YOUR NATIONAL TRANSPORT RESEARCH ORGANISATION

Dural Public School

Safe System Assessment

NTRO Project No.: 01652

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Prepared for: Legacy Property

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Final v3

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Summary

Legacy Property has proposed design options associated with a development proposal to relocate and complement existing school drop-off and pick-up facilities at the Dural Public School.

The design options to be considered include:

- Option 1: The existing school and its facilities.
- Option 2A: The proposed school facilities which include:
  - Existing facilities remain
  - Proposed 25 kiss and drop spaces on the new collector road
  - Collector road / Old Northern Road Intersection configuration as signalised.
- Option 2B: The proposed school facilities which include:
  - Existing facilities remain
  - Proposed 25 kiss and drop spaces on the new collector road
  - Collector road / Old Northern Road Intersection configuration as a seagull arrangement.

Prior to writing this report, NTRO staff conducted a site visit to Old Northern Road during the AM peak on 21 March 2023. During this site visit it was noted that heavy traffic occurs along Old Northern Road, corresponding with traffic volumes included in the traffic impact assessment, which is not ideal in the vicinity of a school. Multiple vehicular movements take place from kerbside parking on the western side of Old Northern Road and from the set-down area on the eastern side of the road.

This report details the Safe System Assessment (SSA) undertaken for the design options, in comparison to the traffic arrangements that currently exist for the school along Old Northern Road in accordance with the *Safe System Assessment Framework* (Austroads 2016) and the *Safe System Assessment Guidelines Version 1.0* (VicRoads 2018).

Using the Safe System Assessment framework, a score out of a possible total score of 448 points is calculated, with a score closer to zero representing a road and roadside environment that is aligned with Safe System principles.

The results of the SSA performed within this project indicated that both options (2A and 2B) offered a reduction in crash risk from the base case (Option 1), primarily due to the new kiss and ride facility along the new collector road which would reduce kids being dropped off and picked up along Old Northern Road, thereby reducing the risk to pedestrians and further the addition of more walkable environments (wide verges and shared paths).

The addition of the new collector road with a signalised Old Northern Road / new collector road intersection as per Option 2A, provided a significant reduction in crash risk overall; the reduction associated with Option 2B was significantly lower than for Option 2A, as the seagull intersection introduces new risks that were not present in the base case. The signalised intersection further improves crossing opportunities for pedestrians and cyclists over Old Northern Road as the footbridge can only be navigated using the stairs.

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1 Introduction

The National Transport Research Organisation (NTRO) was engaged by Legacy Property to undertake a Safe System Assessment (SSA) of the proposed design options for the development surrounding Dural Public School.

The current arrangement at Dural Public School consists of a single access frontage along Old Northern Road, with the following provisions as set out in Table 1-1 and illustrated in Figure 1-1. A report from SCT Consulting indicated that Dural Public School currently accommodates 397 students.

NTRO staff visited the site on 21 March 2023 to observe road conditions and pedestrian activity during school drop off hours. The observations made during this visit will be discussed in detail in subsequent sections of this report.

The concept for the proposed development within the vicinity of the school includes the following (Legacy Property):

- Dwelling yield of approximately 120 residential dwellings.
- Revised road layout, consisting of a proposed collector road with bypass corridor (including two roundabouts) and local roads internal to the site.
- A proposed 160 m section with 25 'kiss and drop' spaces within the collector road, along the northern boundary of the existing Dural Public School.
- A 4,000 sqm local park to the rear of the existing school, including a pedestrian through-site-link which will connect to the school and the residential lots to the south-west and north of the site.

The proposed development is illustrated in Figure 1-2.

Table 1-1 - Current provisions summary

Western Side	Eastern Side
Pedestrian footbridge	Pedestrian footbridge
Kerbside parallel parking (approximately 11 spots)	Separated set-down area – LEFT TURN ONLY provisions on southern exit
Bus bay	Kerbside pedestrian fencing (between Old Northern Road and set-down area)
3.8 m wide kerbside footpath	Kerbside parallel parking within set-down area on nearside (approximately 11 spots)
	Parallel parking within set-down area on offside (approximately 8 spots) – NO PARKING 8am-9am and 3pm-4pm
	1.2 m wide kerbside footpath (both sides of set-down area)
	Bus bay (Old Northern Road)
	Pedestrian crossing (southern extremity of set-down area)

