

Seagull Intersection Layout. Island Point Road - A Case Study

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Abstract

The Seagull junction treatment is at the high end of at grade intersection treatments. It provides separate lanes for both right and left turns off the through road. It also provides a separate lane for vehicles turning right from the side road to enter and accelerate to through traffic speed before merging with through traffic.

There are many Seagull junction layouts across the road network. They exist with many variations in design layout, road geometry and site conditions. They also have varying safety records and have been the object of much discussion about their operational safety.

This case study considers three variations of a Seagull layout that have been in place at the junction of the Princes Highway and Island Point Road approximately 20km south of Nowra on the south coast of NSW. It examines the impact that each of these layouts had on the operational safety of the junction.

Key words

Seagull treatment, sight distance, crash types

Introduction

Island Point Road services the local coastal communities of Tomerong, St Georges Basin and Jervis Bay to the east of the Princes Highway. These communities are serviced by the nearby large regional centre of Nowra, approximately 20 km to the north. The proximity of Nowra reflects the major traffic movements at this junction of left into and right out of Island Point Road. The Annual Average Daily Traffic (AADT) on the Princes Highway at this location is 12,000 vehicles per day, approximately 50% of which turn left into Island Point Road.

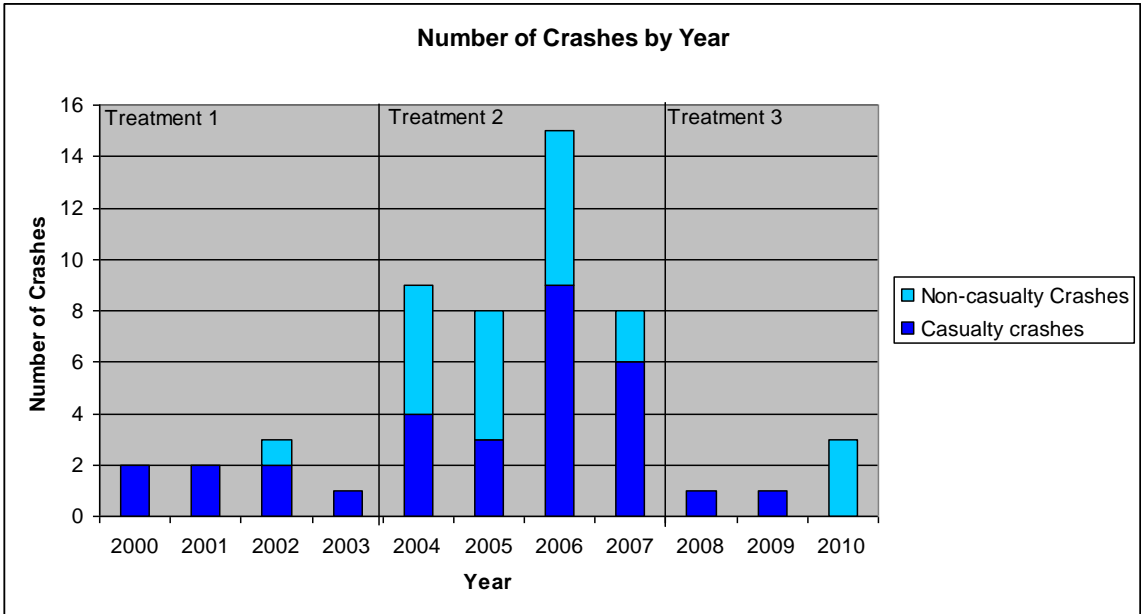
The junction of Island Point Road and the Princes Highway is located in a rural area abutted by forest. The highway is constructed to 100 km/h design speed with a 100 km/h posted speed limit. The junction is located on the back of a 1000m radius curve on an almost level grade. The north and southbound carriageways on the Princes Highway are separated by a raised concrete median at this location. Sight distances well in excess of safe intersection sight distance are available for all movements.

A seagull layout was first constructed at this location in 1996 as part of a realignment of the Princes Highway in the vicinity of Island Point Road. The seagull treatment did not operate as well as anticipated with the development of 'right near' (RUM code 13) type crashes. The site was then modified to address this crash type. Unfortunately this modification did not address the initial crash type and also coincided with the emergence of a 'right thru' (RUM code 21) crash type further reducing the road safety performance of the junction. A third modification to the layout was undertaken which has dramatically reduced the number of crashes at this location.

