

Improving Playground and School Zone Awareness

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Abstract: School and playground zones are used to improve the safety of our neighbourhoods for young vulnerable road users. Despite the increased presence of children at school and playground zone locations speed compliance is often a problem. The City of Calgary embarked on a pilot project to assess the effectiveness of various enhancements in improving awareness of the zone by measuring impact on travel speed. Eight traffic measures were identified as having the highest potential for improving the awareness of playground and school zones in Calgary.



The pilot project was conducted at 23 treatment sites and 6 comparison sites. The four enhancements which were most effective, based on the compliant driver change, were: neighbourhood speed watch program (19%), traffic cones with reflective spinning anemometer (15%), double signing at start of playground/school zone (10%), and road markings (4%). The average speed reduction for these four enhancements ranged between 2.8 km/h and 1.0 km/h, and the 85% speed reduction ranged between 3.2 km/h and 1.1 km/h. The speed watch and traffic cones had consistent effects on improving driver awareness at all trial sites. Double signs and road markings were effective at most of the trial sites. Larger signs, multiple signs, and reflective tape were found to be less effective at reducing speeds and increasing compliance. The use of zone ahead signs appeared to result in increased speeds and reduced compliance.

INTRODUCTION




School and playground zones are used to improve the safety of our neighbourhoods for vulnerable road users by informing drivers about the increased potential for the presence of children and imposing regulatory speed reductions to 30 km/h with the aim of reducing the frequency and severity of collisions. Between 2009 and 2013, 4% of pedestrian collisions in Calgary occurred in school and playground zones and 45% of pedestrians involved were 16 and under. This proportion is more than twice as high as the city-wide average of 17%.

Despite the increased presence of children at school and playground zone locations speed compliance is often a problem. Non-compliance may be caused by disregard for the speed limit or lack of awareness of the school or playground zone. To target the latter group, the City of Calgary embarked on a pilot project to assess the effectiveness of various enhancements in improving awareness of the zone. Over 30 different supplemental measures were examined and based on a survey of Canadian cities, stakeholder input and technical studies, eight measures were identified as having the highest potential for improving the awareness of playground and school zones in Calgary (Miller & Iwaskow, TT2013-0362). These measures are presented in Table 1.

Table 1 Playground and School Zone Supplemental Measures

Treatment	Photo
<p>Traffic cones with reflective spinning anemometer (traffic cones): cones were set up at school zone entrances by volunteers for the duration of the school zone hours.</p>	
<p>Neighbourhood speed watch program (speed watch): volunteers equipped with signs and a radar gun measured the travel speed and encouraged drivers to slow down or thanked them for going within the speed limit.</p>	

Treatment	Photo
<p>Reflective tape on playground/school zone sign poles (reflective tape): fluorescent retro-reflective tape attached to sign poles to improve conspicuity.</p>	
<p>Double signing at start of playground/school zones (double signs): an additional start of zone sign on the left side of the roadway at the beginning of the playground or school zone.</p>	
<p>Larger playground/school zone signs (larger signs): 30% increase in sign size compared to the standard playground and school zone sign</p>	

Treatment	Photo
<p>Multiple playground/school zone signs within a zone (multiple signs): an additional sign within the zone and a BEGINS tab added to the initial sign.</p>	
<p>Zone ahead signs (zone ahead signs): a zone ahead sign added to warn drivers in advance of the beginning of the existing playground/school zone.</p>	
<p>Road marking stencils (road markings): playground/school zone symbol pavement marking added to supplement signage at zone entry.</p>	

The pilot project summarized in this report, was initiated with the following objectives:

- To evaluate the effectiveness of the measures in increasing driver awareness of entering a playground or school zone by measuring the impact on travel speed and compliance, with emphasis on the applicability to a city-wide implementation;
- To gain a better understanding of driver perception of enhancements through a driver intercept survey.

METHODOLOGY AND IMPLEMENTATION

Higher vehicle speeds are strongly associated with higher collision risk and higher severity of pedestrian injuries (Leaf & Preusser). For this reason, comparison of speed data before and after each treatment was used to determine which measures are most effective at increasing driver awareness of entering the playground or school zones and improving safety. Similar methods were employed in a number of other evaluation studies (Schrader, Lazic, Hawkings). In addition, driver intercept surveys were conducted to assess the perception and comprehension of the implemented measures by motorists.

