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16. Abstract

This project was established to provide a means of conducting limited scope evaluations of numerous traffic control device issues. During the second year of the project, researchers completed assessments of three issues: an extinguishable Left Turn Yield sign, a red border Speed Limit sign, and dew-resistant sheeting. For the extinguishable Left Turn Yield sign, researchers evaluated the impacts of the sign on traffic conflicts and events at one site and evaluated the impact on crashes at the same site. For the red border Speed Limit sign, researchers evaluated the short-term impacts of a redesigned sign at four sites and the long-term impacts of adding a red border at three sites that were also evaluated in the first year. The short-term evaluation also included an assessment of the impacts of the sheeting type on the sign. The evaluations consisted of comparisons of before and after speed measurements. For the dew-resistant sheeting evaluation, researchers installed a sign fabricated from standard sheeting and from prototype dew-resistant sheeting and monitored the sign's performance in dew conditions with an automated camera that recorded images at regular intervals throughout the night. The results showed positive benefits for all three evaluations. Researchers recommend use of the extinguishable Left Turn Yield sign at signalized locations with high left-turn crash rates. Researchers recommend the red border be added to the standard Speed Limit sign at locations where the speed limit decreases at the approach to a city or town and there is a need to provide additional emphasis on the reduced speed limit. The dew-resistant sheeting is a prototype material and is not currently available for widespread use. Field evaluations should be conducted before it is implemented on a widespread basis.

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EVALUATION OF TRAFFIC CONTROL DEVICES: SECOND YEAR ACTIVITIES

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DISCLAIMER

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- Jesus Leal, TxDOT Pharr District;
- Dale Picha, TxDOT San Antonio District;
- Brian Stanford, TxDOT Traffic Operations Division;
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CHAPTER 1:
INTRODUCTION

INTRODUCTION

Traffic control devices provide one of the primary means of communicating vital information to road users. Traffic control devices notify road users of regulations and provide warning and guidance needed for the safe, uniform, and efficient operation of all elements of the traffic stream. There are three basic types of traffic control devices: signs, markings, and signals. These devices promote highway safety and efficiency by providing for orderly movement on streets and highways.

Traffic control devices have been a part of the roadway system almost since the beginning of automobile travel. Throughout that time, research has evaluated various aspects of the design, operation, placement, and maintenance of traffic control devices. Although there have been many different studies over the decades, recent improvements in materials, increases in demands and conflicts for drivers, higher operating speeds, and advances in technologies have created continuing needs for the evaluation of traffic control devices. Some of these research needs are significant and are addressed through stand-alone research studies at state and national levels. Other needs are smaller in scope (funding- or duration-wise) but not smaller in significance.

Unlike many other elements of the surface transportation system (like construction activities, structures, geometric alignment, and pavement structures), the service life of traffic control devices is relatively short (typically anywhere from 2 to 12 years). This shorter life increases the relative turnover of devices and presents increased opportunity for implementing research findings. The shorter life also creates the opportunity for incorporating material and technology improvements at more frequent intervals. Also, the capital cost of traffic control devices is usually less than that of these other elements. Research on traffic control devices can also be (but not always) less expensive than research on other infrastructure elements of the system because of the lower capital costs of the devices.

The traditional Texas Department of Transportation (TxDOT) research program planning cycle requires about a year to plan a research project and at least a year to conduct and report the results (often two or more years). With respect to traffic control devices, this type of program is best suited to addressing longer-range traffic control device issues where an implementation decision can wait two or more years for the research results.

In recent years, elected officials have also become more involved in passing ordinances and legislation that are directly related to traffic control devices. Examples include: creating the logo signing program, establishing signing guidelines for traffic generators such as shopping malls, and revising the *Manual on Uniform Traffic Control Devices* (MUTCD) to include specific signs. When these initiatives are initially proposed, TxDOT has a very limited time in which to respond to the concept. While the advantages and disadvantages of a specific initiative may be apparent, there may not be specific data upon which to base the response. Due to the limited available time, such data cannot be developed within the traditional research program planning cycle.

As a result of these factors (smaller scope, shorter service life, lower capital costs, and the typical research program planning cycle), some traffic control device research needs are not addressed in a traditional research program because they do not justify being addressed in a stand-alone project that addresses only one issue. This research project was established to address these types of traffic control device research needs. This project is important for the following reasons:

- It provides TxDOT with the ability to address important traffic control device issues that are not sufficiently large enough (either funding- or duration-wise) to justify research funding as a stand-alone project.
- It provides TxDOT with the ability to respond to traffic control device research needs in a timely manner by modifying the research work plan at any time to add or delete activities (subject to standard contract modification procedures).
- It provides TxDOT with the ability to effectively respond to legislative initiatives associated with traffic control devices.
- It provides TxDOT with the ability to conduct traffic control device evaluations associated with a request for permission to experiment submitted to the Federal Highway Administration (FWHA) (see MUTCD section 1A.10).
- It provides TxDOT with the ability to address numerous issues within the scope of a single project.

- It provides TxDOT with the ability to address many research needs within each year of the project.
- It provides TxDOT with the ability to conduct preliminary evaluations of traffic control device performance issues to determine the need for a full-scale (or stand-alone) research effort.

FIRST YEAR RESEARCH ACTIVITIES

During the first year of this research project, the research team undertook the research activities listed in Table 1-1. The first year report describes the research efforts, results, and recommendations associated with these activities (1). Brief descriptions of the results of the first year efforts, along with the current implementation status, are also presented in Table 1-1.

Table 1-1. First Year Activities.

Activity	Result	Status
Evaluate the effectiveness of dual logos.	Indicated that there is no evidence that the limited use of dual logos would be a problem.	TxDOT plans to implement dual logos with the new logo signing contract in late 2006 or early 2007.
Assess the impacts of rear-facing school speed limit beacons.	Found that rear-facing beacons improve compliance.	TxDOT intends to incorporate rear-facing school beacons into the next Texas MUTCD.
Evaluate the impacts of improving Speed Limit sign conspicuity.	Found some indication that the red border improves compliance, but the data were not conclusive.	The effort was continued into the second year, and the results are described in this report.
Crash-test a sign support structure.	The support structure failed the test.	The support structure was redesigned, and additional crash tests were conducted outside of this project. Those crash tests were successful. FHWA has approved the redesign support, and it is being used in Texas.
Evaluate the benefits of retroreflective signal backplates.	There was no apparent benefit to using the retroreflective backplate at the study location.	FHWA issued an interim rule that allows the use of backplates under specific circumstances.
Develop improved methods for locating no-passing zones.	Provided descriptions of multiple methods for determining the start and end of no-passing zones, but provided no testing of the accuracy of the methods.	A Texas A&M University student developed a conceptual program for calculating the start and end of no-passing zones using global positioning system (GPS) data.

SECOND YEAR RESEARCH ACTIVITIES

During the second year of this research project, the research team undertook three research activities:

- Evaluate the effectiveness of an extinguishable message Left Turn Yield sign at one location (Chapter 2).
- Evaluate the impacts of improving Speed Limit sign conspicuity (Chapter 3).
- Evaluate the benefits of dew-resistant retroreflective sheeting (Chapter 4).

This report describes these activities in the chapters indicated in parenthesis. An overall summary for the second year is provided in Chapter 5. Each of the chapters in this report has been prepared so that it can be distributed as a stand-alone document if desired.

REFERENCES

1. Rose, E.R., H.G. Hawkins, and A.J. Holick. *Evaluation of Traffic Control Devices: First Year Activities*. FHWA/TX-05/4701-1, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, 2004.

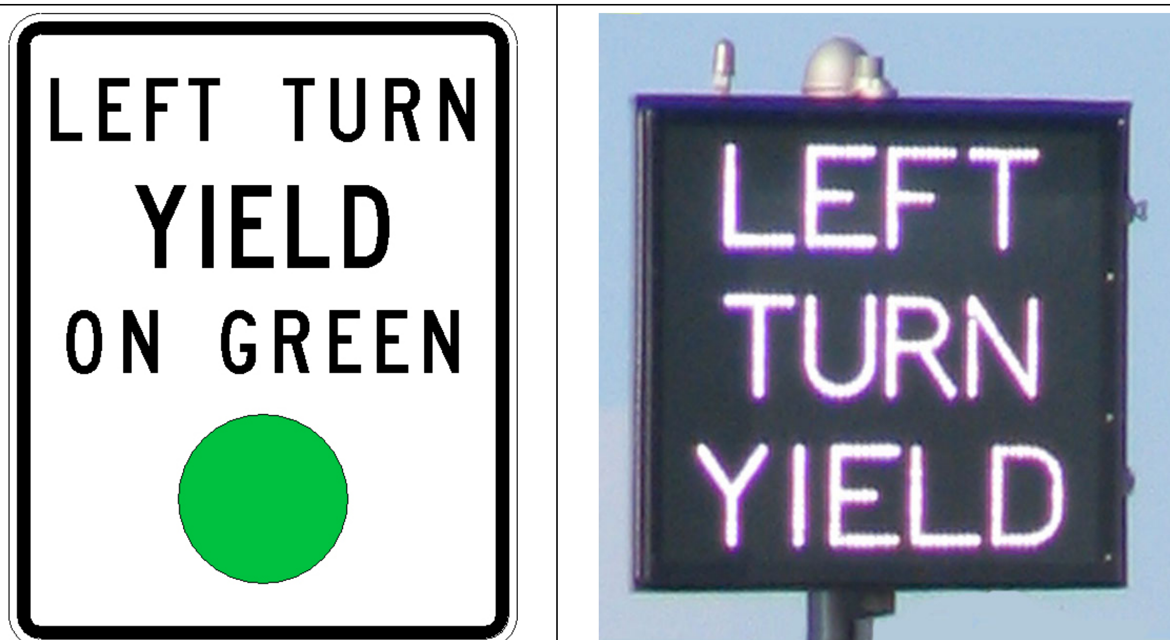
CHAPTER 2:
LEFT TURN YIELD EXTINGUISHABLE MESSAGE SIGN

INTRODUCTION

The purpose of this evaluation was to determine if replacing a standard static sign conveying a left turn yield message at all times with a dynamic sign that conveys the same message only when applicable would improve driver compliance at a left-turn signal. Increased driver compliance would decrease the number of traffic conflicts within the intersection and improve safety at the intersection.

Experimental Treatment

The treatment for this evaluation consisted of replacing the existing Left Turn Yield on Green Ball sign (Figure 2-1a) with an extinguishable message sign (EMS) (Figure 2-1b). The EMS was attached above the signal head directing the left-turn movement. The EMS was synchronized with the signal indications. The EMS would illuminate when the yellow arrow or green ball indications were illuminated on the signal head. Figure 2-2 illustrates the use of the EMS during the green arrow, yellow arrow, and green ball signal indications.



a. Left Turn Yield static sign (R10-12)   b. Left Turn Yield EMS

Figure 2-1. Existing Left Turn Yield Signs.

a. Protected Phase
EMS not illuminated

b. End of Protected Phase
EMS illuminated

c. Permitted/Permissive
EMS illuminated

Figure 2-2. Operation of the Left Turn Yield EMS.

Study Objectives

The objective of the study was to determine if using an EMS with the message Left Turn Yield would enhance the safety and reduce accidents at an intersection.

BACKGROUND INFORMATION

Various types of EMS are currently used as warning signs for weather and traffic events, dynamic detour signing, and restriction signs for turning movements (1). An EMS is a fixed message board (unlike a changeable message sign) that is illuminated only when required by traffic conditions or other events. The *Manual on Uniform Traffic Control Devices* (MUTCD) specifically mentions the use of EMS in railroad grade crossings and light rail transit applications (2). Section 10C.09 reads:

> "Light rail transit operations can include the use of activated blank-out sign technology for turn prohibition (R3-1a, R3-2a) signs. The signs are typically used on roads paralleling a semi-exclusive or mixed-use light rail transit alignment where road users might turn across the light rail transit tracks. A blank-out sign displays its message only when activated. When not activated, the sign face is blank."

In 2001, the California Department of Transportation (CalTrans) issued a policy directive (3) allowing the use of a left-turn yield EMS by local agencies. A field study performed by the City of San Jose supported the policy. Between 1996 and 1999, the City of San Jose experimented with the EMS and concluded that EMS provided a positive benefit when compared to the existing Left Turn Yield on Green Ball sign (4). The policy statement does caution that the San Jose study was limited in scope and did not provide a conclusive safety or operational benefit.

The San Jose study evaluated a left-turn yield EMS against the standard MUTCD R10-12 sign and a no-sign option. The signs were installed at two intersections. One intersection had protected/permitted phasing while the other had permitted/protected phasing. The study addressed two questions:

- Which sign best conveyed the meaning that a driver should yield to oncoming traffic during the green ball indication and wait for oncoming traffic to clear before turning left?
- Did the proposed illuminated sign lead to more confusion, during the protected phase, than the R10-12 sign or the no-sign option?

Surveys were conducted to determine driver preference given the correct meaning of each sign and driver interpretation of the various signal indication and sign combinations. A field study was also conducted to measure driver reaction at the study intersections. A crash history analysis was also performed. The researchers found that drivers understood the meaning of each sign equally. There was confusion with the use of the R10-12 sign during the protected indication. In addition, drivers preferred the EMS when given the sign's meaning. The crash history analyses showed that crash rates and types do not change when using the EMS.

FIELD EVALUATION

The field evaluation was a before and after study of traffic conflicts and traffic events within the intersection. Based on a review of previous studies and the needs of the evaluation, the conflict study focused on left-turn related traffic conflicts and traffic events. These conflicts and events include:

- opposing left turn,
- left turn same direction,

- opposing right-turn-on-red (RTOR),
- hesitating on green arrow,
- hesitating on green ball,
- left-turn red-light violation,
- left-turn yellow violation, and
- yellow trap.

Study Site

The site chosen to study the Left Turn Yield EMS was the intersection of US 59 and Emma Lena Way in Atlanta, Texas. US 59 is a north/south four-lane divided major arterial. The posted speed limit is 55 mph, and the 85th percentile speed is 57 mph. Emma Lena Way is an east/west two-lane two-way minor collector that serves a large discount store and a fast-food restaurant on the east side of the intersection. There is no posted speed. The west side of the intersection is an access drive to a second fast-food restaurant (Figure 2-3). The treatment was installed for both northbound and southbound left turns.

Figure 2-3. US 59 at Emma Lena Way Looking North.

DATA COLLECTION PROCEDURES

To study the effectiveness of the EMS, researchers collected two types of data. In the first effort, researchers conducted a field study where they collected conflict data at a single location before and after the EMS was installed. In the second effort, researchers acquired accident data for the field study site for periods before and after EMS installation.

Intersection Conflict Data

The intersection conflict analyses were performed following the procedures outlined in the *Manual of Traffic Engineering Studies* (5). Sample size calculations indicated that six hours of data collection were required. The data collection was broken into two four-hour sessions over two days. Data were collected between the hours of 1 and 6 PM to cover a peak and non-peak period. Intersection conflicts were collected in the before condition in late October of 2004, and the after data were collected in February 2005. Two observers were stationed at the northeast and southwest corners of the intersection to monitor and record conflicts. The observers specifically recorded left-turn conflicts and also monitored the overall operation of the intersection. The intersection was also recorded using video cameras from two angles in order to collect the northbound and southbound left turns from US 59. The video was used to make turning movement counts and to verify the left-turn conflicts.

The conflict data were divided into traffic conflicts and traffic events. Traffic conflicts are defined as "vehicle interactions, which may lead to crashes" while traffic events are defined as "unusual, dangerous, or illegal non-conflict maneuvers" (6). Because the focus of this study was on left-turning traffic, the conflict analysis was focused on the northbound and southbound US 59 left-turning movements and the conflict points associated with those movements. Table 2-1 lists the conflicts and events used in this study.

Table 2-1. List of Traffic Conflicts and Events.

Traffic Conflicts	Traffic Events
Opposing left turn	Hesitate on green arrow
Left turn same direction	Hesitate on green ball
Opposing right-turn-on-red	Left-turn red-light violation
	Left-turn yellow violation
	Yellow Trap

Intersection Accident Data

Accident reports from the intersection were obtained from the local police department. The accident reports covered a period from January 2004 to June 2005. Accident data were classified by type and location, and a condition diagram (Figure 2-4) and before and after collision diagrams were created from the accident reports (Figures 2-5 and 2-6).

Data Reduction

Turning movement and intersection volume counts were pulled from the video data. All volume counts were binned in 15-minute intervals. Conflict data were taken from the data collection forms. All data were input into spreadsheets for analysis. In addition, the researchers measured stop-bar compliance for the left-turn movements. Stop-bar compliance was also binned into 15-minute intervals.

FIELD STUDY ANALYSIS AND RESULTS

After collecting the field data, researchers organized it into groups for analysis. After analyzing the data, the researchers assessed the results to identify trends and assess the effectiveness of the treatment.

Comparison of Frequency of Intersection Measures of Effectiveness

To assess whether there were any differences in the before and after conditions, researchers compared the before and after frequencies for turning movements, traffic conflicts, traffic events, and stop line violations. These comparisons indicated whether there was a statistical difference in the frequency of events.

The first step in the analysis was to determine if the before and after traffic volumes were consistent with each other. The turning movement volumes taken from the video were analyzed using a two sample *t*-test. The analysis was performed in Excel using the StatistiXL add-in. The results of the analysis are shown in Table 2-2. The before and after movement volumes are provided, and the calculated P-value is given. At a 95 percent confidence interval (α=0.05), the test shows that the before and after volumes are equal for all movements except the northbound left-turn movement. In this movement, the volume decreased by approximately 32 percent. The similarities in traffic volumes allowed for the direct comparison of the before and after results.

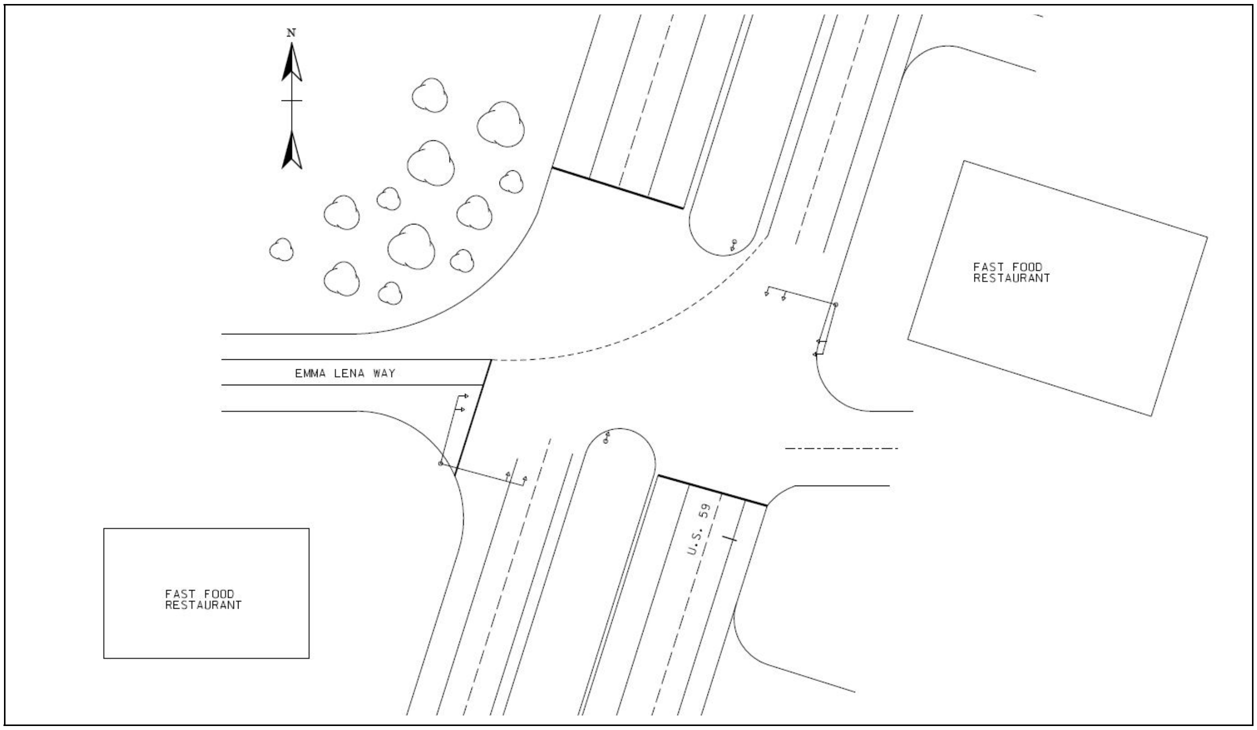


Figure 2-4. Condition Diagram Site 1: US 59 and Emma Lena Way.

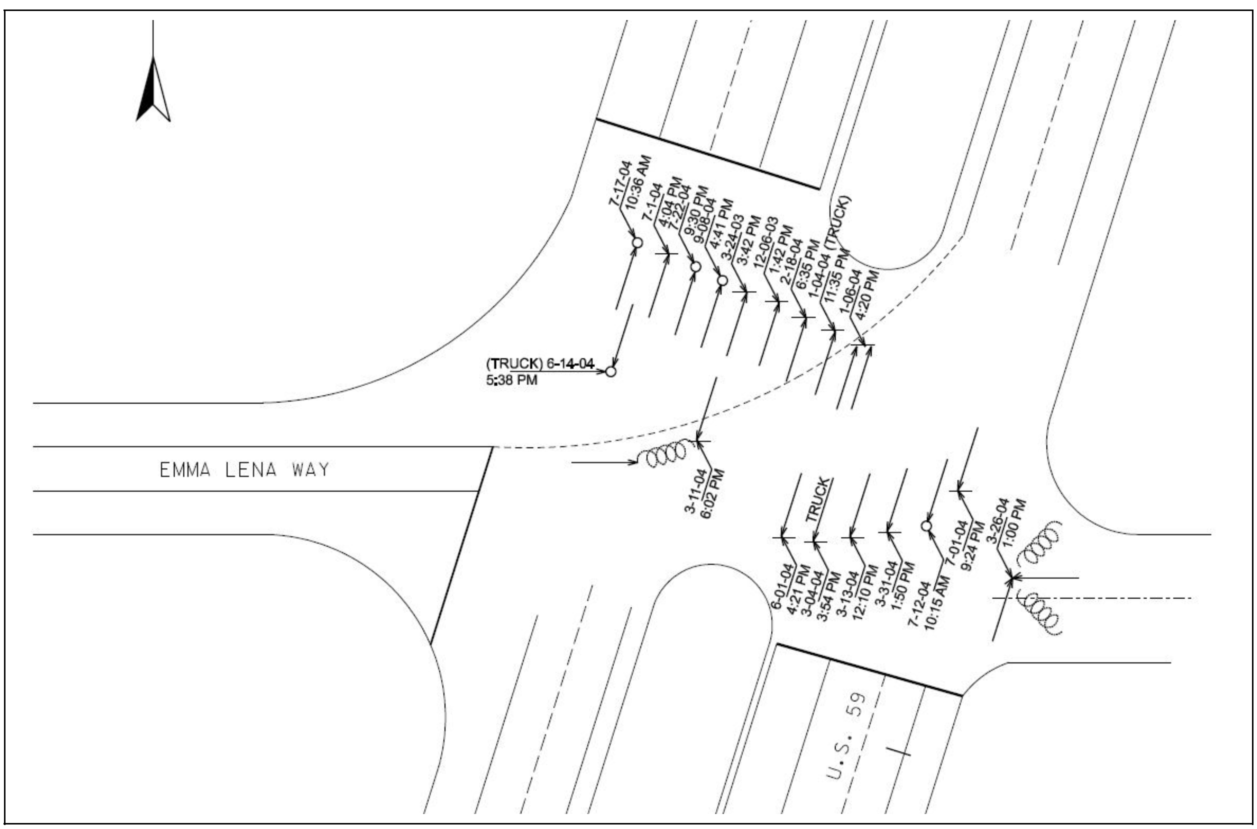


Figure 2-5. Before Condition Collision Diagram.

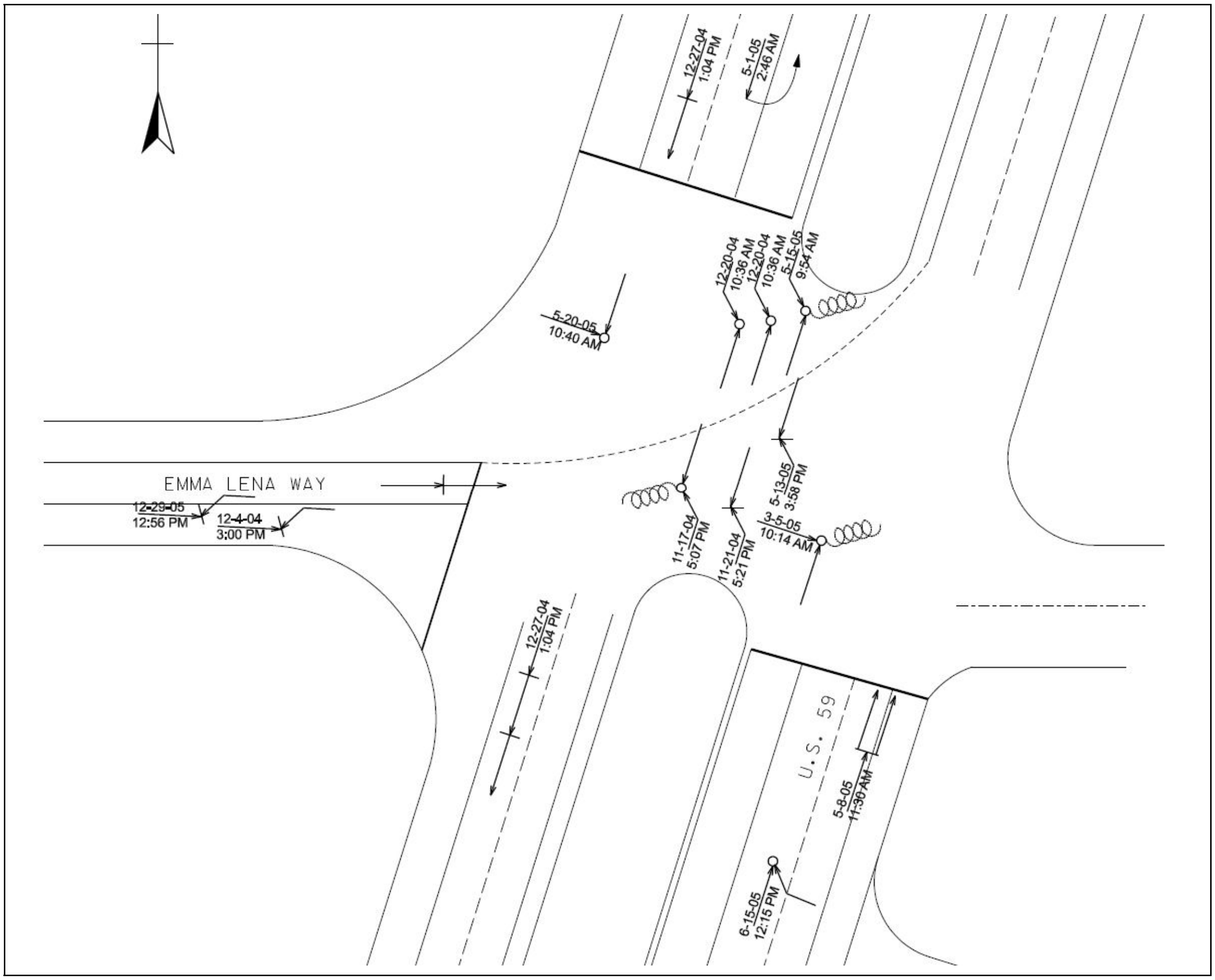


Figure 2-6. After Condition Collision Diagram.

Table 2-2. Statistical Testing Results: Turning Movement Volumes.

Movement		Number of Vehicles			P-value	Counts Equal at α = 0.05?
		Before	After	Difference		
Northbound	Through	2727	2261	-466	0.238	Yes
	Left	982	669	-313	0.025	No
	Right	158	168	10	0.528	Yes
	U-turn	61	84	23	0.344	Yes
Southbound	Through	2517	3172	655	0.291	Yes
	Left	73	129	56	0.051	Yes
	Right	764	959	195	0.294	Yes
	U-turn	4	22	18	0.323	Yes

Researchers also analyzed the traffic conflicts, traffic events, and stop line violations observed at the intersection by comparing the two population's proportions. This analysis was performed to determine if a statistical difference existed between the before and after traffic conflicts and events. Given that the movement volumes were not statistically different, any difference in the proportion of events would indicate an effect from the treatment. The proportion of each conflict type to the number of entering vehicles for that direction was compared for the before and after periods. The null hypothesis is that the before and after proportions (p_1 and p_2 respectively) are equal. A z-statistic was calculated using the following equations:

$$p_1 = \frac{m}{x}, \quad p_2 = \frac{n}{y} \qquad \text{Equation 1}$$

$$Z = \frac{p_1 - p_2}{\sqrt{pq\left(\frac{1}{m} + \frac{1}{n}\right)}} \qquad \text{Equation 2}$$

$$p = \frac{m}{m+n} p_1 + \frac{n}{m+n} p_2 \qquad \text{Equation 3}$$

$$q = 1 - p \qquad \text{Equation 4}$$

Where:

m = sample size of the before population,

n = sample size of the after population,

x = total observed entering vehicles before period,

y = total observed entering vehicles after period,

p_1= proportion of the before conflicts to the observed vehicles,

p_2 = proportion of the after conflicts to the observed vehicles,

Z = calculated z-statistic, and

p = estimate of the population proportion of the single combined sample (m+n).

The rejection region is $z \geq z_{\alpha/2}$ or $z \leq -z_{\alpha/2}$. The results of the traffic conflicts analysis are provided in Table 2-3. The results of the traffic events analysis are given in Table 2-4. The results of stop line violations analysis are given in Table 2-5. Dashed lines in the tables represent conflicts, events, or violations in which a statistical analysis was not possible due having no conflicts or events in either the before or after period.

Table 2-3. Traffic Conflicts Analysis Results.

Conflict		m	x	p_1	n	y	p_2	p	q	Z	$Z_{\alpha/2}$	Result
Northbound	Opposing left turn	14	3928	0.0036	3	3182	0.0009	0.0031	0.9969	0.0741	-1.96	reject H_o
	Left turn same direction	2	3928	0.0005	0	3182	0	-	-	-	-1.96	-
	Opposing RTOR	5	3928	0.0013	0	3182	0	-	-	-	-1.96	-
Southbound	Opposing left turn	7	3358	0.0021	3	4282	0.0007	0.0017	0.9983	0.0491	-1.96	reject H_o
	Left turn same direction	0	3358	0	0	4282	0	-	-	-	-1.96	-
	Opposing RTOR	0	3358	0	0	4282	0	-	-	-	-1.96	-

Table 2-4. Traffic Events Analysis Results.