This study considers the three seagull design variations, the associated crash outcomes from each and identifies the deficiencies of the initial two treatments.

Crash data for each of the treatments at Island Point Road.

The following graph shows the crash data results associated with the three seagull layouts. Although Treatment 1 was constructed in 1996, crash data is only shown from 2000 to provide more equal periods in graphical representation. It should be noted that the crash types shown in the following 3 seagull layouts were not influenced by other contributing factors such as time of day or wet weather etc.



Graph 1: Crashes Vs Treatment Type

As can be seen from this graph there was a significant rise in the crash rate following the construction of Treatment 2, which continued until the construction of Treatment 3 in mid 2007. Construction of Treatment 3 which is currently in place has resulted in a significant improvement in the crash rate. The graph also shows the number of casualty crashes for each year with 9 casualty crashes in 2006. Of the total of 53 crashes, 31 were casualty crashes resulting in 57 injuries and 2 fatalities. The majority of the casualty crashes (22) and injuries (37) and 1 fatality occurred while treatment 2 was in operation.

Seagull treatment layouts and associated crash types

- Seagull treatment 1 (constructed 1996)

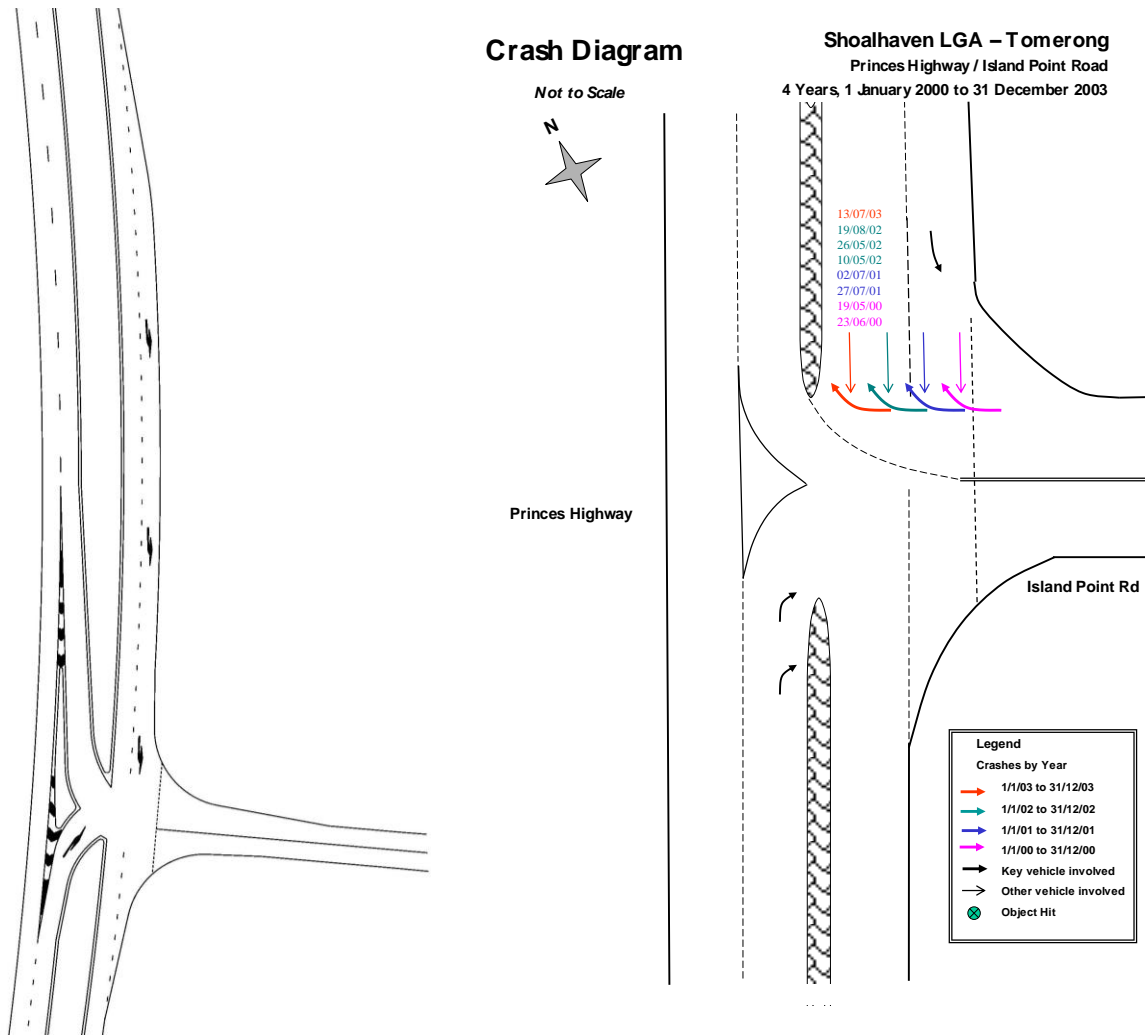


Figure 1: Treatment 1 Design Layout

Figure 1.1: Treatment 1 Crash Diagram 2000 to 2003

The layout depicted in Figure 1 was constructed as part of a larger upgrade of the Princes Highway in this area to improve highway alignment and separate opposing traffic. The layout was designed in accordance with the standard rural seagull design layout. Following the installation of Treatment 1 a 'right near' crash type started to develop as shown in Figure 1.1. The colours in Figure 1.1 represent the different years and the date of each crash is shown. Treatment 2 was then designed and constructed in an attempt to address the 'right near' crashes.

- Seagull treatment 2 (constructed 2004)

