said the posted speed was appropriate; (3) drivers are more likely to think speeds closer to five miles over the posted limits will result in a law enforcement officer stopping a driver—prior to implementation, drivers gave estimates closer to 10 mph over posted limits; (4) more than 70% of drivers say they will slow down in a speed trap even though a patrol car is not there—suggesting that the repeated presence of enforcement vehicles in an area can be expected to produce lasting reductions in driving speeds.

MarketLine Research’s key findings about pre- and post-MSMP changes in the drivers’ awareness of speed limits, their perception of the speeds at which they actually travel, and their perception of enforcement and the impact of this enforcement, are not surprising, given the changes in speed limits and enforcement that were made during the MSMP. However, MarketLine Research’s findings about drivers’ perceptions related to the education aspects of the MSMP are, perhaps, surprising. Pre- and post-MSMP driver responses to the question “During the past three months, have you read, heard or seen anything in the media about speed limits,” were unchanged—with only one third of the drivers in both the pre- and post-MSMP samples responding “Yes.” It seems likely that those drivers who noticed items about travel speeds heard, read, or saw them more often during the MSMP than before. However, the increase in media information that occurred during the MSMP does not appear to have reached a wider audience than the roughly 33% it reached before the MSMP. It is more likely that the radio audience was smaller than expected. Perhaps in future media campaigns, it may be appropriate to use other media, such as the internet, to reach a larger target audience.

5. Recommendations

It is evident that the MSMP, in concert with other efforts that are part of the Minnesota Comprehensive Highway Safety Plan, resulted in reductions in the numbers of speeders on Minnesota Highways and reduced the number of fatal and life-changing (“A” injury) crashes. The speed reductions have made Minnesota’s roads safer. Because this essentially means that the objectives of the program have been achieved, we, therefore, recommend that the Minnesota Speed Management Program be continued and that funding be earmarked to allow this.

It is important to note, that while the numbers of speeders traveling 10 mph or more over the speed limit declined, the effects of the continued presence of enforcement officers remains to be verified. If the program is continued, we recommend that an evaluation element should be included to investigate the long term effectiveness of the program. A multi-year speed management program is likely needed to produce a permanent cultural shift in driving behavior. If there continue to be reductions in the number of speeders traveling 10 mph or more over the speed limit, we would expect to see continuing decreases in the number of fatal and life-changing crashes, bringing Minnesota closer to its Zero Death goal.

It is also worth noting that one fatal crash is estimated to result in a \$3.3 million economic loss to society. Given that figure, this program has almost certainly paid for itself.

Chapter 1. Introduction

1.1. Minnesota Speed Management Program (MSMP)

The Minnesota Speed Management Program (MSMP) was a cooperative project between the Minnesota Department of Transportation (Mn/DOT) and the Minnesota Department of Public Safety (DPS). It began on 9/26/05—Figure 1 shows a new 60 mph speed limit sign being uncovered at the start of the MSMP.



Figure 1.1: A New 60 mph Speed Limit Sign Uncovered at the Start of the MSMP

The MSMP was developed within the framework of the Minnesota Comprehensive Highway Safety Plan. MSMP was an extensive speed control project that included speed limit studies, speed limit adjustment, increased speed enforcement, education, and an evaluation of the effectiveness of this comprehensive approach. The overall goal of the program was to reduce the number of fatal and life-changing crashes on Minnesota highways.

1.2. Background

The Minnesota Comprehensive Highway Safety Plan (CHSP) listed speed enforcement as one of its highest priorities to improve safety on the highways. A press release issued by Mn/DOT on October 5, 2005, shortly after the start of the MSMP stated:

“In the five year period 2000-2004, more than 3,000 persons were killed in traffic crashes on Minnesota roads. Speeding was a factor in 864 of those deaths at an economic impact of \$902 million. Twice as many speed-related fatal crashes occurred in rural areas than in urban areas. Illegal or

unsafe speed was the most often cited factor in crashes involving younger drivers.”

[This press release can be accessed at—

<http://www.dot.state.mn.us/hottopics/speedlimits/dps-heatnews.pdf>]

It is estimated that nationally, the annual cost of speeding related crashes is \$40.4 billion—this is approximately 18% of the total cost of crashes.

Travel speeds on Minnesota roads are excessive, with most drivers ignoring posted speed limits and travel speeds increasing from one year to the next. This is the context within which the Minnesota legislature has introduced bills aimed at raising speed limits on all 2-Lane/2-Way highways with speed limits currently set at 55 mph.

Mn/DOT and DPS do not believe that a comprehensive increase in speed limits is advisable. However, they considered that speeds might be safely increased on some highways with 55 mph limits—specifically those on which the increased limits would match the design standards of the highways—under certain conditions. These conditions are that there should be sufficient resources for law enforcement to ensure that drivers remain strictly within the speed limits and public education that helps motorists understand that the posted speed limit is the true speed limit.

1.3. Effects of the 1997 Increases in Speed Limits

The National Maximum Speed Limit law was repealed in 1995. In 1997, in Minnesota, speed limits were increased to 70 mph on rural interstates and to 65 mph on rural expressways. These changes were reported by the media—however, they were not accompanied by speed enforcement or education efforts.

Mn/DOT conducted a review of crash data obtained in the five years before and the five years after the 1997 speed limit changes. This review, which was conducted in 2005, indicated that there was—

- A 93% increase in fatalities on 4-Lane Divided Highways where speed limits increased to 65 mph.
- A 70% increase in fatalities on Rural Freeways where speed limits increased to 70 mph.

As result of this review, Mn/DOT and DPS concluded that the way in which the speed limit changes were introduced in 1997 was problematic—and that some roads had become more hazardous to motorists. Mn/DOT and DPS believe problems occurred because the changes in speed limits were made without accompanying efforts to educate the public or to increase enforcement. The MSMP was carefully designed to respond to these problems.

1.4. Scope of the MSMP

The MSMP focused on (1) highways on which speed limits were increased in 1997, and (2) 55 mph highways on which speed limits could be raised bringing them into closer alignment with the highways' design speed (a rational speed limit).

Highways on which speed limits were increased in 1997—There were 900 miles of interstates and 970 miles of expressways on which speed limits were increased in 1997. The MSMP aimed to increase law enforcement on the fastest of these roads, in order to reduce the speeds of the faster drivers and to reduce the number of fatal and life-changing crashes related to excessive driving speeds.

Fifty-five-mph highways on which a rational speed limit could be implemented—When many of Minnesota's 55 mph highways were constructed, they were engineered to meet a 60-mph (or higher) standard. However, since the mid-1970s they have operated with a 55-mph limit. Eight hundred and fifty miles of these highways were selected for inclusion in the MSMP—their speed limit was increased to 60 mph and an increased number of law enforcement officers were present on these 850 miles.

During the four MSMP enforcement periods, travel speed data were collected on four types of roadways—

- 2-Lane/2-Way Highways, on which the speed limits were raised from 55 mph to 60 mph.
- 4-Lane Divided Highways, on which the speed limits remained at 65 mph.
- Rural Freeways, on which the speed limits remained at 70 mph.
- Urban Freeways, on which the speed limits were raised from 55 mph to 60 mph.

Maps of the four types of highway on which traffic data were collected are presented—along with the summary findings for each of these highway types—in Chapter 2 of this report.

1.5. Components of the MSMP

The MSMP had four main components—engineering, enforcement, education, and evaluation. These four components are discussed in the four subsections below.

1.5.1 Engineering

In preliminary engineering efforts, highways that were candidates for increasing the speed limit were reviewed. The review included ensuring that the candidate highways had the road geometry to support 60-mph speed limits and that they had six-foot shoulders at a minimum. The review also considered crash rates and connectivity to regional trade centers. Mn/DOT verified that all traffic control devices were operating and that operational issues were addressed before the speed limits were raised on the candidate highways. There were Automatic Traffic Recorders (ATRs) on some of these

highways—a number of the ATRs had been in place for several years; while others were installed shortly before the MSMP began. In addition, mobile data recorders were used on other highways. The ATRs and mobile data recorders were used to collect speed data in order to evaluate the effect of the MSMP on travel speeds.

1.5.2 Enforcement

Throughout the MSMP, various law enforcement officers—State Patrol, county sheriffs, and local law enforcement—worked together. They made deployment decisions on the basis of the number of speeders traveling on the selected highways prior to the MSMP and on the crash history of the highways, particularly with regard to fatal and life-changing crashes. Throughout the MSMP, periods of *Enhanced* Enforcement alternated with periods of *Regular* Enforcement—there were four cycles, or waves, of *Enhanced* Enforcement and *Regular* Enforcement. The first wave began on 9/26/05—for the first six weeks of the first wave there was *Enhanced* Enforcement and then for the next four weeks there was *Regular* Enforcement. The second, third, and fourth waves began with eight weeks of *Enhanced* Enforcement, which were then followed by four weeks of *Regular* Enforcement. During the one six-week and three eight-week *Enhanced* Enforcement periods, each of the participating law enforcement officers kept a log of the number of hours they were on duty, and of the number of motorists they stopped and citations they issued. The schedule of the *Enhanced* Enforcement and *Regular* Enforcement periods is presented in Table 1.1.

Table 1.1: Enforcement Status During the MSMP

Wave	Enforcement Status	Time Period
First Wave	<i>Enhanced</i> Enforcement Period #1	9/26/05 to 11/6/05
First Wave	<i>Regular</i> Enforcement Period #1	11/7/05 to 12/4/05
Second Wave	<i>Enhanced</i> Enforcement Period #2.	12/5/05 to 1/29/06
Second Wave	<i>Regular</i> Enforcement Period #2	1/30/06 to 2/26/06
Third Wave	<i>Enhanced</i> Enforcement Period #3.	2/27/06 to 4/23/06
Third Wave	<i>Regular</i> Enforcement Period #3	4/24/06 to 5/21/06
Fourth Wave	<i>Enhanced</i> Enforcement Period #4	5/22/06 to 7/16/06
Fourth Wave	<i>Regular</i> Enforcement Period #4	7/17/06 to 8/13/06

1.5.3 Education

Also throughout the MSMP, the DPS Office of Traffic Safety organized a public education effort. Approximately 10,000 public service messages were presented on the radio, with the messages grouped together so they were concentrated at the beginning and end of each of the *Enhanced* Enforcement periods. In addition, the Office of Traffic Safety took advantage of opportunities to focus media attention on the MSMP and its objectives of reducing both travel speeds and fatal and life-changing crashes.

1.5.4 Evaluation of the Effectiveness of the MSMP

There were two evaluation efforts. The first evaluation of the effectiveness of the MSMP was conducted by the University of Minnesota. The evaluation consisted of analyzing travel speed data and crash data—comparing both the speed and crash data obtained

during the MSMP in both the *Enhanced* Enforcement and *Regular* Enforcement periods with the historical data from comparable time frames—and in addition reported law enforcement data (number of stops and citations, and hours logged) that were obtained in the *Enhanced* Enforcement areas during the *Enhanced* Enforcement period. The second evaluation effort, conducted by MarketLine Research, involved two telephone surveys. These surveys, which sampled drivers' attitudes and their self reported driving behavior, were conducted shortly before the MSMP began and soon after the fourth *Enhanced* Enforcement period finished.

1.6. Costs of the MSMP

The approximate costs of implementing the MSMP were \$3.0 million, with \$2.5 million for an increased presence of enforcement officers (Minnesota State Patrol, county sheriffs, and local law enforcement), \$349,700 for paid media (primarily radio), and \$150,300 in data collection, analysis and evaluation.

In addition, both Mn/DOT and Minnesota State Patrol (MSP) made significant in-kind contributions involving the following: project management, sign installation, speed detection equipment, traffic engineering reviews, vehicle costs, and fuel.

1.7. Purpose of this Report

This report pertains to evaluation aspects of the program. It presents a summary of the University of Minnesota's assessment of the effectiveness of the program, in terms of its effect on travel speeds, particularly on the number of vehicles traveling 10 mph or more above the speed limit, and fatal crashes and life-changing crashes (i.e., 'A' injury crashes), that occurred during the MSMP (reported as of November 21, 2006). The report also summarizes the survey data collected by MarketLine Research.

[Please note that the University issued five interim reports during the course of the program. The first of these reports dealt with historical speed and crash data; while the remaining four reports presented analyses of the effectiveness of the MSMP, in terms of its effect on driving speeds and crashes, during each of the program's four test periods. These reports are presented at the end of this report—as Appendices 1 through 5. Also, MarketLine's Final Report of their survey findings is located in Appendix 6.]

Chapter 2: Summary of Findings during the MSMP: Objective Speed and Crash Data

2.1 Method

This report presents the University of Minnesota's assessment of effectiveness of the MSMP. During the MSMP, travel speed data as well as fatal and 'A' injury crash data were collected on four types of roadway—(1) 2-Lane/2-Way Highways, (2) 4-Lane Divided Highways, (3) Rural Freeways, and (4) Urban Freeways. The effect of the MSMP on both the travel speed data and fatal and 'A' injury crash data for each of these highway types are discussed in this section of the report.