Figure 1-1 - Current provisions

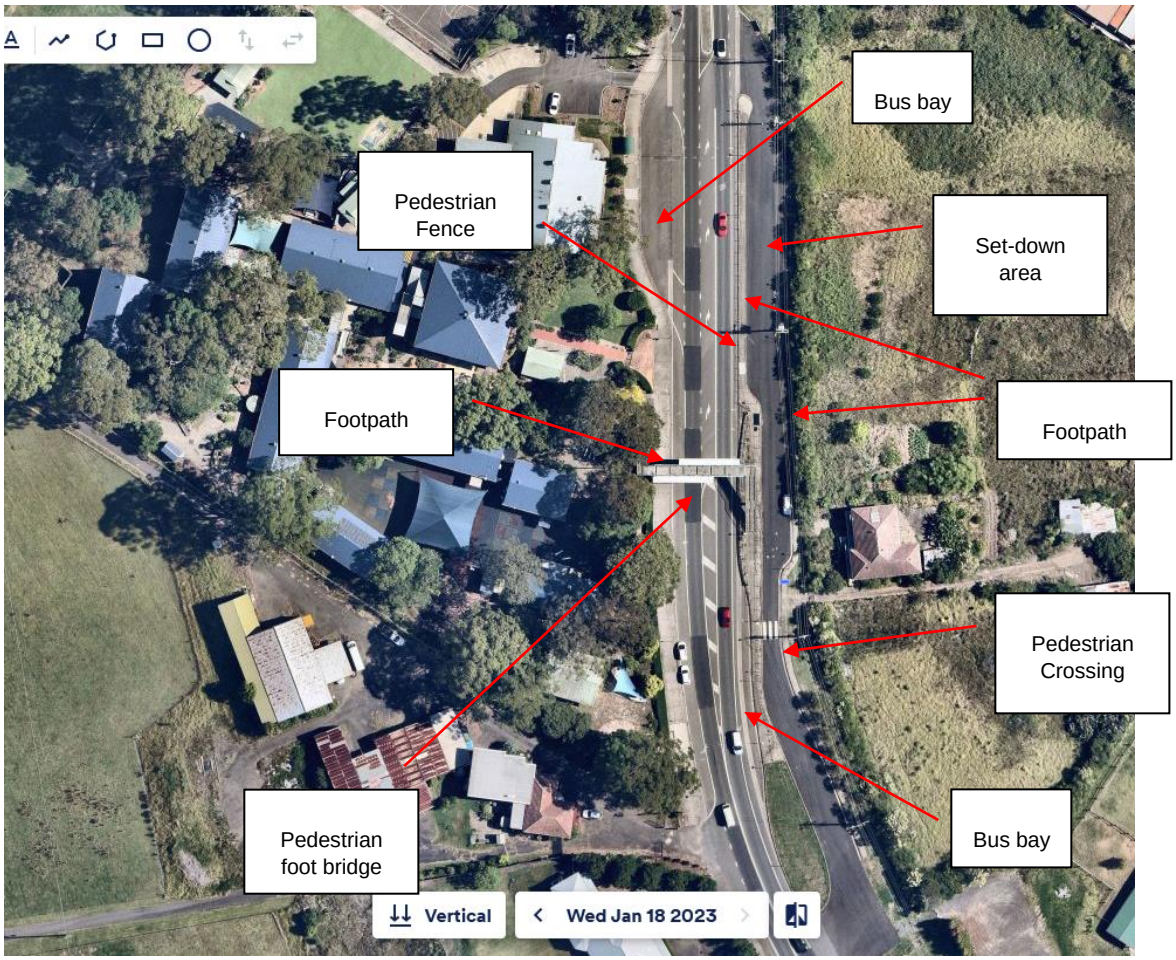


Figure 1-2 - Proposed development

Source: *Legacy Property*

This project undertook a ‘desktop’ Safe System Assessment based on design plans and information provided by Legacy Property and compared it to the existing facilities along Old Northern Road accompanied by site observations undertaken on 21 March 2023.

The assessment was undertaken by the project team over a series of workshops and was based on the guidelines outlined in the Safe System Assessment Framework report (Austroads 2016) and the Safe System Assessment Guidelines Version 1.0 (VicRoads 2018).

The remainder of this report is presented as follows:

- Section 2 provides a brief overview of the Safe System Assessment (SSA) Framework
- Section 3 briefly describes this project and the context of the SSA review
- Section 4 presents the SSA outcomes
- Section 5 provides commentary on the type of treatments that may improve Safe System alignment of the road infrastructure assessed by this project
- Section 6 covers additional Safe System components
- Section 7 provides concluding remarks.

2 The Safe System Assessment Framework

2.1 The Safe System

The Safe System approach for road safety seeks to ensure all elements of a road transport system support a public health focus to minimise harm to road users. Fundamentally, the Safe System approach acknowledges that human beings are fallible and their mistakes in navigating road transport should not result in the death or serious injury of themselves or others; supporting this is the principle that efficient movement should not be at the expense of human wellbeing (Austroads 2018).

The Safe System is typically considered in terms of four key pillars, shown in Figure 2-1. These are: **Safer Vehicles**, **Safer Speeds**, **Safer Road Users** and **Safer Roads**. A fifth pillar, **Post Crash Care**, is also often referenced. Undertaking of a Safe System Assessment is primarily concerned with Safer Roads and Safer Speeds, however all pillars of the Safe System are considered.

Figure 2-1: The Safe System Pillars

Source: (VicRoads 2018)

2.2 Safe System Impact Speeds

Safe System Speeds are the threshold speeds above which a severe outcome of the associated crash of the associated type is a near certainty. This includes speed thresholds of 70 km/h for head-on, 50 km/h for side impact (passenger car to passenger car), 30 km/h for side impact (passenger car to tree/pole) and 30 km/h for pedestrian impact, as illustrated in Figure 2-2. These speeds are consistent with the *Safe System Assessment Framework (*Austroads 2016a) noting that motorcyclists and cyclists are also vulnerable road users and subject to the same Safe System Speed threshold as pedestrians (30 km/h).

Figure 2-2: Safe System Speeds

CRASH TYPE	IMPACT SPEED
 Head on with another vehicle	70 km/h
 Side impact	50 km/h
 Side impact with tree	30 km/h
 Pedestrian & cyclists	30 km/h

Source: (VicRoads 2018)

2.3 The Safe System Assessment Framework

The Safe System Assessment Framework is a practitioner assessment tool to assist in the methodical consideration of Safe System objectives in road infrastructure projects. The tool was developed by NTRO and contributing partners for Austroads (Austroads 2016) to ensure Safe System objectives are being met for road infrastructure projects. The underlying principle of the Safe System is that humans are fallible, and mistakes (and hence crashes) will happen. Ideally, when they do, the system should be designed so as that a fatal or serious injury outcome does not occur. Guidance on how to undertake Safe System Assessments (SSAs) is outlined in the Austroads report (Austroads 2016).

The framework has seen its primary application in the assessment of road infrastructure designs and design options with base scenarios (such as existing conditions). This allows for relative safety of the various design options to be factored into the optioneering process, as well as highlighting the key areas of road safety risk so that they may be addressed. The framework has seen significant uptake in Victoria, with the VicRoads (now Department of Transport) mandating that all projects over $5M have a Safe System Assessment (SSA) undertaken (with the undertaking of a SSA recommended for all projects). VicRoads has produced supplementary guidelines for the undertaking of assessments (VicRoads 2018) that provide valuable additional guidance on the undertaking and reporting of SSAs.

This report draws on both the original Austroads and additional VicRoads guidance in the undertaking of the assessment.

The major output from the undertaking of a Safe System Assessment is the Safe System Matrix. This includes the quantitative assessment of the three components that form risk (exposure, likelihood and severity) against seven key crash types — run-off-road, head-on, intersection, other (primarily rear-ends and side swipes), pedestrian, cyclist and motorcyclist. This aspect of the assessment primarily focuses on the Safe System pillars of ‘Safer Speeds’ and ‘Safer Roads’. In addition, a qualitative review of the other three Safe System Pillars; ‘Safer Road Users’, ‘Safer Vehicles’ and ‘Post Crash Care’, is also undertaken.

3 Project Description

This section outlines the project, including the background, objectives, existing conditions and context. Relevant information for this project is identified using prompts from VicRoads (2018) and Austroads (2016a).

3.1 Project Background and Objective

The project background is summarised in Table 3-1.