Trial Site Selection

The pilot included a trial of each measure at three or four sites, with a total of 23 'treatment' sites, and 6 comparison sites where no changes were made. Sites were selected based on criteria developed during the review of potential measures (Miller & Iwaskow, 2013). The site selection criteria noted below were established to identify typical sites and eliminate biases:

- Collision rates for the zone should be not be above typical values (collisions in last five years/km length of zone);
- Test locations should be on either a residential or collector road;
- Test locations should not be adjacent to all-way stops or signal controlled intersections;
- Test locations should primarily be in residential neighbourhoods;
- Test locations for each treatment should include both playground and school zones, except the; treatment of traffic cones which are restricted to school zones;
- The existing speed zone must meet current Transportation Association of Canada (TAC) warrants for the 30 km/hr speed limit.

All selected sites used for the pilot are presented in Table 2. Each site had between one and three locations where data was collected, depending on road geometry.

Table 2 Treatment and Comparison Sites

Measure	School Zones	Playground Zones	# of Sites
Treatment Sites			
Traffic cones	Saddleridge Elementary School	N/A	3
	Huntington Elementary School		
	Mother Mary Greene School		
Speed watch	Huntington Elementary School NW	Brenner Dr/Brenner Dr NW	4
	Mother Mary Greene School NW	Silver Mead Rd/72 St NW	
Reflective tape	St. Matthew Elementary & Jr. High SE	Shawglen Rd/Shawglen PI SW	3
		Bow Cr/66 St NW	
Double signs	Dalhousie Elementary School NW	Pineland Rd/Pineland PI NE	3
	Ecole St. Cecilia Elementary SE		
Larger signs	Highwood Elementary School NW	Laguna CI NE	3
	Blessed Damien Elementary SE		
Multiple signs	Our Lady of Peace Elementary and Jr. High SW	Woodbend Rd/Winterbourne Cr SE	3
		Palishall Rd SW	
Zone ahead signs	Mckenzie Towne School	Lake Erie Rd/Lake Erie PI SE	3
		Winston Dr SW	
Road markings	Riverbend Elementary SE	Tuscany Ridge Cm/Tuscany Ridge Wy NW	3
	Dr. Oakley School SW		
Comparison Sites			
No Change	Delta West Academy NE	Blakiston Dr/Bell St NW	6
	Calgary French School SW	Deerview Dr/Deerview PI SE	
	Light of Christ School NE	Silverdale Dr/68 St NW	

Trial Timeline

The pilot was conducted from August 2013 to October 2014 including implementation of the following activities: pre-pilot data collection, planning and design of trial measures, installation of trial measures, post-pilot data collection, and driver intercept survey. The timeline for the pilot program was dependent on the availability of City crews to install trial measures and collect data, the availability of volunteers to conduct the neighbourhood speed watch program, and schools being in session.

Most pre-treatment and post-treatment speed data were collected before the harmonized playground and school zone timing was effective, but a small sample of post-treatment data was collected after the zone timing changed. To screen out the potential impact on vehicle speeds made by driver unfamiliarity with the new zone timing, the school zone hours used for analyses were consistently from 7:30 to 17:00 and the playground zone hours used for analysis were from 8:30 to 21:00.

Playground and School Zone Pilot Project Costs

The material and installation costs associated with the pilot project are summarized in Table 3. Costs for data collection and evaluation are not included.

Table 3 Pilot Project Implementation Costs

Treatments	Total Costs
Cones ¹	\$969
Speed watch ²	\$1,803
Reflective tape ³	\$1,397
Double signing ⁴	\$1,349
Larger signs ^{4,5}	\$3,824
Multiple signs ⁴	\$1,679
Zone ahead signs ⁴	\$1,349
Road markings ⁶	\$769
Total	\$13,139

Notes:

¹ 10 traffic cones were purchased from Alberta Traffic Supply, 12 spinning anemometers were purchased from Europe.

² 3 sandwich boards were produced; one radar speed gun and one external 12-volt battery were purchased.

³ 12 reflective tape strips were purchased from Alberta Traffic Supply.

⁴ 2.6 additional signs, on average were required per zone for each treatment.

⁵ Due to the larger size standard sign production equipment could not be used and signs were made by hand.

⁶ 2 stencil sheets with (1.2 m x 2.4 m) were produced for school zone markings, and 2 stencil sheets with the same size were produced for playground zone markings.