Event		m	x	p_1	n	y	p_2	p	q	Z	$Z_{\alpha/2}$	Result
Northbound	Hesitate on green arrow	5	3928	0.0013	1	3182	0.0003	0.0011	0.9989	0.0262	-1.96	reject H_o
	Hesitate on green ball	43	3928	0.0109	20	3182	0.0063	0.0095	0.9905	0.1779	-1.96	reject H_o
	Left turn red-light violation	7	3928	0.0018	1	3182	0.0003	0.0016	0.9984	0.0344	-1.96	reject H_o
	Left turn yellow violation	41	3928	0.0104	31	3182	0.0097	0.0101	0.9899	0.0292	-1.96	reject H_o
	Yellow trap	2	3928	0.0005	1	3182	0.0003	0.0004	0.9996	0.0076	-1.96	reject H_o
Southbound	Hesitate on green arrow	1	3358	0.0003	13	4282	0.0030	0.0028	0.9972	-0.0496	-1.96	reject H_o
	Hesitate on green ball	31	3358	0.0092	13	4282	0.0030	0.0074	0.9926	0.2188	-1.96	reject H_o
	Left turn red-light violation	0	3358	0	1	4282	0.0002	-	-	-	-	-
	Left turn yellow violation	3	3358	0.0009	2	4282	0.0005	0.0007	0.9993	0.0174	-1.96	reject H_o
	Yellow trap	0	3358	0	0	4282	0	-	-	-	-	-

Table 2-5. Stop Line Violations Analysis Results.

Direction	m	x	p_1	n	y	p_2	p	q	Z	$Z_{\alpha/2}$	Result
Northbound	51	3928	0.0130	37	3182	0.0116	0.0124	0.9876	0.0567	-1.96	Reject H_o
Southbound	7	3358	0.0021	5	4282	0.0012	0.0017	0.9983	0.0380	-1.96	Reject H_o

The results of the analysis indicate that there is a statistically significant difference between the before and after conditions for all measures where there was at least one event each in both the before and after periods.

Comparison of Traffic Conflicts, Traffic Events, and Stop Line Rates

To assess the actual impact of the treatment, the researchers analyzed the rates associated with various measures of effectiveness (MOEs) to determine if there was an increase or decrease in a particular MOE. Table 2-6 compares the before and after rates for traffic conflicts, Table 2-7 compares the rates for traffic events, and Table 2-8 compares the rates for stop line violations. The traffic conflict analysis indicates that the use of the EMS produced a significant reduction in opposing left-turn conflicts but not in left-turn same direction and opposing RTOR conflicts (Table 2-6). In addition, the analysis also indicates a significant reduction in the number of traffic events (Table 2-7), especially drivers hesitating on the green arrow. The EMS also produced a significant reduction in the number of stop bar violations in both directions.

Table 2-6. Analysis of Traffic Conflict Rates.

Conflict		Rate (per 1000 entering vehicles)			
		Before	After	Difference	% Difference
Northbound	Opposing left turn	3.56	0.94	-2.62	<u>-73.5</u>
	Left turn same direction	0.51	0.00	-0.51	-100.0
	Opposing RTOR	1.27	0.00	-1.27	-100.0
Southbound	Opposing left turn	2.08	0.70	-1.38	<u>-66.4</u>
	Left turn same direction	0	0	-	-
	Opposing RTOR	0	0	-	-

Note: Underlined text indicates a statistically significant difference, $\alpha = 0.05$

Table 2-7. Analysis of Traffic Event Rates.

	Event	Rate (per 1000 entering vehicles)			
		Before	After	Difference	% Difference
Northbound	Hesitate on green arrow	1.27	0.31	-0.96	-75.3
	Hesitate on green ball	10.95	6.29	-4.66	-42.6
	Left-turn red-light violation	1.78	0.31	-1.47	-82.4
	Left-turn yellow violation	10.44	9.74	-0.70	-6.7
	Yellow trap	0.51	0.31	-0.19	-38.3
Southbound	Hesitate on green arrow	0.30	3.04	2.74	919.5%
	Hesitate on green ball	9.23	3.04	-6.20	-67.1%
	Left-turn red-light violation	0	0.23	0.23	123.4%
	Left-turn yellow violation	0.89	0.47	-0.43	-47.7%
	Yellow trap	0	0	-	-

Note: Underlined text indicates a statistically significant difference, $\alpha = 0.05$

Table 2-8. Analysis of Stop Line Violation Rates.

Direction	Rate (per 1000 entering vehicles)			
	Before	After	Difference	% Difference
North	12.98	11.63	-1.36	-10.4%
South	2.08	1.49	-0.92	-44.0%

Note: Underlined text indicates a statistically significant difference, $\alpha = 0.05$

ACCIDENT STUDY ANALYSIS AND RESULTS

Ezra Hauer (7) details a four-step method for measuring the safety benefit of a safety device using before and after accident data. The method compares the number of after accidents with the device or countermeasure to the expected number of after accidents had the device not been used. Hauer calls this type of study and analysis a Naïve Before and After study. A Poisson distribution is assumed in order to estimate the parameters for the Naïve Before and After analysis. A Poisson distribution is used to predict rare or random occurrences, such as vehicle accidents. The equations used to predict the parameters are:

$$L(j) = after\ period\ accident\ counts \quad \text{Equation 1}$$

$$K(j) = before\ period\ accident\ counts \quad \text{Equation 2}$$

$$r_d(j) = \frac{Duration\ of\ after\ period\ for\ entity\ j}{Duration\ of\ before\ period\ for\ entity\ j} \quad \text{Equation 3}$$

$$\lambda = \sum L(j) \quad \text{Equation 4}$$

$$\pi = \sum r_d(j)K(j) \quad \text{Equation 5}$$

$$VAR\{\lambda\} = \sum L(j) \quad \text{Equation 6}$$

$$VAR\{\pi\} = \sum r_d(j)^2 K(j) \quad \text{Equation 7}$$

$$\delta = \pi - \lambda \quad \text{Equation 8}$$

$$VAR\{\delta\} = VAR\{\pi\} + VAR\{\lambda\} \quad \text{Equation 9}$$

$$\theta = (\lambda/\pi)/[1 + VAR\{\pi\}/\pi^2] \quad \text{Equation 10}$$

$$VAR\{\theta\} \cong \theta^2[(VAR\{\lambda\}/\lambda^2] \quad \text{Equation 11}$$

$$Percent\ reduction\ in\ accident\ frequency = 100(1-\theta) \quad \text{Equation 12}$$

Where:

- *L(j)* is the number of after period accidents,
- *K(j)* is the number of before period accidents,
- λ is the expected number of target accidents in the after period,
- π is the predicted number of target accidents in the after period with no treatment,
- δ is the reduction in the after period, and
- θ is the index of effectiveness.

The four steps are:

- estimate λ and predict π,
- estimate the variance of λ and π ($VAR\{\lambda\}$ and $VAR\{\pi\}$),
- estimate δ and θ, and
- estimate $VAR\ \{\delta\}$ and $VAR\{\theta\}$.

Tables 2-9 and 2-10 show the results of the accident analysis. Table 2-9 shows differences in the total number of accidents at the study intersection. In addition, the difference in the number of accidents involving a left-turn movement from US 59 is given. Table 2-10 lists factors that could contribute to an accident such as weather, pavement surface, or lighting level, and it shows the number and percent of total accidents during the study period exhibiting each contributing factor.

Table 2-9. Changes in Number and Type of Accidents.

Category	Before	After	Decrease	% Difference
Total Number of Accidents	28	15	13	-46
Type of Collision				
Right Angle	25	11	14	-56
Rear End	3	3	0	0
Single Vehicle	0	1	-1	-
Movements from US 59				
NB Left Turn	8	3	5	-63
SB Left Turn	11	3	8	-73
NB Right Turn	1	3	-2	200
SB Right Turn	2	3	-1	50

Table 2-10. Accident Factors.

Factors	Before		After	
	N	%	N	%
Lighting:				
Daylight	25	89	11	73
Dusk	1	4	1	7
Dark, lighted	2	7	2	13
Pavement Surface:				
Dry	24	86	11	73
Wet	4	14	4	27
Weather:				
Clear	25	89	11	73
Rain	1	4	4	27

N = Number of accidents, % = Percent of total accidents during study period

Tables 2-11 and 2-12 show the analysis following Hauer's method. The analysis is performed for:

- all accidents,
- all left-turn accidents, and
- northbound and southbound left-turn accidents.

Table 2-11. Estimated Accident Reductions in the After Period.

Target Accident	Time Period (Months)		Acc. Before	Acc. After	$r_d(j)$	π	VAR $\{\pi\}$	δ	VAR $\{\delta\}$
	Before	After							
All Accidents	10	8	28	15	0.8	22.4	17.92	7.4	32.92
Left Turn	10	8	19	6	0.8	15.2	12.16	9.2	18.16
Northbound	10	8	8	3	0.8	6.4	5.12	3.4	8.12
Southbound	10	8	11	3	0.8	8.8	7.04	5.8	10.04

Table 2-12. Estimate of the Index of Effectiveness.

Target Accident	θ	VAR $\{\theta\}$	Percent Reduction in Accident Frequency
All Accidents	0.694	0.046	30.6
Left Turn	0.416	0.034	58.4
Northbound	0.527	0.101	47.3
Southbound	0.372	0.049	62.8

SUMMARY AND CONCLUSIONS

The analysis shows that installation of a left-turn yield EMS significantly lowered the rate of opposing left-turn traffic conflicts. The rate dropped approximately 66 percent for southbound traffic and 74 percent for northbound traffic.

The results for traffic events are more mixed. The northbound left-turn movement had significant reductions in the number of left-turn red-light violations and the incidence of yellow trap events while the southbound left-turn movement had significant reductions in yellow light violation. The southbound direction also saw a significant increase in the incidence of left-turn red-light violations. This result is misleading, however, because the number of left-turn red-light violations in the after condition totaled one vehicle.

The accident analysis shows an overall reduction in the number of accidents at the intersection. The total number of accidents dropped by half. Of the three types of collisions that occurred at the intersection, the majority were right-angle collisions. This type of collision was also the source of all the reduction. Breaking down the right-angle collisions into the northbound and southbound turn movements, the analysis shows that the reduction in accidents came solely from the left-turn movements from US 59. The northbound and southbound movements had reductions of 63 percent and 73 percent, respectively. The statistical accident analysis indicates a reduction in accident frequency up to 58 percent for the left-turn movement with a 31 percent reduction in all accidents at the intersection. Based on the results, the use of the Left Turn Yield EMS has had a positive effect on the safety of the intersection.

RECOMMENDATIONS

The results indicate a positive safety benefit to the use of an EMS in place of the standard Left Turn Yield on Green Ball sign. Based on the findings for this evaluation, the researchers recommend using this type of sign at locations with a demonstrated history of high left-turn crashes. The Texas *Manual on Uniform Traffic Control Devices* does not need to be revised to accommodate this sign, but the Texas Department of Transportation may want to develop a standard sheet or other guidelines to assist in the implementation of the device. Because these results reflect the impact at only one intersection, additional installations of this treatment should be monitored after installation to confirm the benefit of installation.

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CHAPTER 3: RED BORDER SPEED LIMIT SIGN

INTRODUCTION

Speed Limit signs on our highways are installed to guide and induce motorists to drive at safe speeds. Speeding is a common occurrence on our highways and contributes to a large number of fatal and non-fatal crashes every year. In 2003, speeding was a contributing factor in 31 percent of all fatal crashes. The National Highway Traffic Safety Administration (NHTSA) defines speeding as driving too fast for conditions or exceeding the posted speed limit. Speed-related crashes on Texas highways account for 41 percent of all fatal crashes (1). For these reasons, improving speed limit compliance is a priority. Researchers hypothesized that sometimes motorists do not comply with speed limits because Speed Limit signs do not attract attention. This lack of compliance can be especially true in reduced speed zones well outside the city limits of a rural community that provide no clue to the motorists for a decrease in speed limit other than the Speed Limit sign.

In the second year of this project, the researchers expanded upon the first year effort to evaluate the impact of using a red border Speed Limit sign on compliance with the speed limit (2). The researchers improved upon the design of the red border sign, added sheeting type as a factor in the evaluation, evaluated the sign at several locations, and conducted a long-term follow-up evaluation of the red border signs installed during the first year of the project.

Experimental Treatment

The researchers believe that increasing conspicuity of the Speed Limit sign would result in increased awareness of the posted speed limit and therefore improve compliance with the speed limit. This study was completed using three Speed Limit sign designs:

- The standard Speed Limit sign (R2-1) (shown in Figure 3-1a). This is the standard sign described in the *Manual on Uniform Traffic Control Devices* (MUTCD).
- A standard Speed Limit sign with red border added (shown in Figure 3-1b). This is the sign that was evaluated in the first year of the project.
- A modified red border Speed Limit sign (shown in Figure 3-1c). This is the sign that was evaluated in the second year of the project.

a. Standard Speed Limit Sign (R2-1)

b. Standard Speed Limit Sign with Red Border

c. Modified Speed Limit Sign

Figure 3-1. Signs Evaluated.

The standard sign with a red border was created by placing a red sign that was 6 inches wider and 6 inches taller behind the standard sign. This added a 3-inch red border around the standard sign. The modified sign was created by replacing the black border of the standard Speed Limit sign with a wider red border and increasing the overall sign size by 6 inches in width and height. This allowed the red border to be 4 inches wide. The change to the 4-inch border was based on observations of field installations of the standard sign with a red border. Those observations indicated that the thin black border reduced the conspicuity impacts of the red border when viewed at long distances.

Study Objectives

The basic goal of this activity was to determine if replacing the black border on a Speed Limit sign with a wide red border would improve driver compliance with the speed limit. As mentioned, the effort is a continuation of the previous Texas Transportation Institute (TTI) effort during the first year of this project (2). There were two specific objectives associated with the activity goal:

- Evaluate the short-term impacts of the modified red border Speed Limit sign at four sites.
- Evaluate the long-term impacts (9 to 12 months after installation) of the standard Speed Limit sign with a red border at the three sites evaluated during the first year of the project.

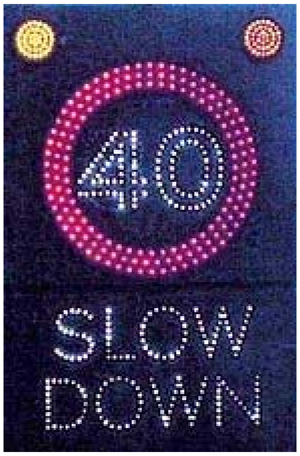
BACKGROUND INFORMATION

Over the years, a variety of Speed Limit sign treatments and related other treatments have been used to encourage greater compliance with speed limits. A few of these using the Reduced Speed Ahead sign, using larger signs, attaching orange flags to the Speed Limit sign, adding a color plaque at the top of a Speed Limit sign as a conspicuity treatment, locating the Speed Limit sign overhead, and using speed feedback signs. The following paragraphs describe some of the research that has been conducted on the effectiveness of a few of these treatments.

The Traffic Operations and Safety (TOPS) Laboratory studied the effectiveness of overhead mounted regulatory speed signs on operating speeds at three different locations along the Milwaukee freeway system (3). Results showed little change in average operating speeds in the after period. The authors concluded there was no significant evidence to indicate any impact on the operating speeds due to the installation of overhead Speed Limit signs. Figure 3-2 shows a Speed Limit sign mounted overhead instead of mounted on the pavement shoulder.

Figure 3-2. Overhead Speed Limit Sign.

The Department of Transport in the United Kingdom (UK) uses vehicle activated signs at sites that have higher speeding and crash statistics (4). When an approaching driver is identified as driving above the speed limit, the sign lights up and flashes the speed limit and "Slow Down." A picture of a vehicle activated Speed Limit sign is shown in Figure 3-3a. The sign has a red circular border around the posted speed limit, which is the case for all Speed Limit signs in the UK. Most Speed Limit signs on European highways have red borders as shown in Figure 3-3b.



a. Vehicle Activated Sign

b. International Speed Limit Sign

Note: In both signs, the circle around the speed is red.

Figure 3-3. International Speed Limit Signs.

In the United States, the first known study to evaluate the use of a red border around a Speed Limit sign was conducted by TTI in a previous research project (5). The researchers evaluated the effect of a 3-inch red border around a standard Speed Limit sign in a rural speed zone. The sign evaluated in that effort was the same at that shown in Figure 3-1b. The results of this study indicated a significant decrease in the mean speeds of passenger vehicles traveling during both daytime and nighttime. The percentage of vehicles exceeding the speed limit also decreased from 80 percent to 65 percent—a statistically significant amount.

The initial TTI research on the red border treatment appeared beneficial, but since the evaluation was conducted at only one site, the results needed additional evaluation to support a wider spread application. Researchers conducted additional evaluations during the first year of the 4701 research project (2). The first year effort found promising and beneficial results at three of the four sites, but the findings were not conclusive enough to recommend a change in the design of Speed Limit signs. Furthermore, observations of the first year installations indicated that the red border treatment was not wide enough to provide the desired level of conspicuity.

SECOND YEAR STUDY APPROACH

This research activity was divided into a short-term study and a long-term study. In the short-term study, researchers conducted a before and after analysis of the effectiveness of the modified Speed Limit sign at four sites. The after evaluations were conducted within eight weeks of the treatment installation. In the long-term study, researchers conducted a second after study at the three sites evaluated during the first year of the project. These after evaluations (referred to as long after evaluations) were conducted 9 to 12 months after the treatment installation.

Short-Term Study

The short-term study evaluated the effectiveness of the modified red border Speed Limit sign (Figure 3-1c) at four sites. These sites were different from the sites evaluated during the first year. Three different sheeting materials were used with the standard and modified signs. Researchers collected before and after speed data at each site using road tubes and traffic counters.

Short-Term Study Sites

The researchers selected four sites for evaluating the treatment during the second year. The sites were selected using criteria developed for the first year study effort (2). The primary consideration for selection of a site was that it represented a rural condition where there was no change in the roadway environment and no apparent reason for a change in the speed limit. The four sites are listed below, and a more detailed description of each site is provided in the following paragraphs:

- Site 1—SH 7 eastbound traffic approaching Marlin,
- Site 2—SH 14 southbound traffic approaching Wortham,
- Site 3—US 79 northbound traffic approaching Oakwood, and
- Site 4—FM 39 northbound traffic approaching Normangee.

Site 1—SH 7 Eastbound Traffic Approaching Marlin

The cross section on SH 7 at site 1 consists of a two-lane highway with one lane in each direction and shoulders on the right side of the road in either direction. The speed limit upstream of the 55 mph Speed Limit sign is 70 mph. The area is rural approaching the town of Marlin. The data at this site were collected using portable automated classifiers connected to pneumatic tubes. The existing sign was 24×30 inches in size with high intensity sheeting. Figure 3-4 is a photo of the site with the red border sign installed.

Figure 3-4. Site 1—SH 7, Marlin Site after Modified Red Border Treatment.

Site 2—SH 14 Southbound Traffic Approaching Wortham

The cross section on SH 14 at site 2 consists of a two-lane highway with one lane in each direction and shoulders on the right side of the road in either direction. The speed limit upstream of the 55 mph Speed Limit sign is 70 mph. The area is rural approaching the town of Wortham. The data at this site were collected using portable automated classifiers connected to pneumatic tubes. The existing sign was 24×30 inches in size with engineering grade sheeting. Figure 3-5 is a photo of this study site.

Figure 3-5. Site 2—SH 14, Wortham Site before Modified Red Border Treatment.

Site 3—US 79 Northbound Traffic Approaching Oakwood

The cross section on US 79 at site 3 consists of a two-lane highway with one lane in each direction and shoulders on the right side of the road in either direction. The speed limit upstream of the 55 mph Speed Limit sign is 70 mph. The area is rural approaching the town of Oakwood. The data at this site were collected using portable automated classifiers connected to pneumatic tubes. The existing sign was 24×30 inches in size with engineering grade sheeting. Figure 3-6 is a photo of this study site.

Site 4—FM 39 Northbound Traffic Approaching Normangee

The cross section on FM 39 at site 4 consists of a two-lane highway with one lane in each direction and shoulders on the right side of the road in either direction. The speed limit upstream of the 55 mph Speed Limit sign is 70 mph. The area is rural approaching the town of Normangee. The data at this site were collected using portable automated classifiers connected to pneumatic tubes. The existing sign was 24×30 inches in size with engineering grade sheeting. Figure 3-7 is a photo of this study site.

Figure 3-6. Site 3—US 79, Oakwood Site after Modified Red Border Treatment.

Figure 3-7. Site 4—FM 39, Normangee Site after Modified Red Border Treatment.

Treatments for Short-Term Study

The treatments evaluated in the short-term study consisted of two sign designs using various combinations of three sheeting types. This evaluation was completed at four new sites using two sign designs and three sheeting materials. The two sign signs were the standard sign (Figure 3-1a) and the modified sign (Figure 3-1c). Combinations of engineering grade, high intensity, and microprismatic sheeting were used with each design as listed below. Table 3-1 shows the sign design and sheeting combinations evaluated at each site.

- standard Speed Limit sign with engineering grade (EG) sheeting, hereafter designated as EG_S;
- standard Speed Limit sign with high intensity (HI) sheeting, hereafter designated as HI_S;
- standard Speed Limit sign with microprismatic (MP) sheeting, hereafter designated as MP_S;
- modified red border Speed Limit sign with high intensity sheeting, hereafter designated as HI_R; and
- modified red border Speed Limit sign with microprismatic sheeting, hereafter designated as MP_R.

Table 3-1. Signs Evaluated at Each Site.

Sign	Site			
	SH 7	SH 14	US 79	FM 39
EG_S	-	X	X	X
HI_S	X	X	-	X
MP_S	X	X	X	-
HI_R	X	X	-	X
MP_R	X	X	X	-

Researchers hypothesized that nighttime speed limit compliance will improve as the sheeting performance increases and compliance will improve overall with the use of the red border treatment. Figure 3-8 illustrates the progression in sheeting improvement and the red border treatment. To understand the impact of individual signs with respect to all other signs, treatments were analyzed in pairs. Pair-wise analysis also makes it possible to directly compare the results of the before and after studies. Table 3-2 shows all of the pairs that were analyzed.

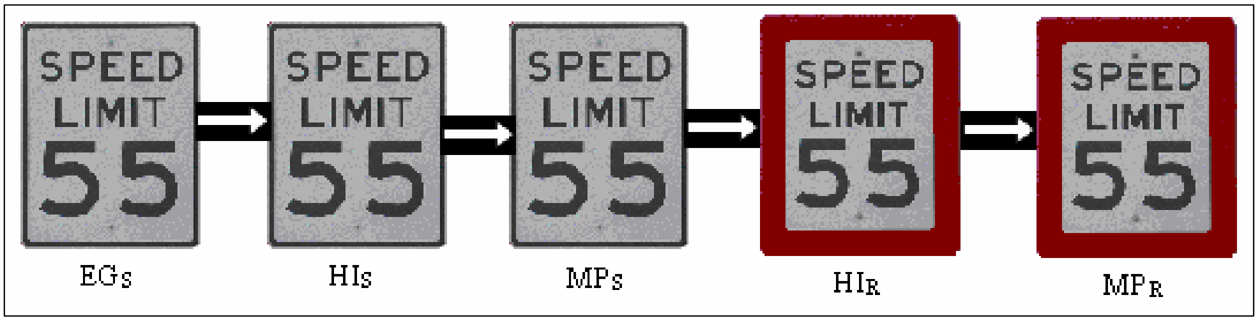


Figure 3-8. Progression of Sign Evaluations.

Table 3-2. Treatment Pairs Evaluated at each Site.

Treatment	Type of Treatment	Treatment Pair (from - to)	Site			
			SH 7	SH 14	US 79	FM 39
1	Sheeting Only	EG_S - HI_S	-	X	-	X
2	Sheeting Only	EG_S - MP_S	-	X	X	-
3	Sheeting Only	HI_S - MP_S	X	X	-	-
4	Sheeting and Border	EG_S - HI_R	-	X	-	X
5	Sheeting and Border	HI_S - HI_R	X	X	-	X
6	Sheeting and Border	MP_S - HI_R	X	X	-	-
7	Sheeting and Border	EG_S - MP_R	-	X	X	-
8	Sheeting and Border	HI_S - MP_R	X	X	-	-
9	Sheeting and Border	MP_S - MP_R	X	X	X	-
10	Sheeting Only	HI_R - MP_R	X	X	-	-

Data Collection for Short-Term Study

For the short-term study, researchers measured speeds at three locations using three automated vehicle classifiers. A speed trap was established at each location by using a pair of pneumatic tubes on the pavement. Figure 3-9 shows the data collection layout. The location of each classifier was decided based on the following factors:

- Control Point (Point 1)—This classifier was located upstream of the treatment location such that the Speed Limit sign could not be seen at this location, thus serving as a control point that allowed comparison of before and after speed data to determine if the before and after conditions were comparable. This point was typically located approximately a half-mile upstream of the Speed Limit sign.

- Legibility Point (Point 2)—This classifier was located at a point well within the legibility of the speed number in the Speed Limit sign. This point represents a location where the driver should be able to clearly read the sign. The location was typically located approximately 250 feet from the Speed Limit sign.
- Downstream Point (Point 3)—This classifier was located approximately 500 feet downstream of the Speed Limit sign. It represents the point at which the driver should clearly have adjusted the vehicle speed to the lower speed limit.

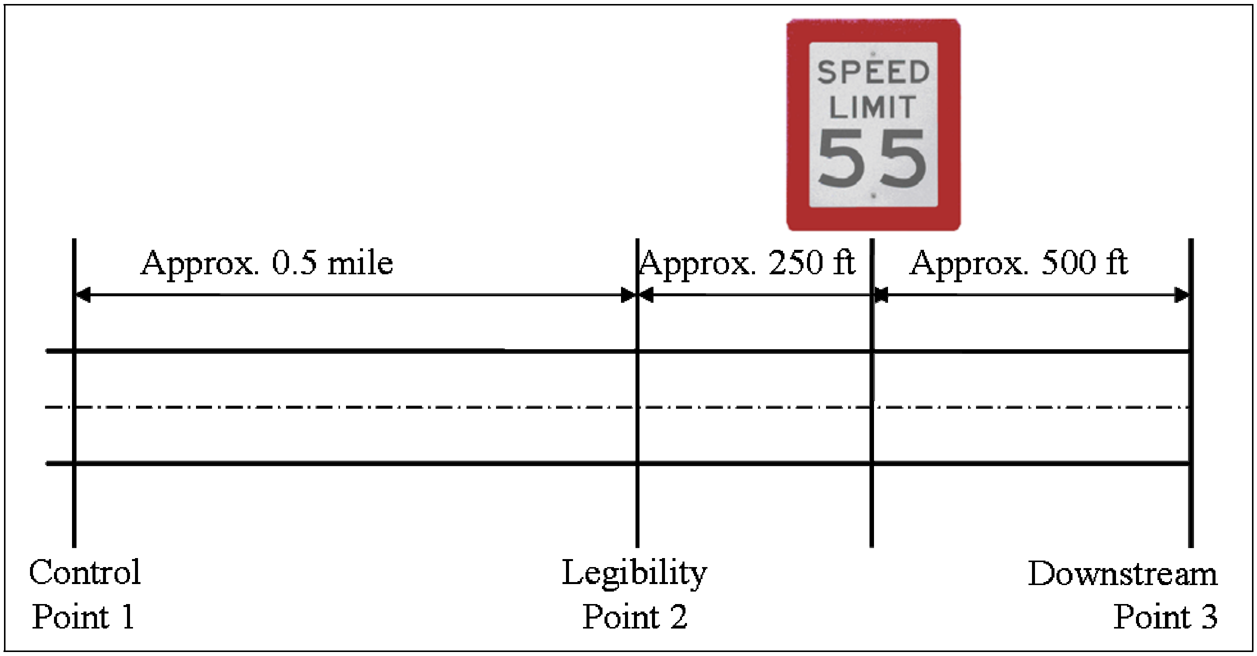


Figure 3-9. Data Collection Layout for Short-Term Study.

Data were collected during weekdays, except for existing signs at two sites, and during clear weather. If rains occurred while data collection equipment was in the field, data collected during rain times were deleted from the final data used for analysis. Table 3-3 shows the dates for the short-term data collection at each site.

Table 3-3. Data Collection Schedule for Short-Term Study.

Sites	Dates of Data Collection (in late-2004 and through mid-2005)				
	EG_S	HI_S	HI_R	MP_S	MP_R
SH 7—Marlin	-	12/1 - 12/6	5/4 - 5/6	7/11 - 7/13, 7/19 - 7/22	6/20 - 6/22
SH 14—Wortham	12/2 - 12/8	3/23 - 3/25	5/3 - 5/5	7/13 - 7/15	6/22 - 6/24
US 79—Oakwood	2/25, 2/28	-	-	5/11 - 5/13	6/8 - 6/10
FM 39—Normangee	3/2 - 3/4	5/10 - 5/12	6/6 - 6/8	-	-

Long-Term Study

The long-term study evaluated the effectiveness of the standard Speed Limit sign with a red border treatment (Figure 3-1b) at three sites evaluated during the first year of the project. At these sites, the red border treatment remained in place from the time it was installed in mid-2004 until the long-term after study in early- to mid-2005. The purpose of the long-term study was to determine if the benefits identified in the initial short-term after evaluation (during the first year) were still present 9 to 12 months later.

Long-Term Study Sites

Four sites were actually evaluated during the first year. However, one of the sites could not be evaluated as part of the long-term study because the red border sign was removed at the end of the first year. The three sites that were included are listed below and described in the following paragraphs:

- Site 5—SH 21 westbound traffic approaching Caldwell,
- Site 6—FM 60 eastbound traffic approaching Snook, and
- Site 7—SH 36 northbound traffic approaching Milano.

Site 5—SH 21 Westbound Traffic Approaching Caldwell

The cross section on SH 21 at site 5 consists of two lanes in each direction separated by a wide median with wide shoulders on the right side of the road in each direction. The speed on the road is 70 mph upstream of the 55 mph Speed Limit sign. The area is rural approaching the town, and the Caldwell City Limit sign is approximately one-half a mile downstream. A flashing intersection beacon is located downstream of the Speed Limit sign but was considered far enough downstream so as not to influence speeds within the test site after treatment. Figure 3-10 is a photo of this study site.

Figure 3-10. Site 5—SH 21, Caldwell Site before 3-Inch Red Border Treatment.

Site 6—FM 60 Eastbound Traffic Approaching Snook

The cross section on FM 60 approaching Snook consists of two lanes, one in each direction and almost no shoulder. The speed limit drops from 70 mph to 55 mph at the Snook city limits. At this site, the area is rural with mostly open fields and sparse residences. About one mile downstream of the 55 mph sign, there are a few small businesses, but nothing is visible from the locations where speed data were collected.

Site 7—SH 36 Northbound Traffic Approaching Milano

The cross section at this site consists of a two-lane road with 12-foot wide shoulders in either direction. The red border was installed on a 55 mph Speed Limit sign that is located just upstream of the Milano City Limits sign. The speed limit for this site also reduces from 70 mph to 55 mph.

Treatment for Long-Term Study

The treatment evaluated in the long-term study was the same as that evaluated in the first year effort. At all three sites, a 3-inch red border was added to the existing Speed Limit sign by placing a red sign behind the existing sign. The red sign was 6 inches wider and 6 inches taller than the existing sign. Figure 3-1b illustrates the long-term treatment. At all three sites, the same standard Speed Limit sign was used in the before, short-term after, and long-term after studies. The standard signs were all engineering grade sheeting. The red border was microprismatic sheeting.

