ABSTRACT OF
A STUDY OF THE EFFECTIVENESS OF SELECTED
SCHOOL ZONE TRAFFIC CONTROL DEVICES

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In this study, the effectiveness of five different school zone traffic control devices were tested. Each was tested at a unique site. Speed data was obtained at each site before the devices were added, and again one month and six months after the devices were installed. The five devices tested in the study were: fiber optic signs, spanwire-mounted flashing yellow beacons, post-mounted flashing yellow beacons, transverse lavender stripes, and large painted legends.

Of the five sites tested, only the site with the fiber optic signs experienced a speed reduction significant at a 95% level. Several of the other sites also experienced decreases in speeds; however, these decreases were not statistically significant.

KEY WORDS: Speed, Schools, fiber optics, tranverse stripes, flashing beacons

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INTRODUCTION

Need To Study School Zones

School zone safety concerns many in our communities. Parents, politicians, police, and traffic engineers all share concern about pedestrian safety in school zones. Parent activism concerning school zone safety is increasing, and with it political intervention in what has traditionally been a police and traffic engineering area. Although the intentions of the parents and politicians are honorable, the results of their efforts are many times ineffective in solving the safety problem, and sometimes can be detrimental. Thus, the need exists for traffic engineers to study which devices, if any, can improve school zone safety.

To parents and politicians, the solutions are easy. Install traffic signals. Install STOP signs. Reduce the speed limit. Although logical, are these solutions effective? If so, which one is the most effective? The most cost effective? The task of the traffic engineer is to determine the answers to these questions.

Springfield's Experiences

Like many other cities, the city of Springfield, Illinois, found itself under increasing pressure from parents and politicians to improve safety in school zones. In 1990, the most common problem in Springfield's school zones was speeding. At that time, most school zones were posted with a speed limit of 20. The lower speed limit was in effect "on school days when children are

present", which is an ambiguous time frame. Due to limited manpower, the school speed limits were not regularly enforced. This lack of regular enforcement also contributed to the speeding problem, as drivers generally tended to ignore the school speed limits when they were not being actively enforced.

Due to the non-effectiveness of periodic enforcement, the city decided to try various devices at school zones, to determine, which, if any, would reduce speeds in school zones. The purpose of this study was to test these various devices and techniques.

STUDY DESIGN

Scope Of This Study

For this study, six sites were selected. These sites were located throughout the city to assure the elimination of any geographical bias. These six sites, and their locations with respect to each other, are shown in Figure 1.

Three criteria were used for the selection of sites. The first criterion was that the site should be an unprotected crossing. In other words, any school zone selected was to be marked only with SPEED LIMIT 20 ON SCHOOL DAYS WHEN CHILDREN ARE PRESENT signs.

The second criterion was that the site should be located on a collector. The rationale behind this criterion was that pedestrian volumes at unprotected crossings are higher on collectors than arterials due to lower vehicular volumes, and local streets do not have enough vehicular traffic to create many vehicle-pedestrian conflicts. In other words, sites were selected