EFFECTIVENESS EVALUATION RESULTS AND ANALYSES

Vehicle speeds were measured before and after the placement of each measure to allow comparison of differences in driver behaviour due to the presence of the treatment. Comparison sites were also measured to indicate changes in driver behaviour during the same time period without any changes to the site (possibly due to education, enforcement, or seasonal factors). Six metrics were used to evaluate the effectiveness for each treatment:

- Average speed reduction
- 85th percentile speed reduction
- Percentage increase in vehicles with a speed equal to or less than 30 km/h
- Percentage decrease in vehicle with a speed between 31 km/h and 35 km/h
- Percentage decrease in vehicles with a speed between 36 km/h and 50 km/h
- Percentage decrease in vehicles with a speed greater than 50 km/h

In general, the small changes in speed or compliance observed indicated that the target audience for these measures (unaware but would comply) was relatively small. This finding suggested that current levels of traffic control near playground and school zones are appropriate for most conditions. Despite best efforts to select typical sites, there were some locations where initial compliance was found to be low. Measures were found to have larger effects when initial compliance was low, as compared to sites where compliance was initially high. A general finding regarding lane widths was that sites with narrower lane widths were found to have better initial compliance than sites with wider lanes. Similarly, local roads had higher levels of compliance initially than collector roadways.

Traffic Cones

This traffic cones with reflective spinning anemometers measure was only evaluated in school zones due to logistics of cone placement and removal during zone hours by school volunteers. Three school zones were initially identified for this treatment but two schools withdrew their participation due to a lack of volunteers to place and remove cones. In order to get more reliable evaluation results for this measure, two school sites that were previously included for the neighbourhood speed watch pilot treatment were also used for traffic cones.

The before and after evaluation results are summarized in Table 4. The results suggest a consistent effectiveness of this measure at all study sites. The overall findings are statistically significant at 95% confidence level based on the Two-Sample t-Test (unequal variances).

Table 4 Before/After Study for Traffic Cones During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Driver Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 1: Saddleridge Elementary School Zone: 2 data collection points results in 4 groups of data						
EB	-3	-1	+14%	-2%	-10%	-2%
WB	-2	-2	+9%	0%	-8%	-1%
NB	-3	0	+20%	-11%	-10%	+1%
SB	-2	-4	+11%	-9%	-3%	+1%
Site 2: Huntington Elementary School Zone: 1 data collection point with 2 groups of data						
EB	-3	-4	+23%	-10%	-12%	-1%
WB	-1	-1	+5%	0%	-4%	-1%
Site 3: Mother Mary Greene School Zones: 1 data collection point with 2 groups of data						
NB	-4	-6	+25%	-7%	-15%	-3%
SB	-2	-2	+12%	0%	-11%	-1%
Overall	-2.50	-2.50	+5% to +25%	-11% to 0%	-15% to -3%	-3% to +1%

Although cones are considered to be effective in increasing driver awareness since they are in a direct line of sight of drivers, this treatment has a few challenges for implementation:

- School staff or volunteer availability and willingness to place and remove cones, especially when school zone hours extend to 21:00.
- Cones placed on the centerline of the undivided roadway are easily damaged by vehicles such as gravel trucks or snow plows.
- Potential for theft (however none occurred during the pilot).

Speed Watch

Volunteers were recruited to undertake this pilot treatment in two school zones and two playground zones. The portable radar guns, sandwich boards signs (Figure 1) and other equipment were provided to volunteers. This pilot treatment lasted two months and the volunteers at the speed watch zones were required to be “watching” one to two times in each two week cycle for at least 2 hours each session. Depending on volunteer willingness and volunteer numbers, the four zones completed between two to six sessions in the two month period.



Figure 1 Neighbourhood Speed Watch Sandwich Boards

The before and after studies indicated that the neighbourhood speed watch measure was effective at increasing driver awareness and lowering speeds at almost all sites except the southbound direction at the Mother Mary Greene school zone (Table 5). A possible explanation for this exception could be the downhill terrain of this approach. The overall findings are statistically significant at 95% confidence level based on the Two-Sample t-Test (unequal variances).

Even though this measure was successful in increasing driver awareness, its application is limited to locations where volunteers are willing to participate. The level of interest should be clearly understood before capital spending on equipment to support this measure is initiated. Furthermore, there may be a lower level of interest in conducting the speed watch during winter conditions.

