PUFFIN Traffic Signal Benefits

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Abstract

Pedestrian User Friendly Intelligent (PUFFIN) crossings have now been used within New Zealand for around 8 years. However not all mid-block signalised pedestrian crossing facilities incorporate the enhanced features of a PUFFIN.

This technical note sets out to quantify the travel time benefits of installing PUFFIN facilities at signalised pedestrian crossings and estimates the resulting benefit cost ratio at alternative traffic volumes, traffic growths and pedestrian compliance.

The conclusion of the study is that there are significant savings and installation should be considered for all pedestrian facilities at mid-block signalised intersections where the vehicle flow exceeds 12,000 vpd.

Introduction

Pedestrian User Friendly Intelligent (PUFFIN) crossings look like any normal signalised pedestrian crossing, however they have the ability to eliminate a pedestrian phase after it has been called or lengthen/shorten a pedestrian clearance phase based on the speed and demand of the pedestrians crossing.

PUFFINs have now been legal in NZ for several years. Hutt City Council (HCC) introduced the first legal one in 2006. Since then HCC has retrofitted a number of PUFFIN features to existing signalised pedestrian crossings and installed four full PUFFINs at new signalised pedestrian crossings.

This experience has enabled HCC to gather some performance data and undertake some benefit-cost calculations.

Features of a PUFFIN crossing

The displays controlling the pedestrians are placed on the near side of the road on the right hand pole, rather than on the opposite side (Picture 1). The system also utilizes sensors which detect the presence, or departure, of pedestrians waiting at the crossing, and as they are crossing the road. Signal timing is controlled by the sensor information. The added intelligence provided by the sensors improves the efficiency of the signals.

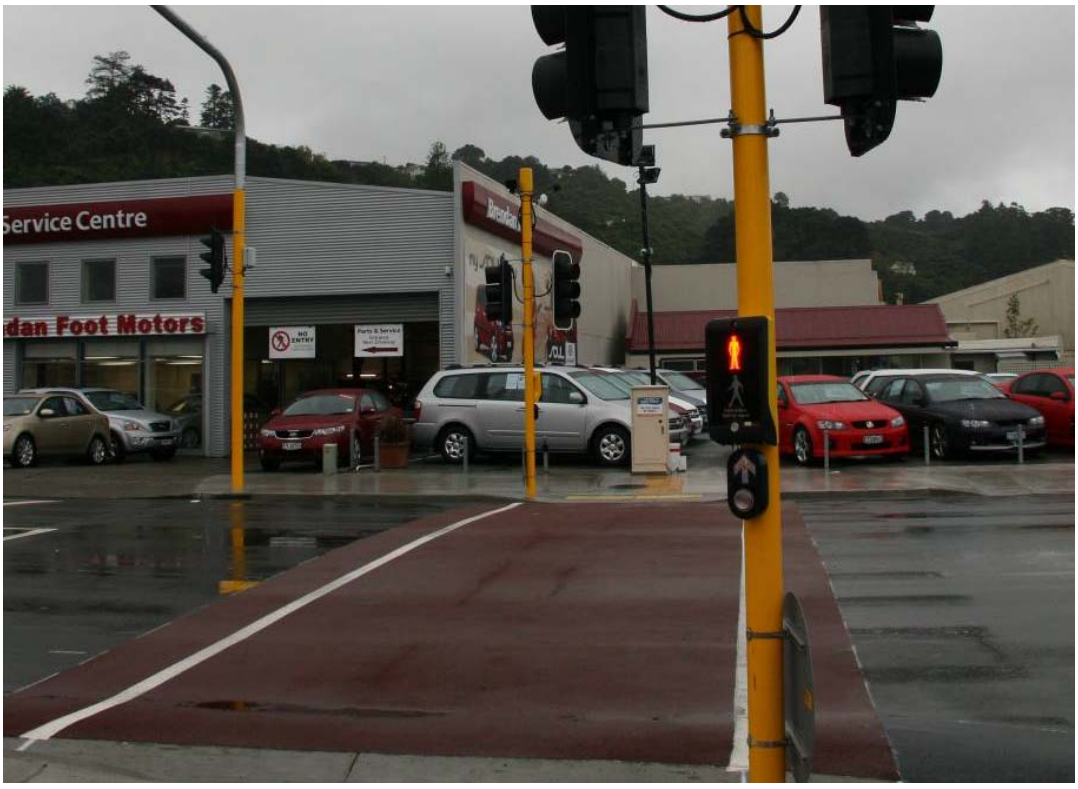

Figure 1: A typical PUFFIN Crossing

Installation Costs

The installation cost of a new signalised pedestrian crossing is around $150,000.

