

Auckland Transport  
Private Bag 92250  
Victoria Street West  
Auckland 1142  
New Zealand

2 March 2020

**Attention: Pete Moth**

Dear Pete,

**Safety Review of Carlton Street Bus Route**

Beca Limited (Beca) has been commissioned by Auckland Transport (AT) as part of the Traffic and Transportation Engineering Professional Services (TTEPs) Panel to undertake an independent safety audit of the new scheduled Frequent Transit Network (FTN) bus service (Route 68) along Carlton Street.

Auckland Transport plan to run buses on Carlton Street, primarily the Route 68, which will run on a 15-minute frequency in both directions for connections to Onehunga and New Lynn. We understand that the local residents are divided between support and opposition and that some residents are concerned about the safety of running buses on Carlton Street. This independent safety audit has been prepared in response to these concerns to review the impact on safety of running buses along Carlton Road and the wider area (Queenstown Road up to the roundabout with Northbound off-ramp and Hillsborough Road between Carlton Road and Littlejohn Street).

Please find the following two documents enclosed with this letter:

- Independent Safety Audit Report of the Carlton Street and wider area
- Responses to the specific issues raised by the Hillsborough Action Group.

In summary, The Safety Audit Team identified 18 safety related issues for this corridor, where 14 were rated as 'Minor' safety issues and four as 'comments'. Please note the risk ratings were based on principles stated on NZTA Road Safety Audit Procedures for Projects (interim release dated May 2013) and qualitative assessments based on independent professional judgements. There were no safety issues identified that were considered to be 'Significant', 'Serious' and 'Moderate'. The key reason for these risk ratings being 'Minor' are due to the lower operating speeds resulting from the closely spaced speed tables along the corridor.

In addition to the independent safety audit report, we have provided a table below summarising the change in risks identified as a result of the proposed operational bus services along the corridor.

Safety issue raised	Risk Rating (existing with no buses)	Risk Rating (existing with bus operations along Carlton Street)	Increased risk with bus operations along Carlton Street
Safety issues at the Frederick Street/Carlton Street Intersection	Minor	Minor	Slight increase in risk due to vehicles overtaking a stationary bus
Substandard Pedestrian Crossing Facilities Frederick Street/Carlton Street Intersection	Minor	Minor	Slight increase in risk due to potential increase in bus users
Limited Sight distance to the Zebra Crossing	Minor	Minor	No change in risk
Narrow footpath widths along the westbound carriageway	Minor	Minor	Slight increase in risk due to potential increase in bus users
Narrow footpath widths along the eastbound carriageway	Minor	Minor	Slight increase in risk due to potential increase in bus users
Inconsistent and poor centreline marking along the corridor	Minor	Minor	No change in risk
Conflict with vehicle exiting/entering Carlton Street from Hillsborough Road	Minor	Minor	Slight increase in risk due to unsafe lane positioning at the centreline
Vegetation obscuring signs	Minor	Minor	No change in risk
Removal of redundant pavement markings and RRPMS	Minor	Minor	No change in risk
Safety issues at the Queenstown Road and Frederick Street Intersection	Minor	Minor	Slight increase in risk for mobility scooter users due to bus tracking
Higher kerb lip at the pedestrian refuge island on Queenstown Road	Minor	Minor	No change in risk
Poor pavement marking and road surface at the Hillsborough Road/Carlton Street Intersection	Minor	Minor	No change in risk
Incorrect curve advisory sign and lack of curve advisory sign	Minor	Minor	No change in risk
Safety Issues at the Hillsborough Road/Littlejohn Street Intersection	Minor	Minor	No change in risk
Vehicles overtaking a stationary bus near bus stops along Carlton Street	N/A	Comment	-
Reduced sight lines at property accesses near the bus stops	N/A	Comment	-
Vehicles crossing the centrelines due to parked cars	Comment	Comment	-
Vegetation and debris near the bus stop	N/A	Comment	-

We trust that the information included covers the scope provided. Should you have any queries please don't hesitate to contact me.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'Rojina Baisyet', with a stylized flourish at the end.