Table 5 Before/After Study for Speed Watch During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Driver Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 2: Huntington Elementary School Zone: 1 data collection point with 2 groups of data						
EB	-3	-4	+19%	-8%	-9%	-2%
WB	-1	-1	+9%	-5%	-4%	0%
Site 3: Mother Mary Greene School Zones: 1 data collection point with 2 groups of data						
NB	-3	-4	+20%	-7%	-11%	-2%
SB	0	0	-3%	5%	-2%	0%
Site 4: Brenner Dr/Brenner Dr Playground: 1 data collection point with 2 groups of data						
EB	-3	-3	+16%	-5%	-11%	0%
WB	-2	0	+23%	-15%	-8%	0%
Site 5: Silver Mead Rd/72 St Playground: 1 data collection point with 2 groups of data						
EB	-6	-4	+37%	-16%	-20%	-1%
WB	-4	-3	+31%	-10%	-18%	-3%
Overall	-2.75	-2.50	-3% to +37%	-16% to +5%	-20% to -2%	-3% to 0%

Reflective Tape

Fluorescent retro-reflective tape attached to sign poles was intended to make existing signs more visible to drivers. However, the results below indicate this treatment had no obvious effect in increasing driver awareness. Moreover, with no parking restriction in advance of the playground and school zone signs, visual obstruction by parked vehicles may frequently limit the effectiveness of the measure. Before and after evaluation results are summarized in Table 6. The overall findings are not statistically significant at 95% confidence level based on the Two-Sample t-Test (unequal variances).

Table 6 Before/After Study for Reflective Tape During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Driver Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 6: St. Matthew Elementary & Jr. High School Zone: 1 data collection point with 2 groups of data						
EB	0	0	+2%	+5%	-6%	-1%
WB	0	-5	+1%	+6%	-7%	0%
Site 7: Shawglen Rd/Shawglen PI Playground: 1 data collection point with 2 groups						
EB	+2	+2	-5%	+4%	+1%	0%
WB	+1	+4	0%	-10%	+10%	0%
Site 8: Bow Cr/66 St Playground: 1 data collection point with 2 groups of data						
EB	-1	-1	+5%	+1%	-4%	-2%
WB	-1	-1	+2%	+5%	-7%	0%
Overall	+0.17	-0.17	-5% to +5%	-10% to +6%	-7% to +10%	-2% to 0%

Double Signing

Double signing involved installation of an additional start of zone sign on the left side of the roadway at the beginning of the playground or school zone. Logically, double signing should be most effective in the two situations: (1) if either sign was blocked by trees or parked vehicles; and (2) if there were drivers turning right into the zone and the zone starts near an intersection or a curve. For zones where the existing signs are clearly visible to drivers this measure may be redundant. The before and after evaluation results are summarized in Table 7. A possible explanation for this exception could be the downhill terrain of this approach. The overall findings are statistically significant at 95% confidence level based on the Two-Sample t-Test (unequal variances).

Table 7 Before/After Study for Double Signing During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Driver Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 9: Dalhousie Elementary School Zone: 1 data collection point with 2 groups of data						
EB	0	+1	0%	+3%	-3%	0%
WB	-1	0	+19%	-7%	-11%	-1%
Site 10: Ecole St. Cecilia Elementary School Zone: 2 data collection points with 4 groups of data						
NB	0	-1	-1%	+4%	-3%	0%
SB	-1	0	-2%	+1%	+1%	0%
NB	+2	0	-5%	+4%	+1%	0%
SB	-1	-1	+4%	-4%	+1%	-1%
Site 11: Pineland Rd/Pineland PI Playground: 1 data collection point with 2 groups of data						
NB	-4	-5	+27%	-2%	-24%	-1%
SB	-7	-3	+40%	-17%	-21%	-2%
Overall	-1.50	-1.13	-5% to +40%	-17% to +4%	-24% to +1%	-2% to 0%

Larger Signs

The existing standard playground and school zone signs with dimensions of 75x120 cm were replaced by signs 30% larger (90x135 cm). Although the overall effectiveness of this measure is lower than neighbourhood speed watch, traffic cones, and double signing, the effect was consistent at two of three trial sites. The before and after evaluation results are summarized in Table 8. The overall findings are statistically significant at 95% confidence level based on the Two-Sample t-Test (unequal variances).