Data Collection for Long-Term Study

For the long-term study, researchers measured speeds at the same five locations that speeds were measured at during the first year. As with the short-term study, automated vehicle classifiers were used with pneumatic tubes to measure speeds. Figure 3-11 shows a schematic of the data collection layout for the long-term study. The location of each classifier was based on the following factors:

- Control (Point 1)—This classifier was located upstream of the treatment location such that the Speed Limit sign could not be seen at this location, thus serving as a control point that allowed comparison of before and after speed data to determine if the before and after conditions were comparable. This point was typically located approximately a half-mile upstream of the Speed Limit sign.
- Threshold (Point 2)—This classifier was located at a point where the number in the Speed Limit sign would first be legible for most drivers. The location was typically 400-500 feet upstream of the Speed Limit sign.
- Legibility (Point 3)—This classifier was located at a point well within the legibility of the speed number in the Speed Limit sign. This point represents a location where the driver should be able to clearly read the sign. The location was typically about halfway between the Speed Limit sign and the Threshold Point.
- Speed Limit Sign (Point 4)—This classifier was located at the location of the Speed Limit sign.
- Downstream (Point 5)—This classifier was located approximately 500 feet downstream of the Speed Limit sign. It represents the point at which the driver should clearly have adjusted the vehicle speed to the lower speed limit.

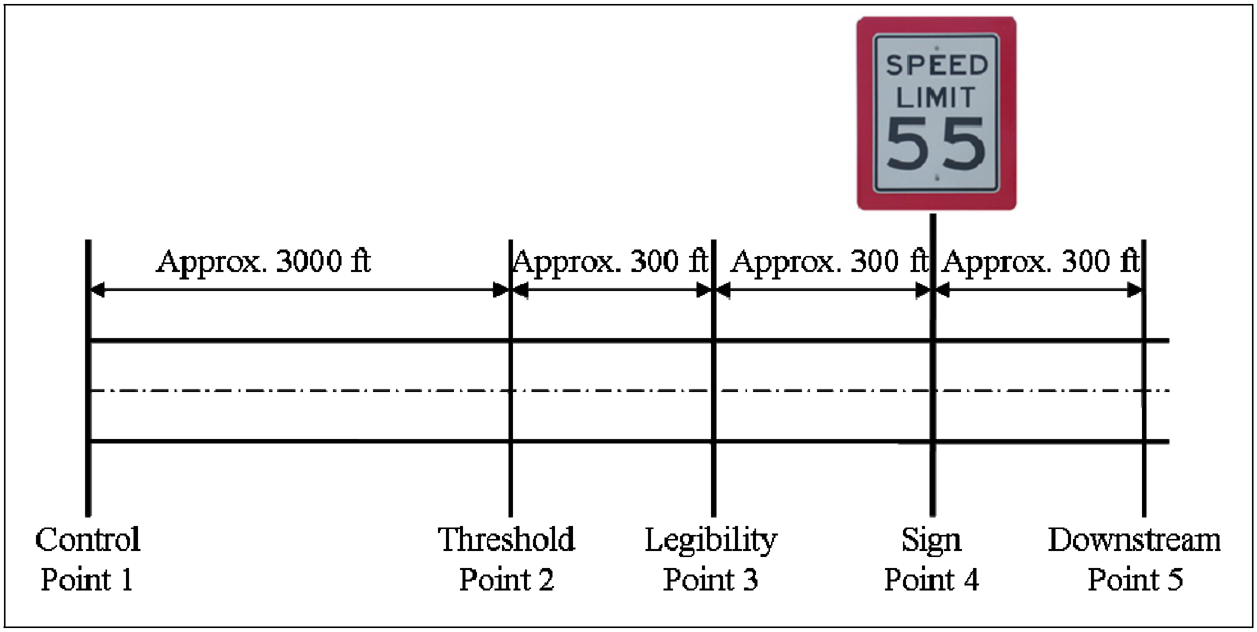


Figure 3-11. Data Collection Layout for Long-Term Study.

Data were collected on weekdays and during clear weather. Data that included rainy conditions were rejected and collected when weather was more favorable. Table 3-4 shows the dates for the long-term data collection at each site.

Table 3-4. Data Collection Schedule for Long-Term Study.

Test Sites	Before Dates	Short-Term After Dates	Long-Term After Dates
Caldwell—SH 21 West	6/16, 6/17, 6/18	7/8, 7/9	4/6, 4/7, 4/8
Snook—FM 60 East	7/1, 7/2, 7/3	7/16, 7/17, 7/18	4/27, 4/28, 4/29
Milano—SH 36 North	6/28, 6/29, 6/30	7/14, 7/15	6/28, 6/29, 6/30
Year	2004	2004	2005

Data Reduction

The raw data collected at the project sites were screened to create a random and unbiased sample of speeds for free-flowing, uninhibited passenger and heavy vehicles. The objective of the data reduction process was to isolate the effect of the red border and/or sign sheeting conspicuity on driver behavior by identifying and eliminating potentially biased data. Therefore, anomalous vehicles were identified and excluded from the final data set during this process. Anomalous vehicles for this project were defined by the following conditions:

- non-free-flowing vehicles (<6-second headway);
- motorcycles; and
- vehicles with uninhibited upstream speed deemed excessively slow (e.g., speed 25 mph or more below the speed limit).

DATA ANALYSIS

The data for each site were divided into daytime data and nighttime data and analyzed separately. Both daytime and nighttime data were further grouped as passenger vehicle data, heavy vehicle data, and all vehicle data. The data were analyzed for three measures of effectiveness (MOEs) to assess the impact of the red border treatment and higher conspicuity materials. Those MOEs were mean speed, 85th percentile speed, and percent of vehicles exceeding a specific speed threshold.

Mean Speeds

The Generalized Linear Model Uni-variate procedure was used to compute mean speeds and to test for differences in mean speeds for different sets of data collected at a site. This procedure provides regression analysis and analysis of variance (ANOVA) for one dependent variable by one or more factors and/or variables. The factor variables divide the population into groups (e.g., passenger vehicles, heavy vehicles). Sign design and sign material were used as an independent variable. Tukey's HSD and Tamhane's T^2 were used to test for differences in mean speeds for various sign treatments at a site.

85th Percentile Speeds

Using Microsoft Excel, researchers computed 85th percentile speeds for each data set. Since 85th percentile speeds are used to set speed limits and are considered an important measure of driver behavior, it was hypothesized that differences in 85th percentile speeds for before and after conditions will prove a good measure to evaluate the effectiveness of various treatments. No statistical analysis was performed to test for differences between 85th percentile speeds for the various data sets.

Percent Exceeding a Specified Speed Threshold

Microsoft Excel was used to compute the percent of vehicles exceeding a specific speed threshold. The difference in the percent of vehicles exceeding a specific speed provides the change in upper extremities of the data. Thus, this measure provides insight for differences in mean speeds. For example, a decrease in average speed and decrease in percent vehicles exceeding a threshold speed would mean faster vehicles decelerated. On the other hand, a decrease in average speed and increase in percent vehicles exceeding a specific speed threshold would mean slower vehicles decelerated more. No direct statistical tests were performed to test for differences in percent vehicles exceeding the speed threshold between various sign treatments.

RESULTS FOR SHORT-TERM STUDY

The short-term study evaluated the change in speeds at four study sites (SH 7, SH 14, US 79, and FM 39) due to changes made to the Speed Limit sign. For the short-term study, the impacts of the changes were measured within weeks of making the change. As indicated in Table 3-2, there were two types of treatments in the short-term study: those treatments that involved only a change in the sign sheeting and those treatments that included both a change in the sheeting and replacing the black border with a wide red border. The sheeting-only treatments were included in the study plan to provide a better assessment of the impacts of sheeting on the effectiveness of the Speed Limit sign. Results for each type of treatment are presented in the following pages. The short-term results presented in this chapter are supported by additional information contained in Appendix A.

ANOVA tests were performed on mean speeds, and then post hoc tests were performed to determine the statistical significance for difference in means for data collected at each site for all treatments used at that site. Daytime and nighttime data were analyzed separately. Daytime data as well as nighttime data were then analyzed for all vehicles, passenger vehicles, and heavy vehicles. Results were then organized in pairs of sign designs and sheeting combinations evaluated. In order to better understand the effect of experimental signs and sheeting materials, results are presented in a before-after fashion, taking only one combination at a time.

Results for Sheeting-Only Treatments

The sheeting-only treatments are those treatments where the sign sheeting was changed but there were no changes in the sign design. The impacts of these changes would be expected to be minimal in daytime conditions and have increasing benefit in the nighttime condition as the sign brightness increases. The specific treatments included in this type are listed below:

- Treatment #1—Change EG standard sign to HI standard sign. Treatment implemented at two sites.
- Treatment #2—Change EG standard sign to MP standard sign. Treatment implemented at two sites.
- Treatment #3—Change HI standard sign to MP standard sign. Treatment implemented at two sites.
- Treatment #10—Change modified HI red border sign to modified MP red border sign. Treatment implemented at two sites.

The results of the short-term data analysis for these four treatments are presented in Appendix A in Tables A-1 through A-12 and A-37 through A-40. Table 3-5 indicates the changes in the mean speeds for all vehicles at the control point and the downstream point and whether the change was an increase or decrease. It also indicates whether the changes in mean speeds from the before speed to the after conditions are statistically significant. These data give an indication of the comparability of the before and after data at a particular site. For the treatment to have a beneficial effect, one of three conditions would exist: the reduction at the downstream point is greater than the reduction at the control point, the increase at the downstream point is less than the increase at the control point, or there is a reduction at the downstream point and an increase at the upstream point. These conditions existed at only 6 of the 15 cases. Furthermore, the change in speeds from before to after was generally less than 1.5 mph for all of the standard sign (no red border) treatments. Based on the analysis of mean speeds, changing the sign sheeting had little beneficial effect on speed limit compliance.

Table 3-5. Changes in Mean Speeds for Short-Term Study: Sheeting Only.

Appendix Table	Condition	Treatment	Measure	Changes in Mean Speeds (mph) from Before to After			
				SH 7	SH 14	US 79	FM 39
A-1	Daytime	1—EG_S to HI_S	Control	-	-1.2*	-	0.8
A-1	Daytime	1—EG_S to HI_S	Downstream	-	-0.1	-	3.5*
A-3	Nighttime	1—EG_S to HI_S	Control	-	-1.3*	-	0.5
A-3	Nighttime	1—EG_S to HI_S	Downstream	-	-0.4	-	2.3*
A-5	Daytime	2—EG_S to MP_S	Control	-	-1.1*	-0.5*	-
A-5	Daytime	2—EG_S to MP_S	Downstream	-	-1.3*	-0.7*	-
A-7	Nighttime	2—EG_S to MP_S	Control	-	-1.1*	0.7	-
A-7	Nighttime	2—EG_S to MP_S	Downstream	-	-0.4	-0.1	-
A-9	Daytime	3—HI_S to MP_S	Control	1.9*	0.1	-	-
A-9	Daytime	3—HI_S to MP_S	Downstream	-0.4	-1.2*	-	-
A-11	Nighttime	3—HI_S to MP_S	Control	-	0.2	-	-
A-11	Nighttime	3—HI_S to MP_S	Downstream	-	0.0	-	-
A-37	Daytime	10—HI_R to MP_R	Control	-3.4*	-3.0*	-	-
A-37	Daytime	10—HI_R to MP_R	Downstream	0.5	0.9*	-	-
A-39	Nighttime	10—HI_R to MP_R	Control	-2.9*	-3.1*	-	-
A-39	Nighttime	10—HI_R to MP_R	Downstream	0.2	-0.2	-	-

Note: Asterisk (*) indicates a statistically significant difference between the before and after speed.

Table 3-6 summarizes the changes between the before and after 85th percentile speed for all vehicles at the control and downstream points. As speed limits are based on 85th percentile speeds, these data provide a useful assessment of the impact of the treatment on changes in speed limit compliance. As with the mean speeds, for the treatment to have a beneficial effect, the relationship between control and downstream points would have to be the same. The 85th percentile speed data showed trends similar to the mean speeds, with six conditions indicating a beneficial effect and nine that did not. Based on the analysis of 85th percentile speeds, changing the sign sheeting had little beneficial effect on speed limit compliance.

The findings for the sheeting-only treatments indicate that there were no consistent trends in the impacts of the sheeting change in daytime or nighttime conditions. For all combinations, the changes in speeds at all sites were small and included both increases and decreases. Based on these results, the impacts of changing the sheeting on a standard or modified Speed Limit sign on driver compliance with the speed limit is minimal or nonexistent.

Table 3-6. Changes in 85th Percentile Speeds for Short-Term Study: Sheeting Only.

Appendix Table	Condition	Treatment	Location	Change in 85th Percentile Speed (mph) from Before to After			
				SH 7	SH 14	US 79	FM 39
A-1	Day	1—EG_S to HI_S	Control	-	-0.9	-	1.5
A-1	Day	1—EG_S to HI_S	Downstream	-	-0.4	-	5.0
A-3	Night	1—EG_S to HI_S	Control	-	-1.3	-	2.0
A-3	Night	1—EG_S to HI_S	Downstream	-	-1.0	-	3.0
A-5	Day	2—EG_S to MP_S	Control	-	-0.5	0.0	-
A-5	Day	2—EG_S to MP_S	Downstream	-	-1.1	0.0	-
A-7	Night	2—EG_S to MP_S	Control	-	-0.9	1.0	-
A-7	Night	2—EG_S to MP_S	Downstream	-	-2.2	0.0	-
A-9	Day	3—HI_S to MP_S	Control	2.5	0.4	-	-
A-9	Day	3—HI_S to MP_S	Downstream	-0.4	-0.7	-	-
A-11	Night	3—HI_S to MP_S	Control	-	0.4	-	-
A-11	Night	3—HI_S to MP_S	Downstream	-	-1.2	-	-
A-37	Day	10—HI_R to MP_R	Control	-3.6	-3.7	-	-
A-37	Day	10—HI_R to MP_R	Downstream	0.9	0.4	-	-
A-39	Night	10—HI_R to MP_R	Control	-2.9	-4.3	-	-
A-39	Night	10—HI_R to MP_R	Downstream	0.0	-1.3	-	-

Results for Border and Sheeting Treatments

The border and sheeting treatments are those treatments where the sign design was modified to incorporate the wide red border. The modified red border sign design was evaluated with various types of sign sheeting. The impacts of the sign design were expected to be apparent in both daytime and nighttime conditions, while the impact of the sheeting was expected to be minimal in daytime but more pronounced during nighttime. The specific treatments included in this type are listed below:

- Treatment #4—Change EG standard sign to modified red border HI sign. Treatment implemented at two sites.
- Treatment #5—Change HI standard sign to modified red border HI sign. Treatment implemented at three sites.
- Treatment #6—Change MP standard sign to modified red border HI sign. Treatment implemented at two sites.

- Treatment #7—Change EG standard sign to modified red border MP sign. Treatment implemented at two sites.
- Treatment #8—Change HI standard sign to modified red border MP sign. Treatment implemented at two sites.
- Treatment #9—Change MP standard sign to modified red border MP sign. Treatment implemented at two sites.

For the analysis of the sign redesign, the researchers evaluated the data relative to mean speeds, 85th percentile speeds, percent of vehicles exceeding speed thresholds, and the change in speeds between the control and downstream points. The results of the short-term data analysis for the red border and sheeting treatments are presented in Appendix A in Tables A-13 through A-36. Table 3-7 indicates the change in mean speeds from the before to the after condition at the control and downstream points. Statistically significant changes are also indicated in the table by an asterisk. The change from a standard sign to a red border sign appears to have a beneficial effect in 17 of the 26 cases based on the analysis of mean speeds. Of the nine cases where the effect was not beneficial, eight of the nine were related to the microprismatic red border sign and six of the nine were on SH 14 near Wortham. There was only one case where the implementation of the red border sign with high intensity sheeting did not have a beneficial effect on mean speeds.

Table 3-8 presents the changes in 85th percentile speed from the before to the after conditions for all vehicles. The results are more mixed than they were with the mean speeds. Eleven of 26 cases produced a beneficial result. Out of the 15 cases that did not have a beneficial result, 11 of them were associated with the microprismatic red border sign.

To gain a better assessment of the impacts of the red border treatment, the researchers also analyzed the impact of the treatment on the percentage of vehicles exceeding various speed thresholds. Table 3-9 presents the change in the percentage of vehicles that were exceeding the upstream daytime or nighttime speed limit (70 or 65 mph, respectively). Although the speed limit changes between the control point and the downstream point, the analysis calculated the percent exceeding the same speed at both locations. This analysis did not indicate any particular benefit to the red border sign.

Table 3-7. Changes in Mean Speeds for Short-Term Study: Border and Sheeting Treatments.

Appendix Table	Condition	Treatment	Location	Change in Mean Speed (mph) from Before to After			
				SH 7	SH 14	US 79	FM 39
A-13	Day	4—EG_S to HI_R	Control		0.0		1.1*
A-13	Day	4—EG_S to HI_R	Downstream		-1.3*		-0.3
A-15	Night	4—EG_S to HI_R	Control		-0.4		-0.2
A-15	Night	4—EG_S to HI_R	Downstream		-0.5		-2.0*
A-17	Day	5—HI_S to HI_R	Control	3.7*	1.2*		0.3*
A-17	Day	5—HI_S to HI_R	Downstream	-1.7*	-1.2*		-3.8*
A-19	Night	5—HI_S to HI_R	Control	3.8*	0.9*		-0.7
A-19	Night	5—HI_S to HI_R	Downstream	-0.6	-0.1		-4.3*
A-21	Day	6—MP_S to HI_R	Control	1.9*	1.1*		
A-21	Day	6—MP_S to HI_R	Downstream	-1.3*	0.0		
A-23	Night	6—MP_S to HI_R	Control		0.7		
A-23	Night	6—MP_S to HI_R	Downstream		-0.1		
A-25	Day	7—EG_S to MP_R	Control		-3.4*	-1.3*	
A-25	Day	7—EG_S to MP_R	Downstream		-0.8*	-1.6*	
A-27	Night	7—EG_S to MP_R	Control		-3.5*	-0.6	
A-27	Night	7—EG_S to MP_R	Downstream		-0.7*	-1.3*	
A-29	Day	8—HI_S to MP_R	Control	0.8*	-2.2*		
A-29	Day	8—HI_S to MP_R	Downstream	-0.7*	-0.7*		
A-31	Night	8—HI_S to MP_R	Control	0.9*	-2.2*		
A-31	Night	8—HI_S to MP_R	Downstream	-0.4	-0.3		
A-33	Day	9—MP_S to MP_R	Control	-1.1*	-2.3*	-0.8*	
A-33	Day	9—MP_S to MP_R	Downstream	-0.3	0.5	-0.9*	
A-35	Night	9—MP_S to MP_R	Control		-2.4*	-1.3*	
A-35	Night	9—MP_S to MP_R	Downstream		-0.3	-1.2*	

Note: Asterisk (*) indicates a statistically significant difference between the before and after speed.

Table 3-8. Changes in 85th Percentile Speeds for Short-Term Study: Border and Sheeting Treatments.

Appendix Table	Condition	Treatment	Location	Change in 85th Percentile Speed (mph) from Before to After			
				SH 7	SH 14	US 79	FM 39
A-13	Day	4—EG_S to HI_R	Control		0.0		1.5
A-13	Day	4—EG_S to HI_R	Downstream		-1.5		1.0
A-15	Night	4—EG_S to HI_R	Control		0.5		1.0
A-15	Night	4—EG_S to HI_R	Downstream		-0.7		-1.0
A-17	Day	5—HI_S to HI_R	Control	4.6	0.9		0.0
A-17	Day	5—HI_S to HI_R	Downstream	-1.7	-1.1		-4.0
A-19	Night	5—HI_S to HI_R	Control	4.7	1.8		-1.0
A-19	Night	5—HI_S to HI_R	Downstream	0.0	0.2		-4.0
A-21	Day	6—MP_S to HI_R	Control	2.1	0.5		
A-21	Day	6—MP_S to HI_R	Downstream	-1.3	-0.4		
A-23	Night	6—MP_S to HI_R	Control		1.4		
A-23	Night	6—MP_S to HI_R	Downstream		1.4		
A-25	Day	7—EG_S to MP_R	Control		-3.7	-1.0	
A-25	Day	7—EG_S to MP_R	Downstream		-1.1	-1.0	
A-27	Night	7—EG_S to MP_R	Control		-3.8	-1.0	
A-27	Night	7—EG_S to MP_R	Downstream		-2.0	-1.0	
A-29	Day	8—HI_S to MP_R	Control	1.0	-2.8		
A-29	Day	8—HI_S to MP_R	Downstream	-0.8	-0.7		
A-31	Night	8—HI_S to MP_R	Control	1.8	-2.5		
A-31	Night	8—HI_S to MP_R	Downstream	0.0	-1.1		
A-33	Day	9—MP_S to MP_R	Control	-1.5	-3.2	-1.0	
A-33	Day	9—MP_S to MP_R	Downstream	-0.4	0.0	-1.0	
A-35	Night	9—MP_S to MP_R	Control		-2.9	-2.0	
A-35	Night	9—MP_S to MP_R	Downstream		0.1	-1.0	

Table 3-9. Changes in Percentage Exceeding 70/65 mph for Short-Term Study: Border and Sheeting Treatments.

Appendix Table	Condition	Treatment	Measure	Change in Percent Exceeding			
				SH 7	SH 14	US 79	FM 39
A-14	Day	4—EG_S to HI_R	Control	-	-0.6	-	11.2
A-14	Day	4—EG_S to HI_R	Downstream	-	0.0	-	1.4
A-16	Night	4—EG_S to HI_R	Control	-	-5.1	-	-1.2
A-16	Night	4—EG_S to HI_R	Downstream	-	0.7	-	-7.7
A-18	Day	5—HI_S to HI_R	Control	27.9	7.9	-	0.9
A-18	Day	5—HI_S to HI_R	Downstream	-3.0	-0.6	-	-10.4
A-20	Night	5—HI_S to HI_R	Control	25.2	5.7	-	-5.4
A-20	Night	5—HI_S to HI_R	Downstream	-0.1	1.4	-	-14.9
A-22	Day	6—MP_S to HI_R	Control	13.8	6.5	-	-
A-22	Day	6—MP_S to HI_R	Downstream	-3.0	0.3	-	-
A-24	Night	6—MP_S to HI_R	Control	-	5.4	-	-
A-24	Night	6—MP_S to HI_R	Downstream	-	2.9	-	-
A-26	Day	7—EG_S to MP_R	Control	-	-23.4	-8.9	-
A-26	Day	7—EG_S to MP_R	Downstream	-	0.3	-3.7	-
A-28	Night	7—EG_S to MP_R	Control	-	-30.4	-5.2	-
A-28	Night	7—EG_S to MP_R	Downstream	-	-3.7	-4.9	-
A-30	Day	8—HI_S to MP_R	Control	8.0	-14.8	-	-
A-30	Day	8—HI_S to MP_R	Downstream	-1.9	-0.3	-	-
A-32	Night	8—HI_S to MP_R	Control	9.0	-19.7	-	-
A-32	Night	8—HI_S to MP_R	Downstream	0.1	-3.0	-	-
A-34	Day	9—MP_S to MP_R	Control	-24.5	-16.3	-15.0	-
A-34	Day	9—MP_S to MP_R	Downstream	-4.9	0.6	-2.0	-
A-36	Night	9—MP_S to MP_R	Control	-	-20.0	-8.0	-
A-36	Night	9—MP_S to MP_R	Downstream	-	-1.5	-8.4	-

Note: The speed limit was 70 mph for daytime and 65 mph for nighttime at the control point. The speed limit was 55 mph at the downstream point.

The final analysis of the short-term data was an assessment of the change in mean speeds from the control point to the downstream point. Instead of comparing the change in speed between two treatments at a given location, the researchers calculated the mean speed at the control point and downstream point for a given treatment. The difference in these means was used to define the effect of that treatment. Table 3-10 presents the results of this analysis. The data analysis indicates that the largest decrease in speeds was realized with the red border treatment with high intensity sheeting. However, the red border with microprismatic sheeting did not show a benefit in comparison to the standard sign treatments. This analysis demonstrated some value to the red border treatment, but not a consistent one.

Table 3-10. Change in Mean Speeds from Control to Downstream Points for Short-Term Analysis.

Site	Daytime					Nighttime				
	EG_S	HI_S	MP_S	HI_R	MP_R	EG_S	HI_S	MP_S	HI_R	MP_R
SH 7	-	5.4	7.7	10.8	6.9	-	6.1	-	10.6	7.4
SH 14	9.6	8.4	9.7	10.8	6.9	9.4	8.5	8.8	9.5	6.7
US 79	8.0	-	8.2	-	8.3	6.2	-	7.0	-	6.9
FM 39	8.7	6.0	-	10.1	-	8.1	6.3	-	9.9	-
Average	8.8	6.6	8.5	10.6	7.4	7.9	7.0	7.9	10.0	7.0

RESULTS FOR LONG-TERM STUDY

The long-term study evaluated the change in speed at three sites (SH 21, SH 36, and FM 60) that were previously evaluated in the first year of the project. During the first year, a red border was added to standard Speed Limit signs at four sites. The red border treatment remained in place at three of the sites following the initial collection of after data (short-term after) during the first year. That allowed researchers to collect a second round of after data (long-term after) approximately nine to twelve months after the treatments were installed. At these sites, the red border was added by placing a solid blank covered with red microprismatic sheeting behind the existing standard Speed Limit sign. The red sign blank was 6 inches wider and 6 inches taller than the existing sign. There was no change in the standard Speed Limit sign between the before, short-term after, and long-term after evaluations. The results for the before, short-term after, and long-term after data collection at each site are given in Appendix B. These tables present data by individual sites, comparing the measured speeds for before, short-term after, and long-term after.

Table 3-11 compares the impacts of the short-term analysis with that of the long-term analysis for the mean speeds. The speeds in this table represent the change in mean speed from the before condition to either the short-term after or long-term after condition. The results indicate that in every case but one, there is a larger reduction in the downstream mean speeds for the long-term after condition than for the short-term after condition. In the one case where there was a small increase in the downstream speed, there was a larger increase in the speed at the control point. These results indicate that the red border treatment had a greater benefit on traffic speeds a year or so after installation than it did immediately after installation.

Table 3-11. Change in Mean Speeds for Long-Term Study.

Location	Condition	Measure	Short-Term Before	Long-Term Before
SH 21	Daytime	Control	1.2*	1.0*
SH 21	Daytime	Downstream	-1.0*	-3.3*
SH 21	Nighttime	Control	0.7	2.0*
SH 21	Nighttime	Downstream	-1.8*	-1.6*
SH 36	Daytime	Control	2.1*	1.0*
SH 36	Daytime	Downstream	-0.1	-5.6*
SH 36	Nighttime	Control	1.7	0.4
SH 36	Nighttime	Downstream	-0.1	-3.8*
FM 60	Daytime	Control	0.8	-3.0*
FM 60	Daytime	Downstream	-0.1	-7.5*
FM 60	Nighttime	Control	1.4*	-1.1*
FM 60	Nighttime	Downstream	-0.6	-4.6*

The researchers also compared the changes in the 85th percentile speeds for the short-term and long-term conditions. Table 3-12 indicates that the 85th percentile speeds at the downstream location were higher for the long-term analysis than they were for the short-term analysis. At two of the three sites, the speed reduction between the before and long-term after conditions were several miles per hour greater than for the short-term condition. These results also indicate a benefit to the red border treatment.

The third type of analysis of the long-term impacts of the first year study sites compared the change in mean speeds between the control and downstream points for each of the three study conditions: before, short-term after, and long-term after. Table 3-13 presents the results of that analysis. The table shows that, for both the daytime and nighttime conditions, the speed reduction shortly after installation (short-term analysis) was greater than the speed reduction before installation and that the speed reduction approximately a year later was greater than it was shortly after installation. These results clearly indicate the benefit of the red border treatment.

Table 3-12. Changes in 85th Percentile Speeds for Long-Term Study.

Location	Condition	Measure	Short-Term Before	Long-Term Before
SH 21	Daytime	Control	1	1
SH 21	Daytime	Downstream	-2	-4
SH 21	Nighttime	Control	1	2
SH 21	Nighttime	Downstream	-1	-2
SH 36	Daytime	Control	2	0
SH 36	Daytime	Downstream	-1	-6
SH 36	Nighttime	Control	3	1
SH 36	Nighttime	Downstream	-1	-4
FM 60	Daytime	Control	0	-4
FM 60	Daytime	Downstream	0	-8
FM 60	Nighttime	Control	2	-2
FM 60	Nighttime	Downstream	-1	-6

Table 3-13. Change in Mean Speeds from Control to Downstream Points for Long-Term Analysis.

Site	Day Results			Night Results		
	Before	Short Term	Long Term	Before	Short Term	Long Term
SH 21	6.00	8.20	10.30	5.40	7.90	9.00
FM 60	5.10	6.00	9.60	6.10	8.10	9.60
SH 36	5.00	7.20	11.60	5.80	7.60	10.00
Average	5.37	7.13	10.50	5.77	7.87	9.53

FINDINGS AND RECOMMENDATIONS

In this task, researchers evaluated the impact of a red border around a Speed Limit sign on driver compliance with the speed limit. Two different types of treatments were used. In the first treatment, which began in the first year of the study, researchers added a 3-inch red border to the outside of a standard Speed Limit sign. In the second treatment, researchers modified the standard sign to eliminate the black border and replace it with a 4-inch wide red border. The first treatment (adding a red border to the standard sign) was evaluated at three sites shortly after installation and approximately a year later. The second treatment (modifying the design of the standard sign) was evaluated at four sites in combination with different types of sign sheeting.

The results of the modified Speed Limit sign design were mixed. The researchers did not find any practical benefit regarding the use of different types of sign sheeting. They did observe a higher driver compliance with the reduced speed limit when the modified sign was used with high intensity sheeting. However, they did not find a similar benefit to using the red border with microprismatic sheeting.

The results of the standard Speed Limit sign with the added red border were much clearer. Both the short-term and the long-term analysis showed a greater driver compliance with the downstream speed limit. The speed reduction between the control point and the downstream point was much greater a year after installation than it had been shortly after installation.

Based on these findings, the researchers believe that it is appropriate to use the red border treatment as a means of improving driver compliance with speed limits at locations where the speed limit decreases on the approach to a city or town. The evaluation findings indicate that the most effective means of implementing the red border is to simply add a 3-inch border to an existing Speed Limit sign. According to information provided by the Federal Highway Administration, such a conspicuity treatment does not require a change in the Texas MUTCD.

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CHAPTER 4:
EFFECTIVENESS OF DEW-RESISTANT SHEETING

INTRODUCTION

Retroreflective sheeting is used on traffic signs so that the signs can convey information to motorists at night. This sheeting uses either microsized glass beads or microsized prisms to redirect light from a vehicle's headlamps back toward the source, thereby illuminating the sign for the driver to see. There are many factors that make it difficult for the light to get to the sign or back to the vehicle, such as rain, snow, fog, or dirt. Dew and frost are also factors that impede headlamp light from getting to the sign and redirected back toward the source. Dew and frost scatter the headlamp light entering the sign and then scatter the light exiting the sign, thereby significantly reducing the amount of light reaching the driver and making the sign less bright.

Dew forms in tiny droplets on the surface of the sign and scatters the light on its way to the sign and then again as it leaves the sign. These droplets result in only a fraction of the light making it to the driver's eye and the sign appearing dark or even non-retroreflective. In order for dew to form on the surface of the sign certain weather conditions need to be present. The skies must be relatively clear so that heat loss from the sign due to radiations will occur. The air must be still so that the sign remains at a lower temperature than the air, and the humidity must be high (1).