**Rojina Baisyet**  
Senior Associate - Transportation

on behalf of

**Beca Limited**

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# Appendix A – Road Safety Audit Report



## Carlton Street Bus Route

Prepared for Auckland Transport  
by Beca Limited

2 March 2020



**make  
everyday  
better.**

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## Revision History

Revision N°	Prepared By	Description	Date
1.0	<b>Madusha Jayawardhena</b>	Issue to AT	02/03/2020

## Document Acceptance

Action	Name	Signed	Date
Prepared by	<b>Madusha Jayawardhena</b>		02/03/2020
Reviewed by	Rojina Baisyet		02/03/2020
Approved by	<b>Rob Mason</b>		02/03/2020
on behalf of	Beca Limited		

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This report has been prepared by Beca on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

# 1 Introduction

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## 1.1 Safety Audit Procedure

A road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc), carried out by an independent competent team who identify and document road safety concerns.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Road to Zero Strategy and the Safe System approach, that is, minimisation of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a safe system and bring those concerns to the attention of the client in order that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

*To deliver completed projects that contribute towards a safe road system that is increasingly free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project.*

A road safety audit should desirably be undertaken at project milestones such as:

- Concept Stage (part of Business Case);
- Scheme or Preliminary Design Stage (part of Pre-Implementation);
- Detailed Design Stage (Pre-implementation / Implementation); and
- Pre-Opening / Post-Construction Stage (Implementation / Post-Implementation).

A road safety audit is not intended as a technical or financial audit and does not substitute for a design check on standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the “NZTA Road Safety Audit Procedures for Projects, Interim Release dated May 2013”, the audit report should be submitted to the client who will instruct the designer to respond. The designer should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client shall make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this instruction, the designer shall action the approved amendments. The client may involve a Technical Services & Design Manager to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations to be completed by the designer, Technical Services & Design Manager and client for each issue documenting the designer response, Project Sponsor

(and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members.

## 1.2 Project Background

Beca Limited (Beca) has been commissioned by Auckland Transport (AT) as part of the Traffic and Transportation Engineering Professional Services (TTEPs) Panel to undertake an independent safety audit of the new scheduled Frequent Transit Network (FTN) bus service (Route 68) along Carlton Street.

Auckland Transport plan to run buses on Carlton Street, primarily the Route 68, which will run on a 15-minute frequency in both directions for connections to Onehunga and New Lynn. We understand that the local residents are divided between support and opposition, and that some residents are concerned about the safety of running buses on Carlton Street. This independent safety audit has been prepared in response to these concerns to review the impact on safety of running buses along Carlton Street and the wider area (Queenstown Road up to the roundabout with Northbound off-ramp and Hillsborough Road between Carlton Street and Littlejohn Street).

This report presents the findings of this independent safety audit of **Carlton Street Bus Route**. Safety issues have been considered against current guidelines, safety experience and practice where relevant.

The field audit and observations were carried out on **10/02/2020** between 7.30am – 10.00am and 3.00pm-5.30pm.

## 1.3 Safety Audit Team

The safety audit team (SAT) for the independent safety audit of Carlton Street Bus Route were as follows:

- Rob Mason                                      Lead Safety Auditor
- Rojina Baisyet                                Road Safety Auditor
- Madusha Jayawardhena                    Road Safety Auditor

## 1.4 Report Structure

The potential road safety problems identified have been ranked as follows:

The expected crash frequency is qualitatively assessed on the basis of expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed on the basis of factors such as expected speeds, type of collision, and type of vehicle involved.

Reference to other projects, historic crash rates, and similar elements of other projects, have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern raised in this report.

The frequency and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the Risk Assessment Matrix in **Table 1** below. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

Table 1: Risk Assessment Matrix

Severity (Likelihood of Death or Serious Injury Consequence)	Frequency (Probability of a Crash)			
	Frequent	Common	Occasional	Infrequent
Very Likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very Unlikely	Moderate	Minor	Minor	Minor

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide a suggested action for each risk category is given in **Table 2** below.

Table 2: Risk Categories

RISK	Suggested Action
Serious	A major safety concern that should be addressed and requires changes to avoid serious safety consequence.
Significant	Significant risk that should be addressed and requires changes to avoid injury consequence
Moderate	Moderate risk that should be addressed to improve overall safety
Minor	Minor risk that should be addressed where practical to improve overall safety.