From the speed data obtained with the ATRs, we derived several speed measures for the *Enhanced* Enforcement and *Regular* Enforcement periods. The same measures were also derived from historical speed data obtained from the ATRs in previous years during the same calendar time periods. In order to compare the MSMP speed data with the historical data, we conducted a series of statistical tests in which the following measures were compared—(1) the mean speed, (2) the percentage of vehicles in the 10 mph pace, (3) the proportion of vehicles traveling at 65 mph or more, (4) the proportion of vehicles traveling at 70 mph or more, (5) the proportion of vehicles traveling at 75 mph or more, (6) the proportion of vehicles traveling at 80 mph or more, and (7) the proportion of vehicles traveling at 85 mph or more.

To test for differences in the mean speeds we used the procedure for comparing population means outlined by Kitchens (1987, p 369-373). For the comparisons involving the percentage of vehicles in the 10 mph pace and proportions of vehicle traveling at various speeds, we treated each distribution of speeds as a Bernoulli population—i.e., a population in which each element is one of two possibilities, in this case, (1) in, or out, of the 10 mph pace, or (2) above, or below, a selected speed (e.g., 75 mph). We then used the procedure for comparing population proportions described by Kitchens (1987, pages 400-404). The statistical tests were conducted in two ways. First, we conducted the tests in the traditional way, using n -values that were equal to the number of vehicles that traveled past each ATRs in the test periods under consideration. In the second, we used an extremely conservative correction, with n -values that were equal to the number of hours in each test period—to correct for the fact that when traffic is congested, individual vehicles may not be independent of each other.

With regard to speed data, in this report, in order to concisely convey evaluation findings, we focus on drivers who were traveling at least 10 mph above the speed limits during the MSMP—i.e., on those drivers who were traveling at 70 mph or more on 2-Lane/2-Way Highways; 75 mph or more on 4-Lane Divided Highways; 80 mph or more on Rural Freeways; and 70 mph or more on Urban Freeways. [Readers interested in knowing the results of the entire analysis are invited to visit Appendices 2 through 5 where all the findings are reported for the four test periods.] All of the reported changes in the number

of drivers traveling at least 10 mph above the speed limits during the MSMP are highly statistically significant.

With regard to the crash data, it should be noted that it is not as readily available as travel speed data: This report deals with Fatal and ‘A’ Injury Crash data that were updated on November 21, 2006—it is possible that the crash data will be revised at some later date. For comparison purposes, we combined the crash data from all four waves of the MSMP and compared them with crash data obtained in the same calendar time period in the five years prior to the MSMP. There were too few crashes to allow us to conduct meaningful statistical comparisons for the individual combinations of highway type, speed limit, and enforcement status. However, it was possible to consider all the combinations at the same time and then use the Sign Test (Siegel and Castellan, 1988, pp. 80-87) to determine whether there was an overall difference between the crash data obtained during the MSMP and the average crash data from the five previous years for the same time period.

The results of our evaluation of the speed and crash data are discussed below.

2.2. Travel Speeds on 2-Lane/2-Way Highways (with Speed Limits that Were Increased from 55 mph to 60 mph or Are Unchanged at 55 mph)

In the MSMP, we obtained speed data from seven ATRs located on 2-Lane/2-Way Highways. Three of these ATRs were located *Within* Enhanced Enforcement Zones. During the MSMP, the speed limit was increased from 55 mph to 60 mph at the locations of all three of these ATRs located *Within* Enhanced Enforcement Zones. The remaining four ATRs were located *Outside* Enhanced Enforcement Zones—and the speed limit remained unchanged, at 55 mph. Details of the locations of all seven ATRs are presented in Table 2.1 and are shown in Figure 2.1.

Table 2.1: Details of the ATRs Located on 2-Lane/2-Way Highways

<i>Within/ Outside</i> Enforcement Zone	ATR	Location	Speed Limit
<i>Within</i>	210	US-71, 1 m. North of Blackduck, Beltrami Co.	Increased—from 55 mph to 60 mph
<i>Within</i>	219	US-2, South East of Warba, Itasca Co.	Increased—from 55 mph to 60 mph
<i>Within</i>	220	US-71, South of CR-89, Hubbard Co.	Increased—from 55 mph to 60 mph
<i>Outside</i>	179	USTH 59, South of Garvin, Lyon Co.	Unchanged at 55 mph
<i>Outside</i>	198	USTH 212, East of TH 23, Chippewa Co.	Unchanged at 55 mph
<i>Outside</i>	199	USTH 75, 0.55 m. N of CR-69, Pipestone Co.	Unchanged at 55 mph
<i>Outside</i>	222	MNTH 65, near Pliny, Aitkin Co.	Unchanged at 55 mph

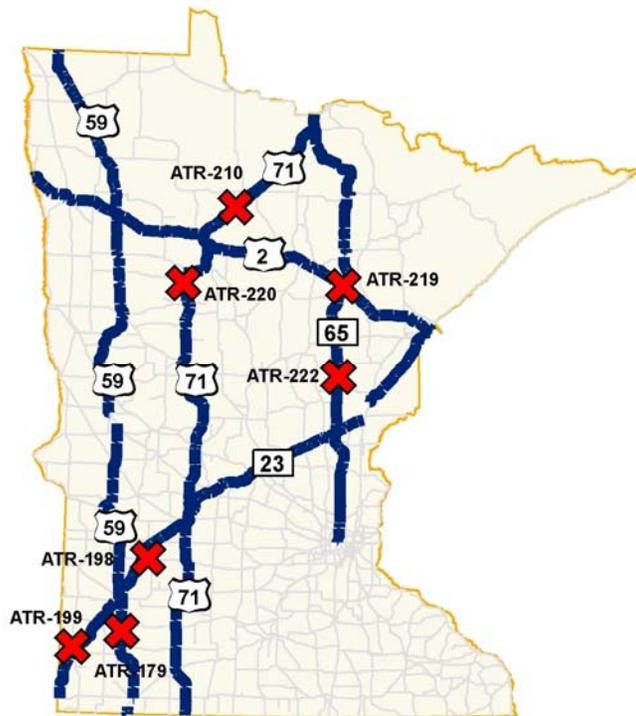


Figure 2.1: Map of Minnesota Showing the Seven ATRs Located of on 2-Lane/2-Way Highways

2.2.1. Speed Data on 2-Lane/2-Way Highways *Within* Enhanced Enforcement Zones

The speed limit was increased from 55 mph to 60 mph at the locations of the three ATRs located *Within* Enhanced Enforcement Zones. To concisely convey our evaluation findings and show the effect of the MSMP on 2-Lane/2-Way Highways, we focused on drivers who were traveling at least 10 mph above the *new* speed limit—i.e., on those drivers who were traveling at 70 mph or more. We combined the data obtained at the three ATRs that were located *Within* Enhanced Enforcement Zones. Then, we compared speed data obtained during both the *Enhanced* Enforcement and *Regular* Enforcement periods during the MSMP with speed data obtained the previous year during the same time frame—when the speed limit was previously 55 mph at the locations of the three ATRs. Figure 2.2 shows the results of this comparison.

2-Lane/2-Way Highways Enhanced Enforcement Zone: % decrease in drivers traveling 70 mph or more

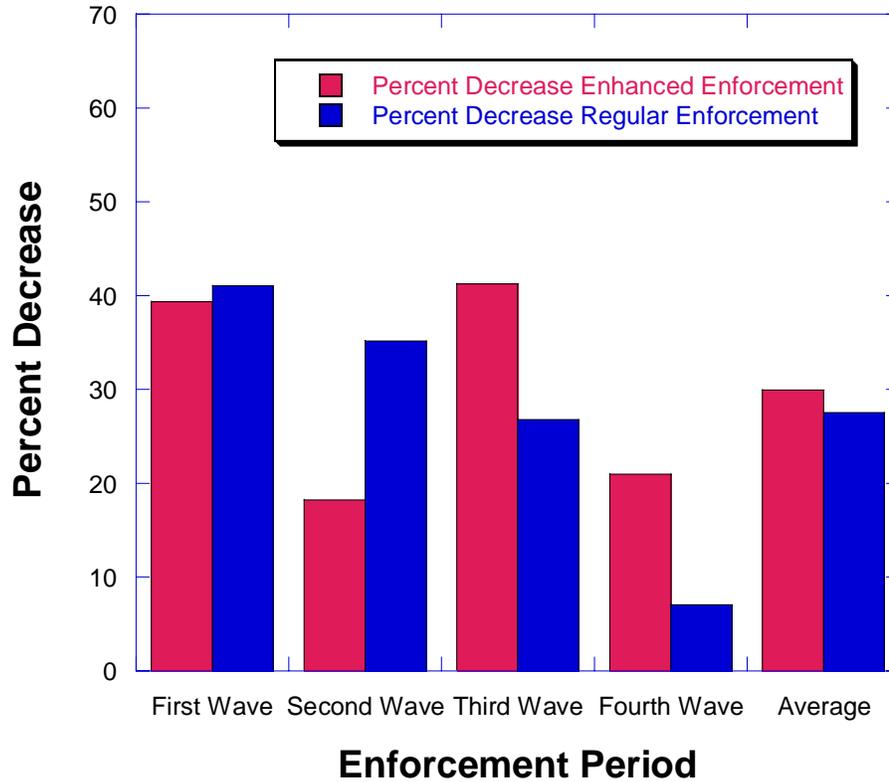


Figure 2.2: 2-Lane/2-Way Highways *Within* the Enhanced Enforcement Zones—Percent Decrease when the Number of Drivers Traveling at 70 mph or More *During* the MSMP (when the speed limit was raised to 60 mph) is compared to the Number of Drivers Traveling at 70 mph or More *Before* the MSMP (when the speed limit was 55 mph), for both the *Enhanced* Enforcement and *Regular* Enforcement periods.

Figure 2.2 shows that for the ATRs located *Within* the Enhanced Enforcement Zones on 2-Lane/2-Way Highways there were reductions in the number of drivers traveling at 70 mph or more throughout the MSMP—both in the *Enhanced* Enforcement periods and the *Regular* Enforcement periods—as compared to the number driving at 70 mph or more before the MSMP. Specifically, in all periods *during* the MSMP there were fewer drivers traveling at 70 mph or more—i.e., 10 mph or more above the *new* speed limit—than there were traveling at this speed *before* the MSMP—i.e., when it was 15 mph or more above the old speed limit. The average reduction was 29.9% in the *Enhanced* Enforcement periods, 27.5% in the *Regular* Enforcement periods, and 28.7% over all eight time periods.

For comparison purposes, three other measures of travel speed—mean speed, the 85th percentile, and the 10 mph pace—are shown in Table 2.2.

Table 2.2 (a): 2-Lane/2-Way Highways *Within Enhancement Zones*—Mean Travel Speed and 85th Percentile in Eight Time Periods *During and Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Mean Speed (mph) During MSMP	61.2	60.0	60.4	60.5	61.4	61.5	61.3	61.8	61.0
Mean Speed (mph) Before MSMP	61.7	61.6	59.0	61.3	61.7	61.6	61.2	61.4	61.2
85 th Percentile (mph) During MSMP	65.1	64.6	64.8	65.0	65.3	65.4	65.3	66.0	65.1
85 th Percentile (mph) Before MSMP	66.5	65.7	64.9	66.1	66.9	66.2	65.6	65.4	65.9

Table 2.2 (b): 2-Lane/2-Way Highways *Within Enhancement Zones*—Percent of Vehicles in 10 mph Pace in Eight Time Periods *During and Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Percent in 10 mph Pace During MSMP	77.6%	71.2%	74.7%	72.7%	76.0%	75.6%	74.9%	74.9%	74.7
Percent in 10 mph Pace Before MSMP	71.2%	73.8%	63.7%	70.6%	68.8%	71.9%	72.6%	74.3%	70.9

As Table 2.2 (a) shows, the mean speeds *during* the MSMP were very similar to the mean speeds *before* the MSMP and, on average, *during* the MSMP, the mean speed was 61.0 mph, while *before* the MSMP it was 61.2 mph.

Similarly, Table 2.2 (a) shows that the speed of the 85th percentile driver *during* the MSMP was very similar to the speed of the 85th percentile driver *before* the MSMP and that, on average, *during* the MSMP the speed of the 85th percentile driver was 65.1 mph, while *before* the MSMP it was 65.9 mph.

As Table 2.2 (b) shows, the percentage of vehicles within the 10 mph pace *during* the MSMP was higher than it was *before* the MSMP—on average the percentage in the 10 mph pace was 74.7% *during* the MSMP and 70.9% *before* the MSMP.

2.2.2. Speed Data on 2-Lane/2-Way Highways Located *Outside* Enhanced Enforcement Zones

The speed limit remained unchanged, at 55 mph, at the locations of the four ATRs on 2-Lane/2-Way Highways located *Outside* Enhanced Enforcement Zones. To convey our evaluation findings and show whether or not there was a change in driving performance at these locations during the MSMP, we again focused on drivers who were traveling at least 10 mph or more above the *new* speed limit—i.e., on those drivers who were traveling at 70 mph or more. However, it should be noted that, in this case at all four of these ATR locations, the speed limit was 55 mph both *during* and *before* the MSMP. Figure 2.3 shows the results of the comparison.