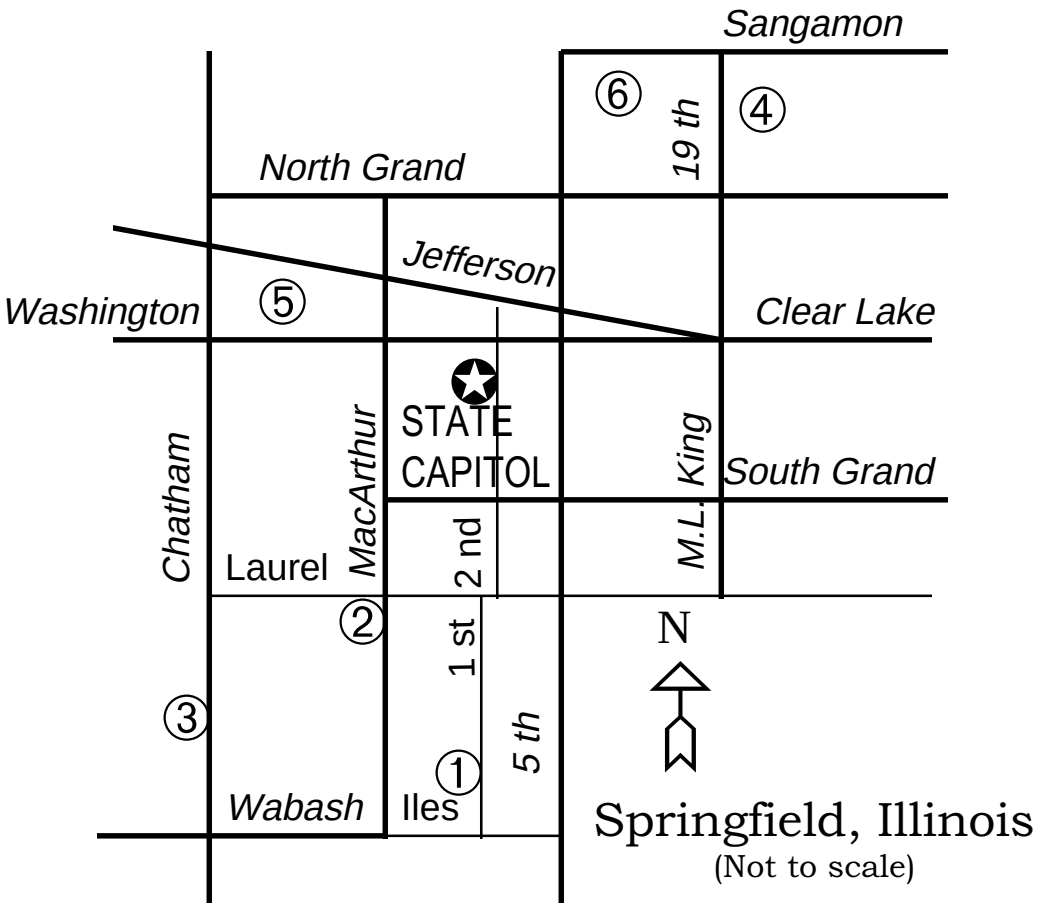

FIGURE 1. Locations of sites studied.

with high enough vehicular volumes to create numerous potential vehicle-pedestrian conflicts, but not high enough to discourage a significant number of pedestrian crossings.

The third criterion was that the site have a high number of 'walkers', students that walk to school. Sites with a high number of 'walkers' also have more potential vehicle-pedestrian conflicts, and therefore a higher chance of pedestrian injury.

Vehicular speed data was collected using radar before any traffic devices were changed at the sites. Vehicular speed data was also collected one month after traffic device changes at the sites were implemented, and again six months after the changes were implemented. (Six month data was not gathered for one of the six sites, as the site was added several months after the changes to the other sites.)

The traffic devices were not changed at one site, the control site, in order to verify that outside influences were not affecting speeds during the study period.

Sites Selected

Site 1: Black Hawk School (Control Site)

The crossing for Black Hawk School, a public elementary school, is located at the intersection of Lenox Avenue, a connection between MacArthur Boulevard and First Street, and College Street. (Figure 2) Numerous children walk to school along Lenox Avenue.

