MIDWEST SMART WORK ZONE DEPLOYMENT INITIATIVE

MwSWZDI

FHWA POOLED FUND STUDY

Report Title	Report Date: 2000
CB Wizard Alert System	

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Supplemental Notes

Abstract

WIZARD CB ALERT SYSTEM

Objectives

The primary goal of this evaluation was to determine the effectiveness of the Wizard CB alert system (CB message) as located in the approach to a highway work zone. The CB message is intended for use both with stationary long-term work zones and with short-term moving projects. The specific research objectives were:

1. To test the effectiveness of the CB message in merging the traffic into one lane before the work zone starts;
2. To test and evaluate the effectiveness of the CB message in reducing the average speeds and speed variance approaching the work zone;
3. To determine the opinion of drivers traveling through the work zone about the CB message; and
4. To determine if the CB message changed the accident rate.

Measures Of Effectiveness

The CB message was expected to provide an advance warning of the lane closure, to encourage motorists to reduce vehicle speed, to reduce the speed variance, and to be safe for motorists. Table 4-47 shows the measures of effectiveness associated with each objective. Lane distribution and speed measurements were disaggregated by vehicle type (passenger vehicle vs. non-passenger vehicle) and by time of day (day, night, and dawn/dusk).

TABLE 4-47 Measures of effectiveness.

Objective	Measures
Provide advance warnings	Lane distribution
Reduce speed	Mean speed 85^{th} percentile speed Mean speed of fastest 15% of vehicles 10-mph pace
Reduce speed variance	Standard deviation of speed % of vehicles in 10-mph pace
Perform for life of project	Observed ease of installation Observed east of use
Provide for safety	Number of accidents related to CB message

Data Collection And Analysis Procedures

The field research was conducted at a stationary, long-term work zone on eastbound Interstate 70 (I-70) near Columbia, Missouri.

Site Description

The highway normally has a 70-mph speed limit, but the posted speed limit approaching the work zone was reduced first to 60-mph and then to 50-mph. The solar-powered, trailer-mounted CB wizard alert system broadcasts a work zone alert and information for advance warning about potentially hazardous conditions on a CB radio channel (Figure 4-36). The CB message was broadcast on Channel 19 from a location approximately 6 miles (9.67 km) upstream of the lane closure. The system transmitted the following message when the right lane was closed: "This is the Missouri Department of Transportation. The right lane of Eastbound I-70 is closed ahead. Watch for slow or stopped traffic." A similar message was transmitted when the left lane was closed.

The pavement-related work at this site included cold milling, pavement repair, and resurfacing. The average daily traffic was approximately 14,600 vehicles, with 25.6 % non-passenger vehicles (three or more axles) in the eastbound direction of travel. The right lane (driving lane) was closed during the study.

Data Collection

Data were collected at four locations along the approach to the work zone, as shown in Figure 4-37, before the CB message was broadcast (before case) and again while the message was broadcast (after case). Vehicle speeds, volumes, and vehicle classifications were collected in 15-minute intervals. Due to breaks in the pneumatic tubes, it was not always possible to collect data at all four sites during all time periods, but approximately 24 hours of data were collected for both the before and after cases. The CB message was initially broadcast on April 23, 1999. Data for the analysis were collected on April 6, 1999 for the before case and on April 27, 1999 for the after case.

Accident data were collected from one mile upstream of the first counter site through the end of the work zone. Drivers were surveyed to determine the availability and efficacy of the message.

FIGURE 4-36 Wizard CB alert system.