Table 3-1: Project Background

Prompts	Comments
What is the reason for the **project**? Is there specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, maintenance/asset renewal, etc.	A development is proposed on the site around Dural Public School including approximately 120 new residential dwellings. Key components of this project include: • Revised road layout, consisting of a proposed collector road with bypass corridor (including two roundabouts) and local roads internal to the site. • Development of a major intersection - proposed collector road / Old Northern Road. • A proposed 160 m 'kiss and drop' area within the collector road, along the northern boundary of the existing Dural Public School, accommodating up to 25 parallel parking spaces. • A 4,000 sqm local park to the rear of the existing school, including a pedestrian through-site-link which will connect to the school and the residential lots to the south-west and north of the site. This project seeks to determine whether the development will provide a safer road environment than what currently exists at the site, and will analyse which of the proposed options will deliver the safest outcome.

Source for prompts: VicRoads (2018a), which are drawn from Austroads (2016a)

3.2 Existing Conditions and Context

Table 3-2 outlines the existing conditions and context of the project.

Table 3-2: Existing Conditions and Context for Project

Prompts	Comments
What is the **function** of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)? What alternative routes exist?	Currently, **only one** access exists to Dural Public School off Old Northern Road. Old Northern Road is the major thoroughfare for vehicles travelling between the Hills District and the townships of Dural, Middle Dural and Glenorie. At the location, Old Northern Road is governed by a 60 km/h speed limit, with a 40 km/h section during school hours, which extends from Redfield College to the south-east, for approximately 1 km. The road consists of a single through-lane in each direction with a right-hand turn auxiliary lane that leads into a set-down area on the eastern side of the road toward the northern end of the school. Old Northern Road is a major bus route, particularly during school drop-off and pick-up hours, with a bus stop on both sides of the roadway within the school envelope. There are approximately 11 kerbside parallel parking spaces on the western side of the road, with a further 19 contained within the eastern set-down area, 8 of which are NO PARKING during school drop-off and pick-up times. Traffic count data taken from the SCT Consulting report indicated that peak traffic volumes occurred between 7am and 8am in the morning and 4pm and 5pm in the afternoon, with approximately 1750 journeys along Old Northern Road during those periods for both directions collectively.
What is the **speed** environment? What is the current speed limit? Has it changed recently? Is it similar to other roads of this type? How does it compare to Safe System Speeds? What is the acceptability of lowering the speed limit at this location?	The speed limit within the vicinity is 60 km/h, with a 40 km/h school zone in operation. This is consistent with similar road environments and road types within the area.
What **road users** are present? Consider the presence of elderly pedestrians, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school speed limits, etc.)	Being a major thoroughfare in the area, Old Northern Road consists of a wide range of traffic types, including busses, heavy vehicles, commuter and local residential traffic. Close to the school, pedestrian activity is concentrated when school starts/finishes, road users predominantly consist of children and parents. A pedestrian footbridge is located across Old Northern Road, facilitating crossing movements to/from the school. The set-down area is separated from Old Northern Road by way of a raised kerb and pedestrian fencing, which further separates the pedestrians from through traffic. A marked pedestrian crossing is located within the set-down area for crossing movements towards the pedestrian footbridge.
What is the **vehicle** composition? Consider the presence of heavy vehicles (and what type), motorcyclists and other vehicles using the roadway.	During the site visit, the composition of vehicles consisted primarily of passenger-type vehicles. There was a moderate quantity of motorcycles and medium rigid type vehicles, with sporadic heavy vehicles, mostly truck and dog combinations.

Source for prompts: VicRoads (2018a), which are drawn from Austroads (2016a)

4 Assessment of Project

A breakdown of the risks common to the project are outlined below. An overview of the Safe System Assessment Matrix scores for the proposed design are presented in this section while the Safe System Assessment matrices for each arrangement is presented in Appendix A.

Firstly, the current arrangement at the school was assessed (i.e. the 'base case'), followed by subsequent assessments reviewing the proposed design options listed as Option 2A and Option 2B, each reviewed and scored individually.

The assessments have been undertaken based on the plans provided by Legacy Property supplemented by aerial photography and a video taken at the site by NTRO staff.

4.1 Assessment of Current Arrangement (Base Case)

A summary of the Safe System Assessment scores based on the current arrangement was conducted for the seven primary crash types considered and is provided in Table 4-1, below.

Table 4-1: Current arrangement (Base Case) Safe System Assessment summary results

Arrangement	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist	Total
Current Arrangement	8/64	36/64	12/64	12/64	9/64	18/64	18/64	113/448

Note: Colour coding of the crash cells reflects an indicative measure of risk, with scores of less than 16 considered 'low risk', greater or equal to 16 but less than 32 'moderate risk', and scores of 32 or greater as 'high risk'.

The traffic volumes along Old Northern Road at this location was taken from the traffic survey data, approximately 17,500 vehicles per day, which correlates with a headway of approximately 4 to 5 seconds during peak periods, and therefore a very high exposure level. The site assessment during the AM peak period estimated the pedestrian and motorcycle exposure to be between 50 and 100 units per day, constituting a high exposure level and analysis of local Strava data to show cyclists to be at a moderate exposure level.

The roadway is divided by double solid centrelines with minimal lateral separation between the two directions. There is a moderate curvature of the road towards the south, with the approach from the north being relatively straight. Parallel parking spaces along the western kerb and within the set-down area have limited accessibility, increasing the prevalence of double parking, non-compliance with parking regulations, U-turn and other turn manoeuvres, leading to the likelihood of head-on and other category crashes (considered as likely). The crash risk of intersection crashes is unlikely based on the provision of a northbound turning lane into the set-down area and the restriction of left-turns only exiting the set-down area. Run-off-road crashes are considered as highly unlikely.

Only the head-on crash type impact is likely to cause a fatality or serious injury for vehicle occupants at this location, however it is likely that any collision involving a vulnerable road user would potentially result in a fatality or serious injury.

4.2 Assessment of Option 2A

Option 2A as proposed by Legacy Property would consist of the existing facilities that are already in place at the site, along with the addition of a signalised intersection at the Old Northern Road / new collector road intersection. Option 2A further includes, a 160 m section containing 25 'kiss and ride' parking spaces on the southern side of the collector road located at the northern boundary of the school, as illustrated in Figure 4-1.