Table 8 Before/After Study for Larger Signs During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Drivers Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 12: Highwood Elementary School Zone: 2 data collection points with 4 groups of data						
NB	-1	-1	+13%	-3%	-8%	-2%
SB	-1	0	+10%	-3%	-7%	0%
EB	-1	-2	+1%	+5%	-5%	-1%
WB	-1	-2	+12%	-6%	-6%	0%
Site 13: Blessed Damien Elementary School Zone: 1 data collection point with 2 groups of data						
NB	-1	-5	+16%	+1%	-14%	-3%
SB	-3	-2	+7%	+1%	-8%	0%
Site 14: Laguna CI Playground: 2 data collection points with 4 groups of data						
NB	-2	+1	+12%	-12%	0%	0%
SB	+3	+3	-19%	+13%	+6%	0%
NB	+4	+7	-25%	+15%	+10%	0%
SB	-1	0	+2%	-4%	+2%	0%
Overall	-0.40	-0.10	-25% to +16%	-12% to +15%	-14% to +10%	-3% to 0%

Multiple Signs

Based on the results of different trial sites, multiple signs show some overall effectiveness, but with inconsistency among the trial sites. The findings suggest that multiple signs may be more effective on a straight and long zone (e.g. Our Lady of Peace Elementary and Jr. High School Zone SB) than on curves or in shorter zones (e.g. Woodbend Rd/Winterbourne Cr. NB and SB). Similar to the measure of double signing, if the original sign at the start of the zone is visible for drivers, this measure appears to have a limited effect. The before and after evaluation results are summarized in Table 9. The overall findings are statistically significant at 95% confidence level based on the Two-Sample t-Test (equal variances).

Table 9 Before/After Study for Multiple Signs During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Drivers Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 15: Our Lady of Peace Elementary and Jr. High School Zone: 1 data collection point with 2 groups of data						
EB	0	-1	-3%	+4%	+1%	-2%
WB	+1	+1	-7%	0%	+7%	0%
NB	0	+2	-4%	0%	+3%	+1%
SB	-3	-3	+17%	-8%	-9%	0%
Site 16: Woodbend Rd/Winterbourne Cr Playground: 1 data collection point with 2 groups of data						
NB	+2	+1	-1%	+1%	0%	0%
SB	+2	+3	-7%	-2%	+9%	0%
Site 17: Palishall Rd Playground: 1 data collection points with 2 groups of data						
NB	-4	-2	+26%	+2%	-30%	+2%
SB	-2	-2	+24%	-6%	-18%	0%
EB	-2	-2	-7%	+14%	-7%	0%
WB	+3	+1	+1%	+2%	-3%	0%
Overall	-0.30	-0.20	-7% to +26%	-8% to +14%	-30% to +9%	-2% to +2%

Zone Ahead Signs

The intention of the ‘zone ahead’ signs was to warn drivers they were approaching a lower speed limit zone. However, at sites where this measure was implemented the average speed increased by 0.83 km/h, and the percentage of vehicles complying with the speed limit decreased by 2%. A possible explanation for this finding is that drivers who were unfamiliar with the ‘zone ahead’ signs may have misinterpreted the sign as a zone start sign, and begin driving at 30 km/h. This misunderstanding would result in an unusually long zone, which could lead to decreased compliance. When these drivers came into the actual zone, their speeds may have increased above 30 km/hr. The before and after evaluation results are summarized in Table 10. The overall findings are statistically significant at 95% confidence level based on the Two-Sample t-Test (equal variances)

Table 10 Before/After Study for Zone Ahead Signs During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Driver Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 18: Mckenzie Towne School Zone: 1 data collection point with 2 groups of data						
EB	0	-1	+3%	+2%	-5%	0%
WB	0	0	-2%	0%	+2%	0%
Site 19: Lake Erie Rd/Lake Erie Pl Playground: 1 data collection point with 2 groups of data						
NB	0	0	-6%	+8%	-3%	+1%
SB	+1	+1	-4%	-1%	+4%	+1%
Site 20: Winston Dr Playground: 1 data collection point with 2 groups of data						
NB	+2	0	-9%	+1%	+9%	-1%
SB	+2	-1	+4%	-8%	+7%	-3%
Overall	+0.83	-0.17	-9% to +4%	-8% to +8%	-5% to +9%	-3% to +1%

Road Markings

Figure 2 shows the dimensions of playground and school road markings. Road markings were placed in the middle of the travel lane, 10 m downstream from the start of the zone. Similar to traffic cones, the road markings are located in the primary view of a driver.