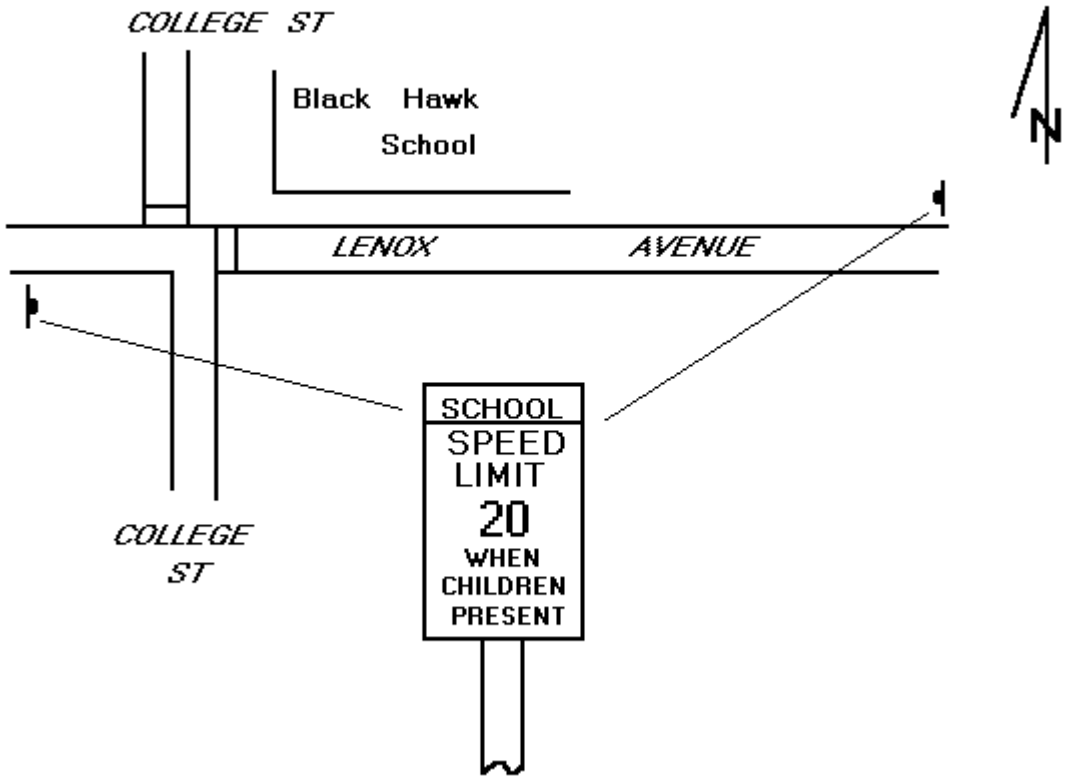

FIGURE 2. Site 1, Black Hawk School (Control Site).

This crossing was the control site; that is, the traffic control devices at this location were not changed. The traffic devices at this location throughout the study period consisted of

SCHOOL SPEED LIMIT 20 ON SCHOOL DAYS WHEN CHILDREN ARE PRESENT signs at each end of the school zone.

Site 2: Butler School (Post-Mounted Flashing Beacons)

The crossing near Butler School, a public elementary school, is located at the intersection of Laurel Street, a crosstown east-west collector, and Dial Court. Numerous Butler School students cross at this crossing. In addition, students from Blessed Sacrament School, located four blocks east of the site, also use this crossing, although at different times of the day than the Butler students.

Post-mounted flashing yellow beacons with SPEED LIMIT 20 WHEN FLASHING signs were the traffic control device improvements at this location, as shown in Figure 3. The total cost for these improvements was approximately $800.

Site 3: Christ the King School (Lavender transverse stripes)

This school zone is located on Brentwood Drive at the south entrance to Christ the King, a parochial grade school. Brentwood is a collector that connects the shopping areas of west Springfield to the residential areas along Chatham Road. Unlike the first two sites, this site does not have a marked crosswalk.