To include PUFFIN facilities into a new pedestrian crossing, the cost will increase by around $16,000 for the overhead pedestrian passage detectors and the on-crossing pedestrian passage detectors.

To retro-fit an existing signalised intersection, the cost for PUFIN facilities is slightly higher, at around $20,000.

Benefits

There are several features provided by a PUFFIN crossing that are of great benefit to drivers and pedestrians.

- Near-side pedestrian displays which strongly encourage the pedestrian to look to the right and face the on-coming traffic. This improves pedestrian safety.

- The perplexing “Flashing Red Man” display is eliminated. (Lack of understanding attributed to the Flashing red man display encourages late starters to enter the conflict area with no expectation they can clear safely.)

- The ability to disregard pedestrian phase calls either because the pedestrian changes their mind or the pedestrian crosses through a perceived safe gap when the traffic phase is still green. When this happens the pedestrian phase is cancelled so that drivers are not unnecessarily interrupted.

- The ability to vary the pedestrian clearance time when vehicles are stopped to match the needs of the pedestrians. A shorter clearance time for fast pedestrians returns valuable green time to the vehicular traffic. A longer clearance time for slower pedestrians provides utility for the less nimble pedestrians only when they need it. Additional green time during times of heavy pedestrian demand provides a better level of service for pedestrians.

These features have been tested by HCC for a number of years and we remain confident that they are extremely valuable. How valuable it has been is anecdotal until now.

Quantifying Benefits

Typically in the Authors experience signalised pedestrian crossings are generally only used in NZ for roads with an ADT above 12,000 vehicles per day. Data from an existing pedestrian crossing was used to estimate the effects of pedestrians not using a crossing after calling a pedestrian crossing phase and the resulting delay to motorised traffic.

Victoria Street in Lower Hutt has a two way ADT of about 19,000 vehicles per day. The pedestrian signal controller has PUFFIN facilities included. It typically has 145 pedestrian calls per day, and we believe around 10-15 of these are cancelled due to the pedestrian walking away, or crossing during the red. Actual data on the number of calls cancelled was not available from the controller at the time of publication.

A Sidra model was set up using a 300 second cycle and a pedestrian phase per cycle, ie 12 pedestrian calls per hour. Using a typical flow rate of 660 vehicles per hour per direction, it was calculated that there were 0.68 vehicle-hours delay when a pedestrian called a pedestrian phase but did not cross.

Economic Analysis

A benefit cost ratio (BCR) calculation was done based on the dis-benefits to motorists if the pedestrian call button was activated but the phase not used. Several alternative scenarios were undertaken based on the number of calls per day that were no longer functional (pedestrian gone).

The BCR analysis was based on the EEM using a 40 year time period and a 6% discount factor. A construction cost of $16,000 was used, being the difference between a standard installation and a PUFFIN installation. Only travel time savings for drivers based on a pedestrian walking away have been included. Accident savings and savings for both pedestrians and drivers due to longer and shorter pedestrian phase lengths have not been included.

The BCR for various traffic volumes with various growth rates of 2% per annum and 10 missed calls a day is tabulated in Table 1:

AADT	7,500 10/DAY	10,000 10/DAY	12,500 10/DAY	15,000 10/DAY	17,500 10/DAY	20,000 10/DAY	22,500 10/DAY
Travel Time Benefits	19573	28104	37940	48483	61676	77983	95771
Cost	16000	16000	16000	16000	16000	16000	16000
BCR	1.2	1.8	2.4	3.0	3.9	4.9	6.0

Table 1: BCR for various flows and 2% growth per annum

Sensitivity tests have been undertaken based on lower growth rates and 10 missed calls a day is tabulated in Tables 2 & 3. Varied missed calls at the 2% growth rate are tabulated in Table 4.