2-Lane/2-Way Highways *Outside* Enforcement Zone: % Increase in drivers traveling 70 mph or more

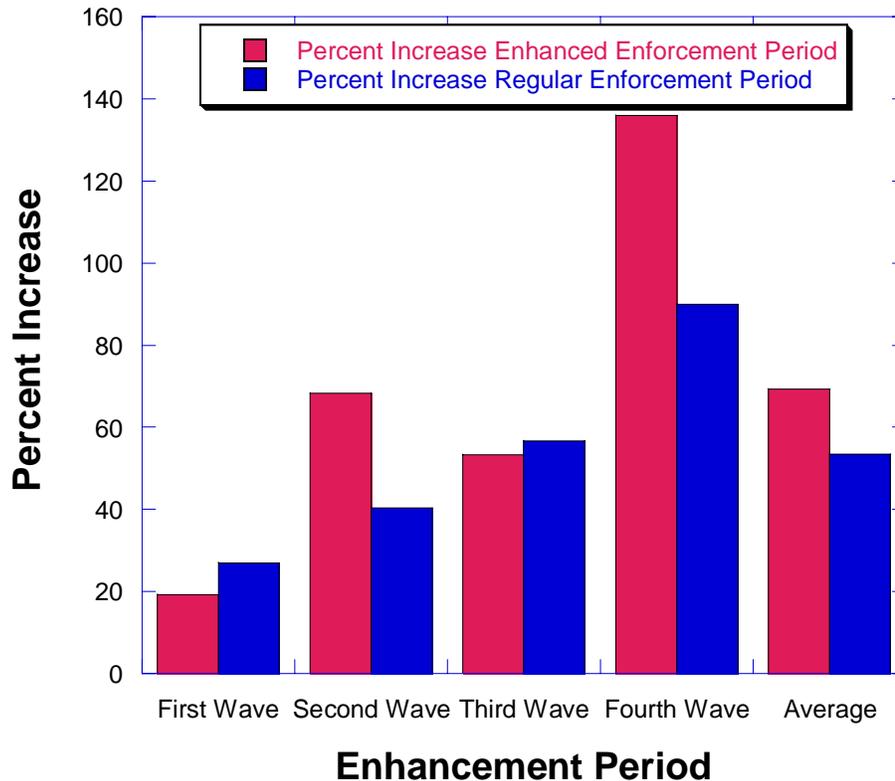


Figure 2.3: 2-Lane/2-Way Highways *Outside* the Enhanced Enforcement Zones—Percent Increase in the Number of Drivers Traveling at 70 mph or More *During* the MSMP compared to *Before* the MSMP, for the equivalent *Enhanced* Enforcement and *Regular* Enforcement periods. (Note, in both cases the speed limit was 55 mph.)

Figure 2.3 shows that, for the three ATRs located *Outside* Enhanced Enforcement Zones on 2-Lane/2-Way Highways, throughout the time period of the MSMP, there were *increases* in the number of drivers traveling at 70 mph or more as compared to the number driving at 70 mph or more before the MSMP. [It should be remembered that 70 mph was 15 mph above the speed limit on these highways both during and before the MSMP.] The average increase was 69.2% in the *Enhanced* Enforcement periods, 53.5% in the *Regular* Enforcement periods, and 61.3% over all eight time periods in the MSMP. During the first *Enhanced* and *Regular* Enforcement periods the smallest percentage increases (of 19.2% and 27.0%, respectively) occurred. However in the remaining six periods, the increases were all considerably larger (the largest increase was 133.0% in the fourth *Enhanced* Enforcement period).

It should be noted that during the first six time periods of the MSMP, the increases in the numbers of vehicles traveling over 70 mph indicated in Figure 2.3, are entirely due to the data from one ATR. This ATR (ATR-222) is located on MNTH 65, near Pliny, in Aitkin County and is much further away from the *Enhanced* Enforcement Zones than any other ATR used in this study. Also, during the last two time periods in the MSMP, the large increase in the numbers of vehicles traveling over 70 mph indicated in Figure 2.3, is due in large part to the data from the ATR near Pliny, although in these last two time periods increases were also noted at another ATR—ATR-199 which is located on USTH 212, East of TH 23, in Chippewa County. The increases in the number of drivers traveling at 70 mph shown in Figure 2.3 or more suggest that MNTH 65 in Aitkin County and, perhaps, USTH 212 in Chippewa County should be considered as candidates for some future *Enhanced* Enforcement Program.

For comparison purposes, three other measures of travel speed—mean speed, the 85th percentile, and the 10 mph pace—are shown in Table 2.3.

Table 2.3 (a): 2-Lane/2-Way Highways *Outside* Enhancement Zones—Mean Travel Speed and 85th Percentile in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Mean Speed (mph) During MSMP	58.0	57.0	56.6	57.2	57.5	57.9	58.7	58.6	57.7
Mean Speed (mph) Before MSMP	58.8	58.4	57.7	57.8	58.2	58.2	58.3	58.5	58.2
85 th Percentile (mph) During MSMP	64.4	64.1	63.6	63.8	63.9	64.2	65.1	64.8	64.2
85 th Percentile (mph) Before MSMP	64.4	64.4	63.7	63.8	63.9	64.1	64.0	64.3	64.1

Table 2.3 (b): 2-Lane/2-Way Highways *Outside* Enhancement Zones—Percent of Vehicles in 10 mph Pace in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Percent in 10 mph Pace During MSMP	63.4%	55.9%	57.2%	60.3%	61.8%	62.9%	61.0%	62.3%	60.6%
Percent in 10 mph Pace Before MSMP	67.3%	65.3%	65.9%	64.8%	66.4%	65.5%	66.9%	65.8%	66.0%

As Table 2.3 (a) shows the mean speeds *during* the MSMP were similar to the mean speeds *before* the MSMP and, on average, *during* the MSMP the mean speed was 57.7 mph while *before* the MSMP it was 58.2 mph.

Table 2.3 (a) also shows that the speed of the 85th percentile driver *during* the MSMP was very similar to the speed of the 85th percentile driver *before* the MSMP and, on average, *during* the MSMP the speed of the 85th percentile driver was 64.2 mph, while *before* the MSMP it was 64.1 mph.

Table 2.3 (b) indicates that the percentage of vehicles within the 10 mph pace *during* the MSMP was lower than in all eight time periods than it was *before* the MSMP and, on average, the percentage in the 10 mph pace was 60.6% *during* the MSMP and 66.0% *before* the MSMP.

Figure 2.3 showed that there were increases in the number of drivers traveling at 70 mph or more *Outside* the Enhanced Enforcement Zones. And Table 2.3 (a) shows there was virtually no change in the mean speed or the 85th percentile. Taking these findings together, it would be expected that the number of drivers traveling within the 10 mph pace *during* the MSMP would be fewer than the number of drivers traveling within the 10 mph pace *before* the MSMP—this proved to be the case, as Table 2.3 (b) indicates. This combination of factors—i.e., of (1) increases in the number of drivers traveling at 70 mph, (2) no change in the mean speed or the 85th percentile, and (3) fewer drivers traveling within the 10 mph pace—*during* the MSMP resulted in an increase in the variability in speed, which is often associated with increases in crash rate.

2.3. Crash Data for 2-Lane/2-Way Highways

The numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on 2-Lane/2-Way Highways *Within* the Enhanced Enforcement Zones are reported in Table 2.4. For comparison purposes, the table also presents the average

numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.4: Crash Data during the MSMP Compared to Average Crash Data for the Prior 5 Years, for 2-Lane/2-Way Highways on which the Speed Limit Was Increased, from 55 mph to 60 mph, and that Were *Within* the Enhanced Enforcement Zones

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	316.790	316.790
Average Daily Traffic	3,959.0038	3,888.6784
Number of Fatal Crashes	5	5.8
Number of ‘A’ Injury Crashes	8	11
Total Number of Serious Crashes	13	16.8

Table 2.4 shows that, on 2-Lane/2-Way Highways where the speed limit was increased from 55 mph to 60 mph and that were *Within* the Enhanced Enforcement Zones, there were 3.8 fewer serious crashes *during* the MSMP than there were on average in the previous 5 years. Although this represents a 22.6% reduction in the number of serious crashes, it should be noted that the number of crashes in the two categories is too small to allow for meaningful statistical testing.

Table 2.5 shows the numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on -Lane/2-Way Highways located *Outside* the Enhanced Enforcement Zones. Again for comparison purposes, the table also presents the average numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.5: Crash Data during the MSMP Compared to Average Crash Data for the Prior 5 Years, for 2-Lane/2-Way Highways on which the Speed Limit Was Unchanged, at 55 mph, and that Were *Outside* the Enhanced Enforcement Zones

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	7,593.783	7,593.783
Average Daily Traffic	2,539.9186	2,481.7046
Number of Fatal Crashes	88	96.2
Number of ‘A’ Injury Crashes	136	155.4
Total Number of Serious Crashes	224	251.6

In the case of the 2-Lane/2-Way Highways that were located *Outside the Enforcement Zones*, as Table 2.5 shows, there were 27.6 fewer Serious Crashes during the period of the MSMP. This 8.9% reduction in the total number of serious crashes during the MSMP is surprising given the increase in average daily traffic and in the number of drivers traveling at 70 mph or more on MNTH 65 in Aitkin County.

Crash data were also available for a highway category for which no travel speed data were available—this is for 2-Lane/2-Way highways on which the speed limit was increased, from 55 mph to 60 mph, but which were located *Outside the Enhanced Enforcement Zones* during the MSMP (and which had no ATRs). Table 2.6 shows the numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on these highways. For comparison purposes, the table also presents the average numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.6: Crash Data during the MSMP Compared to Average Crash Data for the Prior 5 Years, for 2-Lane/2-Way Highways for which the Speed Limit Was Increased, from 55 mph to 60 mph, and that Were *Outside the Enhanced Enforcement Zones*

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	474.511	474.511
Average Daily Traffic	2,745.0887	2,718.1379
Number of Fatal Crashes	4	4.8
Number of ‘A’ Injury Crashes	2	8
Total Number of Serious Crashes	6	12.8

Table 2.6 shows that, on 2-Lane/2-Way Highways where the speed limit was increased from 55 mph to 60 mph and that were *Outside the Enhanced Enforcement Zones*, there were 6.8 fewer serious accidents *during* the MSMP than there were on average in the previous 5 years. Although this represents a 55.6% reduction in the number of serious crashes, it should be noted again that the number of crashes reported in Table 2.6 is too small to allow for meaningful statistical testing.

2.4. Travel Speeds on 4-Lane Divided Highways (with Speed Limits that Were Unchanged at 65 mph)

During the MSMP, speed data were obtained from five ATRs located on 4-Lane Divided Highways. Four of these ATRs were located *Within* Enhanced Enforcement Zones, while the fifth was located *Outside* Enhanced Enforcement Zones. At the locations of all five ATRs the speed limit remained unchanged at 65 mph throughout the MSMP. Details of the five ATRs are presented in Table 2.7 and are shown in Figure 2.4.

Table 2.7: Details of the ATRs on 4-Lane Divided Highways

<i>Within/ Outside Enforcement Zone</i>	ATR	Location	Speed Limit
<i>Within</i>	172	US-10, West of Dilworth, Clay Co.	Unchanged at 65 mph
<i>Within</i>	187	US-10, 0.8 miles West of Rice, Benton Co.	Unchanged at 65 mph
<i>Within</i>	188	US-52, North of Rochester, Olmstead Co.	Unchanged at 65 mph
<i>Within</i>	197	SR-60, 0.7 miles West of junction with SR-4, (St. James) Watonwan Co.	Unchanged at 65 mph
<i>Outside</i>	353	TH 169, South of CR-59, North of Jordan, Scott Co.	Unchanged at 65 mph

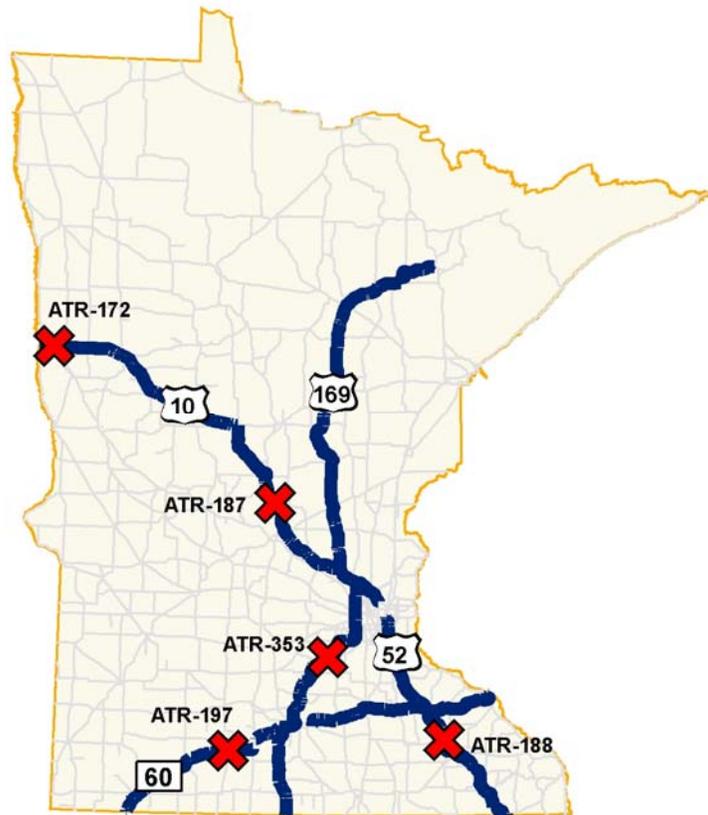


Figure 2.4: Map of Minnesota Showing Five ATRs Located on 4-Lane Divided Highways

2.4.1. Speed Data on 4-Lane Divided Highways *Within* Enhanced Enforcement Zones

To convey our evaluation findings and show the effect of the MSMP on 4-Lane Divided Highways, we focused on drivers who were traveling at least 10 mph above the speed limit—i.e., on those drivers who were traveling at 75 mph or more. We combined the data obtained at the four ATRs located *Within* Enhanced Enforcement Zones, and then compared the speed data obtained during each period of the MSMP with speed data obtained the previous year. Figure 2.5 shows the results of this comparison.