Figure 4-1: Proposed ‘kiss and ride’ facility

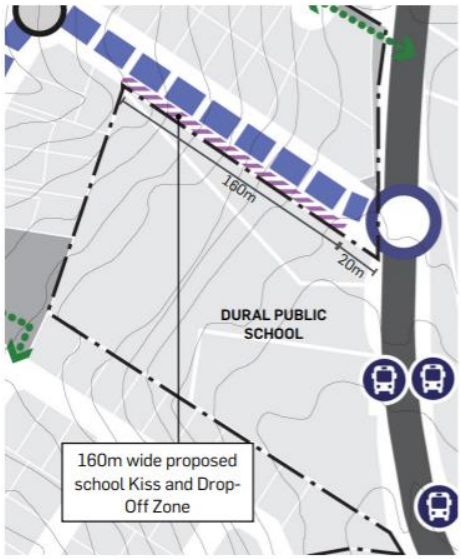


Figure 18 Proposed school kiss and drop off location

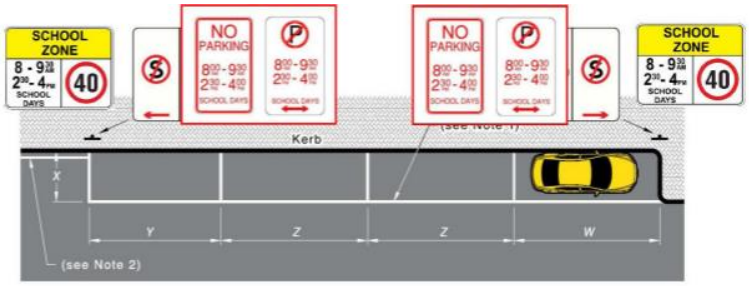


Figure 19 On Street Parking Standard Dimension
Source: AS2890.5 (2020)

Key

X = Width of space, including safety buffer.

Y = Length of end where vehicles may enter or leave the space directly - 5.4 m min.

Z = Length of intermediate space - 6.0 m to 6.7 m, depending on parking turn over traffic volume.

W = Length of end space which is obstructed at one end by a kerb or barrier - 6.3 m or length **Z** of adjacent space, whichever is the greater.

Source: Legacy Property

In the interim stage the collector road will include one through lane per direction with a second lane on the left designated for a ‘kiss and ride’ facility. Provision will be made for future development, consisting of two through lanes per direction with a ‘kiss and ride’ facility accommodated in a third lane on the southern side and parallel kerbside parking on the northern side, as shown in Figure 4-2.

Figure 4-2: Collector road cross-section

Source: Legacy Property

Legacy Property is exploring the option of setting the speed limit along the collector road to a permanent limit of 30 km/h. The safety benefit of this, in comparison to a 40 km/h speed zone will also be evaluated.

Table 4-2 provides a summary of the SSA score based on the additions to the site as explained for Option 2A, evaluated for the seven primary crash types. These scores are representative of the interim stage only (referring to the cross section of the collector road) and do not include the potential future as indicated in Figure 4-2. It is noted that increasing the carriageway to two through lanes in each direction would have an effect on the scores. However, it would not ultimately have a major reflection on the scores contained within this assessment.

Table 4-2: Option 2A - Proposed development and Signalised intersection - Safe System Assessment summary results

Arrangement	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist	Total
Option 2A – 40 km/h	8/64	24/64	6/64	8/64	4.5/64	18/64	18/64	86.5/448

Note: Colour coding of the crash cells reflects an indicative measure of risk, with scores of less than 16 considered 'low risk', greater or equal to 16 but less than 32 'moderate risk', and scores of 32 or greater as 'high risk'.

This assessment has revealed a significant decrease in the overall crash risk of the road network surrounding Dural Public School. Whilst there was no reduction in the run-off-road, cyclist or motorcycle type crash risk, all other crash types saw a reduction in risk levels.

Overall, the proposed works undertaken as Option 2A improves the safety risk of the current 'kiss and ride' offering along Old Northern Road by providing a second option for parents dropping their children off along the new collector road. This will reduce the occurrence of problematic/complex driving behaviour (which increases the crash risk) such as double parking, non-compliance with parking provisions and merging into a heavily trafficked roadway. Physical separation of vehicles on the collector road by way of a vegetated median will decrease the likelihood of a head-on collision occurring.

The signalised intersection will effectively decrease the operating speed of vehicles within the area, reducing the likelihood of a run-off road type collision and improve crossing opportunities for pedestrians and cyclists. The roundabout to be located along the collector road will provide northbound motorists with a safer option to turn around to travel back to the south, removing the need to make a right-turn into the current set-down area, where there is a high concentration of pedestrian activity. This arrangement will reduce the risk of intersection and pedestrian collisions.

4.3 Assessment of Option 2B

Option 2B as proposed by Legacy Property mirrors Option 2A, however instead of a signalised intersection configuration, a seagull arrangement would be installed.

With this configuration, the benefits of improving the safety risk by moving the 'kiss and ride' facility is maintained as in Option 2A. However, the seagull treatment introduces an increased risk for intersection collisions, with a crash orientation closer to 90°. The introduction of a merge manoeuvre between turning traffic and through traffic associated with the right-hand turn from the collector road onto Old Northern Road would also increase the crash risk, particularly for motorcycles who can be lost in blind spots of merging vehicles. Further to that, gap-finding for vehicles turning right from the minor road at seagull intersections can be problematic, especially on roads with high traffic volumes.

The SSA score for this option is displayed in Table 4-3 utilizing a standard 40 km/h school speed zone.

Table 4-3: Option 2B - Proposed development and seagull arrangement intersection - Safe System Assessment summary results

Arrangement	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist	Total
Option 2B – 40 km/h	8/64	24/64	20/64	10/64	4.5/64	18/64	22.5/64	107/448

Note: Colour coding of the crash cells reflects an indicative measure of risk, with scores of less than 16 considered 'low risk', greater or equal to 16 but less than 32 'moderate risk', and scores of 32 or greater as 'high risk'.

4.4 Summary of Risks

A summary of the risk scores is presented in Figure 4-3, and Figure 4-4. These summaries indicate that Option 2A shows a significant reduction in the overall crash risk in the area, while Option 2B displays a minor reduction. Important to note - according to the *Safe System Assessment Framework* (Austroads 2016), changes in score indicate only a likely change in risk, and not the exact magnitude of that change. Put another way, the scoring system should not be interpreted as a linear scale in which, for example, twice the score means twice the risk.

The key findings of the results were:

- Run-off-road: No change in crash risk between base case and either of the proposed options.
- Head-on: Similar reduction from the base case for each of the proposed options (significant reduction).
- Intersection: Significant reduction in crash risk for Option 2A (significant reduction). The addition of a seagull arrangement as per Option 2B introduced a significantly higher level of intersection crash risk (major increase).
- Other: Option 2A provides a reduced crash risk of other types of crashes (medium reduction), while the reduction in crash risk is not as significant for Option 2B (small reduction).
- Pedestrian: Both Option 2A and 2B provide a significant reduction in the crash risk (medium reduction).
- Cyclist: The crash risk remains constant between both Option 2A and Option 2B when compared to the base case.
- Motorcycle: The crash risk for motorcycles for Option 2A remains the same as the base case, while it increases for Option 2B (small to medium increase).