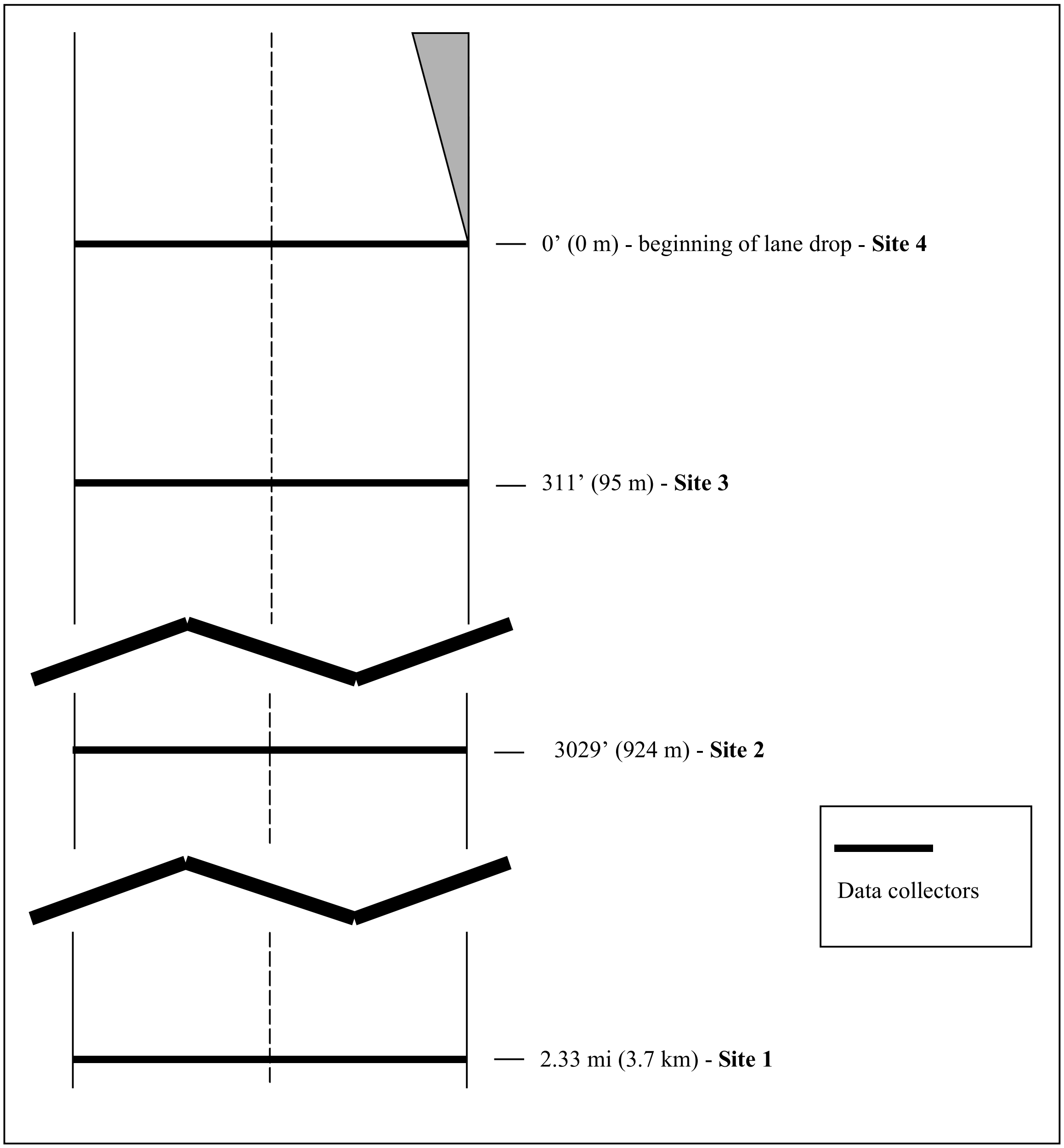

FIGURE 4-37 Schematic location of detectors approaching work zone.

Data Analysis

The primary measures of effectiveness used to analyze the data were mean speed, speed variance, and lane distribution upstream of the work zone. Along with these parameters, the percentage of vehicles below the speed limit, the 10-mph pace, the percentage of vehicles in the 10-mph pace, the 85th percentile speed, and the mean speed of the fastest 15% of vehicles were calculated to evaluate the traffic control devices in detail. The analysis examined the difference in the parameters before and after the device was installed. Significance testing of the parameters used a two-tailed Student’s t-test with a level of significance $\alpha = 0.05$. An F-test was also conducted at the same level of significance to find any significant differences in the speed variance.

Each “before and after” comparison is a test of the hypothesis that the characteristic under study is the same in the before and after cases (i.e., the characteristic did not change). The level of significance (α) used was 0.05. This means that when there was no change, the test can be expected to reach that conclusion correctly (that there is no statistically significant difference) in 95% of the comparisons. However, in 5% of the cases in which there was no change, the test can be expected to indicate a statistically significant difference (this is called a Type I error).