4-Lane Divided Highways Enhanced Enforcement Zone: % decrease in drivers traveling 75 mph or more

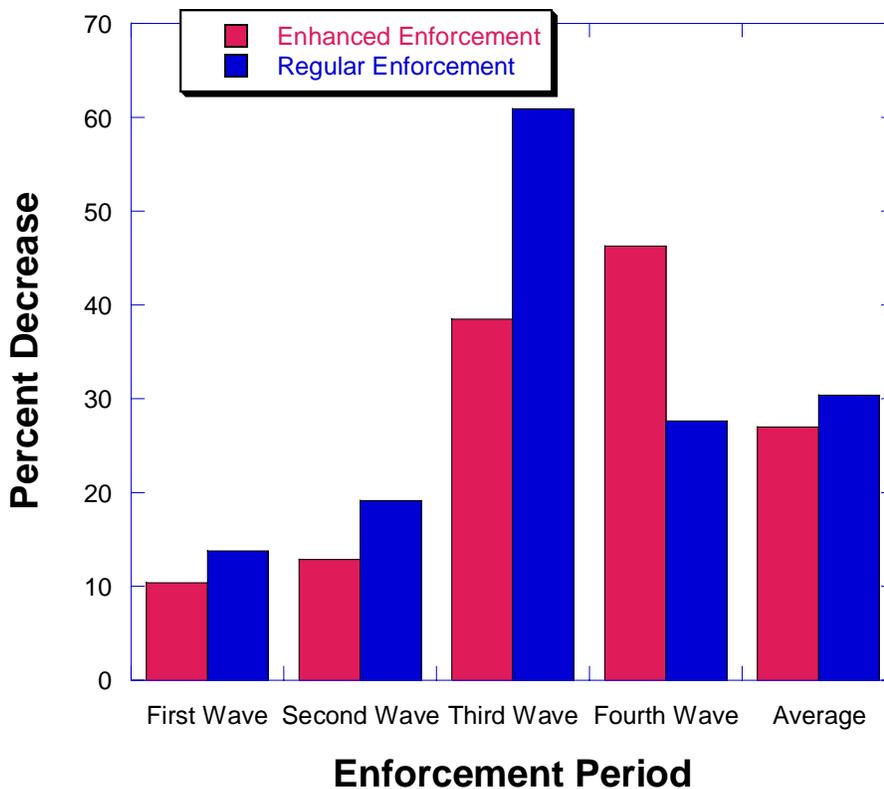


Figure 2.5: 4-Lane Divided Highways *Within* the Enhanced Enforcement Zones—Percent Decrease in the Number of Drivers Traveling at 75 mph or More *During* the MSMP compared to *Before* the MSMP, for both the *Enhanced* Enforcement and *Regular* Enforcement periods.

Figure 2.5 shows that at the four ATRs located *Within* Enhanced Enforcement Zones on 4-Lane Divided Highways there were reductions in the number of drivers traveling at 75 mph or more throughout the MSMP as compared to the number driving at 75 mph or more before the MSMP. The average reduction was 27.0% in the *Enhanced* Enforcement

periods, 30.4% in the *Regular* Enforcement periods, and 28.7% over all eight time periods.

For comparison purposes, three other measures of travel speed—mean speed, the 85th percentile, and the 10 mph pace—are shown in Table 2.8.

Table 2.8 (a): 4-Lane Divided Highways *Within* Enhancement Zones—Mean Travel Speed and 85th Percentile in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Mean Speed (mph) During MSMP	66.7	66.1	65.9	66.3	65.9	64.2	64.5	66.8	65.8
Mean Speed (mph) Before MSMP	66.6	67.1	66.5	67.0	67.6	67.7	67.5	69.0	67.4
85 th Percentile (mph) During MSMP	72.8	72.5	72.3	72.5	72.1	70.1	70.6	73.4	72.0
85 th Percentile (mph) Before MSMP	73.1	73.1	72.7	73.1	73.4	73.3	73.2	74.0	73.2

Table 2.8 (b): 4-Lane Divided Highways *Within* Enhancement Zones—Percent of Vehicles in 10 mph Pace, in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Percent in 10 mph Pace During MSMP	63.1%	59.8%	59.9%	60.5%	62.1%	65.0%	63.9%	60.6%	61.9%
Percent in 10 mph Pace Before MSMP	62.4%	63.8%	61.7%	61.6%	65.1%	65.7%	65.2%	70.6%	64.5%

Table 2.8 (a) shows that there was a slight decrease in mean speeds *during* the MSMP as compared to mean speeds *before* the MSMP and that, on average, *during* the MSMP the mean speed was 65.8 mph, while *before* the MSMP it was 67.4 mph.

Table 2.8 (a) also shows that there was an accompanying slight decrease in the speed of the 85th percentile driver *during* the MSMP as compared to the speed of the 85th percentile driver *before* the MSMP. The table also shows that, on average, *during* the MSMP speed of the 85th percentile driver was 72.0 mph, while *before* the MSMP it was 73.2 mph.

However, as Table 2.8 (b) indicates, there were reductions in the percentage of vehicles within the 10 mph pace *during* the MSMP when compared with the percentage of vehicles within the 10 mph pace *before* the MSMP. On average, the percentage in the 10 mph pace was 61.9% *during* the MSMP and 64.5% *before* the MSMP.

For the 4-Lane Divided Highways *Within* the Enhanced Enforcement Zones, the considerable reduction in the number of drivers traveling at 75 mph or more (i.e., 10 mph above the speed limit) shown in Figure 2.5, was accompanied by small reductions in mean speed, the speed of the 85th percentile driver, and the number of vehicles in the 10 mph pace.

2.4.2. Speed Data on one 4-Lane Divided Highways Located *Outside* Enhanced Enforcement Zones

Speed data were only available from one ATR located *Outside* the Enhanced Enforcement Zones for a 4-Lane Divided Highway. Again, we focused on drivers who were traveling at least 10 mph or more above the speed limit—i.e., on those drivers who were traveling at 75 mph or more—at this location. We compared the number driving at 75 mph or more *during* and *before* the MSMP, with the result shown in Figure 2.6.

**One 4-Lane Divided Highway
Outside Enhanced Enforcement Zone:
 % reduction in drivers traveling 75 mph or more**

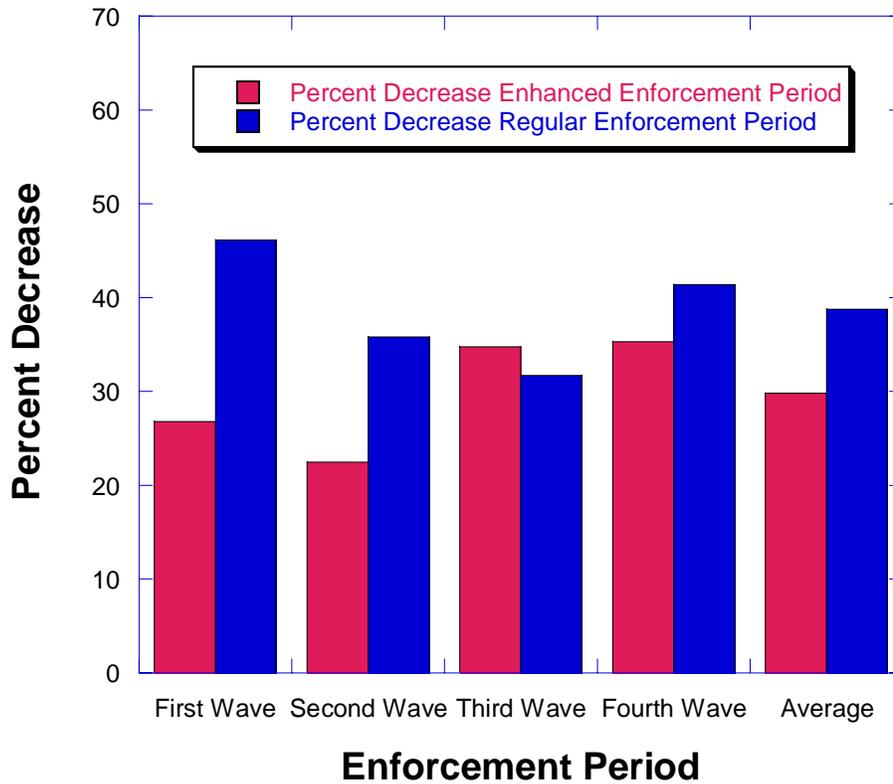


Figure 2.6: One 4-Lane Highway *Outside* the Enhanced Enforcement Zones—Percent Decrease in the Number of Drivers Traveling at 75 mph or More *During* the MSMP compared to *Before* the MSMP, for the equivalent *Enhanced* Enforcement and *Regular* Enforcement periods.

Figure 2.6 shows that, for the single ATR located *Outside* the Enhanced Enforcement Zones on a 4-Lane Divided Highway, throughout the time period of the MSMP, there were *reductions* in the number of drivers traveling at 75 mph or more as compared to the number driving at 75 mph or more before the MSMP. The average reduction was 29.8% in the *Enhanced* Enforcement periods, 38.8% in the *Regular* Enforcement periods, and 34.3% over all eight time periods. At first sight these reductions might seem surprising. However, the single ATR located *Outside* the Enhanced Enforcement Zones is located a few miles to the southwest of the Twin Cities—and a great number of the drivers traveling past this ATR likely have frequently traveled through Enhanced Enforcement Zones in Minneapolis/St. Paul.

For comparison purposes, three other measures of travel speed—mean speed, the 85th percentile, and the 10 mph pace—are shown in Table 2.9.

Table 2.9 (a): Data for One 4-Lane Divided Highway *Outside* the Enhancement Zones—Mean Travel Speed and 85th Percentile in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Mean Speed (mph) During MSMP	67.4	66.1	67.3	67.5	67.6	67.6	67.6	67.5	67.3
Mean Speed (mph) Before MSMP	68.0	68.4	67.7	68.2	68.3	68.3	68.1	68.3	68.2
85 th Percentile (mph) During MSMP	73.0	72.4	73.0	73.0	73.0	73.1	73.0	73.0	72.9
85 th Percentile (mph) Before MSMP	73.5	73.5	73.1	73.5	73.6	73.6	73.5	73.6	73.5

Table 2.9 (b): Data for One 4-Lane Divided Highways *Outside* the Enhancement Zones—Percent of Vehicles in 10 mph Pace, in Eight Test Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Percent in 10 mph Pace During MSMP	66.0%	62.4%	65.1%	66.9%	67.4%	66.9%	67.5%	67.2%	66.2%
Percent in 10 mph Pace Before MSMP	67.0%	69.0%	65.1%	67.7%	68.6%	68.5%	67.9%	68.2%	67.8%

Table 2.9 (a) shows that the mean speed *during* the MSMP was slightly slower than the mean speed *before* the MSMP. In each of the eight periods, the mean speed dropped slightly *during* the MSMP. On average, *during* the MSMP the mean speed was 67.3 mph, while *before* the MSMP it was 68.2 mph.

Table 2.9 (a) also shows that the speeds for the 85th percentile driver *during* the MSMP were all slightly slower than the speeds for the 85th percentile driver *before* the MSMP. On average, *during* the MSMP the speed of the 85th percentile driver was 72.9 mph, while *before* the MSMP it was 73.5 mph.