In addition to the ranked safety issues it is appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, in some cases suggestions may be given by the auditors.

## 1.5 Documents Reviewed

The documents supplied by Auckland Transport reviewed in this Safety Audit, shown in **Table 3**, were as follows:

Table 3: Drawings Reviewed

Drawing Number	Revision (Date Issued)
TES/PULB/15131/JM/1	A (03/07/2019)
TES/PULB/15131/JM/2	A (03/07/2019)
TES/PULB/15131/JM/3	A (03/07/2019)
TES/PULB/15131/JM/4	A (03/07/2019)
TES/PULB/15131/JM/5	A (03/07/2019)

## 1.6 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and its environs, and the opinions of the SAT. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe and no warranty is implied that all safety issues have been identified in this report. Safety audits do not constitute a design review, nor an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific technical advice on matters raised and not rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the safety audit team or their organisations.

## 1.7 Previous Safety Audit

There was a previous safety audit conducted by WPS Opus International Consultant Limited on 5th June 2018, 'Central Bus Tracking Project Site 1: Carlton Street'. It is understood the scope of the previous safety audit is different from this audit, therefore not directly comparable.

## 2 Safety Audit Findings

### 2.1 Minor - Safety issues at the Frederick Street/Carlton Street Intersection

Probability of crash occurring: Occasional

Likelihood of Fatal/Serious injury: Unlikely

**Outcome: Minor**

Carlton Street/Frederick Street/Lilac Grove is a priority-controlled intersection with non-standard T-intersection due to the short cul-de-sac (Lilac Grove) connecting the intersection. The geometric layout of the intersection has an adverse camber with Frederick Street located at the apex of the curve. The following safety issues related to the intersection were identified.

- The principles set out in the Austroads guide for 'Safe Intersection Sight Distance'<sup>1</sup> (SISD) were used to estimate the required sight distance. SISD reflects the intervisibility distance between drivers on Carlton Street and a driver waiting on Frederick Street for an opportunity to enter Carlton Street. The SISD required towards Carlton Street for traffic exiting Frederick Street was calculated to be 65m and on site this was observed to be approximately 60m (Note that these on-site assessments are estimates only as no topography survey data was available to confirm the geometry of the road). This indicates that currently the sight distance towards Carlton Street for vehicles exiting Frederick Street has minor deficiencies due to the geometric layout.
- With the proposed bus stops (two stops with one on each side) at the eastern end of Carlton Street, there may be instances where a vehicle might cross the centreline to overtake a bus stopped at the eastbound bus stop. In this scenario, the driver waiting to turn right out may fail to notice the oncoming overtaking vehicle and may not be able to react in time to avoid a collision. Therefore, it is likely that bus stops may slightly exacerbate the existing limited sight distance. However, the probability of a crash occurring would be low as the frequency of the buses are only four per hour and the likelihood of a vehicle overtaking a stationary bus would be low. The speed of the eastbound approach was estimated to be 30km/h – 35km/h. Vision Zero<sup>2</sup> on speed and intersection crash risks notes that vehicle occupants are protected up to 50 km/h in an intersection crash. Therefore, should a crash occur, the severity of this crash resulting in serious injury would be low as the operating speeds are low at this location. Hence, the risk is considered to be minor given the low probability of a crash occurring at a lower operating speed.
- Due to the limited sight distance, there is also a head-on crash risk between a vehicle overtaking an eastbound bus and vehicle turning left out of Frederick Street. However, probability of a crash occurring would be low due to the low frequency of the buses. Vision Zero<sup>2</sup> on speed and head-on crash risks notes that vehicle occupants are protected up to 70 km/h in a collision. Therefore, this head on crash risk is considered to be minor given the low probability of a crash occurring and lower operating speeds.