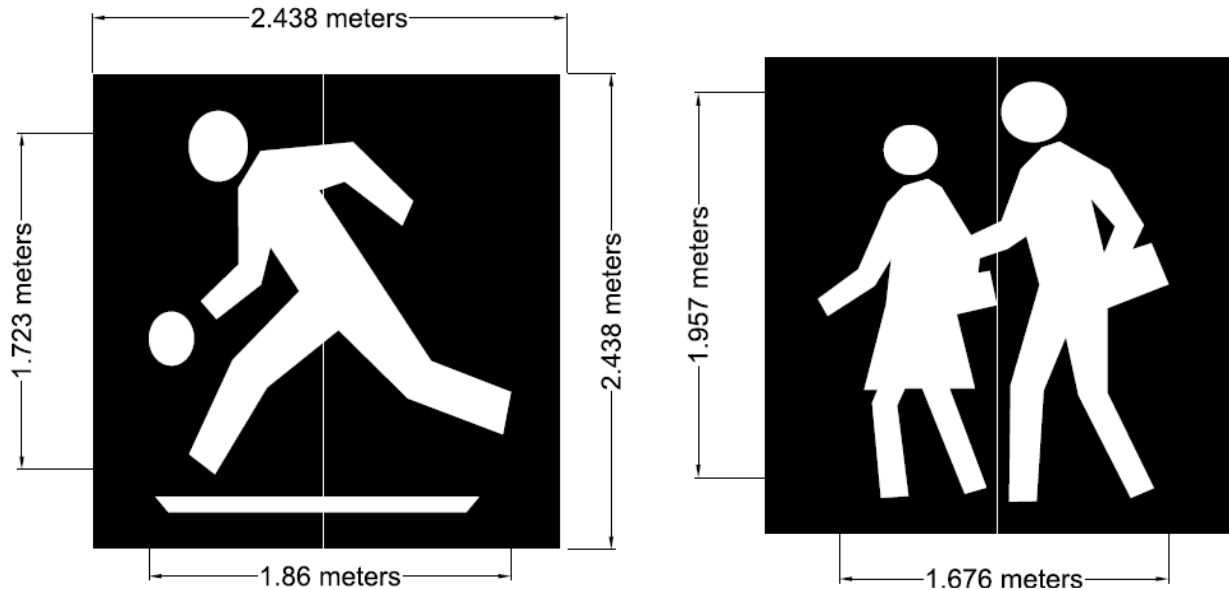


Figure 2 Design of Playground and School Road Marking Stencils

The effectiveness of the road markings may be limited if placed on a downhill grade as compared to an uphill grade. In addition, the effectiveness is limited during the winter when snow may be covered by snow or slush. Furthermore, the results indicated that road markings placed on the road surface near an intersection may be less visible for drivers who turn into the zone. Table 11 shows the evaluation results. The overall findings are statistically significant at 95% confidence level based on the Two-Sample t-Test (unequal variances)

Table 11 Before/After Study for Road Markings During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Driver Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 21: Riverbend Elementary School Zone: 1 data collection point with 2 groups of data						
EB	0	-3	-4%	+7%	-1%	-2%
WB	-4	-10	+6%	+19%	-17%	-8%
Site 22: Dr. Oakley School Zone: 3 data collection points with 6 groups of data						
EB	0	+1	-1%	-1%	+5%	-3%
WB	0	-2	+7%	-2%	-3%	-2%
EB	-1	-3	+4%	+3%	-5%	-2%
WB	-3	-3	+15%	-6%	-10%	+1%
NB	0	-1	-2%	+2%	+1%	-1%
SB	+1	-3	+5%	+5%	-9%	-1%
Site 23: Tuscany Ridge Cm/Tuscany Ridge Wy Playground: 1 data collection point with 2 groups of data						
NB	+1	0	-1%	-3%	+4%	0%
SB	-2	-8	+13%	+1%	-13%	-1%
Overall	-1.00	-3.20	-4% to +15%	-6% to +19%	-17% to +5%	-8% to +1%

Comparison Sites - No Change

The purposes of using comparison sites in the pilot was to evaluate time trend effects due to external factors such as awareness campaigns, enforcement activities, or seasonal effects on speed. The results presented in Table 12 indicate that speeds in 5 of 6 comparison sites decreased without any physical changes to the sites. From this perspective, it appears that compliance in playground and school zones may have improved during the evaluation period due to education, awareness, and enforcement campaigns related to the harmonization of playground and school zone times.