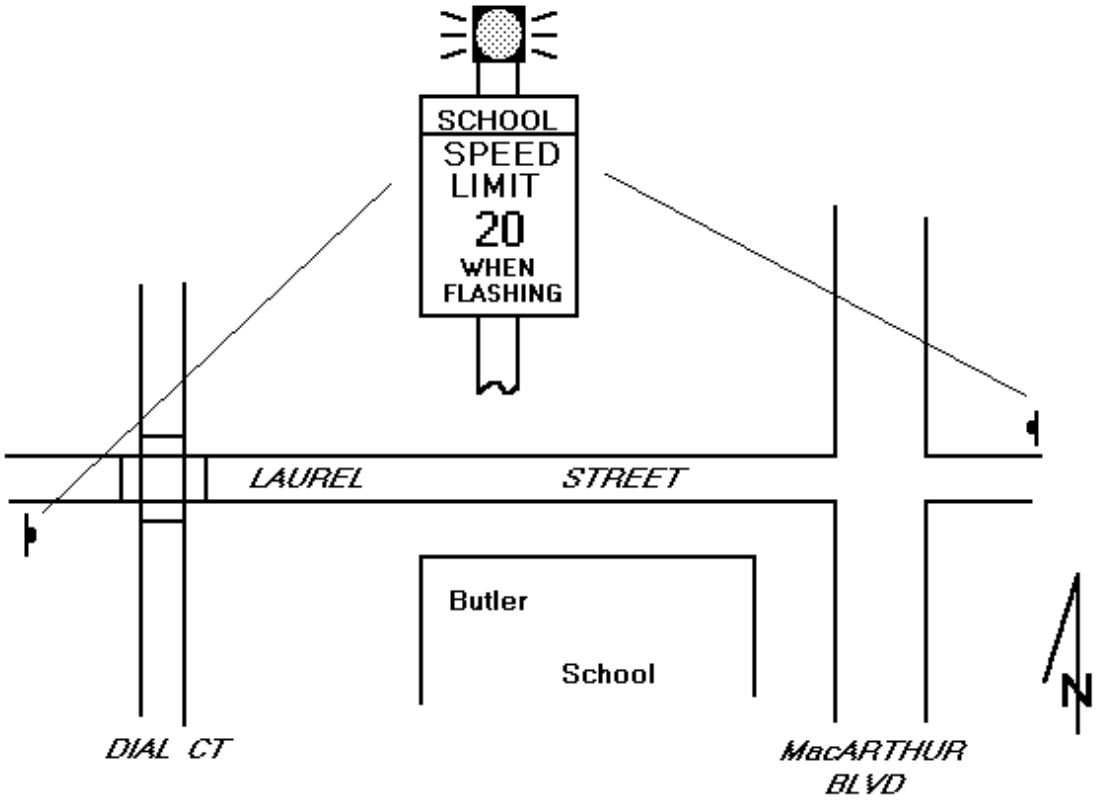

FIGURE 3. Site 2, Butler School

At this location, the posts of the SCHOOL SPEED LIMIT 20 ON SCHOOL DAYS WHEN CHILDREN ARE PRESENT signs were painted lavender. (This color was chosen because of its uniqueness and because it was not a reserved color for traffic control devices.) In addition, transverse lavender stripes were painted on the pavement at the two entrances to the school zone, with the distance between subsequent stripes decreasing as one proceeds into the school zone. (Figure 4) The total cost of the changes to this site was approximately $100.

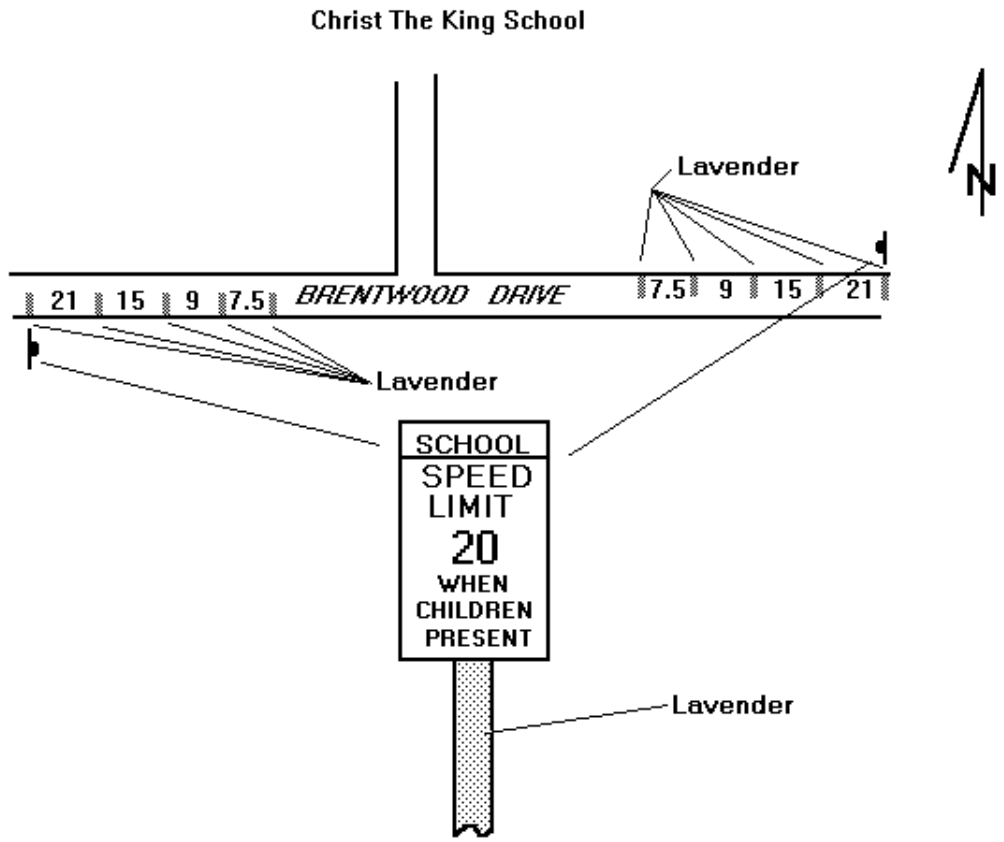

FIGURE 4. Site 3, Christ the King School.

Site 4: Fairview School (Spanwire-mounted Flashing Beacons)

This public elementary school is located on in a residential neighborhood south of Sangamon Avenue and east of Nineteenth Street on Ridgely Avenue. Ridgely is the southernmost connection between a large residential area and Nineteenth Street. This school zone has a marked crosswalk.

As shown in Figure 5, Spanwire-mounted flashing yellow beacons with SPEED LIMIT 20 WHEN FLASHING signs were the traffic control device improvements at this location. Approximately $2400 was spent on the improvements to this site.