The Avery Dennison Corporation has developed a prototype coating for retroreflective sheeting materials that appear to have the ability to resist the formation of dew in a manner that allows the retroreflection to continue to work as designed. This ability to resist dew formation could be a useful breakthrough as traditional retroreflective sheeting materials lose practically all of their ability to retroreflect as dew forms and as long as dew exists on the sign surface. The loss of retroreflectivity at night is of particular concern to many agencies, and the only proven solution to date has been illuminated signs, which is cost prohibitive in most cases.

The prototype coating developed by Avery Dennison was found by the manufacturer to be effective under simulated laboratory conditions. However, there are several issues that still needed to be addressed. The first issue was to determine how the new experimental sheeting performs under real-world conditions on actual sign substrate and mounted in a manner similar to that of a typical installation along the roadside. In other words, does the prototype coating resist dew in outdoor conditions the same as under the simulated laboratory conditions? Other questions of interest were:

- How do the sign substrate and the sign support system impact the development of dew and the coatings' performance?
- Do the dew-resistant characteristics of the coating perform consistently as it ages?
- What is the workability of the new sheeting with respect to sign fabrication and handling?
- Finally, how well does the dew-resistant coating perform in terms of its ability to maintain nighttime legibility/recognition of highway signs under dew conditions?

An initial pilot study was sponsored by the Texas Department of Transportation with the cooperation of the Avery Dennison Corporation to allow testing of the new dew-resistant sign sheeting at the Texas Transportation Institute's (TTI) Riverside Campus. This chapter describes the evaluation and the results.

Objective

The objective of this effort was to test the experimental sheeting under real-world conditions on real sign substrate and mounted in a manner similar to that of a typical installation along the roadside. If the experimental sheeting performed as anticipated based on laboratory tests conducted by Avery Dennison scientists, then additional study would be warranted. However, the effort described in this chapter was designed as a proof of concept only.

EXPERIMENTAL DESIGN

The goal of this evaluation was to assess how the prototype sheeting would affect dew formation in real-world conditions in comparison to standard sheeting. The concept of the evaluation was to fabricate an actual sign using both standard and dew-resistant sheeting, and then to monitor and compare the performance of the sign in high-dew conditions.

Procedure

The basic concept of this effort was to monitor a sign with both regular retroreflective sheeting and dew-resistant retroreflective sheeting in a real-world setting where the actual weather conditions determined the formation of dew on the sign. A camera was set up to automatically record pictures of the test sign in 15-minute increments. Researchers could then review and analyze the pictures to determine the effectiveness of the dew-resistant sheeting.

Equipment

TTI designed a sign layout for the study that could be used to assess the effectiveness of the dew-resistant materials as well as allowing evaluation of other aspects of signing (such as legibility). Avery Dennison provided a sign fabricated according to the TTI specifications, a camera, and a light emitting diode (LED) light source for the evaluation. Figure 4-1 illustrates the test sign used in the evaluation. Figure 4-2 shows a photo of the camera and LED source (in an environmental housing) used to record the sign images during dew formation conditions. These two elements were installed approximately 60 feet from each other as illustrated in Figure 4-3.

Figure 4-4 shows the design of the sign, indicating portions of the sign fabricated from standard sheeting and portions fabricated from the prototype dew-resistant sheeting. The background of the sign is green, and the legend and border are white. Avery Dennison Series T7500 retroreflective sheeting was used for the entire sign, mounted on extruded aluminum. The sign is 6 feet wide and 5 feet high. The C2 and C6 labels represent control material (or material that has not been treated with the dew-resistant coating). The labels DR2 and DR6 represent samples that have been treated with the dew-resistant coating. The left and bottom borders are made with the control sheeting. The top and right borders are made with the dew-resistant sheeting. The top left series of letters (BER) are made from sheeting without the dew-resistant coating. The other three combinations of letters (BER) are made with the dew-resistant sheeting. The left half of the panel is made with green T7500 sheeting. The right half of the panel is made with green T7500 sheeting with the dew-resistant coating. It should be noted that only the four rectangles in the middle of the sign were used for the analysis described herein.

The retroreflectivity of the sign was recorded using a handheld retroreflectometer with a fixed geometry of 0.2/-4.0 degrees. The results of the retroreflectivity readings verified that the material was T7500, or ASTM Type VIII. The average values of the white rectangles for two different dates are shown in Table 4-1. The small changes in retroreflectivity values are typical and not a cause for alarm.

Figure 4-1. Test Sign.

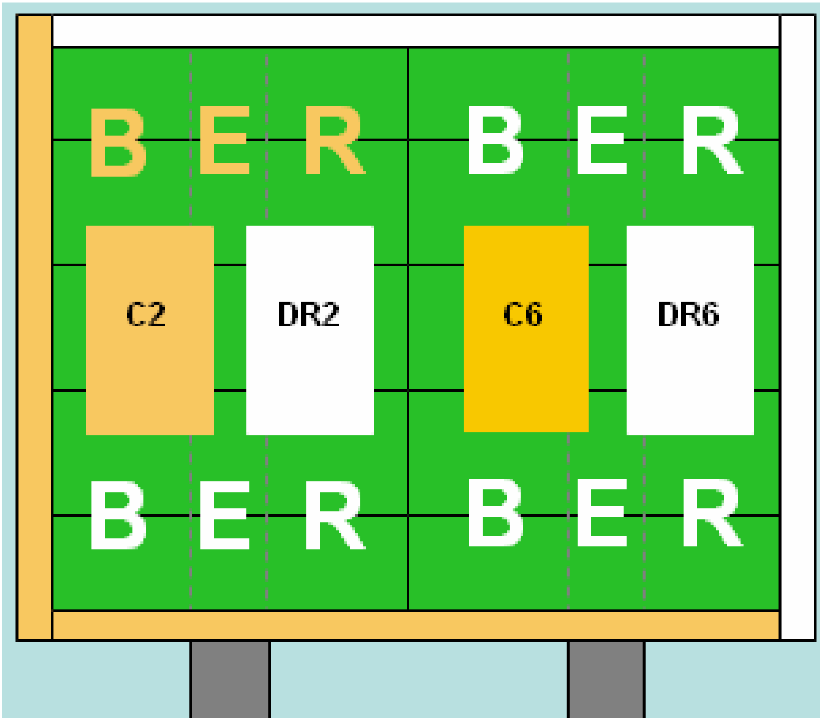
Figure 4-2. Camera and Light Source.

Note: Circles indicate sign and camera.

Figure 4-3. Experimental Setup.

Table 4-1. Measured Retroreflectivity Values (cd/lx/m^2).

Date of Readings	Panel C2	Panel DR2	Panel C6	Panel DR6
August 13, 2004	981	1013	902	950
October 1, 2004	955	970	849	954



Where:
C2 = current sheeting (non-dew-resistant) for legend on non-dew-resistant background.
DR2 = dew-resistant sheeting (prototype) on non-dew-resistant background.
C6 = current sheeting (non-dew-resistant) for legend on dew-resistant background.
DR6 = dew-resistant sheeting (prototype) on dew-resistant background.

Figure 4-4. Schematic of Test Sign.

Process

The system was designed to automatically turn on at 8 PM each night. The LED light source would illuminate, and pictures were taken every 15 minutes with the camera set on a fixed aperture and gain setting. Avery Dennison recorded and later analyzed the images. The data that are used in this report are average pixel intensity levels for each rectangle (sometimes called grey scales). A sample image is shown in Figure 4-5.

RESULTS

Dew events occurred during less than half of the nights the system was in operation, which was June 2004 until December 2004. Data from the non-dew nights show no change in grey scale levels of the rectangles as a function of time. The photo in Figure 4-5 illustrates the appearance of the sign during non-dew conditions. Figure 4-6 shows an example of the measured pixel intensity data through the course of a non-dew night. The brightness level of all four rectangles was the same and remained constant. A value of 255 is the maximum value for the brightness level used in this analysis. It is a unit-less number.

Figure 4-5. Sample Image Recorded by Camera.

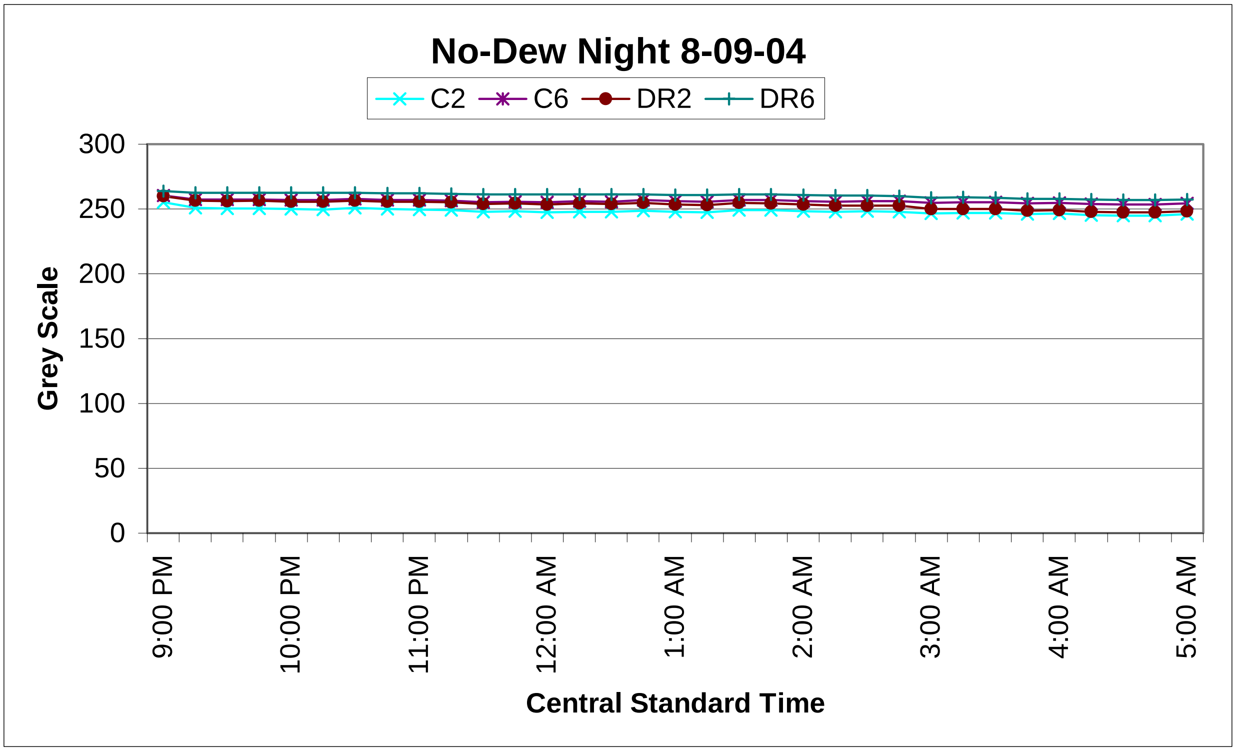


Figure 4-6. Data from a Non-dew Night.

Nights with recorded dew events were much more interesting. Figure 4-7 shows a series of photos for a dew event representing the appearance of the sign at various times during the night. As the evening wears on, it is apparent that the standard sheeting rectangles (non-dew-resistant) are not as bright as the dew-resistant rectangles. Figure 4-8 presents a graphical representation of dew formation on the same night. After 6 AM the sun began to rise and the camera settings, which are set and fixed for dark conditions, are overexposed. Figure 4-9 presents a graphical representation of the data for a different dew night (June 30, 2004) and the effectiveness of the dew-resistant sheeting materials.

Figure 4-7. Hourly Representation of a Dew Event (July 11, 2004).

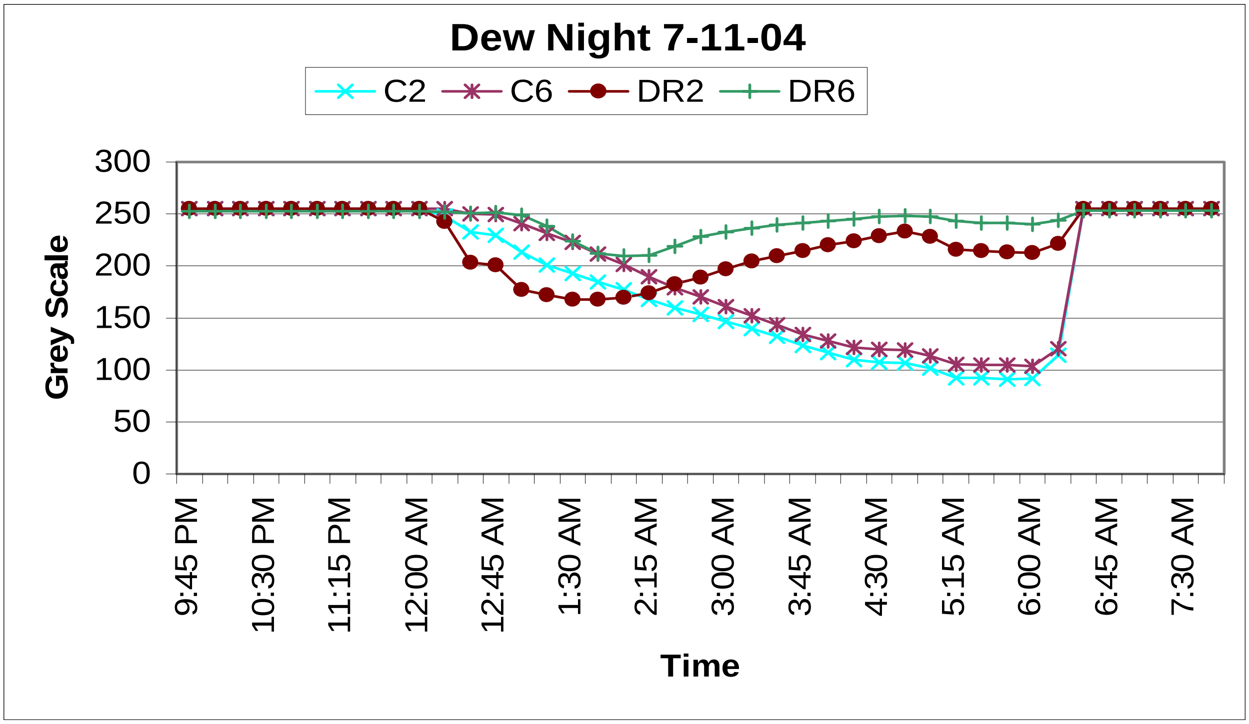


Figure 4-8. Data from a Dew Night.

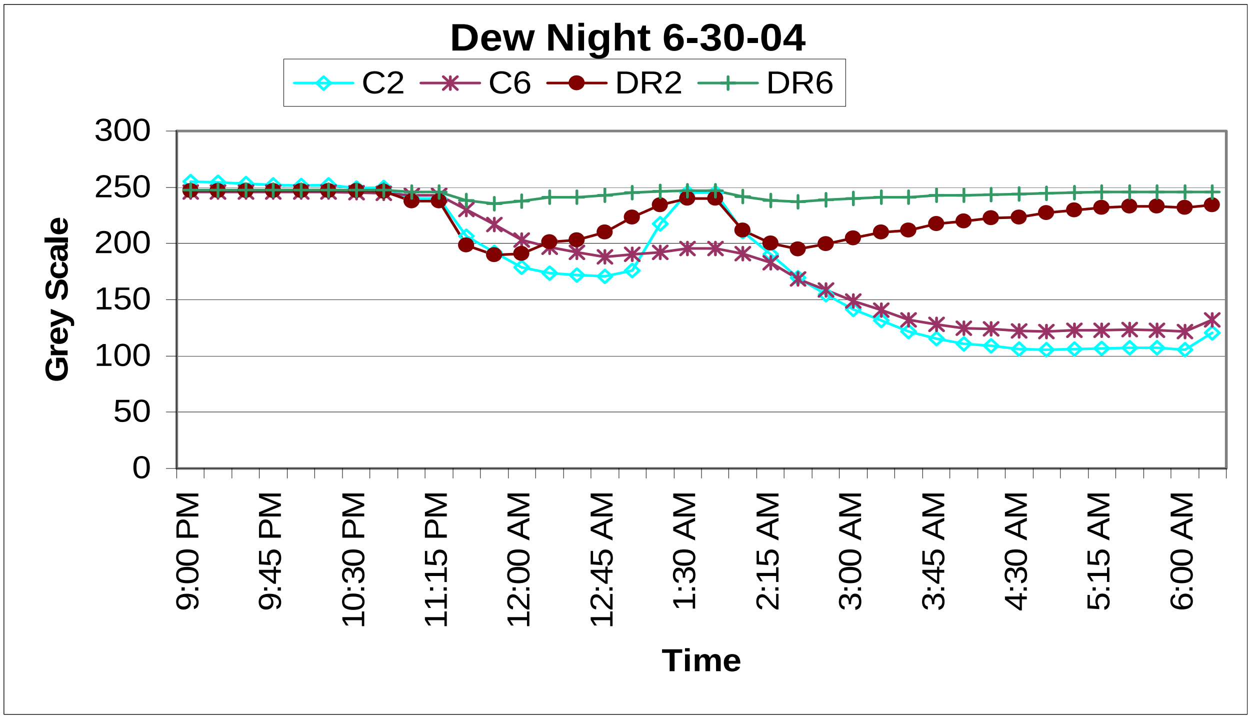


Figure 4-9. Data from a Second Dew Night.

While all dew events appear to be unique, the common theme is that the dew-resistant sheeting appears to be effective in reducing the impacts of dew. Initially, the dew-resistant material appears to degrade similar to the standard material. However, while the standard material continues to degrade, the dew-resistant material begins to regain brightness and nearly reaches full recovery. When the standard material has lost more than half of its effectiveness to retroreflect, the dew-resistant material is working at close to 100 percent of its capability. Figure 4-10 presents a good representation of the appearance of a sign under dew-forming conditions.

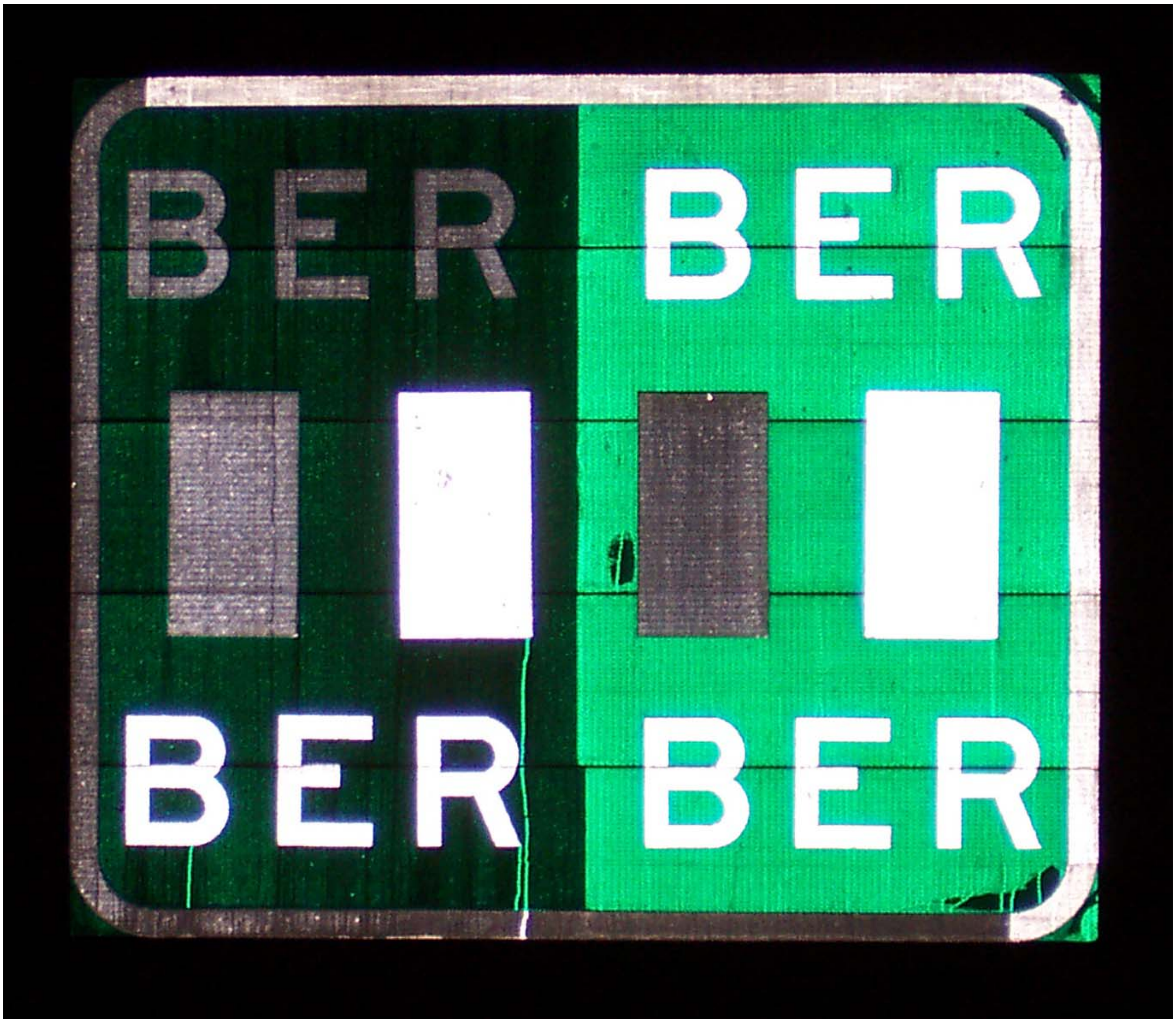


Figure 4-10. Sign Appearance in Dew-Forming Conditions.

CONCLUSIONS AND RECOMMENDATIONS

The research described herein shows that the prototype dew-resistant sheeting tested in this study is effective in reducing and nearly eliminating the negative impacts that dew has on retroreflective traffic signs. The test sign was constructed in the same manner as any traffic sign would be constructed. It was exposed to the elements as a normal traffic sign would be. And it performed as expected based on the laboratory results provided by Avery Dennison, which ultimately led to this research effort. It should be noted that the data presented herein are based on a limited number of dew events. While it is expected that the performance of the material would be similar in other dew events, the limited amount of available data limits prevents a detailed analysis of the variability of the material's performance over a range of conditions.

The next question that needs to be identified is the durability of the dew-resistant properties. In others words, does the effectiveness diminish over time? If so, what is the life of the dew-resistant properties? Would it impact handling of the signs or fabrication processes? And finally, how would the material impact the recognition and legibility of traffic signs? These questions should be explored with continued research efforts.

The data collected as part of this effort indicate that it appears possible to develop products that have enhanced performance with respect to dew formation on the face of signs. The material evaluated in this effort was a prototype material developed by Avery Dennison for evaluation purposes. The evaluation found beneficial results, but several other factors still need to be addressed. Avery Dennison continues to perform additional testing on the prototype material, such as accelerated outdoor weathering in order to investigate durability. The next step for this new technology would be to test its dew-resistant properties under different climatic conditions in an actual road environment. If this material becomes available in the future, the researchers recommend installing it at several field locations for a long-term trial. Nighttime performance in high-dew conditions should be monitored, as well as the long-term durability of the material.

REFERENCES

1. Hutchison, J.W., and T.A. Pullen. Performance of Signs under Dew and Frost Conditions, in *Transportation Research Board 681,* Transportation Research Board, Washington, D.C., 1978, pp. 16-20.

CHAPTER 5:
SUMMARY AND RECOMMENDATIONS

As described in Chapter 1, this research project was funded to address numerous, small-scale research efforts related to traffic control devices. In the second year of the project, three different evaluations were completed.

SUMMARY OF FINDINGS

The three evaluations considered various aspects related to the operational impacts of traffic control device improvements. The following sections provide a brief description of the key issues and types of assessments associated with each of the evaluations.

Left Turn Yield Extinguishable Message Sign

This evaluation assessed the impact of using an extinguishable, or blank-out, sign in place of the standard Left Turn Yield on Green Ball (R10-12) sign. The assessment included a field study of traffic conflicts and a crash analysis at one intersection in Atlanta, Texas.

The results indicate that the sign significantly reduced the conflict rate for left-turn vehicles, with reductions in the two-thirds to three-fourths range. The crash analysis indicated that the overall number of crashes at the intersection was reduced by half.

Red Border Speed Limit Sign

In this evaluation, the researchers installed various treatments (sheeting and border design) of the standard Speed Limit sign. Before and after speed data were collected far upstream (out of sight of the sign, which served as the control), near the sign, and downstream of the sign. Researchers analyzed the data to identify changes in vehicle speeds associated with each type of sign. Researchers collected before and after data at four new sites (short-term after studies) and after data at three sites that were evaluated in the first year (long-term after studies), and compared those to the before and after results from the first year effort. The sign used at the new sites was a modification of the standard Speed Limit sign where the thin black border was replaced with a wide red border. The sign used at the first year sites was a red border added to a standard Speed Limit sign.

The results indicated that the use of the modified red border Speed Limit sign (a wide red border replacing the narrow black border) with high intensity sheeting led to a statistically significant speed reduction. The follow-up evaluation of the first year sites (red border added to a standard sign) indicated even larger speed reductions than had been measured during the short-term after evaluation, indicating that these signs do not have a novelty effect.

Dew-Resistant Retroreflective Sheeting

In this effort, researchers used a remote sensing device to measure the retroreflective capabilities of two types of sign sheeting—standard sheeting and a prototype sheeting that had been treated with a dew-resistant coating. Dew formation was monitored on several nights when conditions were highly favorable for dew formation on the signs. The results indicate that the prototype dew-resistant material demonstrated better retroreflective performance than the standard sheeting material.

IMPLEMENTATION RECOMMENDATIONS

The implementation status of the individual evaluations is described in the following sections.

Left Turn Yield Extinguishable Message Sign

The results indicate a positive safety benefit to the use of an extinguishable message sign (EMS) in place of the standard Left Turn Yield on Green Ball sign. Based on the findings for this evaluation, the researchers recommend using this type of sign at locations with a demonstrated history of high left-turn crashes. The Texas *Manual on Uniform Traffic Control Devices* (MUTCD) does not need to be revised to accommodate this sign, but the Texas Department of Transportation may want to develop a standard sheet or other guidelines to assist in the implementation of the device. Because these results reflect the impact at only one intersection, additional installations of this treatment should be monitored after installation to confirm the benefit of installation.

Red Border Speed Limit Sign

Based on these findings, the researchers believe that it is appropriate to use the red border treatment as a means of improving driver compliance with speed limits at locations where the speed limit decreases on the approach to a city or town. The evaluation findings indicate that the most effective means of implementing the red border is to simply add a 3-inch border to an existing Speed Limit sign. According to information provided by the Federal Highway Administration, such a conspicuity treatment does not require a change in the Texas MUTCD.

Dew-Resistant Retroreflective Sheeting

The material evaluated in this effort is a prototype material that is not currently available as a commercial product. If this material becomes available in the future, the researchers recommend installing it at several field locations for a long-term trial. Nighttime performance in high-dew conditions should be monitored, as well as the long-term durability of the material.

APPENDIX A:
SHORT-TERM RED BORDER SPEED LIMIT SIGN RESULTS

The tables in this appendix present the results of the short-term analysis of the impacts of the modified red border Speed Limit sign. The researchers collected data at four sites. The study treatments represented various combinations of sign sheeting and a standard Speed Limit sign or a modified red border Speed Limit sign.