Table 2.9 (b) shows that the percentage of vehicles within the 10 mph pace *during* the MSMP was smaller (with one exception in which the percentages were unchanged) than the percentage of vehicles within the 10 mph pace *before* the MSMP. On average, *during* the MSMP the percentage of vehicles within the 10 mph pace was 66.2%, while *before* the MSMP it was 67.8%.

For the single ATR on a 4-Lane Divided Highways located *Outside* the Enhanced Enforcement Zones, the marked reduction in the number of drivers traveling at 75 mph or more (i.e., 10 mph above the speed limit) shown in Figure 2.6, was accompanied by slight reductions in mean speed, in the speed of the 85th percentile driver, and in the percent of drivers traveling within the 10 mph pace during the MSMP.

2.5. Crash Data for 4-Lane Divided Highways

The numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on 4-Lane Divided Highways *Within* the Enhanced Enforcement Zones are reported in Table 2.10. For comparison purposes, the table also presents the average numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.10: Crash Data for 4-Lane Divided Highways that Were *Within* the Enhanced Enforcement Zones during the MSMP

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	52.219	52.219
Average Daily Traffic	16,844.8455	16,084.2619
Number of Fatal Crashes	1	3.4
Number of ‘A’ Injury Crashes	4	4.8
Total Number of Serious Injury Crashes	5	8.2

Table 2.10 shows that, on 4-Lane Divided Highways where the speed limit remained unchanged—at 65 mph—and that were *Within* the Enhanced Enforcement Zones, there were 3.2 fewer serious accidents *during* the MSMP than there were on average in the previous 5 years. This represents a 39.0% reduction in the number of serious crashes. However, again there are far too few crashes to allow for meaningful statistical analysis, and it should be noted that this is, in part, because there were only 52.2 miles of roadway in the “4-Lane Divided Highways *Within* Enhanced Enforcement Zones” category.

Table 2.11 shows the numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on 4-Lane Divided Highways located *Outside* the Enhanced Enforcement Zones. The table also presents the average numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.11: Crash Data for 4-Lane Divided Highways that Were *Outside* the Enhanced Enforcement Zones during the MSMP

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	550.525	550.525
Average Daily Traffic	12,279.2783	11,815.7785
Number of Fatal Crashes	14	17.2
Number of ‘A’ Injury Crashes	24	32.4
Total Number of Serious Injury Crashes	38	49.6

Table 2.11 shows that, on 4-Lane Divided Highways where the speed limit remained unchanged—at 65 mph—and that were *Outside* the Enhanced Enforcement Zones, there were 3.2 fewer serious accidents *during* the MSMP than there were on average in the previous 5 years. This represents a 39.0% reduction in the number of serious crashes. However, again the numbers are too small to allow a meaningful comparison for statistical differences.

2.6. Travel Speeds on Rural Freeways (with Speed Limits that Were Unchanged at 70 mph)

In the MSMP, there were five ATRs located on Rural Freeways—unfortunately during the MSMP, data were unavailable from one of these ATRs. We were able to collect travel speed data from three ATRs located *Within* Enhanced Enforcement Zones and one ATR that was located *Outside* the Enhanced Enforcement Zones. At the locations of all four ATRs, the speed limit remained unchanged at 70 mph. Details of the locations of the four ATRs are presented in Table 2.12 and are shown in Figure 2.7.

Table 2.12: Details of the ATRs on Rural Freeways

<i>Within/ Outside</i> Enforcement Zone	ATR	Location	Speed Limit
<i>Within</i>	175	I-94, 0.5 miles South East of Saulk Centre, Stearns Co.	Unchanged at 70 mph
<i>Within</i>	191	I-35, North of Wyoming, Chisago Co.	Unchanged at 70 mph
<i>Within</i>	227	I-90, East of Alden, Freeborn Co.	Unchanged at 70 mph
<i>Outside</i>	200	I-94, Hasty, Wright Co.	Unchanged at 70 mph

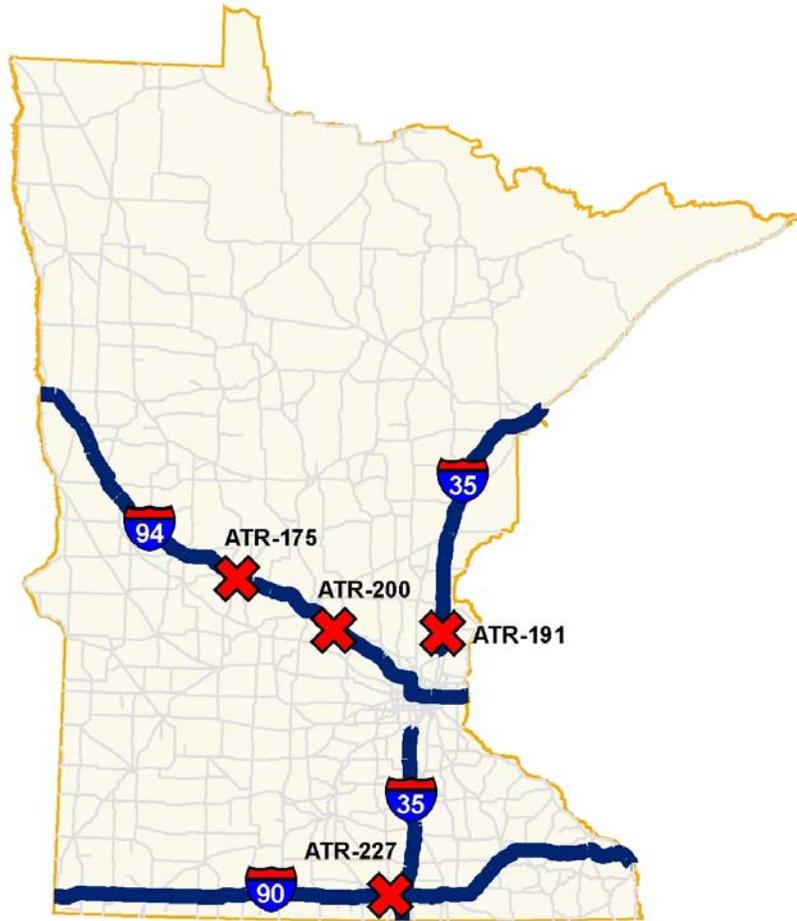


Figure 2.7: Map of Minnesota Showing ATRs Located of on Rural Freeways

2.6.1. Speed Data on Rural Freeways *Within* Enhanced Enforcement Zones

To convey our evaluation findings and to show the effect of the MSMP on Rural Freeways, we focused on drivers who were traveling at least 10 mph above the speed limit on these freeways—i.e., on those drivers who were traveling at 80 mph or more.

We combined the data obtained at the three ATRs located *Within* Enhanced Enforcement Zones, and then compared the speed data obtained during each period of the MSMP with speed data obtained the previous year. Figure 2.8 shows the results of this comparison.

Rural Freeways Enhanced Enforcement Zone: % decrease in drivers traveling 80 mph or more

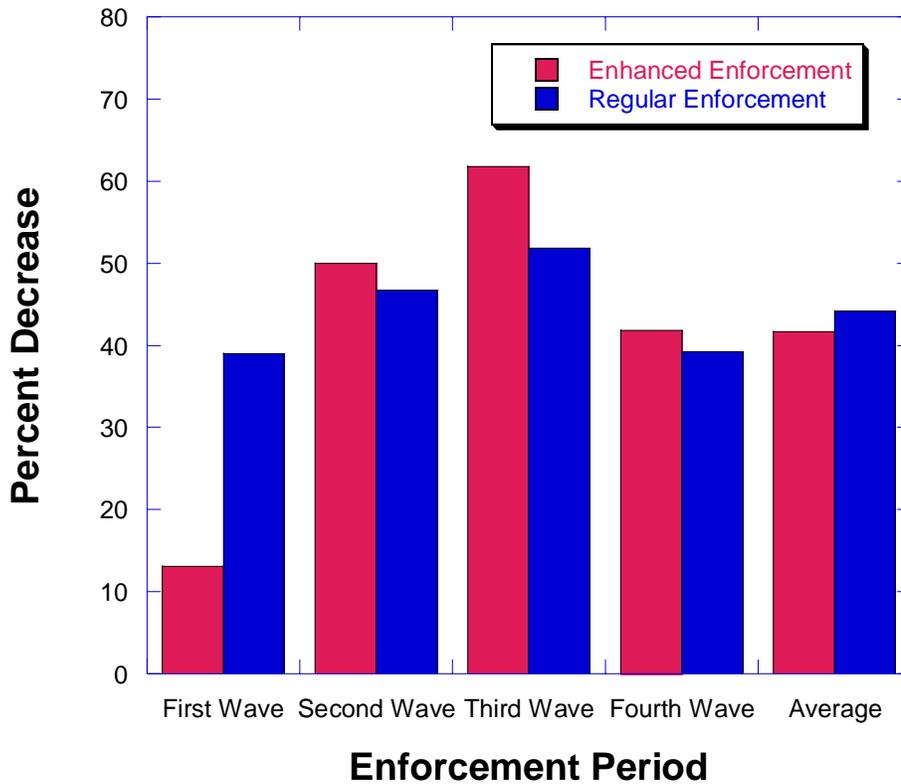


Figure 2.8: Rural Freeways *Within* the Enhanced Enforcement Zones—Percent Decrease in the Number of Drivers Traveling at 80 mph or More *During* the MSMP compared to *Before* the MSMP for the equivalent *Enhanced* Enforcement and *Regular* Enforcement periods.

At the three ATRs located *Within* Enhanced Enforcement Zones on Rural Freeways, as Figure 2.8 shows, there were reductions in the number of drivers traveling at 80 mph or more during the MSMP as compared to the number driving at 80 mph or more before the MSMP. The average reduction, over the eight time periods, was 41.7% in the *Enhanced* Enforcement periods, 44.2% in the *Regular* Enforcement periods, and 42.9% over all eight time periods.

For comparison purposes, three other measures of travel speed—mean speed, the 85th percentile, and the percent in 10 mph pace—are shown in Table 2.13.

Table 2.13 (a): Rural Freeways *Within* Enhancement Zones—Mean Travel Speed and 85th Percentile in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Mean Speed (mph) During MSMP	72.3	69.7	70.7	71.5	71.1	70.9	69.7	71.5	70.9
Mean Speed (mph) Before MSMP	72.7	72.8	71.5	72.4	73.4	72.8	73.0	72.8	72.7
85 th Percentile (mph) During MSMP	78.6	76.3	76.5	76.8	77.2	77.1	77.4	78.0	77.2
85 th Percentile (mph) Before MSMP	79.0	78.5	77.7	78.1	79.2	78.6	78.9	79.0	78.6

Table 2.13 (b): Rural Freeways *Within* Enhancement Zones—Percent of Vehicles in 10 mph Pace in Eight Test Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Percent in 10 mph Pace During MSMP	59.7%	59.5%	65.5%	67.6%	62.7%	62.2%	52.5%	61.4%	61.4%
Percent in 10 mph Pace Before MSMP	56.0%	62.8%	61.0%	64.1%	61.2%	61.1%	62.8%	61.1%	60.9%

Table 2.13 (a) shows that the mean speeds in each of the eight comparison periods dropped slightly *during* the MSMP compared to the mean speeds *before* the MSMP. On average, *during* the MSMP, the mean speed was 70.9 mph, while *before* the MSMP it was 72.7 mph.

Table 2.13 (a) also shows that the speeds for the 85th percentile driver *during* the MSMP were slightly lower than they were *before* the MSMP—and that, on average *during* the MSMP the speed of the 85th percentile driver was 77.2 mph, while *before* the MSMP it was 78.6 mph.

Also as Table 2.13 (b) shows, the percentage of vehicles within the 10 mph pace *during* the MSMP was slightly higher than the percentage of vehicles within the 10 mph *before* the MSMP—on average, *during* the MSMP the percent in the 10 mph pace was 61.4%, while *before* the MSMP it was 60.9 mph. In six of the eight comparisons, the percent in 10 mph pace increased *during* the MSMP compared to the same time frame before the MSMP.

Figure 2.8 indicates that there was a sizable reduction in the number of drivers traveling at 80 mph or more (i.e., 10 mph above the speed limit) *during* the MSMP. There were only very slight reductions in the mean speed and the speed of the 85th percentile driver. However, there was a slight increase in the percentage of vehicles in the 10 mph pace.

2.6.2. Speed Data on one Rural Freeway *Outside* Enhanced Enforcement Zones

Speed data were only available from one ATR located *Outside* the Enhanced Enforcement Zones and on a Rural Freeway. We focused on the drivers who were traveling at least 10 mph or more above the speed limit—i.e., on those drivers who were traveling at 80 mph or more—at this location. It should be noted that only limited historical speed data were available for this ATR—as a result the historical speed data from the third *Regular Enforcement* period had to be used for comparison purposes for the first six time periods. We compared the number driving at 80 mph or more *during* and *before* the MSMP, with the result shown in Figure 2.9.