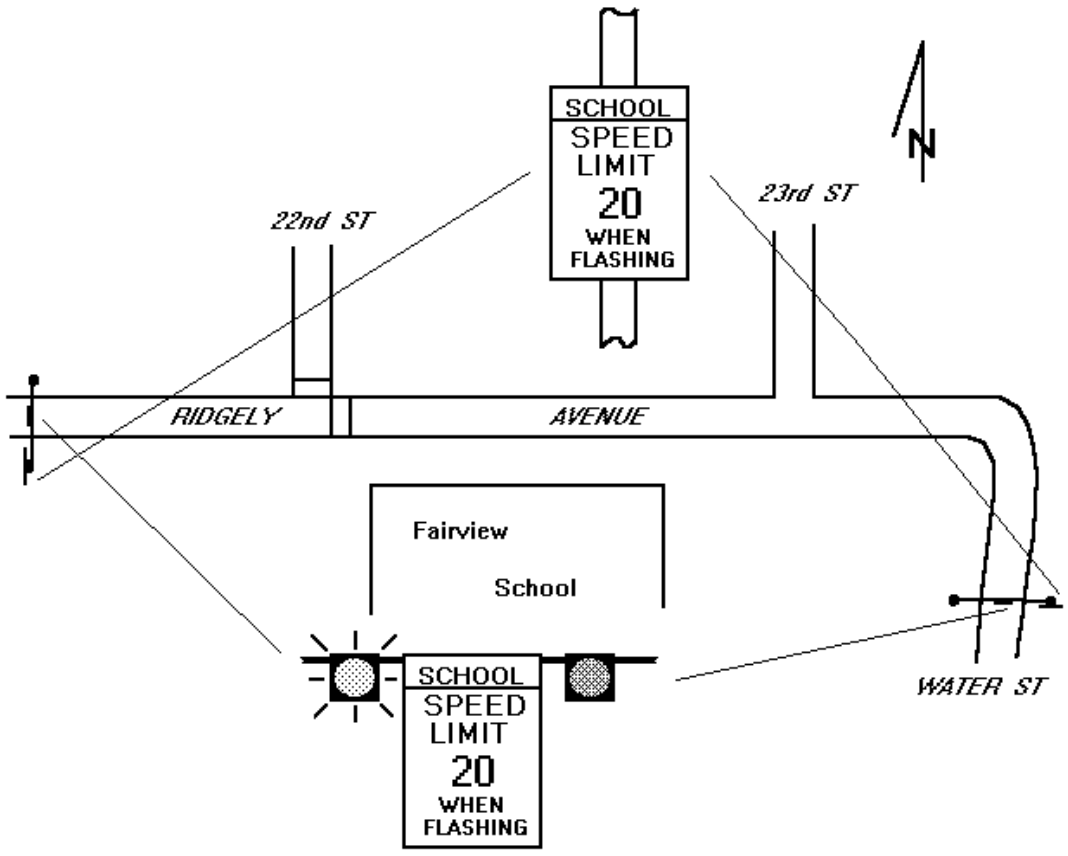

FIGURE 5. Site 4, Fairview School.

Site 5: Saint Agnes School (Fiber Optic Signs)

Saint Agnes School is a parochial located on Amos Avenue, between Washington and Jefferson Streets. Amos is a north-south collector that connects several major east-west corridors. This school zone, like the school zone on Brentwood near Christ the King, does not have a marked crosswalk.

Fiber optic signs with the message SCHOOL SPEED LIMIT 20 were the improvements to this site. (Figure 6) These signs are only illuminated at the beginning and end of the school day. The total installation cost of the fiber optic signs was approximately $4900.