Table 12 Before/After Study of Comparison Sites During Zone Hours

Site & Direction	Avg. Speed Change (km/h)	85% Speed Change (km/h)	Compliant Driver Change	Non-compliant Drivers Change by Speed		
				31-35 km/h	36-50 km/h	>50 km/h
Site 24: Delta West Academy School Zone: 2 data collection point2 with 4 groups of data						
NB	-1	-2	+13%	-8%	-5%	0%
SB	-3	-6	+22%	-10%	-11%	-1%
EB	-1	-4	+13%	-5%	-6%	-2%
WB	-2	-4	+14%	-3%	-11%	0%
Site 25: Calgary French & International School Zone: 1 data collection point with 2 groups of data						
NB	+1	0	-4%	+3%	+1%	0%
SB	+1	0	-2%	+1%	+2%	-1%
Site 26: Light of Christ Elementary & Jr. High School Zone: 1 data collection point with 2 groups of data						
EB	-1	0	+7%	-3%	-3%	-1%
WB	-1	0	+5%	-3%	-2%	0%
Site 27: Blakiston Dr/Bell St Playground: 1 data collection point with 2 groups of data						
EB	-3	-1	+15%	-2%	-12%	-1%
WB	-4	-5	+25%	+5%	-31%	+1%
Site 28: Deerview Dr/Deerview PI Playground: 1 data collection point with 2 groups of data						
NB	+1	+2	+4%	-7%	-1%	+4%
SB	-1	-5	+3%	+15%	-17%	-1%
Site 29: Silverdale Dr/68 St Playground: 1 data collection point with 2 groups of data						
EB	-1	-1	+8%	+4%	-13%	+1%
WB	-1	-3	+9%	+10%	-16%	-3%
Overall	-1.14	-2.07	-4% to +25%	-10% to +15%	-31% to +2%	-3% to +4%

Speed Evaluation & Ranking Summary

The average values of evaluation speed metrics for each measure are summarized in Table 13. Measures are ranked based on the increase in driver compliance (1 being best to 8 being worst).

Table 13 Overall Evaluation of Treatment Effectiveness

Measure	Rank	Avg. Speed change (km/h)	85% Speed change (km/h)	Compliant Driver Change	Non-compliant Drivers Change by Speed		
					31-35 km/h	36-50 km/h	>50 km/h
Speed watch	1	-2.75	-2.50	19%	-8%	-10%	-1%
Cones	2	-2.50	-2.50	15%	-5%	-9%	-1%
Double signing	3	-1.50	-1.13	10%	-2%	-7%	-1%
Do Nothing	-	-1.14	-2.07	9%	0%	-9%	0%
Road markings	4	-1.00	-3.20	4%	3%	-5%	-2%
Multiple signs	5	-0.30	-0.20	4%	1%	-5%	0%
Bigger signs	6	-0.40	-0.10	3%	1%	-3%	-1%
Reflective tape	7	0.17	-0.17	1%	2%	-2%	-1%
Ahead signs	8	0.83	-0.17	-2%	0%	2%	0%

With the exception of reflective tape and zone ahead signs, all measures resulted in lower average speeds, with the neighbourhood speed watch program and traffic cones being the most effective. The 85th percentile speeds were also reduced by all measures, and the most effective three measures in light of this criterion include speed watch, traffic cones, and road markings.

Based on the increases in compliance, the most effective three measures were the speed watch, traffic cones, and double signing, with increases in compliance of 19%, 15%, and 10%, respectively. Other measures increased compliance as well, with the exception of zone ahead signs which decreased compliance. Consistent but small reductions in the percentage of drivers exceeding 50 km/h likely indicate that many drivers in this category belong to the group that are aware, but non-compliant.

Driver Intercept Survey

The driver intercept survey was completed in October 2014 to understand if drivers observed the enhancement measures, if the measures assisted drivers in identifying the zone, and if drivers changed their speed accordingly after identifying the zone. The response to the speed change question is a self reported behaviour and may not accurately represent actual behaviour, but rather intent. The four most effective measures identified from the before and after speed studies were included in the survey. With support from the Calgary Police Service, motorists driving through zones within effective hours with were randomly selected to answer the survey . A total of 212 surveys were completed and the results are summarized in Table 14.