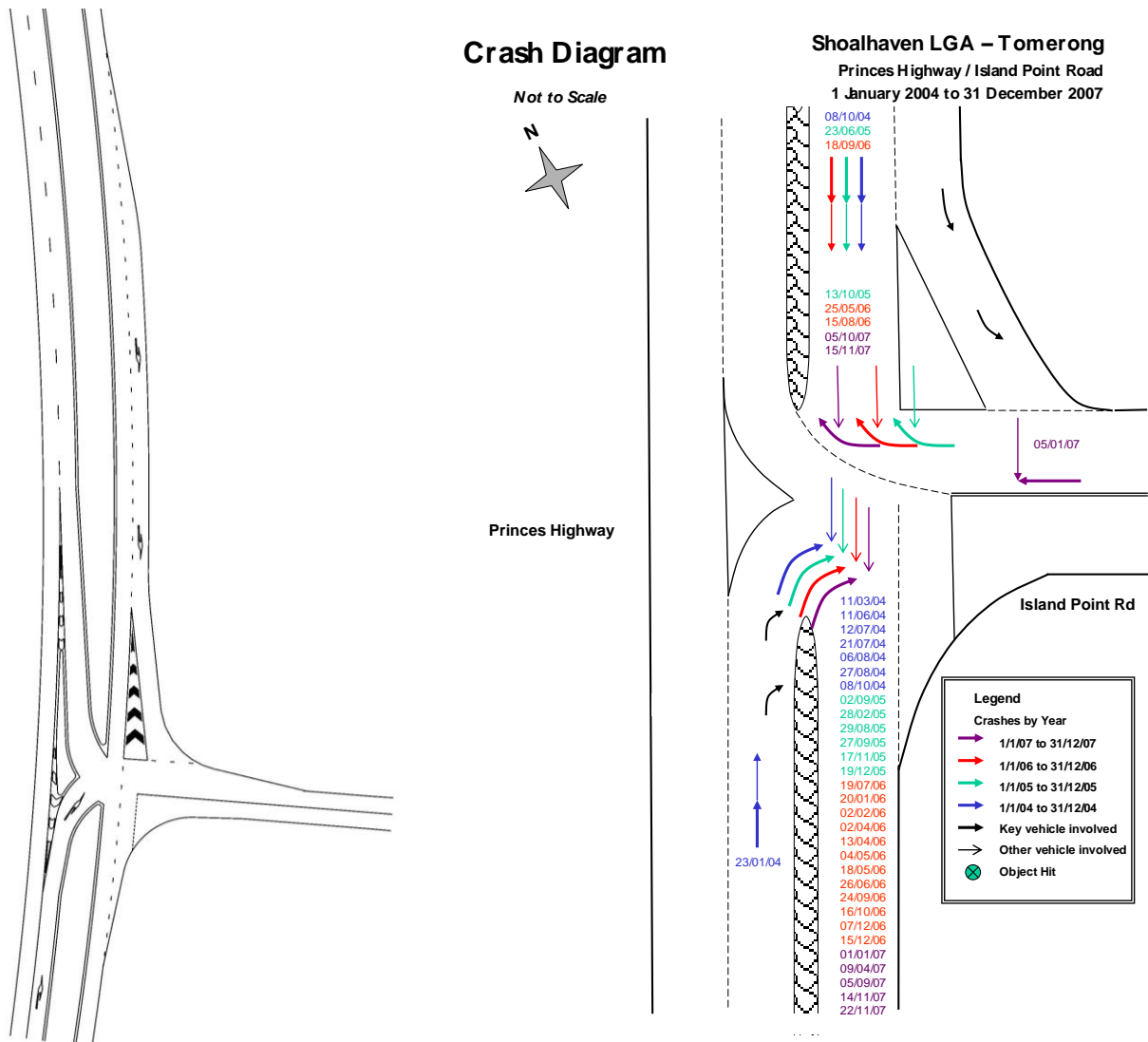


Figure 2: Treatment 2 - Design Layout

Figure 2.1: Treatment 2 Crash Diagram 2004 to 2007

Treatment 2 involved the modification of the original seagull layout with the inclusion of a short left turn splay, which included a small raised concrete island, at the southern end of the painted chevron area. The layout also included the installation of a hold line and give way sign at the left turn deceleration lane's junction with Island Point Road. However the crash data in Figure 2.1 shows the development of a very significant number of 'right through' crashes yet previously there were no crashes of this type. In addition there has been no impact on the 'right out with through southbound' crash type that this layout was intended to address.

- Seagull treatment 3 (constructed 2007)