Figure 4-3: Risk scores per crash type for each of the options presented

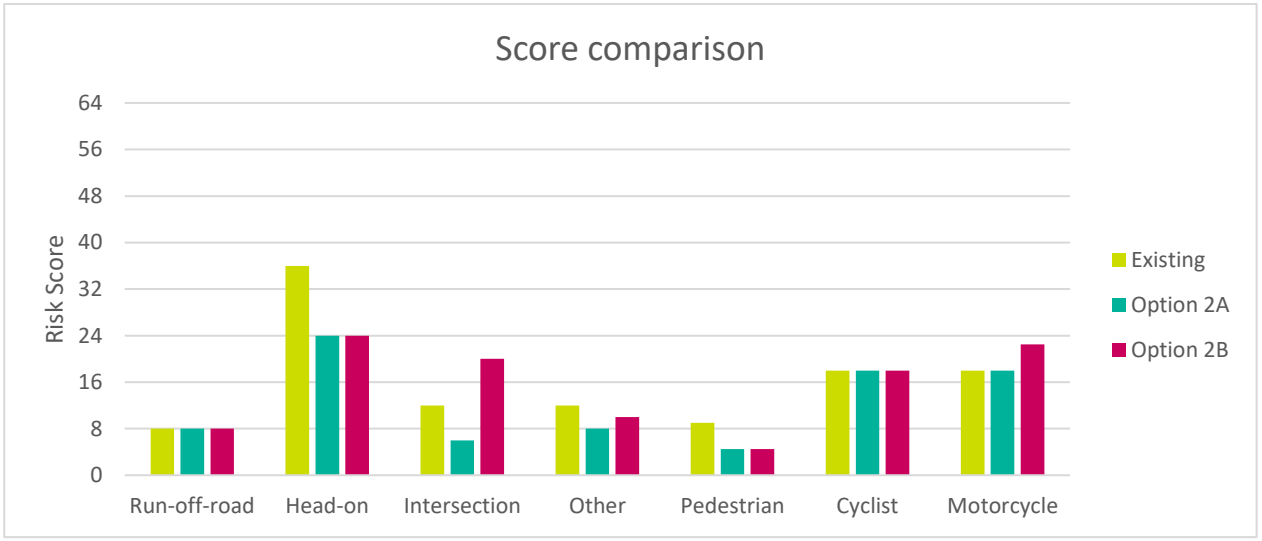
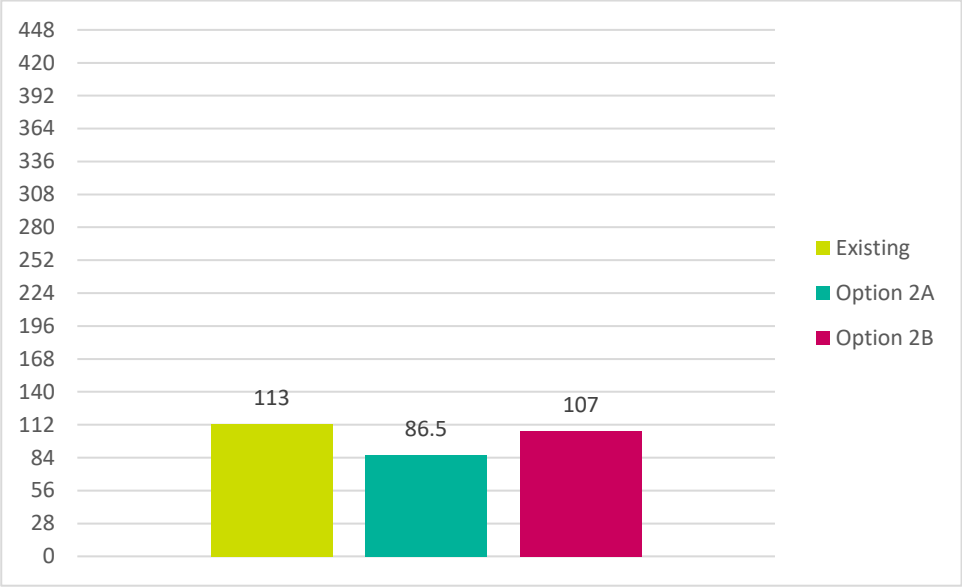


Figure 4-4: Overall crash risk score per option



4.5 Suggested 30 km/h Speed Limits

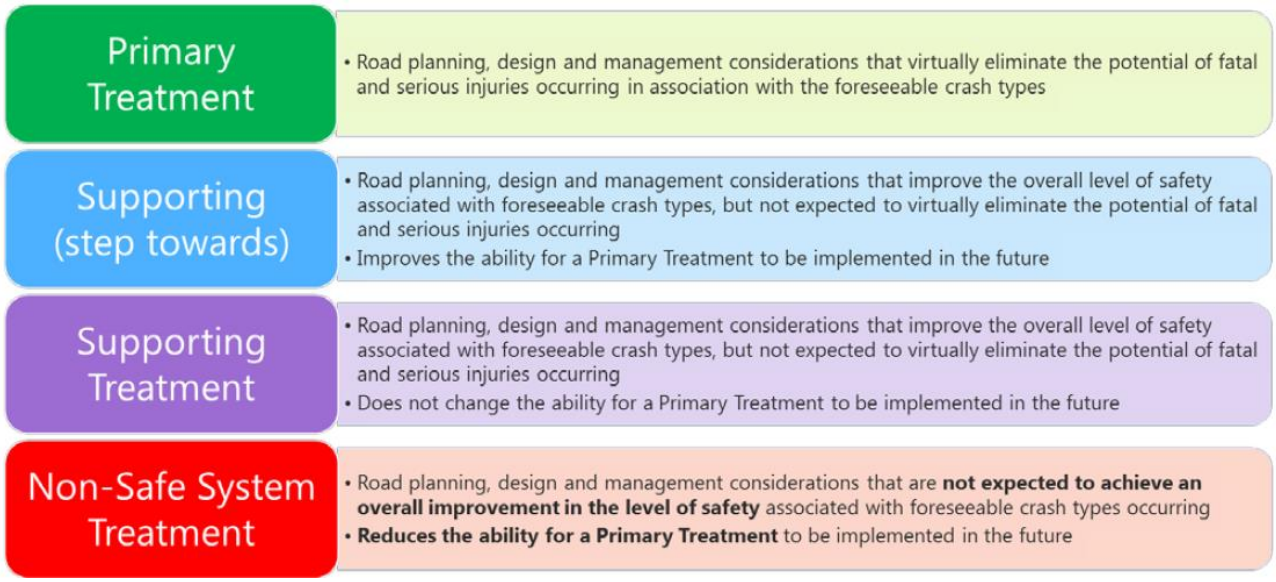
It is understood that Schools Infrastructure NSW has suggested implementation of a permanent 30km/h speed limit on the proposed collector road adjacent to Dural Public School. While this approach would further reduce the crash risk when compared to the more common approach of a 40km/h school zone limit, it is not essential to achieving a reduced risk outcome from the current environment.