Table 14 Driver Intercept Survey Results

Measure	Did you see the measure?		Did you identify the zone?		Did you change your speed?		Current zone time?	
	YES	NO	YES	NO	YES	NO	Correct	Incorrect
Traffic Cones	78 (96.3%)	3 (3.7%)	81 (100%)	0 (0%)	81 (100%)	0 (0%)	43 (53.1%)	38 (46.9%)
Speed watch	53 (72.6%)	20 (27.4%)	72 (98.6%)	1 (1.4%)	72 (98.6%)	1 (1.4%)	28 (38.4%)	45 (61.6%)
Double signing	20 (34.5%)	38 (65.5%)	58 (100%)	0 (0%)	58 (100%)	0 (0%)	20 (34.5%)	38 (65.5%)
Road Markings	102 (68.5%)	47 (31.5%)	148 (99.3%)	1 (0.7%)	148 (99.3%)	1 (0.7%)	69 (46.3%)	80 (53.7%)
Total	-	-	-	-	-	-	91 (42.9%)	121 (57.1%)

The survey results indicated that that traffic cones were reported as the most visible measure to attract driver attention (noticed by 96.3% of drivers) followed by the speed watch program and road markings (noticed by 72.6% and 68.5% of drivers, respectively). The least visible measure was double signs; only 34.5% of drivers noted this measure in the investigated zone. Almost 100% of drivers said that they realized they were entering a playground or school zone and reduced their speed after identifying the zone. Among 212 respondent drivers, 42.9% (91) knew the correct zone timing and 57.1% (121) gave incorrect zone hours; this indicated room for improvement.

CONCLUSIONS

The speed metrics suggest that the neighbourhood speed watch program, traffic cones, double signing and road markings are the four most effective measures and that the other measures had a negligible effect on driver awareness or had a negative impact.

Traffic Cones with Spinning Anemometers

In the trial zones with traffic cones, the speed compliance rate increased by 15% and the average speed reduced by 2.50 km/h, on average. This measure ranks second in the effectiveness of increasing driver awareness. The largest challenge to implementation of this treatment on a city-wide basis is the willingness of school staff/volunteers to place and remove the cones. In this pilot, two of three schools withdrew from the treatment trial, which implies schools may have difficulty finding volunteers to consistently and punctually place and remove cones, especially since the new zone timing started. Also, the material of the spinning anemometer on the top of cones should be reconsidered because the hard plastic material currently used is easily damaged.

Neighbourhood Speed Watch

In the trial zones with the neighbourhood speed watch program, the speed compliance rate increased by 19% and the average speed reduced by 2.75 km/h. These evaluation results indicate this treatment is the most effective for increasing driver awareness. A city-wide implementation of speed watch is not practical; however, a formal volunteer program may be better suited for implementation on limited basis where interest exists.

Double Signing and Road Markings

Double signing and road markings are two measures with lower effectiveness in improving driver awareness as compared to the neighbourhood speed watch and traffic cones. Statistics show that the compliance rate increased by 10% and the average speed reduced by 1.50 km/h at double signing treatment sites; and the average speed compliance rate increased by 4% and the average speed reduced by 1.00 km/h at road marking treatment sites.

The double signs and road markings could be potentially considered as supplemental measures in playground and school zones based on the above evaluations. However, the pilot experience suggests that the greatest benefit from double signs or road markings would be expected where initial compliance is low, and especially where geometric conditions are favourable. For example, the double signs are suggested where the sign on the right side of roadway may be difficult for drivers to see. Similarly, road markings will be more visible if they are used on sag curves (bottom of hills) or level terrain rather than on crest curves (tops of hills).

Larger Signs, Multiple Signs, and Reflective Tape

Larger signs, multiple signs and reflective tape showed some improvement in driver awareness, but to a lower degree than the other measures. Since the related increases in awareness appear to be low, the implementation of these measures on a city-wide basis is not suggested.

Zone Ahead Signs

The use of zone ahead signs was the only measure which suggested a negative impact on driver behaviour when entering playground or school zones: a 2% decrease in speed compliance and a 0.83 km/h increase in average speed was observed. Two potential safety risks are: 1) without education, drivers may confuse the zone ahead signs with the zone start signage; 2) a longer playground or school zone is more likely to result in higher speeds through the zone.

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