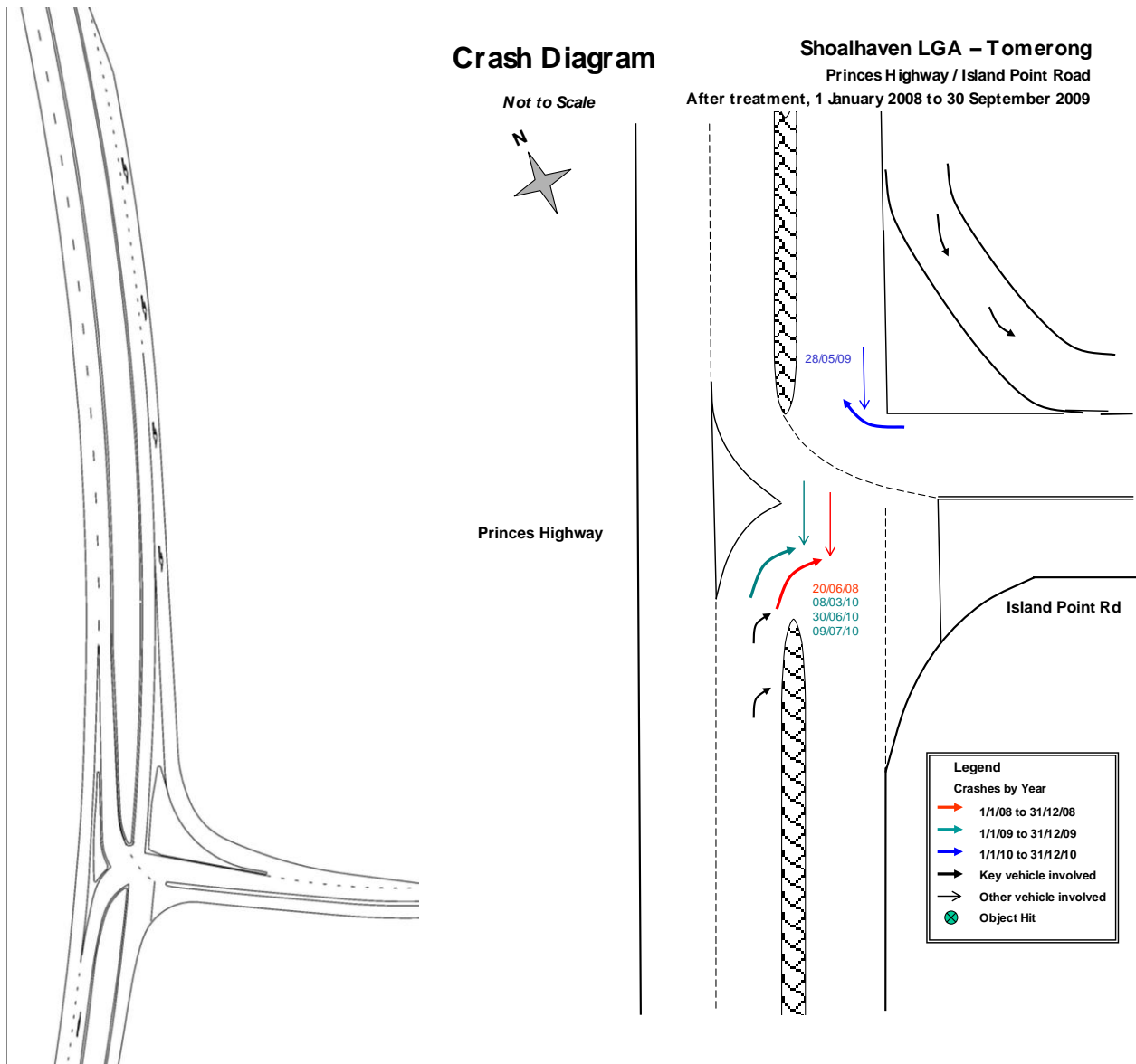


Figure 3: Treatment 3 - Design Layout

Figure 3.1: Treatment 3 Crash Diagram 2008 to 2010

A third modification of the seagull treatment included two key features. The first was to move the junction of the left turn lane with Island Point Road further east from the Princes Highway and provide a merge of the left turn deceleration lane with Island Point Road. The second was a major widening at the throat of the junction to further separate the left turn deceleration lane from the southbound through lane which significantly opens up available sight distance to the north for vehicles exiting Island Point Road. As can be seen from Figure 3.1 this third modification also coincided with a significant reduction in the number of crashes, especially the ‘right thru’ crash type.

Discussion

The first seagull layout (Fig. 1), was constructed in accordance with the standard seagull design layout in 1996 but developed a poor crash history with vehicles turning right out of Island Point Road colliding with through southbound vehicles approaching on their right.

In an attempt to address the crash types that had developed, a relatively minor adjustment was made to the layout (see Fig. 2). This involved the construction of a short left turn splay at the southern end of the left turn deceleration lane near its junction with Island Point Road. It also included the installation of a small concrete island, a hold line and give way sign at the left turn lane's junction with Island Point Road as depicted in Figure 2.

The construction of Treatment 2 did not address the 'right through' type crashes but it was also accompanied by a new and significant crash problem involving vehicles turning right into Island Point Road colliding with through southbound vehicles. There were no crashes of this type prior to the reconfiguration of the left turn arrangement which was in accordance with *Part 4A Austroads Fig 7.14*. It was not immediately obvious why this crash type developed. Drivers turning right into Island Point Road were now appearing to make poor decisions when turning right in front of opposing southbound through traffic. It is of interest that the only adjustment to the layout that coincided with the occurrence of these crash types was a minor modification of the left turn lane and the inclusion of a give way sign for southbound left turning traffic.