Notably, the implementation of a signalised intersection at Old Northern Road compared with a seagull intersection arrangement results in a greater risk reduction compared to the implementation of a 30km/h speed limit and therefore securing a signalised intersection outcome would be considered a higher priority from a safety and risk perspective.

5 Treatments to Improve Safe System Alignment

The approach to improving road infrastructure adherence to Safe System principles considers four primary treatment categories. These have been established based on how supportive a countermeasure may be of the Safe System to transform a risk situation to reduce crash likelihood and severity. The four categories, known collectively as the Safe System Treatment Hierarchy, are described in Austroads, and Figure 5-1, below, provides a summary of them.

Figure 5-1: Safe System treatment hierarchy



Source: (Austroads 2018)

To maximise the Safe System adherence, assessments of infrastructure focus on the primary and supporting level treatments.

Table 5.1 and Table 5.2 present potential treatments to address the specific risks for the current arrangement, that is the base case, identified in Section 4.

Table 5.1: Potential Primary Treatments

Risk	Treatments for Consideration
Little or no separation between opposing lanes on Old Northern Road	Introduction of raised concrete median or painted median treatment.
Overtaking double parked vehicles across double solid lines	Introduction of raised concrete median. New kiss and ride location associated with both options, moving parking to collector road.
Vehicles performing illegal U-turns	Installation of roundabouts to the north and south of Dural Public School on Old Northern Road. Introduction of raised concrete median to prevent U-turn facilitation.
Open car doors encroaching on through lane	Widening of shoulder at 'kiss and ride' facility. New kiss and ride location associated with both options, moving parking to collector road.
Non-compliance with LEFT-TURN ONLY sign at the exit of the set-down area	Installation of a raised a splitter island which prevents right-turns could be considered.
Lack of crossing facilities for cyclists	Introduction of ramp entry/exit to pedestrian footbridge. Introduction of signalised crossing at collector road intersection (Option 2A).
Squeeze points for cyclists	Introduction of cycle lanes.

Table 5.2: Potential Secondary Treatments

Risk	Treatments for Consideration
Non-compliance with parking regulations	Greater level of enforcement
Pedestrians crossing Old Northern Road from east to west, not utilizing pedestrian footbridge	Assume Option 2A will provide for a pedestrian phase at the signalised intersection but Option 2B will not have a pedestrian crossing facility.

6 Additional Safe System Components

As part of this SSA, consideration has been given to other components that comprise the Safe System, i.e. road users, vehicles and post-crash care. Issues identified as relevant to this project are listed in Table 6.1.

Table 6.1: Other Safe System Components

Pillar	Prompts	Comments / Issues
Road user	Are road users likely to be alert and compliant? Are there factors that might influence this? What are the expected compliance and enforcement levels (alcohol / drugs, speed, road rules and driving hours)? What is the likelihood of driver fatigue? Can enforcement activities be conducted safely? Are there special road users (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism) or risk-taking behaviours?	• Being a Public School, there is a large number of young pedestrians which are susceptible to erratic behaviour and lesser understanding of road hazards. • Drivers can be distracted by passengers (children) and situation (school related distractions e.g. running late, misplaced school items and so forth). • High levels of pedestrian distraction, school children can suddenly dart across the road. • Lower levels of compliance based on time constraints. • Drivers might be impatient considering a school environment on this busy road and not adhere to road rules, therefore considering overtaking which can result in serious crashes.
Vehicle	What level of alignment is there with the ideal of safer vehicles? Are there factors that may attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed / existing road design? Is this route used by recreational motorcyclists? Are there resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement activities be undertaken safely? Has vehicle breakdown been catered for?	• Most vehicles are family type vehicles with no glaring safety issues outstanding. • There is a moderate concentration of heavy vehicles utilising this area.
Post-crash care	Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access, stopping space)? Do emergency and medical services operate as efficiently as possible? Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc? Is there provision for e-safety (i.e. safety systems based on modern information and communication technologies, C-ITS)?	• There are moderate to wide shoulders and wide footpaths that would allow for access of emergency vehicles and personnel.

7 Concluding Remarks

This Safe System Assessment has analysed the crash risk associated with the road environment surrounding the Dural Public School as currently constructed (base case). This crash risk was then compared against two proposed development options which include a new collector road to the north of the school, intersecting with Old Northern Road.

As indicated by the current arrangement review, the primary crash risk at the site is head-on collisions, based on the limited separation between opposing lanes and the interaction of through traffic with vehicles entering/exiting/queuing at the kerbside parallel parking facility on the western side of Old Northern Road. These interactions also increase the risk of other crash types, mostly consisting of rear-end and sideswipes. The provision for pedestrians as a whole is considered reasonable, with a separated set-down area on the eastern side of Old Northern Road and a pedestrian footbridge. The primary risk to pedestrians under the current provision is exiting vehicles from the right-hand side (vehicle parked on the western side of Old Northern Road), encroaching on live lanes and non-compliance.

Option 2B, as presented by Legacy Property, introduces the collector road with a seagull intersection along Old Northern Road. The introduction of this intersection will increase the intersection and motorcycle crash risk comparative to the current arrangement, as it will introduce a merge point at which motorcycles are at risk of being unnoticed by merging vehicles. The major benefit in terms of crash risk for Option 2B is moving the ‘kiss and drop’ facility to the collector road and the opportunity for vehicles to turn around, rather than performing a U-turn.

The introduction of the collector road with a signalised intersection, as presented in Option 2A, provides the greatest reduction in crash risk overall, with significant reductions in head-on, intersection, other and pedestrian crash types. These reductions are attributed to moving the ‘kiss and drop’ facility to the collector road, decreased operating speeds, controlled intersection movements and provision for vehicles to turn around. There is no merge point associated with the intersection and as such, there is no increased risk to motorcycles, unlike Option 2B. Further to that Option 2A increases the provision of pedestrian crossing facilities, especially for users unable to use stairs.