**One Rural Freeway *Outside*
Enhanced Enforcement Zone:
% decrease in drivers traveling 80 mph or more**

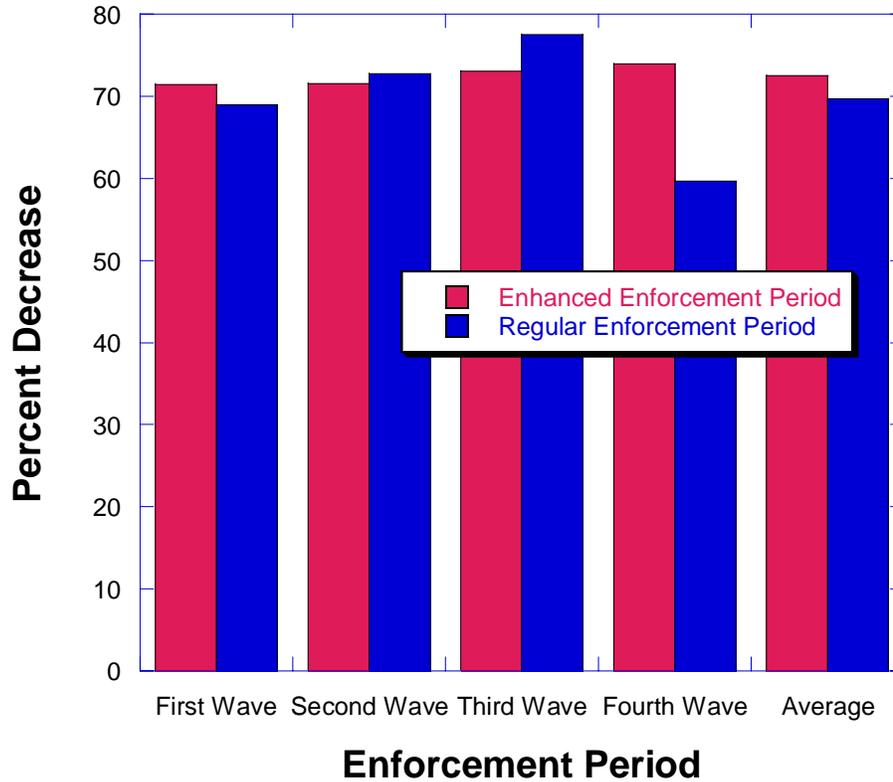


Figure 2.9: One Rural Freeway located *Outside* the Enhanced Enforcement Zones— Percent Decrease in the Number of Drivers Traveling at 80 mph or More *During* the MSMP compared to *Before* the MSMP, for the equivalent *Enhanced* Enforcement and *Regular* Enforcement periods.

Figure 2.9 shows that, for the single ATRs located *Outside* Enhanced Enforcement Zones on a Rural Freeway, throughout the time period of the MSMP, there were considerable *reductions* in the number of drivers traveling at 80 mph or more as compared to the number driving at 80 mph or more before the MSMP. The average reduction, over the eight time periods, was 72.5% in the *Enhanced* Enforcement periods, 69.7% in the *Regular* Enforcement periods, and the reduction was 71.1% overall. At first sight, these reductions may seem surprising. However, the single ATR located *Outside* the Enhanced Enforcement Zones is on I-94, near Hasty, in Wright County—this location is between two Enhanced Enforcement Zones on the same freeway—one to the northwest and the other to the southeast. It is highly likely that drivers passing this ATR had traveled through one or the other of the Enhanced Enforcement Zones. [It should also be noted that there are no other ATRs located *Outside* the Enhanced Enforcement Zones on Rural Freeways that could have been considered for comparison purposes for this study.]

For comparison purposes, three other measures of travel speed—mean speed, the 85th percentile, and the 10 mph pace—are shown in Table 2.14.

Table 2.14 (a): Data for One Rural Freeways *Outside* the Enhancement Zones—Mean Travel speed and 85th Percentile in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Mean Speed (mph) During MSMP	72.1	71.9	72.6	72.8	72.6	71.8	72.0	71.1	72.1
Mean Speed (mph) Before MSMP	73.3*	73.3*	73.3*	73.3*	73.3*	73.3	73.5	73.0	73.3
85 th Percentile (mph) During MSMP	78.2	78.2	78.3	78.4	78.3	77.8	78.0	78.0	78.1
85 th Percentile (mph) Before MSMP	80.0*	80.0*	80.0*	80.0*	80.0*	80.0	79.9	79.2	79.9

*The only historical data available for comparison purposes was from the third regular enforcement time period.

Table 2.14 (b): Data for One Rural Freeways *Outside* the Enhancement Zones—Percent of Vehicles in 10 mph Pace, in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Percent in 10 mph Pace During MSMP	59.7%	59.5%	65.5%	67.6%	62.7%	62.2%	52.5%	61.4%	61.6%
Percent in 10 mph Pace Before MSMP	56.0%	62.8%	61.0%	64.1%	61.2%	61.1%	62.8%	61.1%	53.6%

*The only historical data available for comparison purposes was from the third regular enforcement time period.

Table 2.14 (a) shows that the mean speed dropped slightly *during* the MSMP when compared with the *before* period for each of the eight time periods. On average, *during* the MSMP, the mean speed was 72.1 mph, while *before* the MSMP it was 73.3 mph. It should be noted, however, that the historical data available for comparison purposes was limited to just the third regular enforcement period, so these historical comparisons are not truly meaningful.

Table 2.14 (a) also shows that the speeds for the 85th percentile driver *during* the MSMP were lower than those *before* the MSMP—and that, on average *during* the MSMP the speed of the 85th percentile driver was 78.1 mph and 79.9 mph *before* the MSMP.. Again, however, due to the limited availability of historical data, the comparisons should be regarded with caution.

Table 2.14 (b) indicates that the percentage of vehicles within the 10 mph pace *during* the MSMP was considerably higher than it was *before* the MSMP. On average, *during* the MSMP the percent in the 10 mph pace was 61.6%, while *before* the MSMP it was 53.6 mph. The limited availability of historical comparison data makes meaningful comparisons difficult, however, for anything other than the last three time periods.

Figure 2.9 indicates that there were considerable reductions in the number of drivers traveling at 80 mph or more (i.e., 10 mph above the speed limit) throughout the MSMP on the single Rural Freeway located *Outside* the Enhancement Zones. And Table 2.14 shows that, as might be expected, there were accompanying reductions in mean speed and in the speed of the 85th percentile driver, as well as a considerable increase in the percent of drivers traveling within the 10 mph pace during the MSMP.

2.7. Crash Data for Rural Highways

The numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on Rural Highways *Within* the Enhanced Enforcement Zones are reported in Table 2.15. For comparison purposes, the table also presents the average numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.15: Crash Data for Rural Freeways that Were *Within* the Enhanced Enforcement Zones during the MSMP

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	265.246	265.246
Average Daily Traffic	21,345.3377	20,247.5510
Number of Fatal Crashes	10	13
Number of ‘A’ Injury Crashes	15	18.6
Total Number of Serious Injury Crashes	25	31.6

Table 2.15 shows that, on Rural Freeways where the speed limit remained unchanged—at 70 mph—and that were *Within* the Enhanced Enforcement Zones, there were 5.6 fewer serious accidents *during* the MSMP than there were on average in the previous 5 years. This represents a reduction of 17.7% in the number of serious crashes. However, again the numbers are too small to allow a meaningful comparison for statistical differences.

Table 2.16 shows the numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on 4-Lane Divided Highways located *Outside* the Enhanced Enforcement Zones. The table also presents the average numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.16: Crash Data for Rural Freeways that Were *Outside* the Enhanced Enforcement Zones during the MSMP

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	459.835	459.835
Average Daily Traffic	22,663.6713	21,809.3573
Number of Fatal Crashes	12	17.4
Number of ‘A’ Injury Crashes	25	20.4
Total Number of Serious Injury Crashes	37	37.8

Table 2.16 shows that, on rural freeways *Outside* the Enhanced Enforcement Zones, the number of serious injury crashes was virtually the same *during* and *before* the MSMP—while there were fewer Fatal Crashes *during* the MSMP, there were more ‘A’ Injury Crashes.

2.8. Travel Speeds on Urban Freeways (with Speed Limits that Were Increased from 55 mph to 60 mph)

In the MSMP, we obtained speed data from three ATRs located on Urban freeways. All three of these ATRs were located *Within* Enhanced Enforcement Zones. And, during the MSMP, the speed limit was increased from 55 mph to 60 mph at their locations. Details of the locations of the three ATRs are presented in Table 2.17 and are shown in Figure 2.10.

Table 2.17: Details of the ATRs on Urban Freeways

<i>Within/ Outside Enforcement Zone</i>	ATR	Location	Speed Limit
<i>Within</i>	100	Highway 100, near Brooklyn Center, Hennepin Co.	Increased—from 55 mph to 60 mph
<i>Within</i>	I94	I-94, South of 57 th Street Bridge, Hennepin Co.	Increased—from 55 mph to 60 mph
<i>Within</i>	35WCD	I-35W, near Roseville, Ramsey Co.	Increased—from 55 mph to 60 mph



Figure 2.10: Map of the Twin Cities Showing the Three ATR Locations on Urban Freeways

2.8.1. Speed Data on Urban Freeways *Within* Enhanced Enforcement Zones

To convey our evaluation findings and show the effect of the MSMP on urban freeways, we focused on drivers who were traveling at least 10 mph above the *new* speed limit—i.e., on those drivers who were traveling at 70 mph or more. We combined the data obtained at the three ATRs located *Within* Enhanced Enforcement Zones. Then, we compared speed data that were obtained during both the *Enhanced* Enforcement and *Regular* Enforcement periods during the MSMP with speed data that were obtained just

prior to the start of the MSMP—when the speed limit at the locations of the three ATRs was still 55 mph. It should be noted that the three ATRs were installed in the summer before the MSMP began—because of this, the historical speed data available for comparison purposes are limited to speed data from September, 2005 for one ATR, and to September and two days in August, 2005, for two ATRs. Figure 2.11 shows the results of this comparison.

Urban Freeways Enhanced Enforcement Zone: % decrease in drivers traveling 70 mph or more

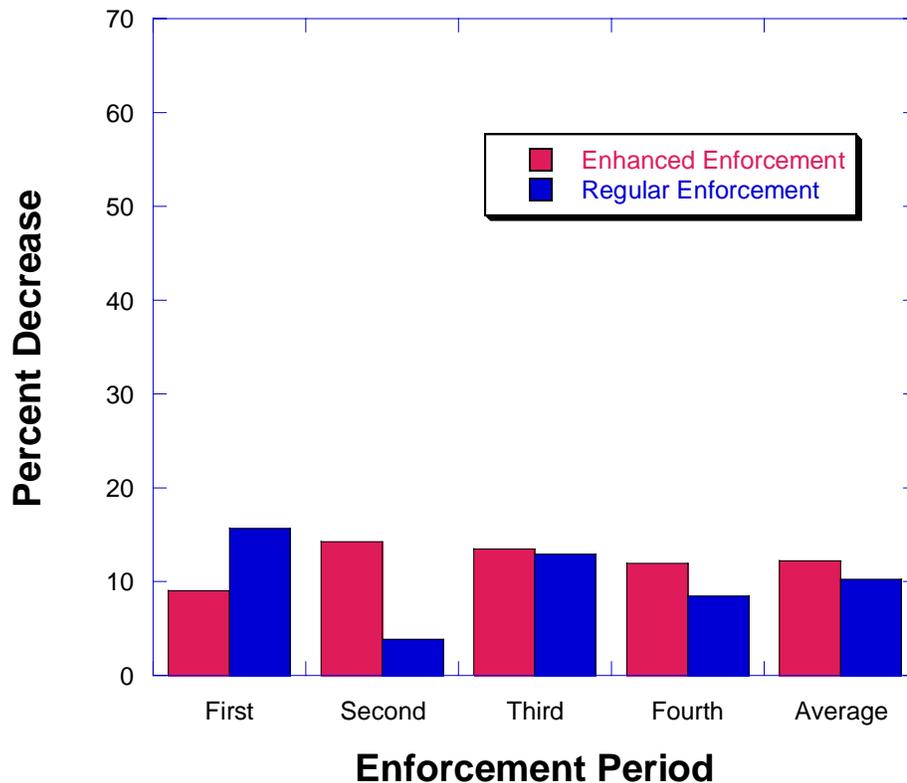


Figure 2.11: Urban Freeways *Within* the Enhanced Enforcement Zones—Percent Reduction when the Number of Drivers Traveling at 70 mph or More *During* the MSMP (when the speed limit was raised to 60 mph) Is Compared to the Number of Drivers Traveling at 70 mph or More *Before* the MSMP (when the speed limit was 55 mph) for both the *Enhanced* Enforcement and *Regular* Enforcement periods

Figure 2.11 shows that, for the ATRs located *Within* Enhanced Enforcement Zones on Urban Freeways, there were reductions in the number of drivers traveling at 70 mph or more throughout the MSMP—both in the *Enhanced* Enforcement periods and the *Regular* Enforcement periods—when compared to the number driving at 70 mph or more just before the MSMP began. In all periods *during* the MSMP there were fewer drivers traveling at 70 mph or more—i.e., 10 mph or more above the *new* speed limit—than there were traveling at this speed *before* the MSMP—i.e., when it was 15 mph or more above

the old speed limit. The average reduction, over the eight time periods, was 12.1% in the *Enhanced* Enforcement periods, 10.2% in the *Regular* Enforcement periods, while over all eight time periods it was 11.2%. The percent reductions were relatively modest—which may be a result of only having limited historical data (that was all obtained in August and September 2005) for comparison purposes and/or because metro drivers are relatively aggressive. Also, on these roads new design may support higher speeds.