With the increasing number of 'right in with through southbound' and the 'right out with through southbound' crash types still occurring and an obvious solution not evident a more detailed investigation was undertaken to determine the cause of these crashes. The investigations involved onsite monitoring, the installation of 'Crashcam' to record crashes and near misses together with a more extensive investigation of statements made to Police by those involved in these types of crashes. It was only after these more extensive examinations of the Police and witness statements that a likely cause was identified.

It was found that traffic turning left off the highway into Island Point Road were stopping at the hold line to give way to those vehicles stored waiting to turn right into Island Point Road off the highway. This was confusing to some drivers waiting to turn right off the highway as it is counterintuitive to the standard give way rules that normally apply at a 'T Junction'. It appears that right turning drivers would be more focused on vehicles in the left lane to anticipate if they would yield right of way, rather than focusing on the opposing through vehicles. On site observations also revealed that in other cases drivers waiting in the left turn lane would actually call right turning drivers through the junction. The drivers of these vehicles were only 8 metres apart.

The fact that distance between the drivers turning right and those turning left was only 8 metres apart, made it easy for both drivers to have good eye contact with each other.

The design of Treatment 2 with the left turn splay arrangement and the inclusion of a 'Give Way' sign at its junction with Island Point Road appear to have put doubt in the minds of drivers, as it was counterintuitive to the Give Way rule applying at 'T Junctions'. Based on the on-site observations of driver behaviour and the more in depth investigations of Police crash reports, it was evident that the confusion between drivers making these turns has contributed significantly to the 'right through' crash type. There were also many accounts of near misses associated with this scenario.