It should be noted that neither Option 2A or Option 2B produce scores of 32 or higher for any of the seven crash types, and as such, none of these crash types are considered as high risk.

The installation of a permanent 30 km/h zone along the collector road would further reduce crash risk, however when compared to the more common approach of a 40 km/h school zone limit, it is not essential to achieving a reduced risk outcome from the current environment. The main benefit of the 30 km/h zone is the reduction of speeds in line with the Safe System Assessment process for crashes with vulnerable road users.

The implementation of a signalised intersection at Old Northern Road / new collector road compared with a seagull intersection arrangement results in a greater risk reduction compared to the implementation of a 30 km/h speed limit, and therefore securing a signalised intersection outcome is considered the higher priority from a safety and risk perspective accompanied by the new ‘kiss and drop’ facility.

References

Austroads 2016, *AP-R509-16 - Safe System Assessment Framework*.

Austroads 2018, 'AP-R560-18-Towards Safe System Infrastructure A Compendium of Current Knowledge'.

Google Street View, map data, Google, Sydney, NSW.

VicRoads 2018, 'Safe System Assessment Guidelines'.

Derriwong Road, Dural - Urban Design Report, Urbis

Old Northern Road and Derriwong Road Dural Planning Proposal - Traffic IMpact Assessment, SCT Consulting

Appendix A Safe System Assessment Matrices

Table A 1: Current arrangement SSA matrix

Location:	Dural Public School						
	Run-off-road 	Head-on 	Intersection 	Other 	Pedestrian 	Cyclist 	Motorcyclist 
Exposure	>17,500 vpd	>17,500 vpd	>17,500 vpd	>17,500 vpd	50-100 units per day (based on site visit in AM peak)	10-50 units per day (based on site visit in AM peak and consultant report)	70 units per day (Assume 0.4% of total traffic from consultants report)
Score	4/4	4/4	4/4	4/4	3/4	2/4	3/4
Likelihood	Factors that increase the likelihood include: •Curvature to the south Factors that decrease the likelihood include: •Not high-speed environment (60km/h or 40km/h in school peaks) •Moderate to wide shoulder width •Kerbed •Good delineation	Factors that increase the likelihood include: •Little or no physical separation between opposing lanes •Potential evasive movements due to vehicles leaving parking bay •Overtaking due to double parking •Vehicles U-turning to head northbound after leaving set-down area Factors that decrease the likelihood include: •Not a high speed environment (60km/h or 40km/h in school peaks) •Good delineation	Factors that increase the likelihood include: •Vehicles taking risky gaps in peak periods •Vehicles U-turning to head northbound after leaving set-down area Factors that decrease the likelihood include: •Not a high-speed environment (60km/h or 40km/h in school peaks) •Good sight distance at the entrance to the set-down area •Left turn only at southern exit to the set-down area •Deceleration and right-turn lane	Factors that increase the likelihood include: •Congestion at peak times may increase rear end incidences (expected low severity) •Non-compliance with parking regulation •Poor sight distance for vehicles exiting parallel parking bay •Open car doors not contained within parking bay Factors that decrease the likelihood include: •Not a high-speed environment (60km/h or 40km/h in school peaks) •Bus bay	Factors that increase the likelihood include: •Potential for rear end on western parking bay •Width of parking bay may mean that occupants leaving via a right-hand door are on the roadway •Non-compliance with use of pedestrian infrastructure (e.g. footpaths and fencing) Factors that decrease the likelihood include: •Pedestrian bridge and fencing) •Pedestrian crossing (zebra) within the set-down area •Footpaths	Factors that increase the likelihood include: •Lack of dedicated cycling infrastructure •No crossing facility for cyclists (unless carrying bicycle up/down-stairs on bridge) •Several 'squeeze' points Factors that decrease the likelihood include: •Wide footpath on western side	Factors that increase the likelihood include: •High volume of crossing movements •Congestion at peak times may increase rear end incidences (expected low severity) Factors that decrease the likelihood include: •Not high-speed environment (60km/h or 40km/h in school peaks) •Good delineation •Straight alignment
Score	1/4	3/4	2/4	3/4	1/4	3/4	2/4
Severity	Factors that increase the likelihood include: Factors that decrease the likelihood include: •Not high-speed environment (60km/h or 40km/h in school peaks) •Barrier on eastern side protecting from bridge	Factors that increase the likelihood include: Factors that decrease the likelihood include: •Not high-speed environment (60km/h or 40km/h in school peaks)	Factors that increase the likelihood include: Factors that decrease the likelihood include: •Not high-speed environment (60km/h or 40km/h in school peaks) •Not likely to be 90 degree impact angle	Factors that increase the likelihood include: Factors that decrease the likelihood include: •Not high-speed environment (60km/h or 40km/h in school peaks)	Factors that increase the likelihood include: •60km/h or 40km/h in school peaks Factors that decrease the likelihood include:	Factors that increase the likelihood include: •60km/h or 40km/h in school peaks Factors that decrease the likelihood include:	Factors that increase the likelihood include: •60km/h or 40km/h in school peaks Factors that decrease the likelihood include:
Score	2/4	3/4	1.5/4	1/4	3/4	3/4	3/4
Crash Score	8/64	36/64	12/64	12/64	9/64	18/64	18/64
						Total	113/448

Table A 2: Option 2A SSA matrix

Location:	Dural Public School - Option 2A - 40km/h						
	Run-off-road 	Head-on 	Intersection 	Other 	Pedestrian 	Cyclist 	Motorcyclist 
Exposure	>17,500 vpd	>17,500 vpd	>17,500 vpd	>17,500 vpd	50-100 units per day (based on site visit in AM peak)	10-50 units per day (based on site visit in AM peak and consultant report)	70 units per day (assume 0.4% of total traffic from consultants report)
Score	4/4	4/4	4/4	4/4	3/4	2/4	3/4
Likelihood	Factors that increase the likelihood include: • Remain unchanged Factors that decrease the likelihood include: • Reducing operating speed with turn into and out of collector road (signalised)	Factors that increase the likelihood include: • Remain unchanged for Old Northern Road Factors that decrease the likelihood include: • Decreased parking traffic/congestion on Old Northern Road • Physical separation with raised and vetated median • Reduced operating speeds with turn into and out of collector road (signalised)	Factors that increase the likelihood include: Factors that decrease the likelihood include: • Reduced operating speeds due to singalised intersection • Intersection control with signals • Creation of appropriate turning facility (roundabout) along collector road reducing need for U-turn • Extended right-turn times at entrance to set-down area due to signalised intersection to north	Factors that increase the likelihood include: • Increased chances of rear-end collision with banked traffic at intersection Factors that decrease the likelihood include: • Reduced operating speeds due to intersection • Decrease in congestion at parking facilities on Old Northern Road • Decrease in merging manoeuvres exiting parking facility	Factors that increase the likelihood include: Factors that decrease the likelihood include: • Decreased pedestrian activity on Old Northern Road • Reduced operating speeds due to intersection • Increased parking on school side of road, reducing need to cross road	Factors that increase the likelihood include: • Extra conflict points associated with collector road intersection Factors that decrease the likelihood include: • Reduced operating speeds due to intersection	Factors that increase the likelihood include: • Extra conflict points associated with collector road intersection Factors that decrease the likelihood include: • Reduced operating speeds due to intersection
Score	1/4	2/4	1/4	2/4	0.5/4	3/4	2/4
Severity	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment • Increased vehicle separation (on collector road)	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment
Score	2/4	3/4	1.5/4	1/4	3/4	3/4	3/4
Crash Score	8/64	24/64	6/64	8/64	4.5/64	18/64	18/64
						Total	86.5/448