Table A-1. Daytime Results for Sheeting Change—EG_S to HI_S.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			FM 39 Normangee		
			Study on Sign		Change HI_S-EG_S	Study on Sign		Change HI_S-EG_S
			EG_S	HI_S		EG_S	HI_S	
Daytime Passenger Vehicles		Sample Size	2357	944		1164	1285	
	Control Point 1	Mean	67.9	66.7	***-1.2****	69.1	70.1	***1.0****
		85th Percentile	73.2	72.2	-1.0	74.2	75.8	1.6
	Legibility Point 2	Mean	63.2	62.5	***-0.7****	62.2	63.0	***0.8****
		85th Percentile	69.9	68.6	-1.3	68.2	70.4	2.2
	Downstream Point 3	Mean	57.9	58.1	0.2	60.1	63.9	***3.8****
		85th Percentile	64.2	64.4	0.2	66.5	71.3	4.8
Daytime Heavy Vehicles		Sample Size	514	288		189	287	
	Control Point 1	Mean	65.4	64.7	-0.7	66.7	67.0	0.3
		85th Percentile	69.9	69.5	-0.4	71.8	71.8	0.0
	Legibility Point 2	Mean	61.6	60.9	-0.7	61.0	60.8	-0.2
		85th Percentile	66.9	65.3	-1.6	66.0	65.0	-1.0
	Downstream Point 3	Mean	57.8	57.0	-0.7	59.2	62.0	***2.8****
		85th Percentile	63.4	62.3	-1.1	65.3	67.8	2.5
Daytime All Vehicles		Sample Size	2871	1232		1353	1572	
	Control Point 1	Mean	67.4	66.2	***-1.2****	68.7	69.5	0.8
		85th Percentile	72.7	71.8	-0.9	73.7	75.2	1.5
	Legibility Point 2	Mean	62.9	62.1	***-0.8****	62.0	62.6	***0.6****
		85th Percentile	69.5	68.2	-1.3	68.0	69.0	1.0
	Downstream Point 3	Mean	57.9	57.8	-0.1	60.0	63.5	***3.5****
		85th Percentile	64.2	63.8	-0.4	66.0	71.0	5.0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-2. Daytime Percent Exceeding Results for Sheeting Change—EG_S to HI_S.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			EG_S	HI_S	EG_S	HI_S	EG_S	HI_S	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	37.1	28.8	91.5	87.6	98.2	97.1	-8.3	-3.9	-1.1
		Point 2	13.0	10.5	68.3	63.8	91.3	89.6	-2.5	-4.6	-1.7
		Point 3	3.2	4.3	32.3	34.2	65.4	65.5	1.1	1.9	0.0
	Heavy Vehicles Daytime	Point 1	14.2	10.1	86.2	85.4	96.9	93.4	-4.1	-0.8	-3.5
		Point 2	6.0	2.4	59.9	61.8	89.7	85.8	-3.6	1.9	-3.9
		Point 3	0.8	0.3	30.4	27.1	67.7	63.9	-0.4	-3.3	-3.8
	All Vehicles Daytime	Point 1	33.0	24.4	90.5	87.1	98.0	96.3	-8.6	-3.4	-1.7
		Point 2	11.7	8.6	66.8	63.3	91.0	88.7	-3.1	-3.5	-2.3
		Point 3	2.8	3.4	31.9	32.5	65.8	65.1	0.6	0.6	-0.7
FM 39 Normangee	Passenger Vehicles Daytime	Point 1	40.3	53.2	95.4	93.7	99.8	98.0	12.9	-1.8	-1.9
		Point 2	9.0	15.2	64.0	65.7	87.9	89.5	6.2	1.7	1.6
		Point 3	5.8	19.8	48.6	68.6	79.1	90.7	13.9	19.9	11.6
	Heavy Vehicles Daytime	Point 1	25.9	27.9	93.7	89.5	99.5	98.3	1.9	-4.1	-1.2
		Point 2	7.4	4.9	52.4	51.6	85.7	87.8	-2.5	-0.8	2.1
		Point 3	5.3	7.7	36.5	60.3	75.7	91.3	2.4	23.8	15.6
	All Vehicles Daytime	Point 1	38.3	48.6	95.2	92.9	99.8	98	10.3	-2.3	-1.8
		Point 2	8.8	13.3	62.4	63.1	87.6	89.2	4.5	0.7	1.6
		Point 3	5.8	17.6	46.9	67	78.6	90.8	11.8	20.1	12.2

Table A-3. Nighttime Results for Sheeting Change—EG_S to HI_S.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			FM 39 Normangee		
			Study on Sign		Change HI_S-EG_S	Study on Sign		Change HI_S-EG_S
			EG_S	HI_S		EG_S	HI_S	
Nighttime Passenger Vehicles		Sample Size	1562	402		309	236	
	Control Point 1	Mean	65.2	63.8	***-1.4****	68.4	69.1	0.7
		85th Percentile	69.9	69.0	-0.9	73.2	75.2	2.0
	Legibility Point 2	Mean	60.4	59.0	***-1.4****	61.6	61.4	-0.2
		85th Percentile	66.9	65.7	-1.2	66.8	67.3	0.5
	Downstream Point 3	Mean	55.6	55.1	-0.5	59.9	62.1	***2.2****
		85th Percentile	62.0	61.3	-0.7	66.1	68.6	2.5
Nighttime Heavy Vehicles		Sample Size	414	105		54	101	
	Control Point 1	Mean	63.7	62.9	-0.8	65.4	66.8	1.4
		85th Percentile	68.6	67.3	-1.3	69.0	70.8	1.8
	Legibility Point 2	Mean	59.6	59.1	-0.5	60.8	60.9	0.1
		85th Percentile	64.9	64.0	-0.9	64.6	65.7	1.1
	Downstream Point 3	Mean	55.3	55.0	-0.3	59.7	62.1	***2.4****
		85th Percentile	60.9	59.2	-1.7	65.3	68.6	3.3
Nighttime All Vehicles		Sample Size	1976	507		363	337	
	Control Point 1	Mean	64.9	63.6	***-1.3****	67.9	68.4	0.5
		85th Percentile	69.9	68.6	-1.3	73.0	75.0	2.0
	Legibility Point 2	Mean	60.2	59.0	***-1.2****	61.5	61.2	-0.3
		85th Percentile	66.4	65.3	-1.1	67.0	67.0	0.0
	Downstream Point 3	Mean	55.5	55.1	-0.4	59.8	62.1	***2.3****
		85th Percentile	61.9	60.9	-1.0	66.0	69.0	3.0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-4. Nighttime Percent Exceeding Results for Sheeting Change—EG_S to HI_S.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			EG_S	HI_S	EG_S	HI_S	EG_S	HI_S	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	52.3	39.3	84.0	74.6	97.4	94.8	-13.0	-9.4	-2.6
		Point 2	21.6	17.2	49.7	39.1	81.1	70.4	-4.5	-10.6	-10.7
		Point 3	7.6	6.7	21.3	18.7	48.3	43.3	-0.8	-2.6	-5.1
	Heavy Vehicles Nighttime	Point 1	39.6	37.1	77.3	74.3	93.7	91.4	-2.5	-3.0	-2.3
		Point 2	13.8	11.4	44.7	39.0	78.3	74.3	-2.3	-5.6	-4.0
		Point 3	5.1	4.8	16.2	13.3	48.8	41.9	-0.3	-2.9	-6.9
	All Vehicles Nighttime	Point 1	49.6	38.9	82.6	74.6	96.6	94.1	-10.8	-8.0	-2.5
		Point 2	20.0	16.0	48.6	39.1	80.5	71.2	-4.0	-9.6	-9.3
		Point 3	7.0	6.3	20.2	17.6	48.4	43.0	-0.7	-2.6	-5.4
FM 39 Normangee	Passenger Vehicles Nighttime	Point 1	74.4	76.3	97.1	94.5	99.4	99.2	1.8	-2.6	-0.2
		Point 2	24.6	27.5	61.5	55.5	87.7	85.6	2.9	-6.0	-2.1
		Point 3	19.4	27.1	46.3	58.5	79.6	87.3	7.7	12.2	7.7
	Heavy Vehicles Nighttime	Point 1	38.9	66.3	87.0	94.1	100.0	100.0	27.4	7.0	0.0
		Point 2	13.0	26.7	53.7	48.5	87.0	88.1	13.8	-5.2	1.1
		Point 3	25.9	28.7	46.3	59.4	75.9	92.1	2.8	13.1	16.2
	All Vehicles Nighttime	Point 1	69.1	73.3	95.6	94.4	99.4	99.4	4.2	-1.2	0.0
		Point 2	22.9	27.3	60.3	53.4	87.6	86.4	4.4	-6.9	-1.2
		Point 3	20.4	27.6	46.3	58.8	79.1	88.7	7.2	12.5	9.6

Table A-5. Daytime Results for Sheeting Change—EG_S to MP_S.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			US 79 Oakwood		
			Study on Sign		Change MP_S-EG_S	Study on Sign		Change MP_S-EG_S
			EG_S	MP_S		EG_S	MP_S	
Daytime Passenger Vehicles		Sample Size	2357	1073		708	955	
	Control Point 1	Mean	67.9	66.6	***-1.3****	70.4	69.7	***-0.7****
		85th Percentile	73.2	72.2	-1.0	75	74	-1
	Legibility Point 2	Mean	63.2	60.4	***-2.8****	68.8	66	***-2.8****
		85th Percentile	69.9	67.3	-2.6	75	72	-3
	Downstream Point 3	Mean	57.9	56.7	***-1.2****	62	61.4	-0.6
		85th Percentile	64.2	63.4	-0.8	69	68	-1
Daytime Heavy Vehicles		Sample Size	514	216		156	347	
	Control Point 1	Mean	65.4	64.9	-0.5	67.2	68.1	0.9
		85th Percentile	69.9	70.4	0.5	71	72	1
	Legibility Point 2	Mean	61.6	59.5	***-2.1****	66.7	64.1	***-2.6****
		85th Percentile	66.9	64.9	-2.0	71	69	-2
	Downstream Point 3	Mean	57.8	56.4	***-1.4****	61.1	60.1	-1
		85th Percentile	63.4	62.0	-1.4	67	65	-2
Daytime All Vehicles		Sample Size	2871	1289		864	1302	
	Control Point 1	Mean	67.4	66.3	***-1.1****	69.8	69.3	***-0.5****
		85th Percentile	72.7	72.2	-0.5	74	74	0
	Legibility Point 2	Mean	62.9	60.2	***-2.7****	68.5	65.5	***-3****
		85th Percentile	69.5	66.9	-2.6	74	71	-3
	Downstream Point 3	Mean	57.9	56.6	***-1.3****	61.8	61.1	***-0.7****
		85th Percentile	64.2	63.1	-1.10	68	68	0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-6. Daytime Percent Exceeding Results for Sheeting Change—EG_S to MP_S.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			EG_S	MP_S	EG_S	MP_S	EG_S	MP_S	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	37.1	27.8	91.5	85.0	98.2	96.6	-9.3	-6.5	-1.7
		Point 2	13.0	6.0	68.3	52.2	91.3	77.5	-7.0	-16.2	-13.8
		Point 3	3.2	3.0	32.3	27.3	65.4	54.8	-0.2	-5.0	-10.6
	Heavy Vehicles Daytime	Point 1	14.2	16.7	86.2	83.8	96.9	96.8	2.5	-2.4	-0.1
		Point 2	6.0	2.3	59.9	44.0	89.7	79.2	-3.7	-15.9	-10.5
		Point 3	0.8	0.0	30.4	26.9	67.7	57.9	-0.8	-3.5	-9.8
	All Vehicles Daytime	Point 1	33.0	25.9	90.5	84.8	98.0	96.6	-7.1	-5.7	-1.4
		Point 2	11.7	5.4	66.8	50.8	91.0	77.8	-6.4	-16.0	-13.2
		Point 3	2.8	2.5	31.9	27.2	65.8	55.3	-0.3	-4.7	-10.5
US 79 Oakwood	Passenger Vehicles Daytime	Point 1	52.1	48.5	98.4	95.7	99.7	99.2	-3.6	-2.7	-0.5
		Point 2	39.1	24.4	92.7	83.5	98.4	96.8	-14.7	-9.2	-1.6
		Point 3	10.2	8.9	60.2	57.3	84.8	83.2	-1.3	-2.9	-1.6
	Heavy Vehicles Daytime	Point 1	21.8	27.1	97.4	93.7	100.0	98.8	5.3	-3.8	-1.2
		Point 2	21.8	10.7	96.2	82.7	99.4	95.1	-11.1	-13.4	-4.3
		Point 3	5.1	4.0	53.8	45.5	92.3	83.6	-1.1	-8.3	-8.7
	All Vehicles Daytime	Point 1	46.6	42.8	98.3	95.2	99.8	99.1	-3.9	-3.1	-0.7
		Point 2	36.0	20.7	93.3	83.3	98.6	96.3	-15.3	-10.0	-2.3
		Point 3	9.3	7.6	59.0	54.1	86.1	83.3	-1.7	-4.9	-2.8

Table A-7. Nighttime Results for Sheeting Change—EG_S to MP_S.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			US 79 Oakwood		
			Study on Sign		Change MP_S-EG_S	Study on Sign		Change MP_S-EG_S
			EG_S	MP_S		EG_S	MP_S	
Nighttime Passenger Vehicles		Sample Size	1562	212		387	267	
	Control Point 1	Mean	65.2	63.7	***-1.5****	68	68.7	0.7
		85th Percentile	69.9	69.0	-0.9	72	74	2
	Legibility Point 2	Mean	60.4	57.9	***-2.5****	67.6	66	***-1.6****
		85th Percentile	66.9	64.2	-2.7	74	72	-2
	Downstream Point 3	Mean	55.6	54.6	***-1.0****	61.9	61.3	-0.6
		85th Percentile	62.0	59.0	-3.0	69	68	-1
Nighttime Heavy Vehicles		Sample Size	414	79		103	134	
	Control Point 1	Mean	63.7	64.0	0.4	65.6	67.2	***1.6****
		85th Percentile	68.6	69.2	0.6	68	71	3
	Legibility Point 2	Mean	59.6	58.5	-1.1	65.2	65.3	0.1
		85th Percentile	64.9	62.8	-2.1	69	70	1
	Downstream Point 3	Mean	55.3	56.4	1.1	59.2	60.9	1.7
		85th Percentile	60.9	62.0	1.1	65	67	2
Nighttime All Vehicles		Sample Size	1976	291		490	401	
	Control Point 1	Mean	64.9	63.8	***-1.1****	67.5	68.2	0.7
		85th Percentile	69.9	69.0	-0.9	72	73	1
	Legibility Point 2	Mean	60.2	58.0	***-2.2****	67.1	65.8	***-1.3****
		85th Percentile	66.4	63.8	-2.6	73	71	-2
	Downstream Point 3	Mean	55.5	55.1	-0.4	61.3	61.2	-0.1
		85th Percentile	61.9	59.8	-2.2	68	68	0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-8. Nighttime Percent Exceeding Results for Sheeting Change—EG_S to MP_S.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			EG_S	MP_S	EG_S	MP_S	EG_S	MP_S	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	52.3	41.5	84.0	73.6	97.4	93.4	-10.8	-10.4	-4.0
		Point 2	21.6	9.9	49.7	32.1	81.1	60.4	-11.7	-17.6	-20.7
		Point 3	7.6	5.2	21.3	10.8	48.3	40.6	-2.4	-10.4	-7.8
	Heavy Vehicles Nighttime	Point 1	39.6	32.9	77.3	78.5	93.7	94.9	-6.7	1.2	1.2
		Point 2	13.8	5.1	44.7	35.4	78.3	73.4	-8.7	-9.2	-4.8
		Point 3	5.1	3.8	16.2	22.8	48.8	58.2	-1.3	6.6	9.4
	All Vehicles Nighttime	Point 1	49.6	39.2	82.6	74.9	96.6	93.8	-10.5	-7.7	-2.8
		Point 2	20.0	8.6	48.6	33.0	80.5	63.9	-11.4	-15.6	-16.6
		Point 3	7.0	4.8	20.2	14.1	48.4	45.4	-2.2	-6.1	-3.1
US 79 Oakwood	Passenger Vehicles Nighttime	Point 1	72.4	75.9	97.4	95.9	99.7	99.2	3.5	-1.5	-0.5
		Point 2	67.2	56.8	89.1	85.0	98.7	95.5	-10.4	-4.1	-3.2
		Point 3	28.2	30.5	60.5	53.8	85.0	82.0	2.3	-6.7	-3.0
	Heavy Vehicles Nighttime	Point 1	54.4	61.9	96.1	93.3	100.0	100.0	7.6	-2.8	0.0
		Point 2	54.4	47.0	90.3	80.6	98.1	98.5	-7.4	-9.7	0.4
		Point 3	12.6	24.6	42.7	49.3	77.7	80.6	12.0	6.5	2.9
	All Vehicles Nighttime	Point 1	68.6	71.3	97.1	95.0	99.8	99.5	2.8	-2.1	-0.3
		Point 2	64.5	53.6	89.4	83.5	98.6	96.5	-10.9	-5.8	-2.1
		Point 3	24.9	28.4	56.7	52.1	83.5	81.5	3.5	-4.6	-1.9

Table A-9. Daytime Results for Sheeting Change—HI_S to MP_S.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin		
			Study on Sign		Change MP_S-HI_S	Study on Sign		Change HI_R-HI_S
			HI_S	MP_S		HI_S	MP_S	
Daytime Passenger Vehicles		Sample Size	944	1073		4166	471	
	Control Point 1	Mean	66.7	66.6	-0.1	67.2	69.3	***2.1****
		85th Percentile	72.2	72.2	0.0	72.2	75.2	3.0
	Legibility Point 2	Mean	62.5	60.4	***-2.1****	64.8	73.9	***9.1****
		85th Percentile	68.6	67.3	-1.3	71.3	81.4	10.1
	Downstream Point 3	Mean	58.1	56.7	***-1.4****	61.7	61.2	-0.5
		85th Percentile	64.4	63.4	-1.0	69.0	68.8	-0.2
Daytime Heavy Vehicles		Sample Size	288	216		487	83	
	Control Point 1	Mean	64.7	64.9	0.2	66.1	67.4	1.3
		85th Percentile	69.5	70.4	0.9	71.3	71.8	0.5
	Legibility Point 2	Mean	60.9	59.5	-1.4	64.5	73.7	***9.2****
		85th Percentile	65.3	64.9	-0.4	70.0	79.9	9.9
	Downstream Point 3	Mean	57.0	56.4	-0.7	61.9	61.9	0.0
		85th Percentile	62.3	62.0	-0.3	68.6	68.5	-0.1
Daytime All Vehicles		Sample Size	1232	1289		4653	554	
	Control Point 1	Mean	66.2	66.3	0.1	67.1	69.0	***1.9****
		85th Percentile	71.8	72.2	0.4	72.2	74.7	2.5
	Legibility Point 2	Mean	62.1	60.2	***-1.9****	64.8	73.9	***9.1****
		85th Percentile	68.2	66.9	-1.3	70.8	81.4	10.6
	Downstream Point 3	Mean	57.8	56.6	***-1.2****	61.7	61.3	-0.4
		85th Percentile	63.8	63.1	-0.7	69.0	68.6	-0.4

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-10. Daytime Percent Exceeding Results for Sheeting Change—HI_S to MP_S.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			HI_S	MP_S	HI_S	MP_S	HI_S	MP_S	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	28.8	27.8	87.6	85.0	97.1	96.6	-1.0	-2.6	-0.6
		Point 2	10.5	6.0	63.8	52.2	89.6	77.5	-4.5	-11.6	-12.1
		Point 3	4.3	3.0	34.2	27.3	65.5	54.8	-1.4	-6.9	-10.7
	Heavy Vehicles Daytime	Point 1	10.1	16.7	85.4	83.8	93.4	96.8	6.6	-1.6	3.4
		Point 2	2.4	2.3	61.8	44.0	85.8	79.2	-0.1	-17.8	-6.6
		Point 3	0.3	0.0	27.1	26.9	63.9	57.9	-0.3	-0.2	-6.0
	All Vehicles Daytime	Point 1	24.4	25.9	87.1	84.8	96.3	96.6	1.5	-2.3	0.3
		Point 2	8.6	5.4	63.3	50.8	88.7	77.8	-3.3	-12.5	-10.9
		Point 3	3.4	2.5	32.5	27.2	65.1	55.3	-0.9	-5.3	-9.8
SH 7 Marlin	Passenger Vehicles Daytime	Point 1	30.8	47.1	88.3	91.7	97.0	97.7	16.3	3.4	0.7
		Point 2	20.1	69.2	77.1	97.2	94.2	99.8	49.1	20.2	5.6
		Point 3	11.1	11.7	57.0	54.1	82.4	78.8	0.6	-2.9	-3.6
	Heavy Vehicles Daytime	Point 1	23.4	27.7	86.9	90.4	96.1	98.8	4.3	3.5	2.7
		Point 2	15.0	72.3	78.9	98.8	95.1	100.0	57.3	19.9	4.9
		Point 3	9.7	7.2	61.0	59.0	86.2	90.4	-2.4	-1.9	4.1
	All Vehicles Daytime	Point 1	30.1	44.2	88.2	91.5	96.9	97.8	14.2	3.3	1.0
		Point 2	19.6	69.7	77.3	97.5	94.3	99.8	50.1	20.2	5.6
		Point 3	10.9	11.0	57.4	54.9	82.8	80.5	0.1	-2.6	-2.3

Table A-11. Nighttime Results for Sheeting Change—HI_S to MP_S.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham		
			Study on Sign		Change MP_S-HI_S
			HI_S	MP_S	
Nighttime Passenger Vehicles		Sample Size	402	212	
	Control Point 1	Mean	63.8	63.7	0.0
		85th Percentile	69.0	69.0	0.0
	Legibility Point 2	Mean	59.0	57.9	***-1.2****
		85th Percentile	65.7	64.2	-1.5
	Downstream Point 3	Mean	55.1	54.6	-0.5
		85th Percentile	61.3	59.0	-2.3
Nighttime Heavy Vehicles		Sample Size	105	79	
	Control Point 1	Mean	62.9	64.0	1.2
		85th Percentile	67.3	69.2	1.9
	Legibility Point 2	Mean	59.1	58.5	-0.6
		85th Percentile	64.0	62.8	-1.1
	Downstream Point 3	Mean	55.0	56.4	1.4
		85th Percentile	59.2	62.0	2.8
Nighttime All Vehicles		Sample Size	507	291	
	Control Point 1	Mean	63.6	63.8	0.2
		85th Percentile	68.6	69.0	0.4
	Legibility Point 2	Mean	59.0	58.0	***-1.0****
		85th Percentile	65.3	63.8	-1.5
	Downstream Point 3	Mean	55.1	55.1	0.0
		85th Percentile	60.9	59.8	-1.2

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-12. Nighttime Percent Exceeding Results for Sheeting Change—HI_S to MP_S.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			HI_S	MP_S	HI_S	MP_S	HI_S	MP_S	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	39.3	41.5	74.6	73.6	94.8	93.4	2.2	-1.0	-1.4
		Point 2	17.2	9.9	39.1	32.1	70.4	60.4	-7.3	-7.0	-10.0
		Point 3	6.7	5.2	18.7	10.8	43.3	40.6	-1.5	-7.8	-2.7
	Heavy Vehicles Nighttime	Point 1	37.1	32.9	74.3	78.5	91.4	94.9	-4.2	4.2	3.5
		Point 2	11.4	5.1	39.0	35.4	74.3	73.4	-6.4	-3.6	-0.9
		Point 3	4.8	3.8	13.3	22.8	41.9	58.2	-1.0	9.5	16.3
	All Vehicles Nighttime	Point 1	38.9	39.2	74.6	74.9	94.1	93.8	0.3	0.4	-0.3
		Point 2	16.0	8.6	39.1	33.0	71.2	63.9	-7.4	-6.1	-7.3
		Point 3	6.3	4.8	17.6	14.1	43.0	45.4	-1.5	-3.5	2.4

Table A-13. Daytime Results for Sheeting Change—EG_S to HI_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			FM 39 Normangee		
			Study on Sign		Change HI_R-EG_S	Study on Sign		Change HI_R-EG_S
			EG_S	HI_R		EG_S	HI_R	
Daytime Passenger Vehicles		Sample Size	2357	1071		1164	1135	
	Control Point 1	Mean	67.9	67.7	-0.2	69.1	70	***0.9****
		85th Percentile	73.2	73.2	0.0	74	75	1.0
	Legibility Point 2	Mean	63.2	61.7	***-1.5****	62.2	59.6	***-2.6****
		85th Percentile	69.9	68.2	-1.7	68	66	-2.1
	Downstream Point 3	Mean	57.9	56.5	***-1.3****	60.1	59.7	-0.4
		85th Percentile	64.2	62.7	-1.5	67	67	0.0
Daytime Heavy Vehicles		Sample Size	514	285		189	128	
	Control Point 1	Mean	65.4	66.3	0.9	66.7	68	1.3
		85th Percentile	69.9	70.8	0.9	72	73	1.4
	Legibility Point 2	Mean	61.6	61.3	-0.3	61	58.8	***-2.2****
		85th Percentile	66.9	66.1	-0.8	66	65	-1.0
	Downstream Point 3	Mean	57.8	56.8	-0.9	59.2	59.4	0.2
		85th Percentile	63.4	62.0	-1.4	65	66	0.4
Daytime All Vehicles		Sample Size	2871	1356		1353	1263	
	Control Point 1	Mean	67.4	67.4	0.0	68.7	69.8	***1.1****
		85th Percentile	72.7	72.7	0.0	73.7	75.2	1.5
	Legibility Point 2	Mean	62.9	61.6	***-1.3****	62	59.5	***-2.5****
		85th Percentile	69.5	67.8	-1.7	68	66	-2.0
	Downstream Point 3	Mean	57.9	56.6	***-1.3****	60	59.7	-0.3
		85th Percentile	64.2	62.7	-1.5	66	67	1.0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-14. Daytime Percent Exceeding Results for Sheeting Change—EG_S to HI_R.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			EG_S	HI_R	EG_S	HI_R	EG_S	HI_R	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	37.1	35.6	91.5	91.0	98.2	97.5	-1.5	-0.4	-0.7
		Point 2	13.0	9.5	68.3	57.4	91.3	85.4	-3.5	-10.9	-5.9
		Point 3	3.2	3.2	32.3	24.1	65.4	55.2	0.0	-8.2	-10.2
	Heavy Vehicles Daytime	Point 1	14.2	20.4	86.2	89.1	96.9	97.9	6.1	2.9	1.0
		Point 2	6.0	2.1	59.9	60.4	89.7	90.5	-3.9	0.4	0.8
		Point 3	0.8	1.4	30.4	23.5	67.7	63.9	0.6	-6.8	-3.8
	All Vehicles Daytime	Point 1	33.0	32.4	90.5	90.6	98.0	97.6	-0.6	0.1	-0.4
		Point 2	11.7	8.0	66.8	58.0	91.0	86.5	-3.8	-8.8	-4.5
		Point 3	2.8	2.8	31.9	24.0	65.8	57.0	0.0	-8.0	-8.8
FM 39 Normangee	Passenger Vehicles Daytime	Point 1	40.3	51.2	95.4	94.1	99.8	98.7	10.9	-1.3	-1.1
		Point 2	9.0	4.3	64.0	44.7	87.9	77.8	-4.7	-19.3	-10.1
		Point 3	5.8	7.3	48.6	42.9	79.1	74.9	1.5	-5.7	-4.2
	Heavy Vehicles Daytime	Point 1	25.9	34.4	93.7	91.4	99.5	97.7	8.4	-2.2	-1.8
		Point 2	7.4	3.9	52.4	40.6	85.7	68.8	-3.5	-11.8	-17.0
		Point 3	5.3	6.3	36.5	39.8	75.7	72.7	1.0	3.3	-3.0
	All Vehicles Daytime	Point 1	38.3	49.5	95.2	93.8	99.8	98.6	11.2	-1.4	-1.2
		Point 2	8.8	4.3	62.4	44.3	87.6	76.9	-4.5	-18.1	-10.7
		Point 3	5.8	7.2	46.9	42.6	78.6	74.7	1.4	-4.3	-3.9

Table A-15. Nighttime Results for Sheeting Change—EG_S to HI_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			FM 39 Normangee		
			Study on Sign		Change HI_R-EG_S	Study on Sign		Change HI_R-EG_S
			EG_S	HI_R		EG_S	HI_R	
Nighttime Passenger Vehicles		Sample Size	1562	275		309	221	
	Control Point 1	Mean	65.2	64.6	-0.6	68.4	68	-0.4
		85th Percentile	69.9	70.4	0.5	73	74	1.0
	Legibility Point 2	Mean	60.4	59.3	***-1.1****	61.6	57.9	***-3.7****
		85th Percentile	66.9	66.1	-0.8	67	65	-2.2
	Downstream Point 3	Mean	55.6	54.8	***-0.8****	59.9	57.8	***-2.1****
		85th Percentile	62.0	60.6	-1.4	66	65	-1.2
Nighttime Heavy Vehicles		Sample Size	414	75		54	47	
	Control Point 1	Mean	63.7	64.3	0.7	65.4	66.2	0.8
		85th Percentile	68.6	68.5	-0.1	69	71	1.6
	Legibility Point 2	Mean	59.6	59.8	0.3	60.8	58.1	***-2.7****
		85th Percentile	64.9	66.4	1.5	65	62	-2.5
	Downstream Point 3	Mean	55.3	55.7	0.4	59.7	57.9	-1.8
		85th Percentile	60.9	61.3	0.4	65	63	-2.5
Nighttime All Vehicles		Sample Size	1976	350		363	268	
	Control Point 1	Mean	64.9	64.5	-0.4	67.9	67.7	-0.2
		85th Percentile	69.9	70.4	0.5	73	74	1.0
	Legibility Point 2	Mean	60.2	59.4	***-0.8****	61.5	58	***-3.5****
		85th Percentile	66.4	66.1	-0.3	67	64	-3.0
	Downstream Point 3	Mean	55.5	55.0	-0.5	59.8	57.8	***-2.0****
		85th Percentile	61.9	61.2	-0.7	66	65	-1.0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-16. Nighttime Percent Exceeding Results for Sheeting Change—EG_S to HI_R.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			EG_S	HI_R	EG_S	HI_R	EG_S	HI_R	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	52.3	44.0	84.0	79.6	97.4	93.5	-8.3	-4.4	-3.9
		Point 2	21.6	17.5	49.7	44.4	81.1	71.3	-4.2	-5.3	-9.8
		Point 3	7.6	7.6	21.3	18.5	48.3	41.1	0.1	-2.7	-7.2
	Heavy Vehicles Nighttime	Point 1	39.6	46.7	77.3	76.0	93.7	97.3	7.1	-1.3	3.6
		Point 2	13.8	20.0	44.7	40.0	78.3	84.0	6.2	-4.7	5.7
		Point 3	5.1	8.0	16.2	20.0	48.8	46.7	2.9	3.8	-2.1
	All Vehicles Nighttime	Point 1	49.6	44.6	82.6	78.9	96.6	94.3	-5.1	-3.7	-2.3
		Point 2	20.0	18.0	48.6	43.4	80.5	74.0	-2.0	-5.2	-6.5
		Point 3	7.0	7.7	20.2	18.9	48.4	42.3	0.7	-1.3	-6.1
FM 39 Normangee	Passenger Vehicles Nighttime	Point 1	74.4	71.0	97.1	89.6	99.4	97.3	-3.4	-7.5	-2.1
		Point 2	24.6	11.8	61.5	34.8	87.7	67.4	-12.8	-26.6	-20.3
		Point 3	19.4	13.6	46.3	32.1	79.6	63.3	-5.8	-14.2	-16.3
	Heavy Vehicles Nighttime	Point 1	38.9	53.2	87.0	89.4	100.0	100.0	14.3	2.3	0.0
		Point 2	13.0	6.4	53.7	31.9	87.0	72.3	-6.6	-21.8	-14.7
		Point 3	25.9	8.5	46.3	29.8	75.9	76.6	-17.4	-16.5	0.7
	All Vehicles Nighttime	Point 1	69.1	67.9	95.6	89.6	99.4	97.8	-1.2	-6.0	-1.6
		Point 2	22.9	10.8	60.3	34.3	87.6	68.3	-12.1	-26.0	-19.3
		Point 3	20.4	12.7	46.3	31.7	79.1	65.7	-7.7	-14.6	-13.4

Table A-17. Daytime Results for Sheeting Change—HI_S to HI_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin			FM 39 Normangee		
			Study on Sign		Change	Study on Sign		Change	Study on Sign		Change
			HI_S	HI_R	HI_R-HI_S	HI_S	HI_R	HI_R-HI_S	HI_S	HI_R	HI_R-HI_S
Daytime Passenger Vehicles		Sample Size	944	1071		4166	1698		1285	1135	
	Control Point 1	Mean	66.7	67.7	***1.0****	67.2	70.8	***3.6****	70.1	70	-0.1
		85th Percentile	72.2	73.2	1.0	72.2	76.8	4.60	76	75	-0.6
	Legibility Point 2	Mean	62.5	61.7	***-0.8****	64.81	72.3	***7.5****	63	59.6	***-3.4****
		85th Percentile	68.6	68.2	-0.4	71.3	80.2	8.9	70	66	-4.3
	Downstream Point 3	Mean	58.1	56.5	***-1.6****	61.7	59.8	***-1.9****	63.9	59.7	***-4.2****
		85th Percentile	64.4	62.7	-1.7	69	66.9	-2.1	71	67	-4.8
Daytime Heavy Vehicles		Sample Size	288	285		487	332		287	128	
	Control Point 1	Mean	64.7	66.3	***1.6****	66.1	70.9	***4.8****	67	68	1
		85th Percentile	69.5	70.8	1.3	71.3	76.3	5.0	72	73	1.4
	Legibility Point 2	Mean	60.9	61.3	0.4	64.5	73.6	***9.1****	60.8	58.8	***-2****
		85th Percentile	65.3	66.1	0.8	70.0	80.2	10.2	65	65	0
	Downstream Point 3	Mean	57.0	56.8	-0.2	61.9	61.2	-0.7	62	59.4	***-2.6****
		85th Percentile	62.3	62.0	-0.3	68.6	67.9	-0.7	68	66	-2.2
Daytime All Vehicles		Sample Size	1232	1356		4653	2030		1572	1263	
	Control Point 1	Mean	66.2	67.4	***1.2****	67.1	70.8	***3.7****	69.5	69.8	***0.3****
		85th Percentile	71.8	72.7	0.9	72.2	76.8	4.6	75.2	75.2	0
	Legibility Point 2	Mean	62.1	61.6	-0.5	64.78	72.52	***7.7****	62.6	59.5	***-3.1****
		85th Percentile	68.2	67.8	-0.4	70.80	80.20	9.4	69	66	-3
	Downstream Point 3	Mean	57.8	56.6	***-1.2****	61.70	60.04	***-1.7****	63.5	59.7	***-3.8****
		85th Percentile	63.8	62.7	-1.1	69	67.3	-1.7	71	67	-4