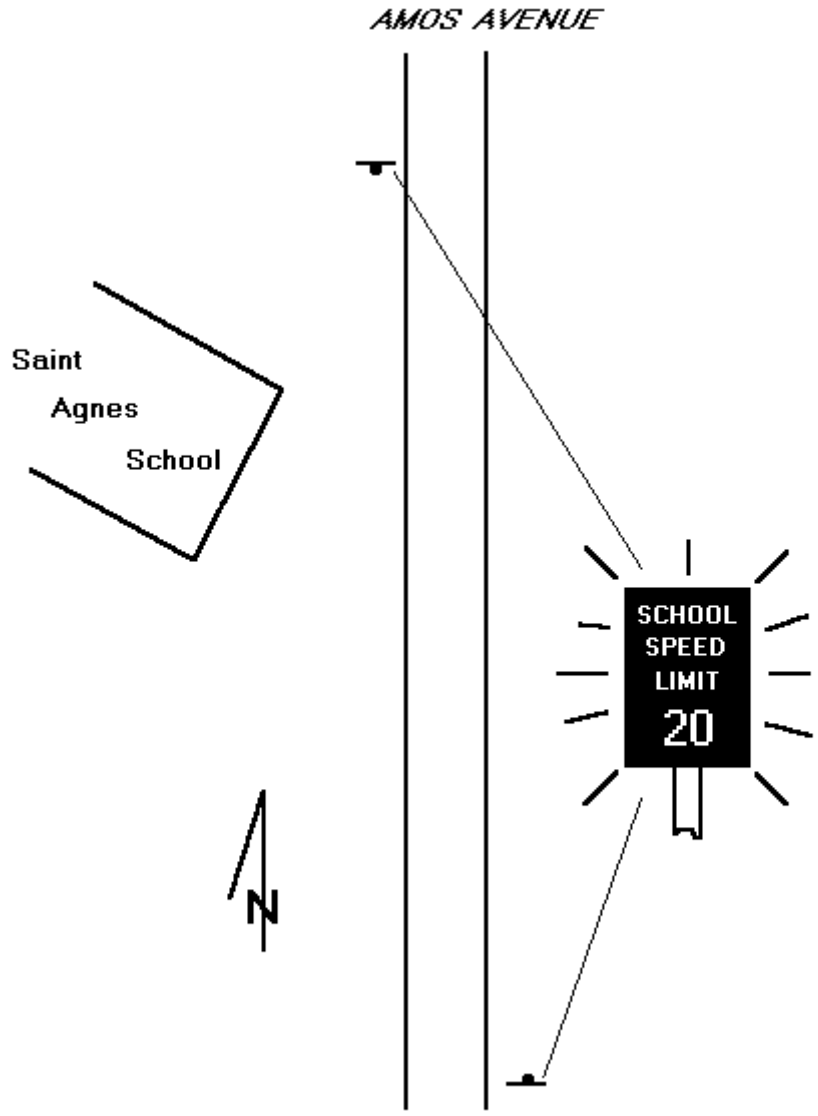

FIGURE 6. Site 5, Saint Agnes School.

Site 6: Ridgely School (2.44 m Painted Legends)

This pubic elementary school is located on Eighth Street, two blocks south of Sangamon Avenue. Eighth is a north-south collector that connects the Illinois State Fairgrounds on Sangamon Avenue with central Springfield. In the vicinity of Ridgely School, Eighth is approximately 15 meters in width.