AADT	7,500 10/DAY	10,000 10/DAY	12,500 10/DAY	15,000 10/DAY	17,500 10/DAY	20,000 10/DAY	22,500 10/DAY
Travel Time Benefits	17942	25443	34479	43516	54525	68004	81979
Cost	16000	16000	16000	16000	16000	16000	16000
BCR	1.1	1.6	2.2	2.7	3.4	4.3	5.1

Table 2: BCR for various flows and 1% growth per annum

AADT	7,500 10/DAY	10,000 10/DAY	12,500 10/DAY	15,000 10/DAY	17,500 10/DAY	20,000 10/DAY	22,500 10/DAY
Travel Time Benefits	16584	23955	32247	40538	50673	62650	75549
Cost	16000	16000	16000	16000	16000	16000	16000
BCR	1.0	1.5	2.0	2.5	3.2	3.9	4.7

Table 3: BCR for various flows and 0% growth per annum

AADT	15,000 20/DAY	15,000 15/DAY	15,000 10/DAY	15,000 5/DAY
Travel Time Benefits	96967	72725	48483	24242

Cost	16000	16000	16000	16000
BCR	6.1	4.5	3.0	1.5

Table 4: BCR for various missed calls and 2% growth per annum

The results have been plotted to show the variance of the BCR (Figure 1) for different traffic flows, and for different numbers of daily missed calls.

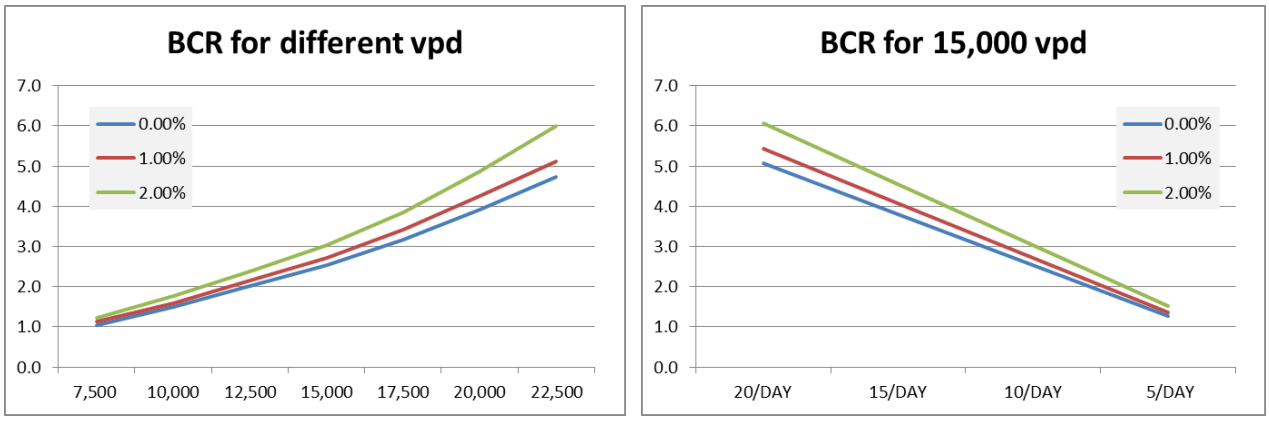

Figure 2: BCR Sensitivity Tests

As can be seen, Roads with ADTs above 15,000 vehicles per day generally result in a BCR of around 3 if there are only 10 missed calls a day (or 7% of the calls per day). The BCR increases to between 5 and 6 for 20 missed calls a day (or 13% of the calls).

Conclusions

The additional cost of incorporating PUFFIN requirements into new signalised crossings is around $16,000 and results in a BCR in the range of 1.0 to 6.1 depending on the traffic volume, growth rates and the number of missed calls per day. The BCR does not include accident benefits.

Retrofitting existing signalised pedestrian crossings will cost slightly more with a correspondingly reduced BCR.

It is concluded that PUFFIN faculties should be incorporated into all new mid-block traffic signal installations if the daily volume of traffic is 12,000 vehicles per day or higher.

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