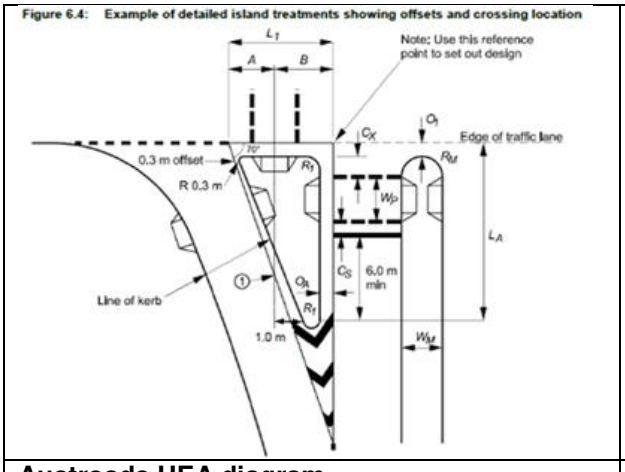
Letter to the Editor/Article for publication in 'Roundabout'

This letter is a response to a paper entitled *Pedestrian Safety – Left Turns at Signals - Research Study* (the 'conference paper') by Bruno Royce of Traffic Engineering Solutions Ltd (TES), presented at the ENZ TG Conference in Wellington in March 2019 - I was informed just after the conference of the commissioned paper and the direction of the results and recommendations in it. I obtained a copy of the paper, and, on reading the paper, I was most surprised at the results which were diametrically opposite to those we (O'Brien Traffic) found in a major peer reviewed study published by the US Transportation Research Board in Transportation Research Record No. 2299 – Pedestrians (2012).

The purpose of this letter is to illustrate where the NZ data entry and analysis was flawed, and to explain that the necessary data corrections and re-analyses would appear to support the outcomes and recommendations of our earlier study.

O'Brien Traffic was engaged by the Victorian State Road Authority (VicRoads) to test whether or not VicRoads should continue with its current policy to encourage the use of well-designed High-Entry-Angle (HEA) left turn slip lanes as its preferred treatment at signalised intersections to manage pedestrian and safety issues. As Mark O'Brien, Principal Author, said in a presentation to AITPM in 2016: "*Two conflicting points of 'common wisdom' were put forward – planners, urbanists and others* "*everyone knows that slip lanes are unsafe for pedestrians and so they should be removed wherever possible and no new ones should be installed*", *and VicRoads* - "*slip lanes significantly improve operations and safety and should be maintained and included in new or upgraded intersections*"". Our study was to identify whether VicRoads was justified in continuing with its policy, and, if so, whether there were any policy and design improvements that should be made. Our full results and reporting have been made available as widely as possible, including to NZTA, in the hope that others could use the results, extend the study, and refine it for local conditions where necessary.

I reviewed the 2018 TES research report (the 'research report') on which the conference paper was based. In the research report I saw that one HEA site had 3 recorded crashes, which I considered to be most unusual. On examining the Appendix C table in that report, it was clear that the treatment at this site had been originally coded as C8 (low-entry-angle (LEA)), but later re-classified to C7 (HEA). The Austroads HEA typical design, and an aerial photo of the subject site are shown below.



Austroads HEA diagram

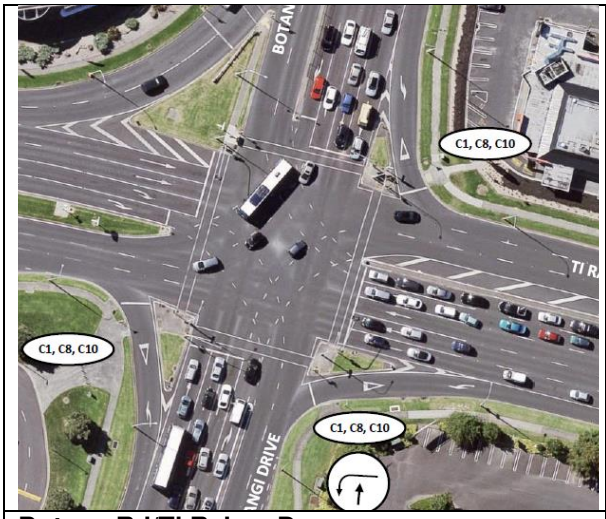
Ellerslie-Panmure Highway/Mt Wellington Hwy

Some differences between the photo and the diagram are obvious: the length of the island – about 3 m compared to a minimum of about 10 m, the continuous sharp radius curve on the right side of the slip lane compared to the straight side in the HEA diagram, and the area of

the islands. At the site, the pedestrian crossing is just prior to the holding line, compared to best practice which is to be a car length back from the holding line (as per roundabout design guidelines), but which is not shown in the Austroads diagram. This site has clearly been 'mis-coded'.

Given the mis-coding of the above site, I then decided to check if other slip lane sites had been mis-coded as HEA. To my surprise, I found the opposite – 91 approaches were coded as LEA instead of HEA and that clearly complied with the Austroads diagram of a HEA slip. There were many others that arguably complied as HEA slips. I reassessed the latter group, and this added a further 69 HEA sites, resulting in a total of 281 HEA sites with 1 minor injury crash and 2 non-injury crashes. But 16 sites that should have been coded as LEA ones were wrongly classified as C7 (HEA) – reducing the overall number of HEA sites to 265.