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-18. Daytime Percent Exceeding Results for Sheeting Change—HI_S to HI_R.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			HI_S	HI_R	HI_S	HI_R	HI_S	HI_R	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	28.8	35.6	87.6	91.0	97.1	97.5	6.8	3.4	0.3
		Point 2	10.5	9.5	63.8	57.4	89.6	85.4	-1.0	-6.3	-4.2
		Point 3	4.3	3.2	34.2	24.1	65.5	55.2	-1.2	-10.1	-10.3
	Heavy Vehicles Daytime	Point 1	10.1	20.4	85.4	89.1	93.4	97.9	10.3	3.7	4.5
		Point 2	2.4	2.1	61.8	60.4	85.8	90.5	-0.3	-1.5	4.8
		Point 3	0.3	1.4	27.1	23.5	63.9	63.9	1.1	-3.6	0.0
	All Vehicles Daytime	Point 1	24.4	32.4	87.1	90.6	96.3	97.6	7.9	3.5	1.3
		Point 2	8.6	8.0	63.3	58.0	88.7	86.5	-0.6	-5.3	-2.2
		Point 3	3.4	2.8	32.5	24.0	65.1	57.0	-0.6	-8.6	-8.1
SH 7 Marlin	Passenger Vehicles Daytime	Point 1	30.8	58.0	88.3	93.5	97.0	98.5	27.1	5.2	1.5
		Point 2	20.1	61.0	77.1	95.4	94.2	99.4	40.9	18.3	5.2
		Point 3	11.1	7.6	57.0	44.3	82.4	74.6	-3.5	-12.7	-7.7
	Heavy Vehicles Daytime	Point 1	23.4	58.1	86.9	95.5	96.1	99.4	34.7	8.6	3.3
		Point 2	15.0	71.4	78.9	97.6	95.1	99.4	56.4	18.7	4.3
		Point 3	9.7	9.9	61.0	51.2	86.2	85.5	0.3	-9.8	-0.7
	All Vehicles Daytime	Point 1	30.1	58.0	88.2	93.8	96.9	98.6	27.9	5.7	1.7
		Point 2	19.6	62.7	77.3	95.8	94.3	99.4	43.2	18.5	5.1
		Point 3	10.9	8.0	57.4	45.4	82.8	76.4	-3.0	-12.0	-6.4
FM 39 Normangee	Passenger Vehicles Daytime	Point 1	53.2	51.2	93.7	94.1	98.0	98.7	-2.0	0.4	0.7
		Point 2	15.2	4.3	65.7	44.7	89.5	77.8	-10.9	-21.0	-11.7
		Point 3	19.8	7.3	68.6	42.9	90.7	74.9	-12.5	-25.7	-15.8
	Heavy Vehicles Daytime	Point 1	27.9	34.4	89.5	91.4	98.3	97.7	6.5	1.9	-0.6
		Point 2	4.9	3.9	51.6	40.6	87.8	68.8	-1.0	-10.9	-19.1
		Point 3	7.7	6.3	60.3	39.8	91.3	72.7	-1.4	-20.4	-18.6
	All Vehicles Daytime	Point 1	48.6	49.5	92.9	93.8	98	98.6	0.9	0.9	0.6
		Point 2	13.3	4.3	63.1	44.3	89.2	76.9	-9.0	-18.8	-12.3
		Point 3	17.6	7.2	67	42.6	90.8	74.7	-10.4	-24.4	-16.1

Table A-19. Nighttime Results for Sheeting Change—HI_S to HI_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin			FM 39 Normangee		
			Study on Sign		Change HI_R-HI_S	Study on Sign		Change HI_R-HI_S	Study on Sign		Change HI_R-HI_S
			HI_S	HI_R		HI_S	HI_R		HI_S	HI_R	
Nighttime Passenger Vehicles		Sample Size	402	275		2025	376		236	221	
	Control Point 1	Mean	63.8	64.6	0.8	64.7	68.5	***3.8****	69.1	68	-1.1
		85th Percentile	69.0	70.4	1.4	69.9	74.7	4.8	75	74	-1
	Legibility Point 2	Mean	59.0	59.3	0.3	61.5	69.3	***7.8****	61.4	57.9	***-3.5****
		85th Percentile	65.7	66.1	0.4	67.8	77.4	9.6	67	65	-2.7
	Downstream Point 3	Mean	55.1	54.8	-0.3	58.5	57.8	-0.8	62.1	57.8	***-4.3****
		85th Percentile	61.3	60.6	-0.7	65.3	65.7	0.4	69	65	-3.7
Nighttime Heavy Vehicles		Sample Size	105	75		250	95		101	47	
	Control Point 1	Mean	62.9	64.3	1.5	64.8	68.7	***3.9****	66.8	66.2	-0.6
		85th Percentile	67.3	68.5	1.2	69.3	73.2	3.9	71	71	-0.2
	Legibility Point 2	Mean	59.1	59.8	0.8	61.7	70.6	***8.9****	60.9	58.1	***-2.8****
		85th Percentile	64.0	66.4	2.5	66.1	76.3	10.2	66	62	-3.6
	Downstream Point 3	Mean	55.0	55.7	0.7	58.9	58.9	0.1	62.1	57.9	***-4.2****
		85th Percentile	59.2	61.3	2.1	64.9	64.2	-0.7	69	63	-5.8
Nighttime All Vehicles		Sample Size	507	350		2275	471		337	268	
	Control Point 1	Mean	63.6	64.5	***0.9****	64.7	68.6	***3.8****	68.4	67.7	-0.7
		85th Percentile	68.6	70.4	1.8	69.5	74.2	4.7	75	74	-1
	Legibility Point 2	Mean	59.0	59.4	0.4	61.6	69.6	***8.0****	61.2	58	***-3.2****
		85th Percentile	65.3	66.1	0.8	67.3	77.4	10.1	67	64	-3
	Downstream Point 3	Mean	55.1	55.0	-0.1	58.6	58.0	-0.6	62.1	57.8	***-4.3****
		85th Percentile	60.9	61.2	0.2	65.3	65.3	0.0	69	65	-4

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-20. Nighttime Percent Exceeding Results for Sheeting Change—HI_S to HI_R.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			HI_S	HI_R	HI_S	HI_R	HI_S	HI_R	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	39.3	44.0	74.6	79.6	94.8	93.5	4.7	5.0	-1.3
		Point 2	17.2	17.5	39.1	44.4	70.4	71.3	0.3	5.3	0.9
		Point 3	6.7	7.6	18.7	18.5	43.3	41.1	0.9	-0.1	-2.2
	Heavy Vehicles Nighttime	Point 1	37.1	46.7	74.3	76.0	91.4	97.3	9.5	1.7	5.9
		Point 2	11.4	20.0	39.0	40.0	74.3	84.0	8.6	1.0	9.7
		Point 3	4.8	8.0	13.3	20.0	41.9	46.7	3.2	6.7	4.8
	All Vehicles Nighttime	Point 1	38.9	44.6	74.6	78.9	94.1	94.3	5.7	4.3	0.2
		Point 2	16.0	18.0	39.1	43.4	71.2	74.0	2.0	4.4	2.8
		Point 3	6.3	7.7	17.6	18.9	43.0	42.3	1.4	1.3	-0.7
SH 7 Marlin	Passenger Vehicles Nighttime	Point 1	47.4	70.2	80.7	87.8	95.5	96.3	22.9	7.0	0.8
		Point 2	27.7	68.9	57.9	87.5	84.0	96.3	41.2	29.6	12.3
		Point 3	15.8	16.5	36.4	32.2	68.1	59.0	0.7	-4.3	-9.1
	Heavy Vehicles Nighttime	Point 1	46.0	81.1	84.8	95.8	96.4	98.9	35.1	11.0	2.5
		Point 2	24.8	78.9	64.0	94.7	87.2	98.9	54.1	30.7	11.7
		Point 3	12.8	10.5	41.6	41.1	73.6	75.8	-2.3	-0.5	2.2
	All Vehicles Nighttime	Point 1	47.2	72.4	81.2	89.4	95.6	96.8	25.2	8.2	1.3
		Point 2	27.3	70.9	58.6	89.0	84.4	96.8	43.6	30.4	12.5
		Point 3	15.4	15.3	37.0	34.0	68.7	62.4	-0.1	-3.0	-6.3
FM 39 Normangee	Passenger Vehicles Nighttime	Point 1	76.3	71.0	94.5	89.6	99.2	97.3	-5.2	-4.9	-1.9
		Point 2	27.5	11.8	55.5	34.8	85.6	67.4	-15.8	-20.7	-18.2
		Point 3	27.1	13.6	58.5	32.1	87.3	63.3	-13.5	-26.3	-23.9
	Heavy Vehicles Nighttime	Point 1	66.3	53.2	94.1	89.4	100.0	100.0	-13.1	-4.7	0.0
		Point 2	26.7	6.4	48.5	31.9	88.1	72.3	-20.3	-16.6	-15.8
		Point 3	28.7	8.5	59.4	29.8	92.1	76.6	-20.2	-29.6	-15.5
	All Vehicles Nighttime	Point 1	73.3	67.9	94.4	89.6	99.4	97.8	-5.4	-4.8	-1.6
		Point 2	27.3	10.8	53.4	34.3	86.4	68.3	-16.5	-19.1	-18.1
		Point 3	27.6	12.7	58.8	31.7	88.7	65.7	-14.9	-27.1	-23.0

Table A-21. Daytime Results for Sheeting Change—MP_S to HI_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin		
			Study on Sign		Change HI_R-MP_S	Study on Sign		Change HI_R-MP_S
			MP_S	HI_R		MP_S	HI_R	
Daytime Passenger Vehicles		Sample Size	1073	1071		471	1698	
	Control Point 1	Mean	66.6	67.7	***1.1****	69.3	70.8	***1.6****
		85th Percentile	72.2	73.2	1.0	75.2	76.8	1.6
	Legibility Point 2	Mean	60.4	61.7	***1.3****	73.9	72.3	***-1.6****
		85th Percentile	67.3	68.2	0.9	81.4	80.2	-1.2
	Downstream Point 3	Mean	56.7	56.5	-0.1	61.2	59.8	***-1.4****
		85th Percentile	63.4	62.7	-0.7	68.8	66.9	-1.9
Daytime Heavy Vehicles		Sample Size	216	285		83	332	
	Control Point 1	Mean	64.9	66.3	1.4	67.4	71.0	***3.6****
		85th Percentile	70.4	70.8	0.4	71.8	76.3	4.5
	Legibility Point 2	Mean	59.5	61.3	***1.8****	73.7	73.6	-0.2
		85th Percentile	64.9	66.1	1.2	79.9	80.2	0.3
	Downstream Point 3	Mean	56.4	56.8	0.5	61.9	61.2	-0.7
		85th Percentile	62.0	62.0	0.0	68.5	67.9	-0.5
Daytime All Vehicles		Sample Size	1289	1356		554	2030	
	Control Point 1	Mean	66.3	67.4	***1.1****	69.0	70.8	***1.9****
		85th Percentile	72.2	72.7	0.5	74.7	76.8	2.1
	Legibility Point 2	Mean	60.2	61.6	***1.4****	73.9	72.5	***-1.3****
		85th Percentile	66.9	67.8	0.9	81.4	80.2	-1.2
	Downstream Point 3	Mean	56.6	56.6	0.0	61.3	60.0	***-1.3****
		85th Percentile	63.1	62.7	-0.4	68.6	67.3	-1.3

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-22. Daytime Percent Exceeding Results for Sheeting Change—MP_S to HI_R.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			MP_S	HI_R	MP_S	HI_R	MP_S	HI_R	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	27.8	35.6	85.0	91.0	96.6	97.5	7.8	6.0	0.9
		Point 2	6.0	9.5	52.2	57.4	77.5	85.4	3.6	5.2	7.9
		Point 3	3.0	3.2	27.3	24.1	54.8	55.2	0.2	-3.2	0.4
	Heavy Vehicles Daytime	Point 1	16.7	20.4	83.8	89.1	96.8	97.9	3.7	5.3	1.1
		Point 2	2.3	2.1	44.0	60.4	79.2	90.5	-0.2	16.4	11.4
		Point 3	0.0	1.4	26.9	23.5	57.9	63.9	1.4	-3.3	6.0
	All Vehicles Daytime	Point 1	25.9	32.4	84.8	90.6	96.6	97.6	6.5	5.8	1.0
		Point 2	5.4	8.0	50.8	58.0	77.8	86.5	2.6	7.2	8.7
		Point 3	2.5	2.8	27.2	24.0	55.3	57.0	0.3	-3.3	1.7
SH 7 Marlin	Passenger Vehicles Daytime	Point 1	47.1	58.0	91.7	93.5	97.7	98.5	10.8	1.8	0.8
		Point 2	69.2	61.0	97.2	95.4	99.8	99.4	-8.2	-1.8	-0.4
		Point 3	11.7	7.6	54.1	44.3	78.8	74.6	-4.1	-9.9	-4.2
	Heavy Vehicles Daytime	Point 1	27.7	58.1	90.4	95.5	98.8	99.4	30.4	5.1	0.6
		Point 2	72.3	71.4	98.8	97.6	100.0	99.4	-0.9	-1.2	-0.6
		Point 3	7.2	9.9	59.0	51.2	90.4	85.5	2.7	-7.8	-4.8
	All Vehicles Daytime	Point 1	44.2	58.0	91.5	93.8	97.8	98.6	13.8	2.3	0.8
		Point 2	69.7	62.7	97.5	95.8	99.8	99.4	-7.0	-1.7	-0.5
		Point 3	11.0	8.0	54.9	45.4	80.5	76.4	-3.0	-9.5	-4.1

Table A-23. Nighttime Results for Sheeting Change—MP_S to HI_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham		
			Study on Sign		Change HI_R-MP_S
			MP_S	HI_R	
Nighttime Passenger Vehicles		Sample Size	212	275	
	Control Point 1	Mean	63.7	64.6	0.8
		85th Percentile	69.0	70.4	1.4
	Legibility Point 2	Mean	57.9	59.3	***1.5****
		85th Percentile	64.2	66.1	1.9
	Downstream Point 3	Mean	54.6	54.8	0.2
		85th Percentile	59.0	60.6	1.6
Nighttime Heavy Vehicles		Sample Size	79	75	
	Control Point 1	Mean	64.0	64.3	0.3
		85th Percentile	69.2	68.5	-0.6
	Legibility Point 2	Mean	58.5	59.8	1.4
		85th Percentile	62.8	66.4	3.6
	Downstream Point 3	Mean	56.4	55.7	-0.7
		85th Percentile	62.0	61.3	-0.7
Nighttime All Vehicles		Sample Size	291	350	
	Control Point 1	Mean	63.8	64.5	0.7
		85th Percentile	69.0	70.4	1.4
	Legibility Point 2	Mean	58.0	59.4	***1.4****
		85th Percentile	63.8	66.1	2.3
	Downstream Point 3	Mean	55.1	55.0	-0.1
		85th Percentile	59.8	61.2	1.4

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-24. Nighttime Percent Exceeding Results for Sheeting Change—MP_S to HI_R.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			MP_S	HI_R	MP_S	HI_R	MP_S	HI_R	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	41.5	44.0	73.6	79.6	93.4	93.5	2.5	6.1	0.1
		Point 2	9.9	17.5	32.1	44.4	60.4	71.3	7.5	12.3	10.9
		Point 3	5.2	7.6	10.8	18.5	40.6	41.1	2.4	7.7	0.5
	Heavy Vehicles Nighttime	Point 1	32.9	46.7	78.5	76.0	94.9	97.3	13.8	-2.5	2.4
		Point 2	5.1	20.0	35.4	40.0	73.4	84.0	14.9	4.6	10.6
		Point 3	3.8	8.0	22.8	20.0	58.2	46.7	4.2	-2.8	-11.6
	All Vehicles Nighttime	Point 1	39.2	44.6	74.9	78.9	93.8	94.3	5.4	3.9	0.5
		Point 2	8.6	18.0	33.0	43.4	63.9	74.0	9.4	10.4	10.1
		Point 3	4.8	7.7	14.1	18.9	45.4	42.3	2.9	4.8	-3.1

Table A-25. Daytime Results for Sheeting Change—EG_S to MP_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			US 79 Oakwood		
			Study on Sign		Change MP_R-EG_S	Study on Sign		Change MP_R-EG_S
			EG_S	MP_R		EG_S	MP_R	
Daytime Passenger Vehicles		Sample Size	2357	1192		708	2192	
	Control Point 1	Mean	67.9	64.4	***-3.4****	70.4	69.1	***-1.3****
		85th Percentile	73.2	69.2	-4.0	75.0	74.0	-1.0
	Legibility Point 2	Mean	63.2	61.7	***-1.5****	68.8	65.9	***-2.9****
		85th Percentile	69.9	69.0	-0.9	75.0	72.0	-3
	Downstream Point 3	Mean	57.9	57.1	***-0.8****	62.0	60.7	***-1.3****
		85th Percentile	64.2	63.4	-0.8	69.0	67.0	-2.0
Daytime Heavy Vehicles		Sample Size	514	275		156	701	
	Control Point 1	Mean	65.4	62.2	***-3.2****	67.2	66.7	-0.5
		85th Percentile	69.9	66.9	-3.0	71.0	71.0	0.0
	Legibility Point 2	Mean	61.6	60.5	-1.1	66.7	63.5	***-3.2****
		85th Percentile	66.9	66.0	-0.9	71.0	68.0	-3.0
	Downstream Point 3	Mean	57.8	57.2	-0.6	61.1	58.8	***-2.3****
		85th Percentile	63.4	62.0	-1.4	67.0	64.0	-3.0
Daytime All Vehicles		Sample Size	2871	1467		864	2893	
	Control Point 1	Mean	67.4	64.0	***-3.4****	69.8	68.5	***-1.3****
		85th Percentile	72.7	69.0	-3.7	74.0	73.0	-1.0
	Legibility Point 2	Mean	62.9	61.4	***-1.5****	68.5	65.3	***-3.2****
		85th Percentile	69.5	68.0	-1.5	74.0	71.0	-3..0
	Downstream Point 3	Mean	57.9	57.1	***-0.8****	61.8	60.2	***-1.6****
		85th Percentile	64.2	63.1	-1.1	68.0	67.0	-1.0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-26. Daytime Percent Exceeding Results for Sheeting Change—EG_S to MP_R.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			EG_S	MP_R	EG_S	MP_R	EG_S	MP_R	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	37.1	11.1	91.5	80.8	98.2	95.2	-26.0	-10.7	-3.0
		Point 2	13.0	9.8	68.3	55.3	91.3	81.5	-3.2	-13.1	-9.8
		Point 3	3.2	3.3	32.3	26.7	65.4	58.5	0.0	-5.6	-6.9
	Heavy Vehicles Daytime	Point 1	14.2	3.3	86.2	68.7	96.9	94.9	-10.9	-17.5	-2.0
		Point 2	6.0	2.9	59.9	49.8	89.7	84.4	-3.1	-10.1	-5.3
		Point 3	0.8	2.2	30.4	25.1	67.7	64.4	1.4	-5.3	-3.3
	All Vehicles Daytime	Point 1	33.0	9.6	90.5	78.5	98.0	95.2	-23.4	-12.0	-2.8
		Point 2	11.7	8.5	66.8	54.3	91.0	82.1	-3.2	-12.6	-9.0
		Point 3	2.8	3.1	31.9	26.4	65.8	59.6	0.3	-5.6	-6.3
US 79 Oakwood	Passenger Vehicles Daytime	Point 1	52.1	43.6	98.4	95.4	99.7	99.5	-8.5	-3.0	-0.2
		Point 2	39.1	23.2	92.7	83.9	98.4	96.9	-15.9	-8.8	-1.5
		Point 3	10.2	6.7	60.2	50.8	84.8	80.4	-3.5	-9.4	-4.4
	Heavy Vehicles Daytime	Point 1	21.8	19.4	97.4	93.6	100.0	99.4	-2.4	-3.9	-0.6
		Point 2	21.8	7.7	96.2	76.5	99.4	94.9	-14.1	-19.7	-4.5
		Point 3	5.1	2.1	53.8	38.9	92.3	74.9	-3.0	-14.9	-17.4
	All Vehicles Daytime	Point 1	46.6	37.8	98.3	95.0	99.8	99.5	-8.9	-3.3	-0.3
		Point 2	36.0	19.4	93.3	82.1	98.6	96.4	-16.6	-11.2	-2.2
		Point 3	9.3	5.6	59.0	48.0	86.1	79.1	-3.7	-11.0	-7.1

Table A-27. Nighttime Results for Sheeting Change—EG_S to MP_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			US 79 Oakwood		
			Study on Sign		Change MP_R-EG_S	Study on Sign		Change MP_R-EG_S
			EG_S	MP_R		EG_S	MP_R	
Nighttime Passenger Vehicles		Sample Size	1562	217		387	505	
	Control Point 1	Mean	65.2	61.7	***-3.4****	68.0	67.4	-0.6
		85th Percentile	69.9	66.1	-3.8	72.0	72.0	0.0
	Legibility Point 2	Mean	60.4	57.7	***-2.7****	67.6	65.2	***-2.4****
		85th Percentile	66.9	63.6	-3.3	74.0	71.0	-3.0
	Downstream Point 3	Mean	55.6	54.4	***-1.2****	61.9	60.3	***-1.6****
		85th Percentile	62.0	59.6	-2.4	69.0	67.0	-2.0
Nighttime Heavy Vehicles		Sample Size	414	85		103	284	
	Control Point 1	Mean	63.7	60.5	***-3.2****	65.6	66.2	0.6
		85th Percentile	68.6	64.2	-4.4	68.0	70.0	2.0
	Legibility Point 2	Mean	59.6	59.1	-0.5	65.2	64.4	-0.8
		85th Percentile	64.9	65.0	0.1	69.0	69.0	0.0
	Downstream Point 3	Mean	55.3	55.7	0.4	59.2	59.5	0.3
		85th Percentile	60.9	60.6	-0.3	65.0	65.0	0.0
Nighttime All Vehicles		Sample Size	1976	302		490	789	
	Control Point 1	Mean	64.9	61.4	***-3.5****	67.5	66.9	-0.6
		85th Percentile	69.9	66.1	-3.8	72.0	71.0	-1.0
	Legibility Point 2	Mean	60.2	58.1	***-2.1****	67.1	64.9	***-2.2****
		85th Percentile	66.4	65.0	-1.4	73.0	70.0	-3.0
	Downstream Point 3	Mean	55.5	54.8	***-0.7****	61.3	60	***-1.3****
		85th Percentile	61.9	59.9	-2.0	68	67	-1

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-28. Nighttime Percent Exceeding Results for Sheeting Change—EG_S to MP_R.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			EG_S	MP_R	EG_S	MP_R	EG_S	MP_R	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	52.3	24.4	84.0	63.6	97.4	90.8	-27.9	-20.4	-6.6
		Point 2	21.6	10.6	49.7	30.9	81.1	60.8	-11.0	-18.8	-20.3
		Point 3	7.6	3.2	21.3	13.4	48.3	38.2	-4.3	-7.9	-10.1
	Heavy Vehicles Nighttime	Point 1	39.6	5.9	77.3	57.6	93.7	90.6	-33.7	-19.6	-3.1
		Point 2	13.8	8.2	44.7	43.5	78.3	70.6	-5.5	-1.2	-7.7
		Point 3	5.1	3.5	16.2	16.5	48.8	49.4	-1.5	0.3	0.6
	All Vehicles Nighttime	Point 1	49.6	19.2	82.6	61.9	96.6	90.7	-30.4	-20.7	-5.9
		Point 2	20.0	9.9	48.6	34.4	80.5	63.6	-10.1	-14.2	-16.9
		Point 3	7.0	3.3	20.2	14.2	48.4	41.4	-3.7	-6.0	-7.0
US 79 Oakwood	Passenger Vehicles Nighttime	Point 1	72.4	66.3	97.4	91.3	99.7	98.0	-6.1	-6.1	-1.7
		Point 2	67.2	51.4	89.1	78.2	98.7	94.0	-15.8	-10.9	-4.7
		Point 3	28.2	23.2	60.5	48.6	85.0	77.6	-5.0	-11.9	-7.4
	Heavy Vehicles Nighttime	Point 1	54.4	58.1	96.1	93.7	100.0	99.6	3.7	-2.5	-0.4
		Point 2	54.4	44.4	90.3	79.9	98.1	97.2	-10.0	-10.4	-0.9
		Point 3	12.6	14.4	42.7	42.6	77.7	77.8	1.8	-0.1	0.1
	All Vehicles Nighttime	Point 1	68.6	63.4	97.1	92.1	99.8	99.1	-5.2	-5.0	-0.7
		Point 2	64.5	48.9	89.4	78.8	98.6	95.2	-15.6	-10.6	-3.4
		Point 3	24.9	20.0	56.7	46.4	83.5	77.7	-4.9	-10.3	-5.8

Table A-29. Daytime Results for Sheeting Change—HI_S to MP_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin		
			Study on Sign		Change MP_R-HI_S	Study on Sign		Change MP_R-HI_S
			HI_S	MP_R		HI_S	MP_R	
Daytime Passenger Vehicles		Sample Size	944	1192		4166	1714	
	Control Point 1	Mean	66.7	64.4	***-2.3****	67.2	67.9	***0.7****
		85th Percentile	72.2	69.2	-3.0	72.2	73.2	1.0
	Legibility Point 2	Mean	62.5	61.7	***-0.8****	64.8	69.5	***4.7****
		85th Percentile	68.6	69.0	0.4	71.3	76.0	4.7
	Downstream Point 3	Mean	58.1	57.1	***-1.0****	61.7	60.8	***-0.8****
		85th Percentile	64.4	63.4	-1.0	69.0	68.2	-0.8
Daytime Heavy Vehicles		Sample Size	288	275		487	269	
	Control Point 1	Mean	64.7	62.2	***-2.5****	66.1	67.3	***1.2****
		85th Percentile	69.5	66.9	-2.6	71.3	73.1	1.8
	Legibility Point 2	Mean	60.9	60.5	-0.3	64.5	70.2	***5.7****
		85th Percentile	65.3	66.0	0.7	70.0	76.0	6.1
	Downstream Point 3	Mean	57.0	57.2	0.2	61.9	61.8	-0.1
		85th Percentile	62.3	62.0	-0.3	68.6	68.1	-0.5
Daytime All Vehicles		Sample Size	1232	1467		4653	1983	
	Control Point 1	Mean	66.2	64.0	***-2.2****	67.1	67.9	***0.8****
		85th Percentile	71.8	69.0	-2.8	72.2	73.2	1.0
	Legibility Point 2	Mean	62.1	61.4	***-0.7****	64.8	69.6	***4.8****
		85th Percentile	68.2	68.0	-0.2	70.8	76.0	5.2
	Downstream Point 3	Mean	57.8	57.1	***-0.7****	61.7	61.0	***-0.7****
		85th Percentile	63.8	63.1	-0.7	69.0	68.2	-0.8

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-30. Daytime Percent Exceeding Results for Sheeting Change—HI_S to MP_R.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			HI_S	MP_R	HI_S	MP_R	HI_S	MP_R	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	28.8	11.1	87.6	80.8	97.1	95.2	-17.7	-6.8	-1.9
		Point 2	10.5	9.8	63.8	55.3	89.6	81.5	-0.7	-8.5	-8.1
		Point 3	4.3	3.3	34.2	26.7	65.5	58.5	-1.1	-7.5	-7.0
	Heavy Vehicles Daytime	Point 1	10.1	3.3	85.4	68.7	93.4	94.9	-6.8	-16.7	1.5
		Point 2	2.4	2.9	61.8	49.8	85.8	84.4	0.5	-12.0	-1.4
		Point 3	0.3	2.2	27.1	25.1	63.9	64.4	1.8	-2.0	0.5
	All Vehicles Daytime	Point 1	24.4	9.6	87.1	78.5	96.3	95.2	-14.8	-8.6	-1.1
		Point 2	8.6	8.5	63.3	54.3	88.7	82.1	-0.1	-9.1	-6.6
		Point 3	3.4	3.1	32.5	26.4	65.1	59.6	-0.3	-6.2	-5.5
SH 7 Marlin	Passenger Vehicles Daytime	Point 1	30.8	39.2	88.3	89.4	97.0	96.7	8.4	1.1	-0.3
		Point 2	20.1	44.6	77.1	90.8	94.2	98.2	24.5	13.7	4.1
		Point 3	11.1	8.8	57.0	51.3	82.4	79.2	-2.3	-5.7	-3.1
	Heavy Vehicles Daytime	Point 1	23.4	30.5	86.9	91.1	96.1	97.4	7.1	4.2	1.3
		Point 2	15.0	48.7	78.9	94.4	95.1	99.3	33.7	15.6	4.2
		Point 3	9.7	11.2	61.0	56.9	86.2	86.6	1.5	-4.1	0.4
	All Vehicles Daytime	Point 1	30.1	38.0	88.2	89.7	96.9	96.8	8.0	1.5	-0.1
		Point 2	19.6	45.1	77.3	91.3	94.3	98.4	25.6	14.0	4.1
		Point 3	10.9	9.1	57.4	52.1	82.8	80.2	-1.9	-5.3	-2.5

Table A-31. Nighttime Results for Sheeting Change—HI_S to MP_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin		
			Study on Sign		Change MP_R-HI_S	Study on Sign		Change MP_R-HI_S
			HI_S	MP_R		HI_S	MP_R	
Nighttime Passenger Vehicles		Sample Size	402	217		2025	366	
	Control Point 1	Mean	63.8	61.7	***-2.0****	64.7	65.6	0.9
		85th Percentile	69.0	66.1	-2.9	69.9	71.8	1.9
	Legibility Point 2	Mean	59.0	57.7	***-1.4****	61.5	66.0	***4.5****
		85th Percentile	65.7	63.6	-2.1	67.8	73.0	5.2
	Downstream Point 3	Mean	55.1	54.4	-0.7	58.5	57.9	-0.6
		85th Percentile	61.3	59.6	-1.7	65.3	64.6	-0.7
Nighttime Heavy Vehicles		Sample Size	105	85		250	98	
	Control Point 1	Mean	62.9	60.5	***-2.3****	64.8	65.8	1.0
		85th Percentile	67.3	64.2	-3.1	69.3	69.7	0.4
	Legibility Point 2	Mean	59.1	59.1	0.0	61.7	67.1	***5.4****
		85th Percentile	64.0	65.0	1.0	66.1	72.0	5.9
	Downstream Point 3	Mean	55.0	55.7	0.7	58.9	59.5	0.6
		85th Percentile	59.2	60.6	1.4	64.9	66.5	1.6
Nighttime All Vehicles		Sample Size	507	302		2275	464	
	Control Point 1	Mean	63.6	61.4	***-2.2****	64.7	65.6	***0.9****
		85th Percentile	68.6	66.1	-2.5	69.5	71.3	1.8
	Legibility Point 2	Mean	59.0	58.1	***-1.0****	61.6	66.3	***4.7****
		85th Percentile	65.3	65.0	-0.3	67.3	73.0	5.7
	Downstream Point 3	Mean	55.1	54.8	-0.3	58.6	58.2	-0.4
		85th Percentile	60.9	59.9	-1.1	65.3	65.3	0.0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-32. Nighttime Percent Exceeding Results for Sheeting Change—HI_S to MP_R.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			HI_S	MP_R	HI_S	MP_R	HI_S	MP_R	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	39.3	24.4	74.6	63.6	94.8	90.8	-14.9	-11.0	-4.0
		Point 2	17.2	10.6	39.1	30.9	70.4	60.8	-6.6	-8.2	-9.6
		Point 3	6.7	3.2	18.7	13.4	43.3	38.2	-3.5	-5.3	-5.0
	Heavy Vehicles Nighttime	Point 1	37.1	5.9	74.3	57.6	91.4	90.6	-31.3	-16.6	-0.8
		Point 2	11.4	8.2	39.0	43.5	74.3	70.6	-3.2	4.5	-3.7
		Point 3	4.8	3.5	13.3	16.5	41.9	49.4	-1.2	3.1	7.5
	All Vehicles Nighttime	Point 1	38.9	19.2	74.6	61.9	94.1	90.7	-19.7	-12.6	-3.4
		Point 2	16.0	9.9	39.1	34.4	71.2	63.6	-6.0	-4.6	-7.6
		Point 3	6.3	3.3	17.6	14.2	43.0	41.4	-3.0	-3.3	-1.6
SH 7 Marlin	Passenger Vehicles Nighttime	Point 1	47.4	55.5	80.7	82.0	95.5	93.2	8.1	1.2	-2.3
		Point 2	27.7	51.4	57.9	77.3	84.0	93.2	23.7	19.4	9.2
		Point 3	15.8	14.2	36.4	34.2	68.1	63.1	-1.5	-2.3	-5.0
	Heavy Vehicles Nighttime	Point 1	46.0	59.2	84.8	91.8	96.4	100.0	13.2	7.0	3.6
		Point 2	24.8	62.2	64.0	86.7	87.2	98.0	37.4	22.7	10.8
		Point 3	12.8	20.4	41.6	43.9	73.6	76.5	7.6	2.3	2.9
	All Vehicles Nighttime	Point 1	47.2	56.3	81.2	84.1	95.6	94.6	9.0	2.9	-0.9
		Point 2	27.3	53.7	58.6	79.3	84.4	94.2	26.3	20.7	9.8
		Point 3	15.4	15.5	37.0	36.2	68.7	65.9	0.1	-0.8	-2.8