Table A 3: Option 2B SSA matrix

Location:	Dural Public School - Option 2B - 40km/h						
	Run-off-road 	Head-on 	Intersection 	Other 	Pedestrian 	Cyclist 	Motorcyclist 
Exposure	>17,500 vpd	>17,500 vpd	>17,500 vpd	>17,500 vpd	50-100 units per day (based on site visit in AM peak)	10-50 units per day (based on site visit in AM peak and consultant report)	70 units per day (assume 0.4% of total traffic from consultants report)
Score	4/4	4/4	4/4	4/4	3/4	2/4	3/4
Likelihood	Factors that increase the likelihood include: • Remain unchanged Factors that decrease the likelihood include: • Reduced operting speed with turn into and out of collector road	Factors that increase the likelihood include: • Remain unchanged for Old Northern Road Factors that decrease the likelihood include: • Decreased parking traffic/congestion on Old Northern Road • Physical separation with raised and vegetated median • Reduced operating speeds with turn into and out of collector road	Factors that increase the likelihood include: • Turning movements across Old Norther Road (into and out of collector road) Factors that decrease the likelihood include: • Creation of appropriate turning facility (roundabout) along collector road, reducing need for U-turn	Factors that increase the likelihood include: • Increased change of sideswipe collision as vehicles merge onto Old Northern Road at seagull arrangement • Potential for vehicles queuing in the seagull right-turn lanes, increase risk of rear-end Factors that decrease the likelihood include: • Reduced operating speeds due to intersection • Decrease in congestion at parking facilities on Old Northern Road • Decrease in merging manoeuvres exiting parking facility	Factors that increase the likelihood include: Factors that decrease the likelihood include: • Decreasd pedestrian activity on Old Northern Road • Reduced operating speeds due to intersection • Increased parking on school side of road, reducing need to cross road	Factors that increase the likelihood include: • Extra conflict points associated with collector road intersection Factors that decrease the likelihood include: • Reduced operating speeds due to intersection	Factors that increase the likelihood include: • Additional conflict points at collector road intersection • Increased chance of side swipe collisions as vehicles merge Factors that decrease the likelihood include: • Reduced operating speeds due to intersection
Score	1/4	2/4	2/4	2.5/4	0.5/4	3/4	2.5/4
Severity	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed enviroment • Increased vehicle separation (on collector road)	Factors that increase severity outcome include: • Impact orientation closer to 90 degrees Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Not high speed environment (60km/h or 40km/h in school peaks)	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment
Score	2/4	3/4	2.5/4	1/4	3/4	3/4	3/4
Crash Score	8/64	24/64	20/64	10/64	4.5/64	18/64	22.5/64
						Total	107/448

Table A 4: Option 2B – 30 km/h SSA matrix

Location:	Dural Public School - Option 2B - 30km/h						
	Run-off-road 	Head-on 	Intersection 	Other 	Pedestrian 	Cyclist 	Motorcyclist 
Exposure	>17,500 vpd	>17,500 vpd	>17,500 vpd	>17,500 vpd	50-100 units per day (based on site visit in AM peak)	10-50 units per day (based on site visit in AM peak and consultant report)	70 units per day (assume 0.4% of total traffic from consultants report)
Score	4/4	4/4	4/4	4/4	3/4	2/4	3/4
Likelihood	Factors that increase the likelihood include: • Remain unchanged Factors that decrease the likelihood include: • Reduced operting speed with turn into and out of collector road	Factors that increase the likelihood include: • Remain unchanged for Old Northern Road Factors that decrease the likelihood include: • Decreased parking traffic/congestion on Old Northern Road • Physical separation with raised and vegetated median • Reduced operating speeds with turn into and out of collector road	Factors that increase the likelihood include: • Turning movements across Old Norther Road (into and out of collector road) Factors that decrease the likelihood include: • Creation of appropriate turning facility (roundabout) along collector road, reducing need for U-turn	Factors that increase the likelihood include: • Increased change of sideswipe collision as vehicles merge onto Old Northern Road at seagull arrangement • Potential for vehicles queuing in the seagull right-turn lanes, increase risk of rear-end Factors that decrease the likelihood include: • Reduced operating speeds due to intersection • Decrease in congestion at parking facilities on Old Northern Road • Decrease in merging manoeuvres exiting parking facility	Factors that increase the likelihood include: Factors that decrease the likelihood include: • Decreasd pedestrian activity on Old Northern Road • Reduced operating speeds due to intersection • Increased parking on school side of road, reducing need to cross road	Factors that increase the likelihood include: • Extra conflict points associated with collector road intersection Factors that decrease the likelihood include: • Reduced operating speeds due to intersection	Factors that increase the likelihood include: • Additional conflict points at collector road intersection • Increased chance of side swipe collisions as vehicles merge Factors that decrease the likelihood include: • Reduced operating speeds due to intesection
Score	1/4	2/4	2/4	2.5/4	0.5/4	3/4	2.5/4
Severity	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed enviroment • Increased vehicle separation (on collector road)	Factors that increase severity outcome include: • Impact orientation closer to 90 degrees Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Not high speed environment (60km/h or 40km/h in school peaks)	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment	Factors that increase severity outcome include: Factors that decrease severity outcome include: • Further reduction to speed environment
Score	2/4	3/4	2.5/4	1/4	2/4	2/4	2/4
Crash Score	8/64	24/64	20/64	10/64	3/64	12/64	15/64
						Total	92/448

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