For comparison purposes, three other measures of travel speed—mean speed, the 85th percentile, and the 10 mph pace—are shown in Table 2.18.

Table 2.18 (a): Urban Freeways *Within* Enhancement Zones—Mean Travel speed and 85th Percentile in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Mean Speed (mph) During MSMP	60.8	59.9	59.7	60.2	60.1	59.2	59.6	60.4	60.0
Mean Speed (mph) Before MSMP	61.6*	61.6*	61.6*	61.6*	61.6*	61.6*	61.6*	61.6*	61.6
85 th Percentile (mph) During MSMP	69.2	68.7	68.5	69.1	68.7	68.7	68.8	69.1	68.7
85 th Percentile (mph) Before MSMP	69.5*	69.5*	69.5*	69.5*	69.5*	69.5*	69.5*	69.5*	69.5

*The historical data available for comparison purposes was collected shortly before the start of the MSMP.

Table 2.18 (a): Urban Freeways *Within* Enhancement Zones—Percent of Vehicles in 10 mph Pace, in Eight Time Periods *During* and *Before* the MSMP

	First Enhanced	First Regular	Second Enhanced	Second Regular	Third Enhanced	Third Regular	Fourth Enhanced	Fourth Regular	Overall Average
Percent in 10 mph Pace During MSMP	51.9%	51.2%	49.1%	47.4%	52.1%	46.1%	47.8%	49.9%	49.5%
Percent in 10 mph Pace Before MSMP	53.5%*	53.5%*	53.5%*	53.5%*	53.5%*	53.5%*	53.5%*	53.5%*	53.5%

*The historical data available for comparison purposes was shortly before the start of the MSMP.

Table 2.18 (a) shows that the mean speeds *during* the MSMP were slower than the mean speed just before the MSMP began. On average, *during* the MSMP, the mean speed was 60.0 mph, while *before* the MSMP it was 61.1 mph.

Table 2.18 (a) shows that the speeds for the 85th percentile driver *during* the MSMP were slightly slower than the speed of the 85th percentile driver just before the MSMP began. On average, the speed of the 85th percentile driver was 68.7 mph *during* the MSMP and 69.5 mph *before* the MSMP.

And as Table 2.18 (b) shows, the percentage of vehicles within the 10 mph pace *during* the MSMP was smaller than the percentage of vehicles within the 10 mph pace just before the MSMP began—on average, *during* the MSMP the percent in the 10 mph pace was 61.6%, while *before* the MSMP it was 53.6 mph.

As Figure 2.11 shows the number of drivers traveling at 70 mph or more (i.e., 10 mph above the *new* speed limit) was reduced in the MSMP. And Table 2.18 (a) indicates there were, as might be expected accompanying reductions in the mean speed and speed of the 85th percentile driver. However, the number of drivers traveling within the 10 mph pace during the MSMP declined when compared with the 10 mph pace just before the MSMP began. Due to the limited availability of historical data for Urban Freeways, comparisons of speed data obtained *during* the MSMP with historical data should be viewed with caution.

Unfortunately, no speed data were available for urban freeways *Outside* the Enhanced Enforcement Zones.

2.9. Crash Data for Urban Freeways

The numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on Urban Freeways *Within* the Enhanced Enforcement Zones are reported in Table 2.20. For comparison purposes, the table also presents the average numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.20: Crash Data for Urban Freeways for which the Speed Limit Was Increased, from 55 mph to 60 mph, and that Were *Within* the Enhanced Enforcement Zones during the MSMP

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	27.337	27.337
Average Daily Traffic	102,733.2401	101,270.2829
Number of Fatal Crashes	2	3.8
Number of ‘A’ Injury Crashes	7	9.4
Total Number of Serious Injury Crashes	9	13.2

Table 2.20 shows that, on Urban Freeways where the speed limit was increased from 55 mph to 60 mph and that were *Within* the Enhanced Enforcement Zones, there were 4.2 fewer serious accidents *during* the MSMP than there were on average in the previous five years. Although this represents a 31.8% reduction in the number of serious crashes, it should be noted again that the number of crashes reported in Table 2.20 is too small to allow for meaningful statistical analysis—this is, in part, because there were only 27.3 miles of roadway in the “Urban Freeways *Within* Enhanced Enforcement Zones” category.

Table 2.21 shows the numbers of Fatal and ‘A’ Injury Crashes that occurred during the 46-weeks of the MSMP on Urban Freeways located *Outside* the Enhanced Enforcement Zones. The table also presents the average numbers for the two crash types during the same time period—i.e., between 9/26 and 8/13—for the previous five years.

Table 2.21: Crash Data for Urban Freeways for which the Speed Limit Was Unchanged, at 55 mph, and that Were *Outside* the Enhanced Enforcement Zones during the MSMP

	MSMP (9/26/05 to 8/13/06)	Average Crash Data for the Prior 5 Years—for the Period from 9/26 to 8/13
Length (miles)	89.397	89.397
Average Daily Traffic	90,578.2219	89,933.0580
Number of Fatal Crashes	10	8.2
Number of ‘A’ Injury Crashes	9	18.6
Total Number of Serious Injury Crashes	19	26.8

Table 2.21 shows that, on Urban Freeways where the speed limit was increased from 55 mph to 60 mph and that were *Outside* the Enhanced Enforcement Zones, there were 7.8 fewer serious accidents *during* the MSMP than there were on average in the previous five years. Although this represents a 29.1% reduction in the number of serious crashes,

again it should be noted that the number of crashes reported in Table 2.20 is too small to allow for meaningful statistical analysis.

2.10. Note on Statistical Significance of Crash Data

Crash data are presented above, in subsections 2.2, 2.4, 2.6, and 2.8, for the following highways—2-Way/2-Lane Highways, 4-Lane Divided Highways, Rural Freeways, and Urban Freeways, respectively. There are a total of nine crash data tables in the four subsections. For the 2-Way/2-Lane Highways, there are three crash data tables—the first for highways on which there was an increase in speed limits and enhanced enforcement, the second for highways on which there was no increase in speed limits and no enhanced enforcement, and the third for highways on which there was an increase in speed limits but no enhanced enforcement. For both the 4-Lane Divided Highways and Rural Freeways, there are two crash data tables—the first for highways on which there was enhanced enforcement, and the second for highways on which there was no enhanced enforcement. And for the Urban Freeways, there are two crash data tables—the first for highways on which there was an increase in speed limits and enhanced enforcement, and the second for highways on which there was no increase in speed limits and no enhanced enforcement.

As already mentioned, there were too few crashes to allow us to make meaningful individual statistical comparisons for any of the nine combinations of highway type, speed limit, and enforcement status. However, it is possible to take the nine combinations and use the Sign Test to determine whether there was an overall difference between the crash data for the MSMP time period and the average crash data from the five previous years for the same time period. For eight of the nine combinations of highway type, speed limit, and enforcement status, there was a reduction in the number of Fatal Crashes during the MSMP compared to the average number of crashes that occurred during the same time period over the previous five years (the single exception was for the Urban Freeways *Outside* the Enforcement Zones). Also, for eight of the nine combinations there was a reduction in the number of ‘A’ Injury Crashes during the MSMP compared to the average number of crashes that occurred during the same time period over the previous five years (in this case, the single exception was for the Rural Freeways *Outside* the Enforcement Zones). Using the Sign Test (see Siegel and Castellan, 1988, pp. 80-87), we found that overall the reductions in the number of Fatal Crashes and ‘A’ Injury Crashes are both statistically significant (at the $p=0.0195$ level).

2.11 Citation Data

During all four Enhanced Enforcement periods of the MSMP, citation data were collected. Citation data for the highways *Within* the Enhanced Enforcement Zones for which travel speed data were collected are presented below. Please note, there were a number of highway segments on which there was *Enhanced* Enforcement, but which lacked ATRs—so that no speed data were available from them. The citation data for

these segments is not included in the Tables 2.22 through 2.25—although these data are included in the final summary table (Table 2.26). There is one table for each of the four Enhanced Enforcement periods. Each table presents the Number of Speed Citations and the Number of Speed Warnings that were given during the *Enhanced* Enforcement period. Each table also presents the Number of Vehicles that were Stopped and the Number of Hours of Enforcement in that *Enhanced* Enforcement period. In Tables 2.22, 2.23, 2.24, and 2.25, we present the citation data for the highways *Within* the *Enhanced* Enforcement Zones for which travel speed data were collected for the First, Second, Third, and Fourth *Enhanced* Enforcement periods respectively.

Table 2.22: Citation Data in First Enhanced Enforcement Period—for the Four Types of Highways on Which ATRs Were Located

Type of Highway	Number of Speed Citations	Number of Speed Warnings	Number of Vehicles Stopped	Hours of Enforcement
2-Lane/2-Way Highway	677	2,416	3,330	1,312
4-Lane Divided Highway	893	1,225	2,248*	979
Rural Freeway	997	1,101	2,205	852
Urban Freeway	1,388	923	2,671	918
Total	3,955	4,742	10,454*	4,061

Table 2.23: Citation Data for the Second Enhanced Enforcement Period—for the Four Types of Highways on Which ATRs Were Located

Type of Highway	Number of Speed Citations	Number of Speed Warnings	Number of Vehicles Stopped	Hours of Enforcement
2-Lane/2-Way Highway	475	1,774	2,549	1,754
4-Lane Divided Highway	753	1,180	2,113	1,439
Rural Freeway	758	882	1,792	1,375
Urban Freeway	1,472	505	2,585	1,757
Total	3,458	4,341	9,039	6,325

Table 2.24: Citation Data for the Third Enhanced Enforcement Period—for the Four Types of Highways on Which ATRs Were Located

Type of Highway	Number of Speed Citations	Number of Speed Warnings	Number of Vehicles Stopped	Hours of Enforcement
2-Lane/2-Way Highway	377	1,488	2,053	1,128
4-Lane Divided Highway	598	1,084	1,876	960
Rural Freeway	957	1,325	2,532	976
Urban Freeway	2,676	1,622	4,775	1,747
Total	4,608	5,519	11,236	4,811

Table 2.25: Citation Data for the Fourth Enhanced Enforcement Period—for the Four Types of Highways on Which ATRs Were Located

Type of Highway	Number of Speed Citations	Number of Speed Warnings	Number of Vehicles Stopped	Hours of Enforcement
2-Lane/2-Way Highway	1,110	3,547	5,078	2,145
4-Lane Divided Highway	812	1,441	2,441	1,115.5
Rural Freeway	1,149	1,903	3,352	1,495
Urban Freeway	2,276	1,508	4,570	1,687
Total	5,347	8,399	15,441	6,442.5

A complete summary of Citation Data obtained throughout the MSMP is presented in Table 2.26. Please note that in addition to the data provided in Tables 2.22, 2.23, 2.24 and 2.25, Table 2.26 also includes the data for the highway segments on which there was Enhanced Enforcement, but no speed data was available.

Table 2.26: Summary of All Citation Data

Violation	Number of Citations	Number of Warnings
Speed	33,686	45,672
Seatbelt	2,684	1,549
DAR/DAS	1,638	
Equipment	1,143	5,847
No Insurance	917	
Warrants	422	
Drugs	235	
DWI	136	
Child Restraint	101	57
Open Bottle	86	
Minor Consumption	34	
Vehicle Forfeiture	25	
Weapons	14	
Miscellaneous	6,459	16,402
Total Warnings		69,402
Total Citations	47,580	

Total Officers Involved	6,513
Total Vehicles Stopped	47,580

Chapter 3: Summary of Findings during the MSMP: Driver Perceptions

3.1. Introduction

In addition to the objective speed and crash data reported in Chapter 2, data relating to driver perceptions were also obtained before and after the MSMP using a survey instrument. The surveys were conducted by MarketLine Research: They used a 26-question survey in pre-MSMP interviews that were conducted by telephone between August 15 and August 24, 2005. Then, they used the same survey instrument to conduct post-MSMP telephone interviews between August 4 and August 29, 2006—the first of these post-MSMP interviews were conducted 19 days after the fourth Enhanced Enforcement period had ended.

3.2. Sampling Techniques

In the surveys, MarketLine used two different sampling techniques.