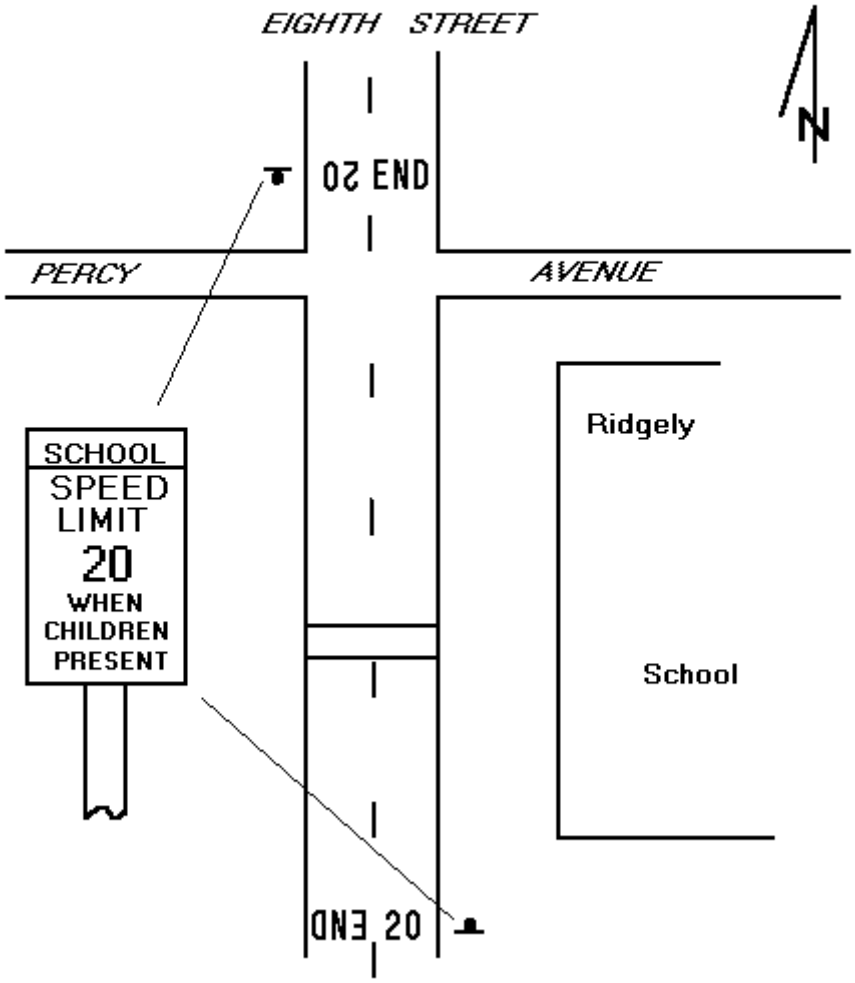

FIGURE 7. Site 6, Ridgely School.

This site was added several months after the first five were selected, and thus six month data for this site was not obtained. At this location, special pavement markings were added. For

each direction of travel, a 2.44 meter high "20" was painted at the beginning of the school zone, and a 2.44 meter high "END" was painted at each end of the school zone. (Figure 7) These improvements cost approximately $250.

DATA ANALYSIS

Results

The 85th percentile speeds before and after the changes to the sites for each site are given in Table 1. Speeds at the control site, Black Hawk School, did not drop after changes were made to the other sites, which suggests that outside influences probably did not contribute to speed decreases at the other sites. Both short term (1 month after the changes) and long term (6 months after the changes) speeds were reduced at Butler, the locations where post-mounted flashing beacons were installed, and Saint Agnes School, where the fiber optic signs were added; Christ the King, the location of the lavender stripes, experienced only a short term reduction; Fairview School did not experience a short term reduction after the installation of the spanwire-mounted flashing beacons, but did experience a long term reduction. Speeds were also reduced at Ridgely School, but long term data of the effectiveness of the 2.44 m legends at this location was not obtained. In other words, all five sites where the traffic control devices were improved experienced a decrease in speeds at some point in time.

TABLE 1. Comparison of 85th percentile speeds before and after traffic control device changes.

DATA SET	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Black Hawk School (No changes)										
BEFORE	34	32	28	26	27	25	27			
1 MONTH AFTER	33	35	27	28	26	29	30			
6 MONTHS AFTER	33	29	26	29	26	29	29			
Butler School (Post-mounted flashing yellow beacons)										
BEFORE	20	26	26	31	29	28	28	26	29	30
1 MONTH AFTER	23	27	28	28	27	27	26	30	25	27
6 MONTHS AFTER	26	27	26	27	26	29	26	29	26	27
Christ the King School (Transverse lavender stripes)										
BEFORE	30	29	28	27	24	24	28	29		
1 MONTH AFTER	28	27	26	25	26	25	25	26		
6 MONTHS AFTER	27	28	29	28	27	26	28	26		
Fairview School (Spanwire-mounted flashing yellow beacons)										
BEFORE	25	29	27	25	25	23	25			
1 MONTH AFTER	29	28	25	30	25	25	25			
6 MONTHS AFTER	25	29	26	24	26	24	23			
Saint Agnes School (Fiber optic signs)										
BEFORE	36	32	30	32	37	33	30	35		
1 MONTH AFTER	32	31	30	29	27	29	30	30		
6 MONTHS AFTER	31	31	29	30	28	31	28	34		
Ridgely School (2.44 m painted legends)										
BEFORE	33	35	33	34	33	33	28			
1 MONTH AFTER	32	34	32	34	31	32	28			

Statistical Analysis

For this study, the "t" test was used to statistically analyze the data. For this analysis, the test hypothesis was that speeds decreased after the changes to the sites. This hypothesis was tested for a 95% level of significance. The results of this analysis are listed in Table 2.

As can be seen from Table 2, Saint Agnes School was the only site that experienced a significant decrease, which it experienced both one month and six months after the fiber optic signs were installed. The mean speed at this location was initially 33.12. One month after the changes, the mean speed decreased by 3.37 to 29.75. Six months after the changes, the mean speed was 30.25, 2.87 less than the initial mean speed.

At Butler School, the mean speed was 0.50 and 0.40 lower than the initial mean speed one month and six months, respectively, after the post-mounted flashing beacons were installed. Although the mean speed did decrease, this decrease was not significant at the 95% level.