Table A-33. Daytime Results for Sheeting Change—MP_S to MP_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin			US 79 Oakwood		
			Study on Sign		Change	Study on Sign		Change	Study on Sign		Change
			MP_S	MP_R	MP_R-MP_S	MP_S	MP_R	MP_R-MP_S	MP_S	MP_R	MP_R-MP_S
Daytime Passenger Vehicles		Sample Size	1073	1192		471	1714		955	2192	
	Control Point 1	Mean	66.6	64.4	***-2.2****	69.3	67.9	***-1.3****	69.7	69.1	***-0.6****
		85th Percentile	72.2	69.2	-3.0	75.2	73.2	-2.0	74	74	0
	Legibility Point 2	Mean	60.4	61.7	***1.3****	73.9	69.5	***-4.4****	66	65.9	-0.1
		85th Percentile	67.3	69.0	1.7	81.4	76.0	-5.4	72	72	0
	Downstream Point 3	Mean	56.7	57.1	0.4	61.2	60.8	-0.4	61.4	60.7	***-0.7****
		85th Percentile	63.4	63.4	0.0	68.8	68.2	-0.6	68	67	-1
Daytime Heavy Vehicles		Sample Size	216	275		83	269		347	701	
	Control Point 1	Mean	64.9	62.2	***-2.7****	67.4	67.3	***0.1****	68.1	66.7	***-1.4****
		85th Percentile	70.4	66.9	-3.5	71.8	73.1	1.3	72	71	-1
	Legibility Point 2	Mean	59.5	60.5	1.0	73.7	70.2	***-3.5****	64.1	63.5	-0.6
		85th Percentile	64.9	66.0	1.1	79.9	76.0	-3.9	69	68	-1
	Downstream Point 3	Mean	56.4	57.2	0.8	61.9	61.8	-0.1	60.1	58.8	***-1.3****
		85th Percentile	62.0	62.0	0.0	68.5	68.1	-0.4	65	64	-1
Daytime All Vehicles		Sample Size	1289	1467		554	1983		1302	2893	
	Control Point 1	Mean	66.3	64.0	***-2.3****	69.0	67.9	***-1.1****	69.3	68.5	***-0.8****
		85th Percentile	72.2	69.0	-3.2	74.7	73.2	-1.5	74	73	-1
	Legibility Point 2	Mean	60.2	61.4	***1.2****	73.9	69.6	***-4.3****	65.5	65.3	-0.2
		85th Percentile	66.9	68.0	1.1	81.4	76.0	-5.4	71	71	0
	Downstream Point 3	Mean	56.6	57.1	0.5	61.3	61.0	-0.3	61.1	60.2	***-0.9****
		85th Percentile	63.1	63.1	0.0	68.6	68.2	-0.4	68	67	-1

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-34. Daytime Percent Exceeding Results for Sheeting Change—MP_S to MP_R.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			MP_S	MP_R	MP_S	MP_R	MP_S	MP_R	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	27.8	11.1	85.0	80.8	96.6	95.2	-16.7	-4.2	-1.3
		Point 2	6.0	9.8	52.2	55.3	77.5	81.5	3.9	3.1	4.0
		Point 3	3.0	3.3	27.3	26.7	54.8	58.5	0.3	-0.6	3.7
	Heavy Vehicles Daytime	Point 1	16.7	3.3	83.8	68.7	96.8	94.9	-13.4	-15.1	-1.9
		Point 2	2.3	2.9	44.0	49.8	79.2	84.4	0.6	5.8	5.2
		Point 3	0.0	2.2	26.9	25.1	57.9	64.4	2.2	-1.8	6.5
	All Vehicles Daytime	Point 1	25.9	9.6	84.8	78.5	96.6	95.2	-16.3	-6.3	-1.4
		Point 2	5.4	8.5	50.8	54.3	77.8	82.1	3.2	3.4	4.3
		Point 3	2.5	3.1	27.2	26.4	55.3	59.6	0.6	-0.9	4.3
SH 7 Marlin	Passenger Vehicles Daytime	Point 1	47.1	39.2	91.7	89.4	97.7	96.7	-7.9	-2.3	-1.0
		Point 2	69.2	44.6	97.2	90.8	99.8	98.2	-24.6	-6.5	-1.5
		Point 3	11.7	8.8	54.1	51.3	78.8	79.2	-2.9	-2.8	0.5
	Heavy Vehicles Daytime	Point 1	27.7	30.5	90.4	91.1	98.8	97.4	2.8	0.7	-1.4
		Point 2	72.3	48.7	98.8	94.4	100.0	99.3	-23.6	-4.4	-0.7
		Point 3	7.2	11.2	59.0	56.9	90.4	86.6	3.9	-2.2	-3.7
	All Vehicles Daytime	Point 1	44.2	38.0	91.5	89.7	97.8	96.8	-6.2	-1.9	-1.1
		Point 2	69.7	45.1	97.5	91.3	99.8	98.4	-24.5	-6.2	-1.4
		Point 3	11.0	9.1	54.9	52.1	80.5	80.2	-1.9	-2.8	-0.3
US 79 Oakwood	Passenger Vehicles Daytime	Point 1	48.5	43.6	95.7	95.4	99.2	99.5	-4.9	-0.3	0.3
		Point 2	24.4	23.2	83.5	83.9	96.8	96.9	-1.2	0.4	0.1
		Point 3	8.9	6.7	57.3	50.8	83.2	80.4	-2.2	-6.5	-2.8
	Heavy Vehicles Daytime	Point 1	27.1	19.4	93.7	93.6	98.8	99.4	-7.7	-0.1	0.6
		Point 2	10.7	7.7	82.7	76.5	95.1	94.9	-3.0	-6.2	-0.2
		Point 3	4.0	2.1	45.5	38.9	83.6	74.9	-1.9	-6.6	-8.7
	All Vehicles Daytime	Point 1	42.8	37.8	95.2	95.0	99.1	99.5	-5.0	-0.2	0.4
		Point 2	20.7	19.4	83.3	82.1	96.3	96.4	-1.3	-1.1	0.1
		Point 3	7.6	5.6	54.1	48.0	83.3	79.1	-2.0	-6.2	-4.3

Table A-35. Nighttime Results for Sheeting Change—MP_S to MP_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham Study on Sign MP_S	SH 14 Wortham Study on Sign MP_R	SH 14 Wortham Change MP_R-MP_S	US 79 Oakwood Study on Sign MP_S	US 79 Oakwood Study on Sign MP_R	US 79 Oakwood Change MP_R-MP_S
Nighttime Passenger Vehicles		Sample Size	212	217		267	505	
	Control Point 1	Mean	63.7	61.7	***-2.0****	68.7	67.4	***-1.3****
		85th Percentile	69.0	66.1	-2.9	74.0	72.0	-2.0
	Legibility Point 2	Mean	57.9	57.7	-0.2	66	65.2	-0.8
		85th Percentile	64.2	63.6	-0.6	72.0	71.0	-1.0
	Downstream Point 3	Mean	54.6	54.4	-0.2	61.3	60.3	-1.0
		85th Percentile	59.0	59.6	0.6	68.0	67.0	-1.0
Nighttime Heavy Vehicles		Sample Size	79	85		134	284	
	Control Point 1	Mean	64.0	60.5	***-3.5****	67.2	66.2	-1.0
		85th Percentile	69.2	64.2	-5.0	71.0	70.0	-1.0
	Legibility Point 2	Mean	58.5	59.1	0.6	65.3	64.4	-0.9
		85th Percentile	62.8	65.0	2.2	70.0	69.0	-1.0
	Downstream Point 3	Mean	56.4	55.7	-0.8	60.9	59.5	-1.4
		85th Percentile	62.0	60.6	-1.4	67.0	65.0	-2.0
Nighttime All Vehicles		Sample Size	291	302		401	789	
	Control Point 1	Mean	63.8	61.4	***-2.4****	68.2	66.9	***-1.3****
		85th Percentile	69.0	66.1	-2.9	73.0	71.0	-2.0
	Legibility Point 2	Mean	58.0	58.1	0.0	65.8	64.9	***-0.9****
		85th Percentile	63.8	65.0	1.2	71.0	70.0	-1.0
	Downstream Point 3	Mean	55.1	54.8	-0.3	61.2	60	***-1.2****
		85th Percentile	59.8	59.9	0.1	68.0	67.0	-1.0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-36. Nighttime Percent Exceeding Results for Sheeting Change—MP_S to MP_R.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			MP_S	MP_R	MP_S	MP_R	MP_S	MP_R	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	41.5	24.4	73.6	63.6	93.4	90.8	-17.1	-10.0	-2.6
		Point 2	9.9	10.6	32.1	30.9	60.4	60.8	0.7	-1.2	0.5
		Point 3	5.2	3.2	10.8	13.4	40.6	38.2	-2.0	2.5	-2.3
	Heavy Vehicles Nighttime	Point 1	32.9	5.9	78.5	57.6	94.9	90.6	-27.0	-20.8	-4.3
		Point 2	5.1	8.2	35.4	43.5	73.4	70.6	3.2	8.1	-2.8
		Point 3	3.8	3.5	22.8	16.5	58.2	49.4	-0.3	-6.3	-8.8
	All Vehicles Nighttime	Point 1	39.2	19.2	74.9	61.9	93.8	90.7	-20.0	-13.0	-3.1
		Point 2	8.6	9.9	33.0	34.4	63.9	63.6	1.3	1.4	-0.3
		Point 3	4.8	3.3	14.1	14.2	45.4	41.4	-1.5	0.1	-4.0
US 79 Oakwood	Passenger Vehicles Nighttime	Point 1	75.9	66.3	95.9	91.3	99.2	98.0	-9.6	-4.6	-1.2
		Point 2	56.8	51.4	85.0	78.2	95.5	94.0	-5.4	-6.8	-1.5
		Point 3	30.5	23.2	53.8	48.6	82.0	77.6	-7.3	-5.2	-4.4
	Heavy Vehicles Nighttime	Point 1	61.9	58.1	93.3	93.7	100.0	99.6	-3.8	0.4	-0.4
		Point 2	47.0	44.4	80.6	79.9	98.5	97.2	-2.6	-0.7	-1.3
		Point 3	24.6	14.4	49.3	42.6	80.6	77.8	-10.2	-6.6	-2.8
	All Vehicles Nighttime	Point 1	71.3	63.4	95.0	92.1	99.5	99.1	-8.0	-2.9	-0.4
		Point 2	53.6	48.9	83.5	78.8	96.5	95.2	-4.7	-4.7	-1.3
		Point 3	28.4	20.0	52.1	46.4	81.5	77.7	-8.4	-5.7	-3.9

Table A-37. Daytime Results for Sheeting Change—HI_R to MP_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin		
			Study on Sign		Change MP_R-HI_R	Study on Sign		Change MP_R-HI_R
			HI_R	MP_R		HI_R	MP_R	
Daytime Passenger Vehicles		Sample Size	1071	1192		1698	1714	
	Control Point 1	Mean	67.7	64.4	***-3.2****	70.8	67.9	***-2.9****
		85th Percentile	73.2	69.2	-4.0	76.8	73.2	-3.6
	Legibility Point 2	Mean	61.7	61.7	0.0	72.3	69.5	***-2.8****
		85th Percentile	68.2	69.0	0.8	80.2	76.0	-4.2
	Downstream Point 3	Mean	56.5	57.1	0.5	59.8	60.8	***1.0****
		85th Percentile	62.7	63.4	0.7	66.9	68.2	1.3
Daytime Heavy Vehicles		Sample Size	285	275		332	269	
	Control Point 1	Mean	66.3	62.2	***-4.1****	71.0	67.3	***-3.6****
		85th Percentile	70.8	66.9	-3.9	76.3	73.1	-3.2
	Legibility Point 2	Mean	61.3	60.5	-0.8	73.6	70.2	***-3.4****
		85th Percentile	66.1	66.0	-0.1	80.2	76.0	-4.2
	Downstream Point 3	Mean	56.8	57.2	0.3	61.2	61.8	0.6
		85th Percentile	62.0	62.0	0.0	67.9	68.1	0.2
Daytime All Vehicles		Sample Size	1356	1467		2030	1983	
	Control Point 1	Mean	67.4	64.0	***-3.4****	70.8	67.9	***-3.0****
		85th Percentile	72.7	69.0	-3.7	76.8	73.2	-3.6
	Legibility Point 2	Mean	61.6	61.4	-0.1	72.5	69.6	***-2.9****
		85th Percentile	67.8	68.0	0.2	80.2	76.0	-4.2
	Downstream Point 3	Mean	56.6	57.1	0.5	60.0	61.0	***0.9****
		85th Percentile	62.7	63.1	0.4	67.3	68.2	0.9

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-38. Daytime Percent Exceeding Results for Sheeting Change—HI_R to MP_R.

Site	Vehicle Group	Location	Percent Exceeding 70 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			HI_R	MP_R	HI_R	MP_R	HI_R	MP_R	70 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Daytime	Point 1	35.6	11.1	91.0	80.8	97.5	95.2	-24.5	-10.2	-2.3
		Point 2	9.5	9.8	57.4	55.3	85.4	81.5	0.3	-2.1	-3.9
		Point 3	3.2	3.3	24.1	26.7	55.2	58.5	0.1	2.6	3.3
	Heavy Vehicles Daytime	Point 1	20.4	3.3	89.1	68.7	97.9	94.9	-17.1	-20.4	-3.0
		Point 2	2.1	2.9	60.4	49.8	90.5	84.4	0.8	-10.5	-6.2
		Point 3	1.4	2.2	23.5	25.1	63.9	64.4	0.8	1.6	0.5
	All Vehicles Daytime	Point 1	32.4	9.6	90.6	78.5	97.6	95.2	-22.8	-12.1	-2.4
		Point 2	8.0	8.5	58.0	54.3	86.5	82.1	0.6	-3.8	-4.4
		Point 3	2.8	3.1	24.0	26.4	57.0	59.6	0.3	2.4	2.6
SH 7 Marlin	Passenger Vehicles Daytime	Point 1	58.0	39.2	93.5	89.4	98.5	96.7	-18.7	-4.1	-1.8
		Point 2	61.0	44.6	95.4	90.8	99.4	98.2	-16.4	-4.6	-1.1
		Point 3	7.6	8.8	44.3	51.3	74.6	79.2	1.2	7.1	4.6
	Heavy Vehicles Daytime	Point 1	58.1	30.5	95.5	91.1	99.4	97.4	-27.6	-4.4	-2.0
		Point 2	71.4	48.7	97.6	94.4	99.4	99.3	-22.7	-3.2	-0.1
		Point 3	9.9	11.2	51.2	56.9	85.5	86.6	1.2	5.7	1.1
	All Vehicles Daytime	Point 1	58.0	38.0	93.8	89.7	98.6	96.8	-20.0	-4.2	-1.8
		Point 2	62.7	45.1	95.8	91.3	99.4	98.4	-17.6	-4.5	-1.0
		Point 3	8.0	9.1	45.4	52.1	76.4	80.2	1.1	6.7	3.8

Table A-39. Nighttime Results for Sheeting Change—HI_R to MP_R.

Vehicle Group	Location	MOE: Speed (mph)	SH 14 Wortham			SH 7 Marlin		
			Study on Sign		Change MP_R-HI_R	Study on Sign		Change MP_R-HI_R
			HI_R	MP_R		HI_R	MP_R	
Nighttime Passenger Vehicles		Sample Size	275	217		376	366	
	Control Point 1	Mean	64.6	61.7	***-2.8****	68.5	65.6	***-2.9****
		85th Percentile	70.4	66.1	-4.3	74.7	71.8	-2.9
	Legibility Point 2	Mean	59.3	57.7	***-1.7****	69.3	66.0	***-3.3****
		85th Percentile	66.1	63.6	-2.5	77.4	73.0	-4.4
	Downstream Point 3	Mean	54.8	54.4	-0.4	57.8	57.9	0.1
		85th Percentile	60.6	59.6	-1.0	65.7	64.6	-1.1
Nighttime Heavy Vehicles		Sample Size	75	85		95	98	
	Control Point 1	Mean	64.3	60.5	***-3.8****	68.7	65.8	***-2.9****
		85th Percentile	68.5	64.2	-4.3	73.2	69.7	-3.5
	Legibility Point 2	Mean	59.8	59.1	-0.8	70.6	67.1	***-3.4****
		85th Percentile	66.4	65.0	-1.4	76.3	72.0	-4.3
	Downstream Point 3	Mean	55.7	55.7	0.0	59.0	59.5	0.5
		85th Percentile	61.3	60.6	-0.7	64.2	66.5	2.3
Nighttime All Vehicles		Sample Size	350	302		471	464	
	Control Point 1	Mean	64.5	61.4	***-3.1****	68.6	65.6	***-2.9****
		85th Percentile	70.4	66.1	-4.3	74.2	71.3	-2.9
	Legibility Point 2	Mean	59.4	58.1	***-1.4****	69.6	66.3	***-3.3****
		85th Percentile	66.1	65.0	-1.1	77.4	73.0	-4.4
	Downstream Point 3	Mean	55.0	54.8	-0.2	58.0	58.2	0.2
		85th Percentile	61.2	59.9	-1.3	65.3	65.3	0.0

Note: Bold text with asterisk indicates a statistically significant difference.

Table A-40. Nighttime Percent Exceeding Results for Sheeting Change—HI_R to MP_R.

Site	Vehicle Group	Location	Percent Exceeding 65 mph		Percent Exceeding 60 mph		Percent Exceeding 55 mph		Change in Percent Exceeding		
			HI_R	MP_R	HI_R	MP_R	HI_R	MP_R	65 mph	60 mph	55 mph
SH 14 Wortham	Passenger Vehicles Nighttime	Point 1	44.0	24.4	79.6	63.6	93.5	90.8	-19.6	-16.0	-2.7
		Point 2	17.5	10.6	44.4	30.9	71.3	60.8	-6.9	-13.5	-10.4
		Point 3	7.6	3.2	18.5	13.4	41.1	38.2	-4.4	-5.2	-2.8
	Heavy Vehicles Nighttime	Point 1	46.7	5.9	76.0	57.6	97.3	90.6	-40.8	-18.4	-6.7
		Point 2	20.0	8.2	40.0	43.5	84.0	70.6	-11.8	3.5	-13.4
		Point 3	8.0	3.5	20.0	16.5	46.7	49.4	-4.5	-3.5	2.7
	All Vehicles Nighttime	Point 1	44.6	19.2	78.9	61.9	94.3	90.7	-25.4	-16.9	-3.6
		Point 2	18.0	9.9	43.4	34.4	74.0	63.6	-8.1	-9.0	-10.4
		Point 3	7.7	3.3	18.9	14.2	42.3	41.4	-4.4	-4.6	-0.9
SH 7 Marlin	Passenger Vehicles Nighttime	Point 1	70.2	55.5	87.8	82.0	96.3	93.2	-14.7	-5.8	-3.1
		Point 2	68.9	51.4	87.5	77.3	96.3	93.2	-17.5	-10.2	-3.1
		Point 3	16.5	14.2	32.2	34.2	59.0	63.1	-2.3	2.0	4.1
	Heavy Vehicles Nighttime	Point 1	81.1	59.2	95.8	91.8	98.9	100.0	-21.9	-4.0	1.1
		Point 2	78.9	62.2	94.7	86.7	98.9	98.0	-16.7	-8.0	-1.0
		Point 3	10.5	20.4	41.1	43.9	75.8	76.5	9.9	2.8	0.7
	All Vehicles Nighttime	Point 1	72.4	56.3	89.4	84.1	96.8	94.6	-16.1	-5.3	-2.2
		Point 2	70.9	53.7	89.0	79.3	96.8	94.2	-17.2	-9.6	-2.6
		Point 3	15.3	15.5	34.0	36.2	62.4	65.9	0.2	2.2	3.5

APPENDIX B:
LONG-TERM RED BORDER SPEED LIMIT SIGN RESULTS

The tables in this appendix present the results of the long-term analysis of the impacts of the red border added to a standard Speed Limit sign. The researchers collected data at three sites over the course of approximately one year. The before data were collected before the red border was added to the existing sign. The short-term after data were collected within one month of the installation of the red border. The long-term data were collected 9 to 12 months after the installation of the red border.

Table B-1. Daytime Results for SH 21, All Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	1285	1182	3783			
Control Point 1	Mean	69	70.2	70	***1.2****	***1****	-0.2
	85th Percentile	74	75	75	1	1	0
	Std. Dev.	5.3	4.9	5.4			
Threshold Point 2	Mean	68.4	70.4	65.3	***2****	***-3.1****	***-5.1****
	85th Percentile	74	76	70	2	-4	-6
	Std. Dev.	5.8	5.9	5.2			
Legibility Point 3	Mean		64.2	64.7			0.5
	85th Percentile		70	71			1
	Std. Dev.		6.1	5.9			
Sign Point 4	Mean	63.3	64.3	65.5	***1****	***2.2****	***1.2****
	85th Percentile	70	71	73	1	3	2
	Std. Dev.	6.4	6.5	6.9			
Downstream Point 5	Mean	63	62	59.7	***-1****	***-3.3****	***-2.3****
	85th Percentile	71	69	67	-2	-4	-2
	Std. Dev.	6.8	6.6	7.3			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-2. Nighttime Results for SH 21, All Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	377	253	967			
Control Point 1	Mean	65.6	66.3	67.6	0.7	***2****	***1.3****
	85th Percentile	71	72	73	1	2	1
	Std. Dev.	5.6	6.1	5.4			
Threshold Point 2	Mean	65	65.7	62.9	0.7	***-2.1****	***-2.8****
	85th Percentile	71	73	69	2	-2	-4
	Std. Dev.	6.4	6.6	5.4			
Legibility Point 3	Mean		60.1	62.3			2.2
	85th Percentile		68	69			1
	Std. Dev.		7.1	6			-1.1
Sign Point 4	Mean	60.1	60.5	63.4	0.4	***3.3****	***2.9****
	85th Percentile	66	68	70	2	4	2
	Std. Dev.	6.4	7.1	6.7			-0.4
Downstream Point 5	Mean	60.2	58.4	58.6	***-1.8****	***-1.6****	0.2
	85th Percentile	67	66	65	-1	-2	-1
	Std. Dev.	6.7	6.9	7.5			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-3. Daytime Results for SH 21, Passenger Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	1176	1075	3400			
Control Point 1	Mean	69.2	70.6	70.4	***1.4****	***1.2****	-0.2
	85th Percentile	74	75	75	1	1	0
	Std. Dev.	5.2	4.8	5.3			
Threshold Point 2	Mean	68.6	70.7	65.6	***2.1****	***-3****	***-5.1****
	85th Percentile	74	76	70			
	Std. Dev.	5.8	5.9	5.2			
Legibility Point 3	Mean		64.5	65			0.5
	85th Percentile		70	71			1
	Std. Dev.		6.1	5.9			
Sign Point 4	Mean	63.5	64.7	65.7	***1.2****	***2.2****	***1****
	85th Percentile	70	71	73	1	3	2
	Std. Dev.	6.4	6.5	6.9			
Downstream Point 5	Mean	63.1	62.3	59.8	***-0.8****	***-3.3****	***-2.5****
	85th Percentile	71	69	67	-2	-4	-2
	Std. Dev.	6.8	6.6	7.1			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-4. Daytime Results for SH 21, Heavy Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	109	107	383			
Control Point 1	Mean	66.1	66.3	66.6	0.2	0.5	0.3
	85th Percentile	72	71	72	-1	0	1
	Std. Dev.	5.8	4.8	5.5			
Threshold Point 2	Mean	65.7	66.8	62.7	1.1	***-3****	***-4.1****
	85th Percentile	72	72	67	0	-5	-5
	Std. Dev.	5.9	4.9	5			
Legibility Point 3	Mean		60.9	62.2			1.3
	85th Percentile		67	68			1
	Std. Dev.		5.3	5.4			
Sign Point 4	Mean	61.1	61.2	63.2	0.1	***2.1****	***2****
	85th Percentile	68	67	69	-1	1	2
	Std. Dev.	6.2	5.7	6.1			
Downstream Point 5	Mean	61	59.3	58.4	-1.7	***-2.6****	-0.9
	85th Percentile	68	66	65	-2	-3	-1
	Std. Dev.	6.7	5.3	8.8			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-5. Nighttime Results for SH 21, Passenger Vehicles.

Location	**MOE: Speed (mph)**	**Before (B)**	**Short-Term After (STA)**	**Long-Term After (LTA)**	**STA-B**	**LTA-B**	**LTA-STA**
	Sample Size	335	225	861			
Control Point 1	Mean	65.8	66.3	67.8	0.5	***2****	***1.5****
	85th Percentile	71	72	73	1	2	1
	Std. Dev.	5.6	5.9	5.5			
Threshold Point 2	Mean	65	65.7	63	0.7	***-2****	***-2.7****
	85th Percentile	71	73	69	2	-2	-4
	Std. Dev.	6.4	6.5	5.7			
Legibility Point 3	Mean		60.1	62.4			2.3
	85th Percentile		68	69			1
	Std. Dev.		7	6.1			-0.9
Sign Point 4	Mean	60.1	60.3	63.4	0.2	***3.3****	***3.1****
	85th Percentile	67	68	71	1	4	3
	Std. Dev.	6.5	7.1	6.9			-0.2
Downstream Point 5	Mean	60.2	58.3	58.6	***-1.9****	***-1.6****	0.3
	85th Percentile	67	65	65	-2	-2	0
	Std. Dev.	6.8	6.8	7.5			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-6. Nighttime Results for SH 21, Heavy Vehicles.

Location	**MOE: Speed (mph)**	**Before (B)**	**Short-Term After (STA)**	**Long-Term After (LTA)**	**STA-B**	**LTA-B**	**LTA-STA**
	Sample Size	42	28	106			
Control Point 1	Mean	64.1	66.2	66.2	2.1	***2.1****	0
	85th Percentile	68	74	70	6	2	-4
	Std. Dev.	5.1	7.8	4.3			
Threshold Point 2	Mean	65.2	65.9	62.3	0.7	***-2.9****	***-3.6****
	85th Percentile	70	70	67	0	-3	-3
	Std. Dev.	5.8	7.2	4.4			
Legibility Point 3	Mean		60.6	61.9			1.3
	85th Percentile		66	67			1
	Std. Dev.		7.7	4.7			-3
Sign Point 4	Mean	60.4	61.3	63.4	0.9	***3****	2.1
	85th Percentile	65	68	69	3	4	1
	Std. Dev.	5.7	7.7	5.2			-2.5
Downstream Point 5	Mean	60.4	59.3	58.4	-1.1	-2	-0.9
	85th Percentile	64	67	63	3	-1	-4
	Std. Dev.	6.1	7.4	7.5			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-7. Daytime Percent Exceeding Results for SH 21.

Vehicle Group	Location	Percent Exceeding 70 mph			Percent Exceeding 60 mph			Percent Exceeding 55 mph		
		B	STA	LTA	B	STA	LTA	B	STA	LTA
Passenger Vehicles Daytime	Point 1	40.0	56.1	53.3	94.2	96.4	95.4	99.4	99.0	99.0
	Point 2	38.3	57.4	14.6	91.3	93.5	84.2	98.7	98.5	96.1
	Point 3	-	14.5	17.1	-	78.7	76.9	-	90.5	94.3
	Point 4	14.5	18.5	25.4	67.9	74.7	75.9	87.9	90.5	93.6
	Point 5	16.0	12.3	6.7	63.2	59.1	41.5	87.0	84.1	69.6
Heavy Vehicles Daytime	Point 1	21.1	22.4	24.5	89.0	86.9	88.0	95.4	98.1	95.8
	Point 2	21.1	24.3	3.7	81.7	92.5	69.2	95.4	99.1	91.1
	Point 3	-	3.7	5.7	-	49.5	61.6	-	85.0	89.3
	Point 4	8.3	3.7	12.0	52.3	52.3	63.7	78.9	86.9	90.1
	Point 5	11.0	1.9	4.4	51.4	34.6	30.5	78.9	76.6	61.1
All Vehicles Daytime	Point 1	38.4	53.0	50.4	93.8	95.5	94.7	99.1	98.9	98.7
	Point 2	36.8	54.4	13.5	90.5	93.4	82.7	98.4	98.6	95.6
	Point 3	-	13.5	15.9	-	76.1	75.3	-	90.0	93.8
	Point 4	14.0	17.2	24.1	66.6	72.7	74.6	87.2	90.2	93.2
	Point 5	15.6	11.3	6.4	62.2	56.9	40.4	86.3	83.4	68.7

Table B-8. Change in Daytime Percent Exceeding Results for SH 21.

Vehicle Group	Location	Change in Percent Exceeding:					
		70 mph		60 mph		55 mph	
		LTA-B	LTA-STA	LTA-B	LTA-STA	LTA-B	LTA-STA
Passenger Vehicles Daytime	Point 1	13.3	-2.8	1.2	-1.0	-0.4	0.0
	Point 2	-23.7	-42.8	-7.1	-9.3	-2.6	-2.4
	Point 3	17.1	2.6	76.9	-1.8	94.3	3.8
	Point 4	10.9	6.9	8.0	1.2	5.7	3.1
	Point 5	-9.3	-5.6	-21.7	-17.6	-17.4	-14.5
Heavy Vehicles Daytime	Point 1	3.4	2.1	-1.0	1.1	0.4	-2.3
	Point 2	-17.4	-20.6	-12.5	-23.3	-4.3	-8.0
	Point 3	5.7	2.0	61.6	12.1	89.3	4.3
	Point 4	3.7	8.3	11.4	11.4	11.2	3.2
	Point 5	-6.6	2.5	-20.9	-4.1	-17.8	-15.5
All Vehicles Daytime	Point 1	12.0	-2.6	0.9	-0.8	-0.4	-0.2
	Point 2	-23.3	-40.9	-7.8	-10.7	-2.8	-3.0
	Point 3	15.9	2.4	75.3	-0.8	93.8	3.8
	Point 4	10.1	6.9	8.0	1.9	6.0	3.0
	Point 5	-9.2	-4.9	-21.8	-16.5	-17.6	-14.7

Table B-9. Nighttime Percent Exceeding Results for SH 21.