The analysis methods, as well as classification procedures, were the same as those used to evaluate the removable orange rumble strips (refer to page 4-1).

Results

Results related to lane distribution, speed, speed variance, driver response to the CB message, and safety are presented below. All comparisons described are the after case compared to the before case, and after cells that show a statistically significant difference from the before case (α= 0.05) are shaded in the tables. A blank cell indicates that there were no such conditions observed, and a dash (–) indicates that it was not possible to calculate the particular parameter. For example, if only one vehicle were observed in a 15-minute interval, it would not be possible to calculate a standard deviation of speed.

Due to problems with the data collection device at Site 4, data are only reported for Sites 1, 2, and 3. Data collection sites 1, 2, and 3 were 2.33 miles, 3029 feet, and 311 feet upstream from the beginning of the lane closure, respectively. Drivers at all three locations probably could have heard the CB message if they were listening to Channel 19.

Lane Distribution

The lane distribution is considered to be improved in the after case if a lower percentage of vehicles is in the closed lane.

Figures 4-38 to 4-40 present profiles of the percentage of traffic remaining in the lane closed downstream. In all cases at Data Collection Site 1, the majority of traffic is in the right-side driving lane (the lane closed downstream). At Sites 2 and 3, the majority of traffic is in the left-side passing lane (the lane open downstream). In general, the percentage of traffic in the closed lane was lower in the after case than in the before case. Non-passenger vehicles exhibited greater reductions than passenger vehicles.

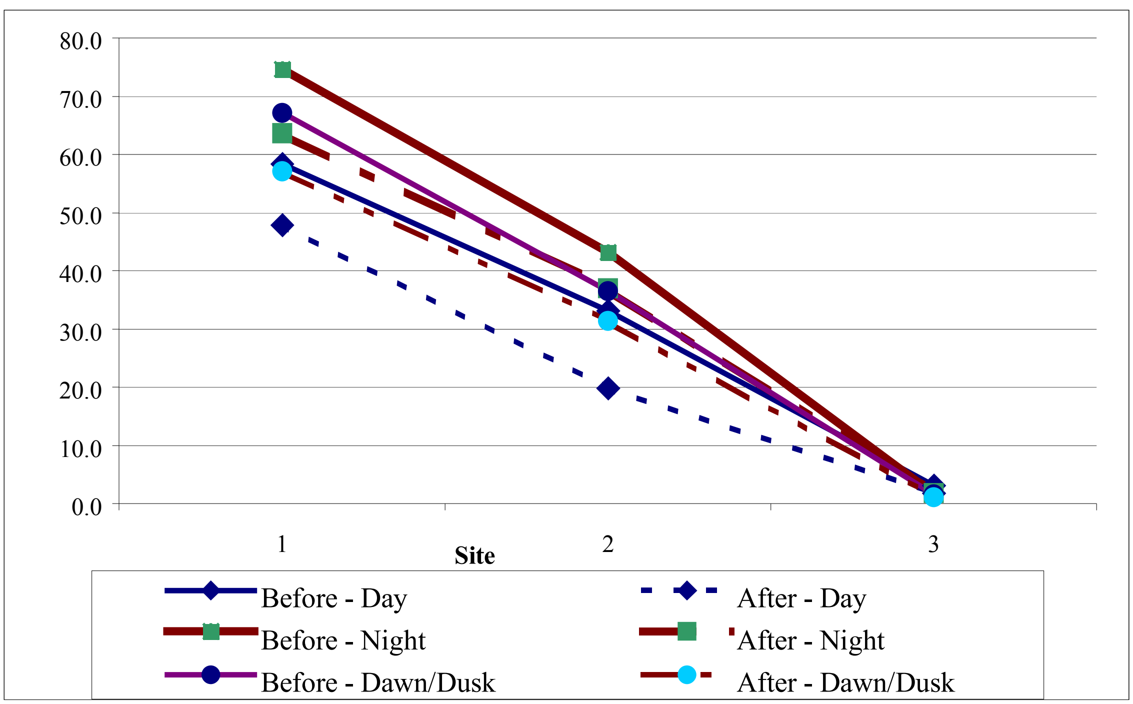

FIGURE 4-38 Profile of percentage of traffic in closed lane – all vehicles.