Two of the locations with a total of 7 wrongly-coded left turn treatments (C8 instead of C7), and that also had crashes, are shown below.

<table>
<tr>
<td> 
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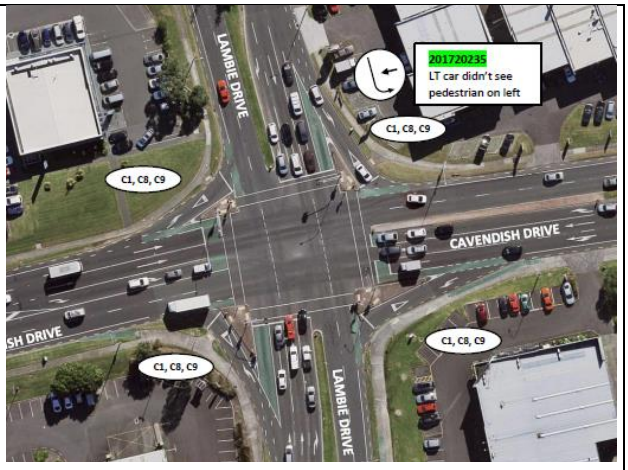
<td> 
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<tr>
<td>Botany Rd/Ti Rakau Dve</td>
<td>Cavendish Dve/Lambie Dve</td>
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The conference paper safety outcomes are shown in the Table 1 below, with the revised results in Table 2 following it.

Treatment	TES Study	
	Frequency	5 Year Crashes
	No. of Sites	No. of Crashes
a - Shared signalised	675	13
b - Exclusive Signalised	384	6
c - Left Turn Slip	637	25
Total	**1,696**	**44**
c1 – Slip standard	404	12
c2 – Slip + Ped Xing	147	13
c3 – Slip + Platform	3	0
c4 – Slip + Ped Xing Platform	1	0
c5 – Slip Signalised	54	0
c6 – Slip Free Flow	28	0
Total Slip Lanes	**637**	**25**
c7 – Slip Sharp Angle	121	3
c8 – Slip Gentle Angle	516	22
Total Slip Lanes	**637**	**25**
c9 – Slip Short Length	205	10
c10 – Slip Long Length	432	15
Total Slip Lanes	**637**	**25**

Table 1 – left turn treatments and recorded crashes – from the conference paper

The corrected critical data are shown in the Table 2. Note that there were no crashes in the C3, C4 and C6 categories, and that 'slip sharp angle' is the same as HEA, and 'gentle angle' is the same as LEA.

Revised data analysis (by O'Brien Traffic)		
	No. of Sites	**Crashes per 5 years**
a - Shared signalised	675	10 (M), 3 (N)
b – Exclusive signalised	384	1 (S), 3(M), 2 (N)
c7 – Slip Sharp Angle (HEA)	265	1 (M), 2 (N)
c8 – Slip Gentle Angle (LEA)	372	4 (S), 15 (M), 2 (N)
Total Slip Lanes	637	
Sub-categories:		
c7 - Slip Sharp Angle - with Pedestrian crossing	50	0
c8 – Slip Gentle Angle - with Pedestrian crossing	100	3 (S), 8 (M), 2 (N)

Table 2 – Revised site category numbers and crashes

The revised injury crash data in Table 2 shows that the 'C7 Slip Sharp Angle (HEA) slip lane treatment is far safer than any of the other types. The crash data also indicates that there is no reason not to incorporate pedestrian crossings at such slip lanes.

In terms of injury crashes per site, 'shared signalised' is about 1 in 68, 'exclusive signalised' is about 1 in 96, 'HEA left turn slip lanes' is about 1 in 265, and LEA left turn slip lanes' is about 1 in 20. These results support conclusions diametrically opposite to those reported by Royce.

The crash data also support the original reasoning for doing away with the other unsafe slip lane types. One of the under-pinning principles in developing the HEA slip lane was to control speed of left turn traffic, and this is done by requiring the left turn movement to be through a tight radius at the end of the slip lane. Another later principle was to keep pedestrians in view of the driver prior to a potential conflict. It is noted that the NZ data

included crashes involving pedestrians where there was no injury – differentiating it from the Melbourne study which did not include non-injury crashes as those are not reportable.

It is my firm opinion, based on a logical assessment of the slip lane angles, that the main conclusions within the published paper need to be revised, to be:

- HEA slip lanes provide the safest form of treatment - and by a significant margin;
- LEA slip lanes are the most hazardous treatment - also by a significant margin;
- Pedestrian crossings on HEA slip lanes had no observed safety issues – clearly indicating that using pedestrian crossings on HEA slip lanes do not make those slip lanes less safe for pedestrians.

Further, I submit that the results, conclusions, and recommendations in the research report and the conference paper are so misleading that the latter needs to be corrected in data entry, related analyses, and results to more accurately reflect the true safety performance of the various slip lane facilities relative to the other left turn treatment options. If the paper is published as it stands, it is likely to distort public policy-making in both NZ and Australia for a significant period. However, if it is corrected, the conference paper would strongly suggest that most localities in both countries are likely to benefit in the same way from policy refinements and design improvement with respect to slip lanes.

Yours respectfully

Andrew O'Brien

Chairman

O'Brien Traffic

Melbourne