Vehicle Group	Location	Percent Exceeding 65 mph			Percent Exceeding 60 mph			Percent Exceeding 55 mph		
		B	STA	LTA	B	STA	LTA	B	STA	LTA
Passenger Vehicles Nighttime	1	46.9	61.8	67.9	86.9	84.4	92.6	96.1	95.1	98.1
	2	46.3	50.7	32.1	74.9	75.1	68.4	94.9	95.1	90.0
	3		23.6	29.8		50.2	60.4		66.7	85.9
	4	21.2	25.3	34.7	43.0	51.1	63.1	75.2	72.0	88.2
	5	19.4	15.1	13.5	41.2	36.9	34.5	76.7	63.1	61.9
Heavy Vehicles Nighttime	1	28.6	60.7	57.5	76.2	78.6	93.4	100.0	89.3	97.2
	2	45.2	57.1	23.6	85.7	78.6	68.9	97.6	92.9	95.3
	3		17.9	20.8		53.6	63.2		67.9	93.4
	4	9.5	21.4	32.1	50.0	50.0	67.0	76.2	75.0	94.3
	5	9.5	17.9	7.5	50.0	28.6	27.4	71.4	67.9	66.0
All Vehicles Nighttime	1	44.8	61.7	66.8	85.7	83.8	92.7	96.6	94.5	98.0
	2	46.2	51.4	31.1	76.1	75.5	68.5	95.2	94.9	90.6
	3		22.9	28.9		50.6	60.7		66.8	86.6
	4	19.9	24.9	34.4	43.8	51.0	63.5	75.3	72.3	88.8
	5	18.3	15.4	12.8	42.2	36.0	33.7	76.1	63.3	62.4

Table B-10. Change in Nighttime Percent Exceeding Results for SH 21.

Vehicle Group	Location	Change in Percent Exceeding:					
		65 mph		60 mph		55 mph	
		LTA-B	LTA-STA	LTA-B	LTA-STA	LTA-B	LTA-STA
Passenger Vehicles Nighttime	Point 1	21.0	6.1	5.7	8.2	2.0	3.0
	Point 2	-14.2	-18.6	-6.5	-6.7	-4.9	-5.1
	Point 3	29.8	6.2	60.4	10.2	85.9	19.2
	Point 4	13.5	9.4	20.1	12.0	13.0	16.2
	Point 5	-5.9	-1.6	-6.7	-2.4	-14.8	-1.2
Heavy Vehicles Nighttime	Point 1	28.9	-3.2	17.2	14.8	-2.8	7.9
	Point 2	-21.6	-33.5	-16.8	-9.7	-2.3	2.4
	Point 3	20.8	2.9	63.2	9.6	93.4	25.5
	Point 4	22.6	10.7	17.0	17.0	18.1	19.3
	Point 5	-2.0	-10.4	-22.6	-1.2	-5.4	-1.9
All Vehicles Nighttime	Point 1	22.0	5.1	7.0	8.9	1.4	3.5
	Point 2	-15.1	-20.3	-7.6	-7.0	-4.6	-4.3
	Point 3	28.9	6.0	60.7	10.1	86.6	19.8
	Point 4	14.5	9.5	19.7	12.5	13.5	16.5
	Point 5	-5.5	-2.6	-8.5	-2.3	-13.7	-0.9

Table B-11. Daytime Results for FM 60, All Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	1560	349	1702			
Control Point 1	Mean	70.1	70.9	67.1	0.8	***-3****	***-3.8****
	85th Percentile	76	76	72	0	-4	-4
	Std. Dev.	5.8	5.6	5.7			
Threshold Point 2	Mean	68.3	67.7	63.2	-0.6	***-5.1****	***-4.5****
	85th Percentile	74	73	70	-1	-4	-3
	Std. Dev.	6.2	6.1	6			
Legibility Point 3	Mean	66.2	66.5	66.2	0.3	0	-0.3
	85th Percentile	72	73	73	1	1	0
	Std. Dev.	5.8	6	6.8			
Sign Point 4	Mean	67.1	66.4	60.7	-0.7	***-6.4****	***-5.7****
	85th Percentile	73	73	67	0	-6	-6
	Std. Dev.	6.3	6.4	6.1			
Downstream Point 5	Mean	65	64.9	57.5	-0.1	***-7.5****	***-7.4****
	85th Percentile	72	72	64	0	-8	-8
	Std. Dev.	6.3	6.5	5.7			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-12. Nighttime Results for FM 60, All Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	498	189	656			
Control Point 1	Mean	66.9	68.3	65.8	***1.4****	***-1.1****	***-2.5****
	85th Percentile	73	75	71	2	-2	-4
	Std. Dev.	5.8	6.1	6.2			
Threshold Point 2	Mean	63.4	63.1	61.1	-0.3	***-2.3****	***-2****
	85th Percentile	70	69	67.7	-1	-2.3	-1.3
	Std. Dev.	6.2	5.6	6.4			
Legibility Point 3	Mean	62.1	62.1	64	0	***1.9****	***1.9****
	85th Percentile	68	68	72	0	4	4
	Std. Dev.	6.3	5.7	7.3			
Sign Point 4	Mean	62	61.5	58.8	-0.5	***-3.2****	***-2.7****
	85th Percentile	69	68	65	-1	-4	-3
	Std. Dev.	6.6	6.1	6.7			
Downstream Point 5	Mean	60.8	60.2	56.2	-0.6	***-4.6****	***-4****
	85th Percentile	68	67	62	-1	-6	-5
	Std. Dev.	6.5	5.9	6.2			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-13. Daytime Results for FM 60, Passenger Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	1401	333	1512			
Control Point 1	Mean	70.3	70.8	67.5	0.5	***-2.8****	***-3.3****
	85th Percentile	76	76	72	0	-4	-4
	Std. Dev.	5.8	5.6	5.6			
Threshold Point 2	Mean	68.5	67.6	63.4	-0.9	***-5.1****	***-4.2****
	85th Percentile	75	73	70	-2	-5	-3
	Std. Dev.	6.2	6.1	6			
Legibility Point 3	Mean	66.3	66.4	66.4	0.1	0.1	0
	85th Percentile	72	73	73	1	1	0
	Std. Dev.	5.9	6.1	6.8			
Sign Point 4	Mean	67.2	66.3	60.8	-0.9	***-6.4****	***-5.5****
	85th Percentile	73	73	67	0	-6	-6
	Std. Dev.	6.3	6.4	6.1			
Downstream Point 5	Mean	65.1	64.7	57.6	-0.4	***-7.5****	***-7.1****
	85th Percentile	72	71	64	-1	-8	-7
	Std. Dev.	6.3	6.6	5.8			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-14. Daytime Results for FM 60, Heavy Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	159	16	190			
Control Point 1	Mean	68.6	71.9	64.2	3.3	***-4.4****	-7.7
	85th Percentile	74	77	70	3	-4	-7
	Std. Dev.	5.7	5.2	5.7			
Threshold Point 2	Mean	67.2	70.3	61.5	3.1	***-5.7****	-8.8
	85th Percentile	73	76	67	3	-6	-9
	Std. Dev.	5.9	4.7	6			
Legibility Point 3	Mean	65.6	69.1	64.6	3.5	-1	-4.5
	85th Percentile	71	75	71	4	0	-4
	Std. Dev.	5.6	4.8	6.6			
Sign Point 4	Mean	66.1	69.5	59.6	3.4	***-6.5****	-9.9
	85th Percentile	73	76	65	3	-8	-11
	Std. Dev.	6.4	5.5	5.5			
Downstream Point 5	Mean	64.5	68.2	56.6	3.7	***-7.9****	-11.6
	85th Percentile	70	74	62	4	-8	-12
	Std. Dev.	6.2	4.8	5.2			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-15. Nighttime Results for FM 60, Passeneger Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	473	174	624			
Control Point 1	Mean	67	68.6	65.9	***1.6****	***-1.1****	***-2.7****
	85th Percentile	73	75	71	2	-2	-4
	Std. Dev.	5.8	6.1	6.2			
Threshold Point 2	Mean	63.4	63.3	61.3	-0.1	***-2.1****	***-2****
	85th Percentile	70	69	68	-1	-2	-1
	Std. Dev.	6.3	5.6	6.4			
Legibility Point 3	Mean	62.2	62.2	64.1	0	***1.9****	***1.9****
	85th Percentile	69	68	72	-1	3	4
	Std. Dev.	6.3	5.8	7.3			
Sign Point 4	Mean	62	61.6	58.9	-0.4	***-3.1****	***-2.7****
	85th Percentile	69	68	66	-1	-3.3	-2.3
	Std. Dev.	6.7	6.2	6.7			
Downstream Point 5	Mean	60.8	60.3	56.2	-0.5	***-4.6****	***-4.1****
	85th Percentile	68	67	62	-1	-6	-5
	Std. Dev.	6.5	6	6.3			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-16. Nighttime Results for FM 60, Heavy Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	25	15	32			
Control Point 1	Mean	65.2	65.1	63	-0.1	-2.2	-2.1
	85th Percentile	71	69	68	-2	-2.8	-0.8
	Std. Dev.	5.5	4.4	5.5			
Threshold Point 2	Mean	62.1	61.3	58.3	-0.8	***-3.8****	-3
	85th Percentile	68	65	63	-3	-5	-2
	Std. Dev.	4.9	4.7	5.1			
Legibility Point 3	Mean	60.7	60.5	60.8	-0.2	0.1	0.3
	85th Percentile	67	64	66	-3	-1	2
	Std. Dev.	5.2	4.4	5.8			
Sign Point 4	Mean	60.3	60.3	56.5	0	***-3.8****	-3.8
	85th Percentile	66	65	60	-1	-6	-5
	Std. Dev.	5.9	4.4	5			
Downstream Point 5	Mean	60	59.5	54.4	-0.5	***-5.6****	-5.1
	85th Percentile	65	64	59	-1	-6	-5
	Std. Dev.	5.7	4.9	4.5			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-17. Daytime Percent Exceeding Results for FM 60.

Vehicle Group	Location	Percent Exceeding 70 mph			Percent Exceeding 60 mph			Percent Exceeding 55 mph		
		B	STA	LTA	B	STA	LTA	B	STA	LTA
Passenger Vehicles Daytime	Point 1	46.7	54.4	29.8	94.6	95.2	90.5	99.0	98.5	97.3
	Point 2	36.3	32.7	12.2	90.0	86.5	71.2	97.6	96.1	91.3
	Point 3	20.9	23.1	30.7	84.2	82.9	81.3	96.5	93.7	95.0
	Point 4	28.5	24.3	5.6	85.4	80.8	54.0	96.7	93.7	81.8
	Point 5	18.1	18.0	1.9	74.9	71.8	31.6	93.6	90.7	64.0
Heavy Vehicles Daytime	Point 1	32.7	62.5	15.3	89.3	100.0	78.9	99.4	100.0	93.2
	Point 2	23.3	56.3	9.5	86.2	100.0	60.0	97.5	100.0	84.2
	Point 3	15.7	43.8	19.5	79.9	100.0	75.8	96.2	100.0	89.5
	Point 4	20.8	43.8	3.7	79.9	100.0	44.7	96.9	100.0	77.9
	Point 5	14.5	37.5	1.1	73.6	100.0	24.2	91.8	100.0	62.1
All Vehicles Daytime	Point 1	45.3	54.7	28.1	94.1	95.4	89.2	99.0	98.6	96.8
	Point 2	35.0	33.8	11.9	89.6	87.1	69.9	97.6	96.3	90.5
	Point 3	20.4	24.1	29.4	83.8	83.7	80.7	96.5	94.0	94.4
	Point 4	27.7	25.2	5.4	84.8	81.7	52.9	96.7	94.0	81.4
	Point 5	17.7	18.9	1.8	74.8	73.1	30.8	93.4	91.1	63.7

Table B-18. Change in Daytime Percent Exceeding Results for FM 60.

Vehicle Group	Location	Change in Percent Exceeding:					
		70 mph		60 mph		55 mph	
		LTA-B	LTA-STA	LTA-B	LTA-STA	LTA-B	LTA-STA
Passenger Vehicles Daytime	Point 1	-16.9	-24.6	-4.1	-4.7	-1.7	-1.2
	Point 2	-24.1	-20.5	-18.8	-15.3	-6.3	-4.8
	Point 3	9.8	7.6	-2.9	-1.6	-1.5	1.3
	Point 4	-22.9	-18.7	-31.4	-26.8	-14.9	-11.9
	Point 5	-16.2	-16.1	-43.3	-40.2	-29.6	-26.7
Heavy Vehicles Daytime	Point 1	-17.4	-47.2	-10.4	-21.1	-6.2	-6.8
	Point 2	-13.8	-46.8	-26.2	-40.0	-13.3	-15.8
	Point 3	3.8	-24.3	-4.1	-24.2	-6.7	-10.5
	Point 4	-17.1	-40.1	-35.2	-55.3	-19.0	-22.1
	Point 5	-13.4	-36.4	-49.4	-75.8	-29.7	-37.9
All Vehicles Daytime	Point 1	-17.2	-26.6	-4.9	-6.2	-2.2	-1.8
	Point 2	-23.1	-21.9	-19.7	-17.2	-7.1	-5.8
	Point 3	9.0	5.3	-3.1	-3.0	-2.1	0.4
	Point 4	-22.3	-19.8	-31.9	-28.8	-15.3	-12.6
	Point 5	-15.9	-17.1	-44.0	-42.3	-29.7	-27.4

Table B-19. Nighttime Percent Exceeding Results for FM 60.

Vehicle Group	Location	Percent Exceeding 65 mph			Percent Exceeding 60 mph			Percent Exceeding 55 mph		
		B	STA	LTA	B	STA	LTA	B	STA	LTA
Passenger Vehicles Nighttime	Point 1	61.1	70.7	52.4	88.2	90.8	86.4	98.1	97.7	96.5
	Point 2	35.5	38.5	25.6	65.3	67.2	55.3	90.5	89.7	84.6
	Point 3	29.8	31.6	42.5	58.1	58.6	67.3	85.8	86.2	91.5
	Point 4	32.8	28.2	17.6	56.0	55.2	39.6	81.0	81.6	68.6
	Point 5	24.3	20.7	8.5	46.7	45.4	25.8	75.1	75.9	52.4
Heavy Vehicles Nighttime	Point 1	52.0	53.3	31.3	80.0	80.0	71.9	100.0	100.0	93.8
	Point 2	28.0	13.3	12.5	52.0	53.3	34.4	96.0	86.7	71.9
	Point 3	20.0	13.3	21.9	52.0	46.7	50.0	76.0	93.3	87.5
	Point 4	24.0	13.3	3.1	44.0	40.0	15.6	80.0	93.3	65.6
	Point 5	16.0	13.3	3.1	44.0	33.3	9.4	80.0	80.0	46.9
All Vehicles Nighttime	Point 1	60.6	69.3	51.4	87.8	89.9	85.7	98.2	97.9	96.3
	Point 2	35.1	36.5	25.0	64.7	66.1	54.3	90.8	89.4	84.0
	Point 3	29.3	30.2	41.5	57.8	57.7	66.5	85.3	86.8	91.3
	Point 4	32.3	27.0	16.9	55.4	54.0	38.4	80.9	82.5	68.4
	Point 5	23.9	20.1	8.2	46.6	44.4	25.0	75.3	76.2	52.1

Table B-20. Change in Nighttime Percent Exceeding Results for FM 60.

Vehicle Group	Location	Change in Percent Exceeding:					
		65 mph		60 mph		55 mph	
		LTA-B	LTA-STA	LTA-B	LTA-STA	LTA-B	LTA-STA
Passenger Vehicles Nighttime	Point 1	-8.7	-18.3	-1.8	-4.4	-1.6	-1.2
	Point 2	-9.9	-12.9	-10.0	-11.9	-5.9	-5.1
	Point 3	12.7	10.9	9.2	8.7	5.7	5.3
	Point 4	-15.2	-10.6	-16.4	-15.6	-12.4	-13.0
	Point 5	-15.8	-12.2	-20.9	-19.6	-22.7	-23.5
Heavy Vehicles Nighttime	Point 1	-20.7	-22.0	-8.1	-8.1	-6.2	-6.2
	Point 2	-15.5	-0.8	-17.6	-18.9	-24.1	-14.8
	Point 3	1.9	8.6	-2.0	3.3	11.5	-5.8
	Point 4	-20.9	-10.2	-28.4	-24.4	-14.4	-27.7
	Point 5	-12.9	-10.2	-34.6	-23.9	-33.1	-33.1
All Vehicles Nighttime	Point 1	-9.2	-17.9	-2.1	-4.2	-1.9	-1.6
	Point 2	-10.1	-11.5	-10.4	-11.8	-6.8	-5.4
	Point 3	12.2	11.3	8.7	8.8	6.0	4.5
	Point 4	-15.4	-10.1	-17.0	-15.6	-12.5	-14.1
	Point 5	-15.7	-11.9	-21.6	-19.4	-23.2	-24.1

Table B-21. Daytime Results for SH 36, All Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	518	480	1573			
Control Point 1	Mean	70	72.1	71	***2.1****	***1****	***-1.1****
	85th Percentile	75	77	75	2	0	-2
	Std. Dev.	5.5	5.1	5.3			
Threshold Point 2	Mean	67.1	68.3	67.8	***1.2****	0.7	-0.5
	85th Percentile	73	73	73	0	0	0
	Std. Dev.	6.1	5.2	5.7			
Legibility Point 3	Mean	66.8	67.7	66	***0.9****	***-0.8****	***-1.7****
	85th Percentile	73	73	72	0	-1	-1
	Std. Dev.	6.1	5.7	5.9			
Sign Point 4	Mean	65	65.4	66.5	0.4	***1.5****	***1.1****
	85th Percentile	71	71	74	0	3	3
	Std. Dev.	5.9	5.7	7.1			
Downstream Point 5	Mean	65	64.9	59.4	-0.1	***-5.6****	***-5.5****
	85th Percentile	72	71	66	-1	-6	-5
	Std. Dev.	6.3	6.1	6.2			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-22. Nighttime Results for SH 36, All Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	238	71	463			
Control Point 1	Mean	67.4	69.1	67.8	1.7	0.4	-1.3
	85th Percentile	72	75	73	3	1	-2
	Std. Dev.	4.8	5.7	5.2			
Threshold Point 2	Mean	63	64.3	64.3	1.3	***1.3****	0
	85th Percentile	69	70	70	1	1	0
	Std. Dev.	5.6	5.5	5.9			
Legibility Point 3	Mean	62.9	63.9	63.1	1	0.2	-0.8
	85th Percentile	69	69	69	0	0	0
	Std. Dev.	5.4	5.7	5.8			
Sign Point 4	Mean	61.2	61.8	64.3	0.6	***3.1****	***2.5****
	85th Percentile	67	68	71	1	4	3
	Std. Dev.	5.5	5.6	6.4			
Downstream Point 5	Mean	61.6	61.5	57.8	-0.1	***-3.8****	***-3.7****
	85th Percentile	68	67	64	-1	-4	-3
	Std. Dev.	5.8	5.3	5.5			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-23. Daytime Results for SH 36, Passenger Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	361	364	1318			
Control Point 1	Mean	71	72.8	71.4	***1.8****	0.4	***-1.4****
	85th Percentile	76	77	76	1	0	-1
	Std. Dev.	5.5	5.2	5.4			
Threshold Point 2	Mean	68.7	69.2	68.3	0.5	-0.4	***-0.9****
	85th Percentile	73	74	74	1	1	0
	Std. Dev.	5.8	5.1	5.7			
Legibility Point 3	Mean	68.2	68.5	66.4	0.3	***-1.8****	***-2.1****
	85th Percentile	73	74	72	1	-1	-2
	Std. Dev.	6	5.7	6			
Sign Point 4	Mean	66.2	65.9	66.7	-0.3	0.5	0.8
	85th Percentile	72	72	74	0	2	2
	Std. Dev.	6	5.9	7.3			
Downstream Point 5	Mean	66.2	65.3	59.6	-0.9	***-6.6****	***-5.7****
	85th Percentile	73	72	66	-1	-7	-6
	Std. Dev.	6.4	6.3	6.4			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-24. Daytime Results for SH 36, Heavy Vehicles.

Location	MOE: Speed (mph)	Before (B)	Short-Term After (STA)	Long-Term After (LTA)	STA-B	LTA-B	LTA-STA
	Sample Size	157	116	255			
Control Point 1	Mean	67.6	70	69.2	***2.4****	***1.6****	-0.8
	85th Percentile	73	74	72	1	-1	-2
	Std. Dev.	4.7	4.3	4.1			
Threshold Point 2	Mean	63.6	65.6	65.2	***2****	***1.6****	-0.4
	85th Percentile	68	70	70	2	2	0
	Std. Dev.	5.1	4.6	4.9			
Legibility Point 3	Mean	63.6	65.4	64.1	***1.8****	0.5	-1.3
	85th Percentile	68	70	69	2	1	-1
	Std. Dev.	4.8	5.1	4.9			
Sign Point 4	Mean	62.1	63.9	64.9	***1.8****	***2.8****	1
	85th Percentile	66	69	70	3	4	1
	Std. Dev.	4.8	4.8	5.5			
Downstream Point 5	Mean	62.3	63.8	58.5	1.5	***-3.8****	***-5.3****
	85th Percentile	66	70	63	4	-3	-7
	Std. Dev.	5.1	5.3	4.9			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-25. Nighttime Results for SH 36, Passenger Vehicles.

Location	**MOE: Speed (mph)**	**Before (B)**	**Short-Term After (STA)**	**Long-Term After (LTA)**	**STA-B**	**LTA-B**	**LTA-STA**
	Sample Size	120	63	347			
Control Point 1	Mean	68.2	69.2	68.5	1	0.3	-0.7
	85th Percentile	73	75	74	2	1	-1
	Std. Dev.	5.6	5.9	5.5			
Threshold Point 2	Mean	65.5	64.5	65.5	-1	0	1
	85th Percentile	71	70	71	-1	0	1
	Std. Dev.	5.3	5.3	5.8			
Legibility Point 3	Mean	64.9	64.1	64.1	-0.8	-0.8	0
	85th Percentile	70	69	70	-1	0	1
	Std. Dev.	5.4	5.5	5.9			
Sign Point 4	Mean	62.8	61.9	65.3	-0.9	***2.5****	***3.4****
	85th Percentile	69	68	72	-1	3	4
	Std. Dev.	5.6	5.4	6.6			
Downstream Point 5	Mean	63	61.5	58.5	-1.5	***-4.5****	***-3****
	85th Percentile	70	67	65	-3	-5	-2
	Std. Dev.	5.9	4.9	5.6			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-26. Nighttime Results for SH 36, Heavy Vehicles.

Location	**MOE: Speed (mph)**	**Before (B)**	**Short-Term After (STA)**	**Long-Term After (LTA)**	**STA-B**	**LTA-B**	**LTA-STA**
	Sample Size	118	8	116			
Control Point 1	Mean	66.6	68.3	65.9	1.7	-0.7	-2.4
	85th Percentile	69	70	70	1	1	0
	Std. Dev.	3.7	3.8	3.6			
Threshold Point 2	Mean	60.5	62.1	60.7	1.6	0.2	-1.4
	85th Percentile	65	69	65	4	0	-4
	Std. Dev.	4.7	7	4.5			
Legibility Point 3	Mean	61	61.6	60.2	0.6	-0.8	-1.4
	85th Percentile	66	68	65	2	-1	-3
	Std. Dev.	4.8	7	4.5			
Sign Point 4	Mean	59.6	61	61.5	1.4	***1.9****	0.5
	85th Percentile	65	68	67	3	2	-1
	Std. Dev.	4.8	7.4	4.8			
Downstream Point 5	Mean	60.2	61.1	55.6	0.9	***-4.6****	***-5.5****
	85th Percentile	66	67	60	1	-6	-7
	Std. Dev.	5.3	7.9	4.2			

Note: Asterisk (*) indicates a statistically significant difference between the compared speeds.

Table B-27. Daytime Percent Exceeding Results for SH 36.

Vehicle Group	Location	Percent Exceeding 70 mph			Percent Exceeding 60 mph			Percent Exceeding 55 mph		
		B	STA	LTA	B	STA	LTA	B	STA	LTA
Passenger Vehicles Daytime	Point 1	54.8	65.7	61.2	95.6	99.2	97.5	100.0	100.0	99.3
	Point 2	39.9	38.7	38.8	90.3	94.5	92.1	96.4	98.9	98.4
	Point 3	34.9	34.9	26.9	88.9	90.1	84.1	97.0	98.4	95.9
	Point 4	22.7	19.0	33.8	83.1	79.9	81.0	94.7	96.4	95.1
	Point 5	26.6	19.8	4.9	79.5	77.2	46.3	95.0	93.4	74.1
Heavy Vehicles Daytime	Point 1	25.5	48.3	39.6	94.3	97.4	98.4	98.1	99.1	99.6
	Point 2	8.3	12.9	15.7	70.7	87.1	85.5	95.5	97.4	100.0
	Point 3	7.0	14.7	11.0	74.5	83.6	79.6	96.8	97.4	96.9
	Point 4	4.5	9.5	14.5	63.7	76.7	78.8	90.4	94.8	98.0
	Point 5	7.6	7.8	1.2	65.0	72.4	38.0	88.5	93.1	73.7
All Vehicles Daytime	Point 1	45.9	61.5	57.7	95.2	98.8	97.6	99.4	99.8	99.4
	Point 2	30.3	32.5	35.1	84.4	92.7	91.0	96.1	98.5	98.7
	Point 3	26.4	30.0	24.3	84.6	88.5	83.4	96.9	98.1	96.1
	Point 4	17.2	16.7	30.7	77.2	79.2	80.6	93.4	96.0	95.5
	Point 5	20.8	16.9	4.3	75.1	76.0	44.9	93.1	93.3	74.0

Table B-28. Change in Daytime Percent Exceeding Results for SH 36.

Vehicle Group	Location	Change in Percent Exceeding:					
		70 mph		60 mph		55 mph	
		LTA-B	LTA-STA	LTA-B	LTA-STA	LTA-B	LTA-STA
Passenger Vehicles Daytime	Point 1	6.4	-4.5	1.9	-1.7	-0.7	-0.7
	Point 2	-1.1	0.1	1.8	-2.4	2.0	-0.5
	Point 3	-8.0	-8.0	-4.8	-6.0	-1.1	-2.5
	Point 4	11.1	14.8	-2.1	1.1	0.4	-1.3
	Point 5	-21.7	-14.9	-33.2	-30.9	-20.9	-19.3
Heavy Vehicles Daytime	Point 1	14.1	-8.7	4.1	1.0	1.5	0.5
	Point 2	7.4	2.8	14.8	-1.6	4.5	2.6
	Point 3	4.0	-3.7	5.1	-4.0	0.1	-0.5
	Point 4	10.0	5.0	15.1	2.1	7.6	3.2
	Point 5	-6.4	-6.6	-27.0	-34.4	-14.8	-19.4
All Vehicles Daytime	Point 1	11.8	-3.8	2.4	-1.2	0.0	-0.4
	Point 2	4.8	2.6	6.6	-1.7	2.6	0.2
	Point 3	-2.1	-5.7	-1.2	-5.1	-0.8	-2.0
	Point 4	13.5	14.0	3.4	1.4	2.1	-0.5
	Point 5	-16.5	-12.6	-30.2	-31.1	-19.1	-19.3

Table B-29. Nighttime Percent Exceeding Specific Results for SH 36.

Vehicle Group	Location	Percent Exceeding 65 mph			Percent Exceeding 60 mph			Percent Exceeding 55 mph		
		B	STA	LTA	B	STA	LTA	B	STA	LTA
Passenger Vehicles Nighttime	Point 1	70.0	84.1	77.8	92.5	93.7	95.1	100.0	98.4	98.6
	Point 2	58.3	44.4	53.9	82.5	77.8	83.0	96.7	95.2	96.5
	Point 3	51.7	41.3	46.1	79.2	76.2	74.9	95.0	93.7	93.1
	Point 4	34.2	27.0	50.7	65.0	58.7	75.8	89.2	90.5	94.8
	Point 5	36.7	23.8	12.1	63.3	54.0	38.6	90.0	90.5	68.6
Heavy Vehicles Nighttime	Point 1	67.8	87.5	56.0	95.8	100.0	94.8	100.0	100.0	100.0
	Point 2	14.4	37.5	17.2	50.0	50.0	56.9	83.1	75.0	88.8
	Point 3	19.5	37.5	14.7	51.7	50.0	49.1	83.1	62.5	87.1
	Point 4	13.6	25.0	22.4	45.8	50.0	62.1	74.6	62.5	91.4
	Point 5	16.1	37.5	0.9	46.6	50.0	16.4	78.8	62.5	54.3
All Vehicles Nighttime	Point 1	68.9	84.5	72.4	94.1	94.4	95.0	100.0	98.6	98.9
	Point 2	36.6	43.7	44.7	66.4	74.6	76.5	89.9	93.0	94.6
	Point 3	35.7	40.8	38.2	65.5	73.2	68.5	89.1	90.1	91.6
	Point 4	23.9	26.8	43.6	55.5	57.7	72.4	81.9	87.3	94.0
	Point 5	26.5	25.4	9.3	55.0	53.5	33.0	84.5	87.3	65.0

Table B-30. Change in Nighttime Percent Exceeding Specific Results for SH 36.

Vehicle Group	Location	Change in Percent Exceeding:					
		65 mph		60 mph		55 mph	
		LTA-B	LTA-STA	LTA-B	LTA-STA	LTA-B	LTA-STA
Passenger Vehicles Nighttime	Point 1	7.8	-6.3	2.6	1.4	-1.4	0.2
	Point 2	-4.4	9.5	0.5	5.2	-0.2	1.3
	Point 3	-5.6	4.8	-4.3	-1.3	-1.9	-0.6
	Point 4	16.5	23.7	10.8	17.1	5.6	4.3
	Point 5	-24.6	-11.7	-24.7	-15.4	-21.4	-21.9
Heavy Vehicles Nighttime	Point 1	-11.8	-31.5	-1.0	-5.2	0.0	0.0
	Point 2	2.8	-20.3	6.9	6.9	5.7	13.8
	Point 3	-4.8	-22.8	-2.6	-0.9	4.0	24.6
	Point 4	8.8	-2.6	16.3	12.1	16.8	28.9
	Point 5	-15.2	-36.6	-30.2	-33.6	-24.5	-8.2
All Vehicles Nighttime	Point 1	3.5	-12.1	0.9	0.6	-1.1	0.3
	Point 2	8.1	1.0	10.1	1.9	4.7	1.6
	Point 3	2.5	-2.6	3.0	-4.7	2.5	1.5
	Point 4	19.7	16.8	16.9	14.7	12.1	6.7
	Point 5	-17.2	-16.1	-22.0	-20.5	-19.5	-22.3