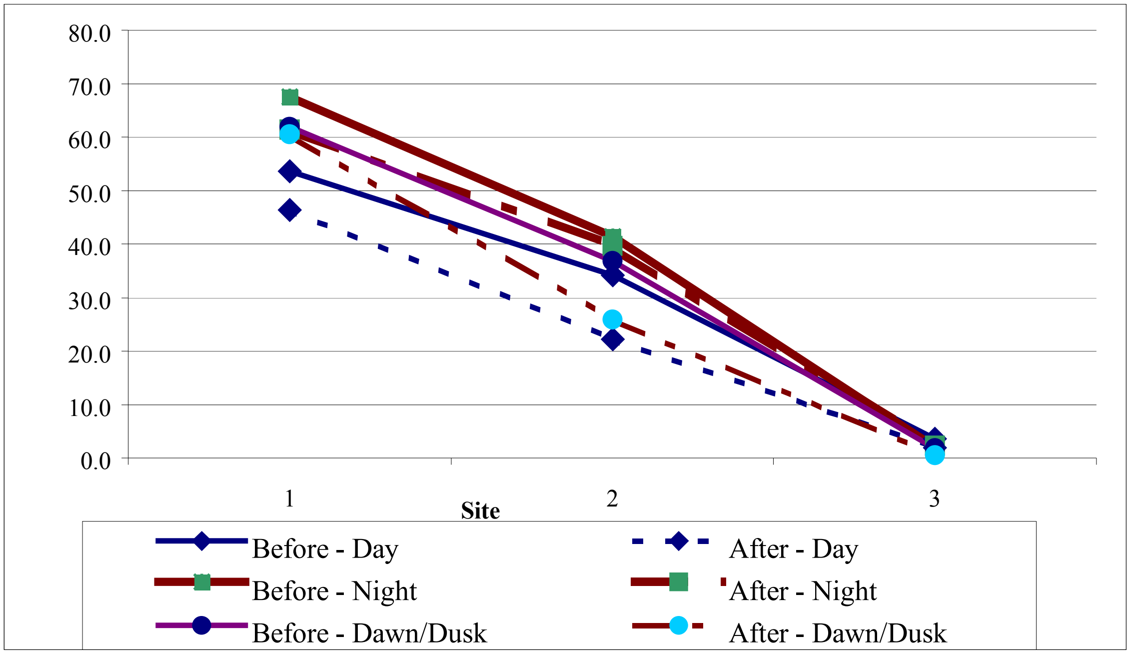

FIGURE 4-39 Profile of percentage of traffic in closed lane – ***passenger vehicles.***