The mean speed decreased from 27.38 to 26.00 one month after the transverse lavender stripes were installed at Christ the King. However, the mean speed at six months after the changes was 27.38, the same as the mean speed before the changes. Thus, the changes at this location only had a short term effect on speeds, and even this effect was not significant at a 95% level.

Fairview School experienced an increase of the mean speed from 25.57 to 26.71 within the first month after the spanwire-mounted flashing beacons at the site were activated. However, the mean speed six months after the changes was 25.29, which is less than the mean speed before the changes. This decrease was not statistically significant.

TABLE 2. Statistical analysis of the changes in the 85th percentile speeds.

	m[1]	$m_b - m_a$[2]	t_α[3]	t[4]	Is $t > t_\alpha$?[5]
Black Hawk School (No changes)					
BEFORE	28.43				
1 MONTH AFTER	29.71	-1.28	1.782	<0	NO
6 MONTHS AFTER	28.71	-0.28	1.782	<0	NO
Butler School (Post-mounted flashing yellow beacons)					
BEFORE	27.30				
1 MONTH AFTER	26.80	0.50	1.734	0.437	NO
6 MONTHS AFTER	26.90	0.40	1.796	0.381	NO
Christ the King School (Transverse lavender stripes)					
BEFORE	27.38				
1 MONTH AFTER	26.00	1.38	1.833	1.553	NO
6 MONTHS AFTER	27.38	0.00	1.833	0.000	NO
Fairview School (Spanwire-mounted flashing yellow beacons)					
BEFORE	25.57				
1 MONTH AFTER	26.71	-1.14	1.782	<0	NO
6 MONTHS AFTER	25.29	0.28	1.782	0.748	NO
Saint Agnes School (Fiber optic signs)					
BEFORE	33.12				
1 MONTH AFTER	29.75	3.37	1.796	2.708	YES
6 MONTHS AFTER	30.25	2.87	1.761	0.275	YES
Ridgely School (2.44 m painted legends)					
BEFORE	32.71				
1 MONTH AFTER	31.86	0.85	1.782	0.748	NO

[1] m= mean 85th percentile speed

[2] m_b= mean 85th percentile speed before changes

m_a= mean 85th percentile speed after changes

[3] Source: Ott, Lyman. An Introduction to Statistical Methods and Data Analysis, 3rd Edition. PWS-Kent, Boston, MA, 1988, p. A-5.
[NOTE: Variations in ta due to variations in the degrees of freedom.]

[4] t= test statistic.
Source (of procedure): Ibid, pp. 170 - 175.

[5] If $t > t_\alpha$, then the decrease is significant at the 95% level.

The mean speed one month after the 2.44 m legends were painted at Ridgely School, 31.86, was less than the mean speed before the changes, 32.17, although not significantly so. Since data was not obtained six months after the changes to this site, it cannot be determined whether or not this decrease was only temporary, as was the case with the lavender stripes at Christ the King.

As stated previously, speeds at the control site, Black Hawk School, were higher after the changes to the other site. This increase strongly indicates that external influences did not contribute to the decreased speeds at the other five sites, that is, the decreased speeds at the other sites were a result of the changes at those sites.

CONCLUSION

Summary

Of the five traffic control devices tested, only one, the fiber optic signs, significantly decreased speeds. The decrease was not only short term, i.e., within one month after the signs were installed, but also long term, i.e., six months after the signs were installed.

The other four devices, the two types of flashing yellow beacons and the two types of pavement markings, did not significantly reduce speeds, although the site with the post-mounted flashing beacons did experience a modest decrease in speeds. However, it cannot be determined whether or not these decreases were a direct result of the beacons, or a random sample variation.

In summation, the only site at which significant speed decreases occurred was at Saint Agnes School, where fiber optic signs were installed. It is probable that these decreases can be attributed to the fiber optic signs.

Recommendations for Further Study

Because of the very limited scope of this study, these results should not be considered conclusive and absolute. All of the devices should be tested at other locations, to determine if the effectiveness or non-effectiveness of a particular device can be attributed to the device itself or some other site specific influence. These possible site specific influences include the type of school (private vs. public), type of pavement (asphalt vs. concrete), width of pavement, and the socio-economic characteristics of the neighborhood in which the school is located.

All of the devices should also be tested on other classifications of facilities, to determine which device is the best for a particular classification of roadway (i.e. specific applications), as well as which is the best for all roadway classifications (i.e. general applications).

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