Following identification of the contributing factors associated with the 'right through' crashes, Treatment 3 (see Fig.3) was developed. In developing this treatment careful consideration was given to address not only this crash type but also the 'right out with through southbound' crashes. Any proposed countermeasures needed to be combined into the one treatment.

The first part of the countermeasure was to move the junction of the left turn lane with Island Point Road further away from the Princes Highway. This increased the separation of left turning vehicles from the vehicles waiting to turn right into Island Point Road thus reducing any confusion that may have previously occurred where drivers had eye contact. As part of this work the left turn lane was returned onto Island Point Road where a merge was provided. The need for either driver to yield to the other at the junction was now removed in favour of a merge away from the junction. It also made the decision process for drivers turning right simpler as they now only had to focus on through southbound traffic. This countermeasure focused on addressing the 'right through' crash type.

The second countermeasure was to move the left turning traffic clear of the sight line of vehicles waiting to turn right from Island Point Road. This was done by providing greater separation between the left turn deceleration lane and through southbound vehicles on the Princes Highway. This not only further increased sight distance to the north for vehicles exiting Island Point Road but also reduced the potential for left turning vehicles to 'mask' through southbound vehicles. This countermeasure focused on crashes involving vehicles turning right out colliding with through southbound vehicles on the Princes Highway. This crash type had developed under Treatment 1 and continued under Treatment 2. As can be seen in Figure 3.2 the construction of Treatment 3 has been effective in significantly addressing both crash types.

It is important to remember that the variations between the three constructed treatments were restricted to changes to the left turn lane. No other adjustments were made to the layout. All treatments had the same arrangement for right in, right out and left out movements.

Conclusion

The findings from these investigations and subsequent countermeasures indicate that careful consideration should be given to road environment, traffic volumes, turning patterns, sight distances and possible counterintuitive elements when considering the most appropriate design for a seagull treatment at 'T Junctions'. The findings also suggest that in-depth analysis of the contributing crash factors may need to be undertaken to ensure that the appropriate countermeasure is implemented.

There were two issues identified in this case study in relation to the standard rural seagull layout. The first was that the design of the connection for the left lane into Island Point Road was critical in ensuring that drivers did not become confused as to who had right of way. It also reduced the decision making process for drivers turning right into Island Point Road. They now only have to focus on southbound through traffic. In widening the 'T Junction', the 3rd treatment also further separated the conflict points, thereby simplifying the decision making process for all drivers. While the final treatment adopted at Island Point Road was to return the left turn lane into the side road to provide a merge well clear of the Princes Highway, other countermeasures were also considered.

The second issue identified in this study is that there was a significant road safety benefit in the construction of the left turn lane well clear of the sight line for a vehicle waiting to turn right from the side road. This is obviously a more costly option in both land required and construction costs. While this treatment was justified and successful in this instance, further research would be required to determine at what traffic volumes this crash type becomes an issue and when this treatment may be justified at other locations.

Further, it would seem reasonable to expect that the issues identified at Island Point Road, associated with the design of the left turn deceleration lane, would exist at most junctions regardless of the right turn arrangements. This suggests that it would be of benefit, when considering the design of any rural auxiliary left turn lane, to install the lane well clear of the sight line for vehicles entering from the side road, regardless of the 'T Junction' design, i.e. a seagull treatment, channelized right turn or any other right turn arrangement.

It is also worth noting that there are many variations to the standard seagull design layout. These variations can be influenced by the road environment, traffic volumes, turning movements and existing crash patterns and types. For these reasons there are probably no two exactly the same seagull design layouts. There are many elements within each design that can impact on the safety performance of the junction treatment in its set of circumstances. Examining only crash statistics will not always lead to the identification of contributing factors nor to the development of an effective countermeasure. In this particular instance the crash type that developed under Treatment 2 in no way indicated the true contributing factors. Care also needs to be taken when investigating crash data and developing countermeasures to ensure that any proposed engineering works are not misinterpreted by road users.

The casualty crash rate types should also be carefully considered as they tend to highlight the more critical crash types, which under a safe system approach should be given higher priority

While there has been considerable discussion about the design and subsequent safety of seagull layouts, especially in high speed rural areas, this case study clearly shows that when applied correctly 'seagull treatments' can be an effective road safety engineering treatment at rural 'T Junctions'.