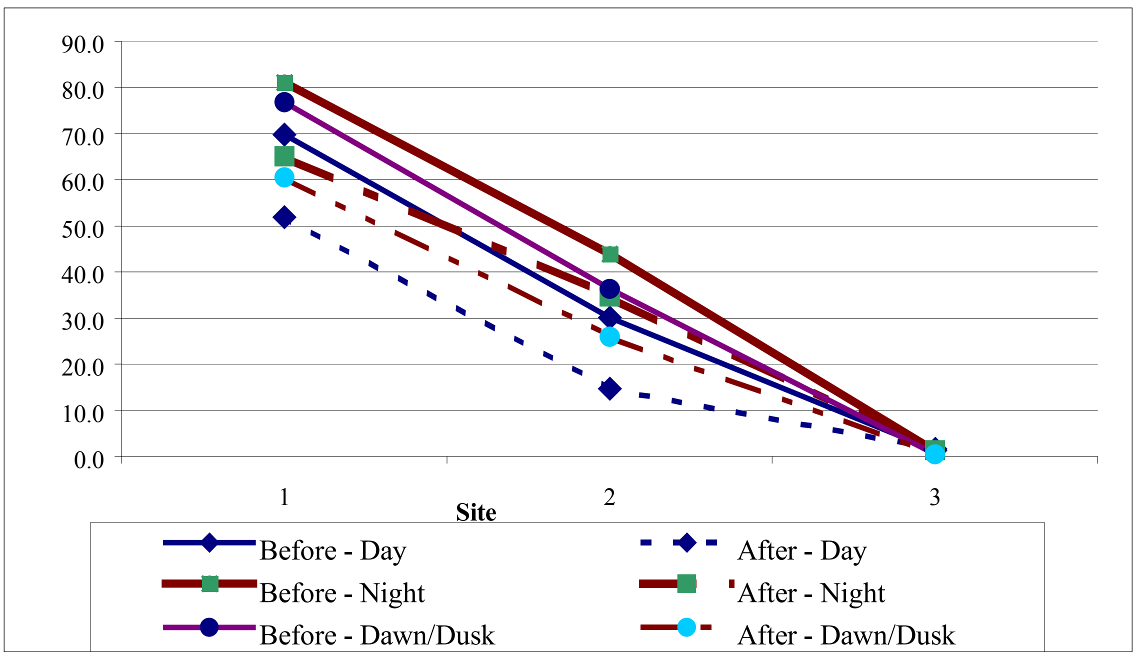

FIGURE 4-40 Profile of percentage of traffic in closed lane – ***non-passenger vehicles.***

Tables 4-48 to 4-50 show the percentage of traffic remaining in the lane closed downstream during the day, night, and dawn/dusk in the before and after cases.

During the day (Table 4-48), lane distribution was better at all three sites under both uncongested and congested conditions. In several of the uncongested cases, the improvement was at a statistically significant level.

At night (Table 4-50), lane distribution improved at both Sites 1 and 2, with most of the improvements at a statistically significant level. Site 3 showed some small increases in the percentage of traffic in the closed lane, but the changes were not statistically significant.

During the dawn/dusk periods (Table 4-48), lane distribution improved at all sites in almost all cases.

TABLE 4-48 Percentage of traffic in the closed lane – day.

Vehicle type	Case	Uncongested Conditions at Site			Congested Conditions at Site		
		1	2	3	1*	2*	3
All vehicles	Before	58.3	33.1	3.0			5.1
	After	**47.8**	**19.7**	**1.8**			1.4
Passenger vehicles	Before	53.6	34.1	3.6			6.2
	After	**46.4**	**22.2**	**1.9**			1.7
Non-passenger vehicles	Before	69.8	30.1	1.4			1.8
	After	**51.9**	14.7	1.6			0.6
* No congested conditions were observed at Sites 1 and 2							

TABLE 4-49 Percentage of traffic in the closed lane – night.

Vehicle type	Case	Uncongested Conditions at Site*		
		1	2	3
All vehicles	Before	74.7	43.2	1.7
	After	**63.6**	**36.9**	1.8
Passenger vehicles	Before	67.5	41.5	2.0
	After	**61.4**	39.7	2.2
Non-passenger vehicles	Before	81.1	44.0	1.2
	After	**65.1**	**34.7**	1.4
* No congested conditions were observed				

TABLE 4-50 Percentage of traffic in the closed lane – dawn/dusk.

Vehicle type	Case	Uncongested Conditions at Site*		
		1	2	3
All vehicles	Before	67.19	36.50	1.48
	After	**57.07**	31.30	1.00
Passenger vehicles	Before	61.88	36.8	1.77
	After	54.27	34.4	1.25
Non-passenger vehicles	Before	76.87	36.4	0.47
	After	**60.50**	25.9	0.51
* No congested conditions were observed				

Mean Speed Characteristics

This section presents results for mean speed, percentage of vehicles below the speed limit, 10-mph pace, 85th percentile speed, and mean speed of the fastest 15% of vehicles during the day, night, and dawn/dusk. A lower mean speed, 10-mph pace, 85th percentile speed, and mean speed of the fastest 15% of vehicles are associated with improved conditions, as is an increase in the percentage of vehicles below the speed limit.

<u>Mean Speeds</u>

Figures 4-41 to 4-43 show the mean speed profiles for the open lane for the before and after cases. At Sites 2 and 3, mean speeds tended to be lower in the after case.

Tables 4-51 to 4-53 present the results for mean speeds in the before and after cases.