- The first sampling technique was aimed at obtaining a *statewide* sample of drivers.
- The second sampling technique was aimed at obtaining three specific samples:
 1. A sample that was specific to *speed corridors*—this sample involved drivers who traveled on highways which had an increase in the speed limit, but did not have changes in enforcement levels, during the MSMP
 2. A sample that was specific to *enforcement corridor* users—this sample involved drivers who traveled on highways which had enhanced enforcement during the MSMP, but did not have changes in the speed limit.
 3. A sample that was specific to drivers who traveled primarily on highways which had both enhanced enforcement and an increase in the speed limit during the MSMP.

Three hundred drivers were surveyed as part of the statewide sample and 200 drivers were surveyed in the supplemental sample.

For more details of the survey methodology used by MarketLine see Appendix 6, pp. 1-4. [Please note Appendix 6 is MarketLine's October 2006 report submitted to Mn/DOT.]

3.3. Survey Objectives

MarketLine's objectives in conducting the surveys included determining drivers'—

- awareness of speed limits.
- perception of the speeds at which they actually travel.
- perception of enforcement and the impact of this enforcement.

3.4 Survey Findings

MarketLine’s key findings were as follows—(Quotation marks indicate direct quotes from MarketLine Research’s report to Mn/DOT.)

- “Nearly 9 in 10 drivers are supportive of the increase in speed limits on selected state freeways and highways. After implementation, support is now similar in the 8-County Metro and Greater Minnesota areas.”
- “Following implementation, significantly more drivers feel the appropriate speed for their most frequented highway is equal to the posted speed limit. Six in 10 drivers now feel the posted speed limit is the speed they consider appropriate—up 9% from the [pre-MSMP] survey of representative drivers.”
This finding is to be expected from those drivers who, thanks to the MSMP, were able to experience driving on highways which had an increase in the speed limit—and realized that it increased to a speed more appropriate to the highway. And for “speed corridor drivers” MarketLine Research found there was a 15% increase in post-MSMP respondents who said the posted speed was appropriate.
- “The average driver typically drives at a speed a few miles per hour over the speed limit, but slower than what they think the speed limit should be. Most think that law enforcement officers should ticket a driver who exceeds the speed limit by 10 miles per hour or more. Following implementation [of the MSMP], drivers are now more likely to think speeds closer to five miles over the posted limits will result in a law enforcement officer stopping a driver. Prior to implementation, drivers gave estimates closer to 10 miles per hour over posted limits.”
This finding may be the result of the media campaign suggesting that drivers are more likely to be stopped by an enforcement officer if they exceed the posted speed.
- “Drivers’ attitudes towards speed limits are influenced by how and where they drive. That is, drivers who travel on roads with a lower posted speed are more likely to feel comfortable driving over the posted speed limit. Many drivers who are driving at higher rates of speed think that they are already driving fast enough. As a result, many drivers are less likely to think that someone should be stopped for a speeding violation when they are traveling 60 or 65 miles per hour in a 55 mile per hour zone. However, most think that drivers should receive a ticket when they are traveling 75 or 80 miles per hour in a 70 mile per hour zone.”
- “More than one fourth of all drivers indicated that it is important to reduce speeding.”

This finding may be the result of the media campaign suggesting that higher speeds are dangerous.

- “About one in two drivers now state they see enforcement vehicles at least 2 or 3 times a week. Now more than one in four drivers say an observed speed trap area would cause them to drive slower all the time in that area. Increased enforcement during the implementation period did little to change driver perceptions of required enforcement levels. Consistent with findings prior to the [MSMP], three fourths of the drivers think that the level of enforcement of speed limits is ‘about right’.”

Given the pronounced decrease in the number of drivers traveling at 10 mph over the new speed limit—very likely due to the increased presence of enforcement officers—it is surprising that there was no change in the responses of the “speed and enforcement corridor drivers” to the survey question “How often do you see a law enforcement officer”—“most speed and enforcement corridor drivers claimed to have seen a law enforcement officer at least 2 or 3 times a week” both before and after the MSMP. However, for this question, the survey allowed only four responses—“almost every day,” “2 or 3 times a week,” “2 or 3 times a month,” and “less often.” If the survey instrument had been more sensitive and allowed more alternative responses, then it is possible that a difference might have been discovered.

It is also of note that the survey found that “More than 70% of all drivers say they will slow down in a speed trap even though a patrol car is not there.” This suggests that the repeated presence of enforcement vehicles in an area can be expected to produce lasting reductions in driving speeds.

- “Key changes in driving behavior and attitudes of speed corridor drivers were seen following the [MSMP]. The most significant of which include:
 - “Speed corridor drivers [are] more likely to view posted speeds as ‘about right’—more in line with personal travel speeds,
 - “Speed corridor drivers [are] more likely to view posted speeds as more in line with what they feel is appropriate, and
 - “Speed corridor drivers [are] more likely to say they are driving at posted speeds.”

This group of findings might be expected from drivers like this group of “speed corridor drivers” who had experienced the increased speed limits.

MarketLine Research’s key findings about pre- and post-MSMP changes in the drivers’ awareness of speed limits, their perception of the speeds at which they actually travel, and their perception of enforcement and the impact of this enforcement, are not surprising, given the changes in speed limits and enforcement that were made during the MSMP.

However, MarketLine Research’s findings about drivers’ perceptions related to the education aspects of the MSMP (see Appendix 6, p. 30) are, perhaps, surprising. The pre- and post-MSMP driver responses to the question “During the past three months, have you read, heard or seen anything in the media about speed limits,” were

unchanged—with only one third of the drivers in both the pre- and post-MSMP samples responding “Yes.” Within that one-third who responded “Yes,” the percentage of drivers who read, heard, or saw information about speed limits in a news story was unchanged (at about 60%)—while, the percentage who read, heard, or saw information about speed limits in public service announcements increased significantly in that one-third from 36% to 57%. Taken together, these responses suggest that those drivers who noticed items about travel speeds heard, read, or saw them more often during the MSMP than before. However, the increase in media information that occurred during the MSMP does not appear to have reached a wider audience than roughly 33% it originally reached. It is possible that some of the audience who might have heard the radio announcements did not remember hearing them when they responded to the survey. But it is more likely that the radio audience was smaller than expected. Perhaps in future media campaigns, it may be appropriate to use other media, such as the internet, to reach a larger target audience.

[Additional findings comparing the pre- and post-MSMP responses of the statewide samples are presented in Appendix 6. In addition, Appendix 7 presents MarketLine Research’s detailed comparisons of pre- and post-MSMP responses for participants organized by geographic areas; and Appendix 8 presents MarketLine Research’s detailed comparisons of pre- and post-MSMP responses for participants organized by speed and/or enforcement corridors.]

Chapter 4. Conclusions and Recommendations

The objective of the MSMP was to reduce travel speeds and fatal and life-changing ('A') injury crashes on Minnesota Highways. Speed and crash data were collected on four types of roadway—(1) 2-Lane/2-Way Highways, (2) 4-Lane Divided Highways, (3) Rural Freeways, and (4) Urban Freeways. Our evaluation showed that there was a decrease in the number of drivers who were traveling at excessive speeds and reductions in the number of serious crashes. Our findings are summarized in Table 4.1.

Table 4.1: Summary of the effect of the MSMP on Travel Speeds and Serious Injury Crashes

			85 th Percentile		Mean Speed		Fatal and "A" Injury Crashes		ATRs Used*
			Before	During	Before	During	Before (5 yr Avg.)	During	
2-Way/2-Lane	Miles	Percent Change Drivers>70 mph							
Within EEZs (SL—55-60 mph)	317	-28.7%	65.9	65.1	61.2	61.0	16.8	13	3
Outside EEZs (SL—55-55 mph)	7,594	+61.3%	64.1	64.2	58.2	57.7	251.6	224	4
Outside Heat (SL—55-60 mph)	475	N/A	N/A	N/A	N/A	N/A	12.8	6	0

			85 th Percentile		Mean Speed		Fatal and "A" Injury Crashes		ATRs Used*
			Before	During	Before	During	Before (5 yr Avg.)	During	
4-Lane Divided (SL—65 mph)	Miles	Percent Change Drivers>70 mph							
Within EEZs	52	-28.7%	73.2	72.0	67.4	65.8	8.2	5	4
Outside EEZs	550	-34.3%	73.5	72.9	68.2	67.3	49.6	38	1

			85 th Percentile		Mean Speed		Fatal and "A" Injury Crashes		ATRs Used*
			Before	During	Before	During	Before (5 yr Avg.)	During	
Rural Freeway (SL—70mph)	Miles	Percent Change Drivers>70 mph							
Within EEZs	265	-42.9%	78.6	77.2	72.7	70.9	31.6	25	3
Outside EEZs	460	-71.1%	79.9	78.1	73.3	72.1	37.8	37	1

			85 th Percentile		Mean Speed		Fatal and "A" Injury Crashes		ATRs Used*
			Before	During	Before	During	Before (5 yr Avg.)	During	
Urban Freeway (SL—55-60mph)	Miles	Percent Change Drivers>70 mph							
Within EEZs	27	-11.2%	69.5	68.7	61.6	60.0	13.2	9	3
Outside EEZs	89	N/A	N/A	N/A	N/A	N/A	26.8	19	0

EEZs—Enhanced Enforcement Zones

N/A—Data Not Available

*ATRs Used—Automatic Traffic Recorders embedded in the roadway that record speed, class, and volume data

As Table 4.1 shows, during the MSMP, in the Enhanced Enforcement Zones there were large decreases in the number of drivers traveling at least 10 mph above the speed limit. There was a decrease of 28.7% in the number of drivers traveling at 70 mph or more on 2-Lane/2-Way Highways (where the new speed limit was 60 mph); a decrease, also of

28.7%, in the number of drivers traveling at 75 mph or more on 4-Lane Divided Highways (where the speed limit was 65 mph); a decrease of 42.9% in the number of drivers traveling at 80 mph or more on Rural Freeways (where the speed limit was 70 mph); and a decrease of 11.2% in the number of drivers traveling at 70 mph or more on Urban Freeways (where the new speed limit was 60 mph). Decreases were found with the speed data collected from ATRs located *within* the *Enhanced* Enforcement Zones and *outside* the *Enhanced* Enforcement Zones. The reductions in the number of drivers traveling at 10 mph over the speed limit *within* the *Enhanced* Enforcement Zones are very likely due to the increased presence of enforcement officers on those roads. And, the similar reductions from speed data collected at ATRs located *outside* the *Enhanced* Enforcement Zones are likely due to their close proximity to those *Enhanced* Enforcement Zones.

There was one exception in the speed reduction findings—there was a pronounced *increase*, of 61.3%, in the number of drivers traveling at 70 mph or more on 2-Lane/2-Way Highways located *outside* the *Enhanced* Enforcement Zone. One ATR in particular was responsible for a large share of this increase: This ATR is located on MNTH 65, near Pliny, in Aitkin County. It should be noted that this ATR was located much further away from the *Enhanced* Enforcement Zones than any other ATR in this study

With regard to the crash data, this report deals with Fatal and ‘A’ Injury Crash data that were updated on November 21, 2006. The crash data obtained during the MSMP were compared with average crash data obtained during the five years prior to the MSMP. There were too few crashes to allow us to conduct meaningful statistical comparisons for the individual combinations of highway type, speed limit, and enforcement status. However using the Sign Test (Siegel and Castellan, 1988, pp. 80-87), it was possible to consider all the combinations at the same time and determine whether there was an overall difference between the crash data for the MSMP time period and the average crash data from the five previous years for the same time period. Our evaluation showed that during the MSMP there were reductions in the numbers of Fatal and “A” Injury Crashes. The results obtained using the Sign Test indicated that the reduction was statistically significant.

It is evident that the MSMP, in concert with other efforts that are part of the Minnesota Comprehensive Highway Safety Plan, has resulted in reductions in the numbers of speeders on Minnesota Highways and may have also reduced the number of fatal and life-changing (“A” injury) crashes. The speed reductions have made Minnesota’s roads safer. Because this essentially means that the objectives of the program have been achieved, we, therefore, recommend that the Minnesota Speed Management Program be continued and that funding be earmarked to allow this.

It is important to note, that while the numbers of speeders traveling 10 mph or more over the new speed limit declined, the effects of the continued presence of enforcement officers remains to be verified. If the program is continued, we recommend that an evaluation element should be included to investigate the long term effectiveness of the program. A multi-year speed management program is likely needed to produce a

permanent cultural shift in driving behavior. If there continue to be reductions in the number of speeders traveling 10 mph or more over the speed limit, we would expect to see continuing decreases in the number of fatal and life-changing crashes, bringing Minnesota closer to its Zero Death goal.

It is also worth noting that one fatal crash is estimated to result in a \$3.3 million economic loss to society. Given that figure, this program has almost certainly paid for itself.

References

Kitchens, L.J (1987). *Exploring Statistics: A Modern Introduction*. St. Paul, MN: West Publishing.

Siegel, S. and Castellan, N.J., Jr. (1988). *Nonparametric Statistics for the Behavioral Sciences: Second Edition*. New York, NY: MCGraw-Hill, Inc