Under uncongested conditions during the day (Table 4-51), in the after cases, Site 1 speeds were higher while Site 2 and 3 speeds (closer to the merge point) were all lower. Site 3 speeds were also lower under congested conditions.

At night (Table 4-52), Site 1 again showed higher mean speeds in the after case, while Sites 2 and 3 showed lower mean speeds.

In the dawn/dusk periods (Table 4-53), mean speeds at Site 1 tended to be higher in the after case. Site 2 speeds were mostly lower, and Site 4 speeds were all lower in the after case.

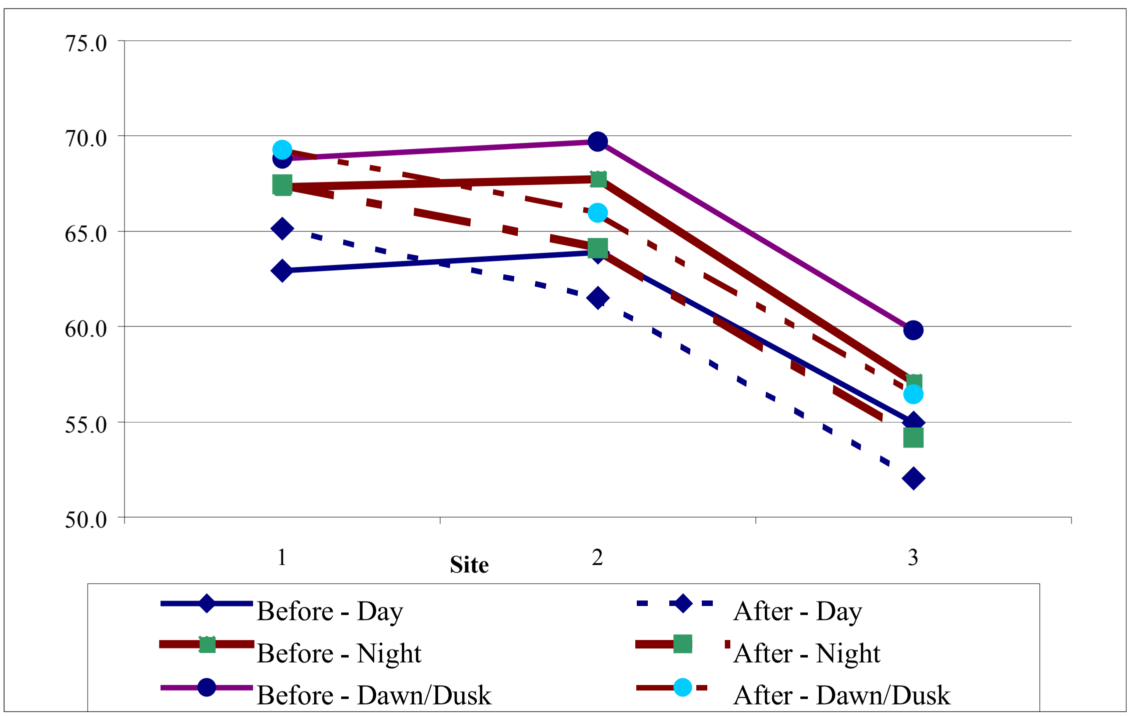

FIGURE 4-41 Mean speed profiles for open lane – *all vehicles.*

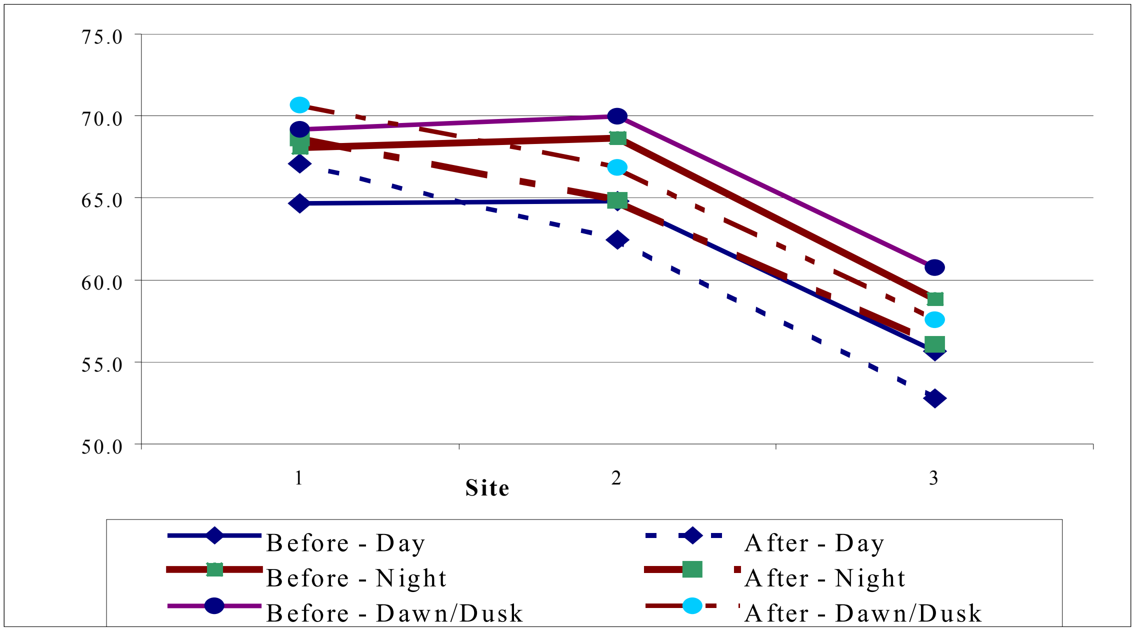

FIGURE 4-42 Mean speed profiles for open lane – ***passenger vehicles.***

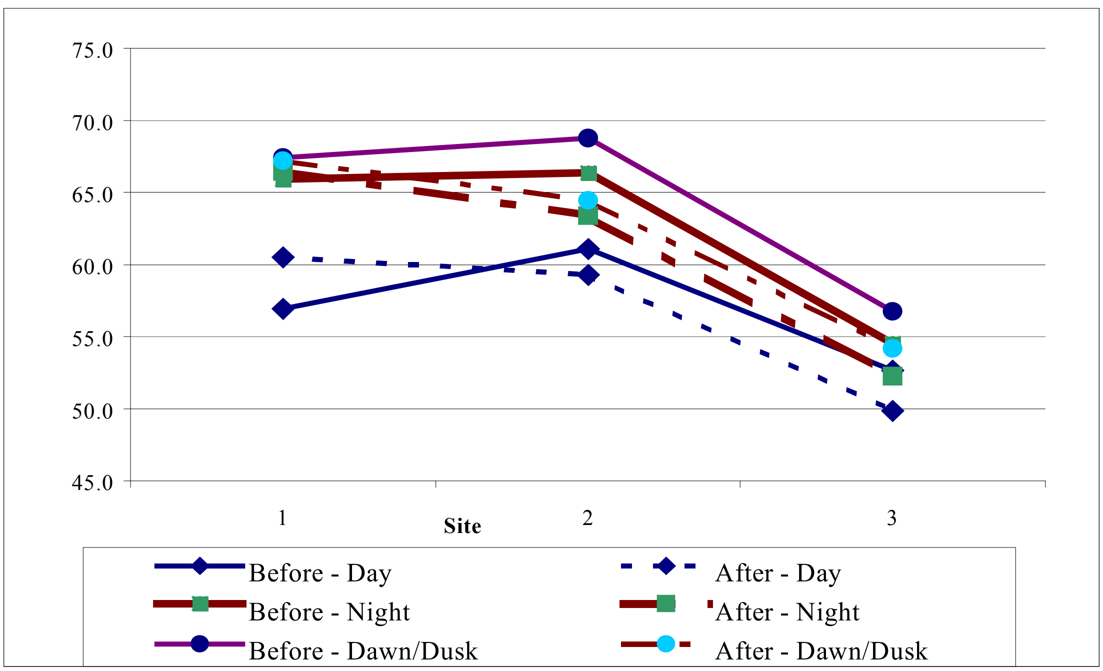

FIGURE 4-43 Mean speed profiles for open lane – ***non-passenger vehicles.***