<sup>1</sup> Austroads Guide to Road Design, Part 4A Section 3.3 – 07 June 2017

<sup>2</sup> Vision Zero for Tamaki Makaurau, Transport Safety Strategy and Action Plan to 2030 Report



Figure 1: Limited sight distance on left for side for traffic exiting Frederick Street towards Carlton Street

- During the AM period, it was observed that the vehicle queue in the eastbound direction along Carlton Street extends past this intersection and there was extensive queuing along Frederick Street. It was difficult for the traffic wanting to turn right out of Frederick Street to find a gap and excessive waiting times were observed. These delays result in frustration, with some drivers observed to be undertaking risky merging movements such as forcing their way into small gaps and partially straddling over the westbound lane. The westbound drivers may not anticipate a partially straddled vehicle increasing the risk of collision. However, this existing safety risk is unlikely to be exacerbated due to the running of the buses along this corridor.



Figure 2: AM Peak queues along Carlton Street towards Queenstown Road at the Frederick Street intersection.

**Recommendation:**

The following recommendations may be considered to mitigate the risks identified above:

- Provide no overtaking double yellow lines between the bus stops. This may potentially discourage any drivers who intend to overtake a stationary bus, reducing the likelihood of a crash occurring.
- Provide further speed reduction treatments, such as raised platforms approaching the intersection from Frederick Street (east) to reduce the approach speed.
- Provide additional advanced curve warning signs in both directions along Carlton Street indicating the concealed access to warn drivers of the side road.

- Provide additional signage and pavement marking treatments such as 'SLOW' threshold marking approaching the curve for the westbound traffic to further reduce speeds.
- Provide 'Keep Clear' markings at the intersection to provide safe merging opportunities and to enhance the intersection for the approaching drivers.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<i>Client Decision:</i>
<i>Action Taken:</i>



## 2.2 Minor – Substandard Pedestrian Crossing Facilities Frederick Street/Carlton Street Intersection

Probability of crash occurring: Occasional

Likelihood of Fatal/Serious injury: Unlikely

**Outcome: Minor**

At present, there are no median refuge islands or other crossing facilities across Frederick Street and Lilac Grove. The current pram ramps are substandard, narrow and not orientated correctly. The surface conditions are uneven. There are no tactile ground surface indicators (TGSIs) for visually impaired footpath users. The gradient of the footpath and the pram ramp towards Carlton Street may not be suitable for mobility scooter or wheelchair users. If pedestrians with mobility aids, wheelchairs or walking frames were to access the bus stops from Queenstown Road, these users may not be able to access the bus stops at this intersection independently due to the poor crossing facilities across Frederick Street. Note that the footpath widths approaching these pram crossings are also narrow due to the roadside safety barrier and concrete barrier further limiting the access to these bus stops for mobility scooters, wheelchairs and prams (raised in **Section 2.4**).

The principles set out in the Austroads guide for 'Crossing Sight Distance'<sup>3</sup> (CSD) reflects the adequate distance where a pedestrian can see the approaching traffic to judge a safe gap and cross the road. For a pedestrian crossing Frederick Street (south), on the southwest corner, the required CSD towards Carlton Street is calculated to be 27m and on site this was estimated to be 14m. This indicates that there is insufficient intervisibility between a right turning vehicle into Frederick Street and pedestrians waiting at the southwest corner of the intersection, increasing the risk of a pedestrian crash. The limited sight distance is due to the uphill geometry of the intersection and the pram crossing being located further south of Frederick Street. With the proposed bus stops, near this intersection, there may be an increased pedestrian demand at this intersection to access these bus stops, thus increasing the probability of a crash. However, the right turn speeds were observed to be approximately 15km/h. Vision Zero<sup>2</sup> on speed and crash risks suggests that pedestrian survivability in a crash is improved in a crash with vehicle speeds less than 30km/h. Therefore, should a crash occur at this intersection, the severity would be low given the low turning speeds. The CSD on other approaches across Frederick Street were adequate on site.

There are no existing crossing facilities across Carlton Street at this intersection or any facilities proposed across Carlton Street between the bus stops. There are no formal crossing points and as a result typically, bus stop users will cross behind the bus stop. Therefore, it is important that bus users can see approaching traffic adequately to judge a safe gap to cross the road. Site observations indicated that currently there is sufficient CSD between these bus stops for the pedestrians. However, as there are no pram ramps, mobility scooter or wheelchair users do not have adequate crossing facilities to cross between the bus stops. With the existing concrete barrier along the southern footpath path, bus stop users may be either forced to cross at the intersection of Frederick Street or near Sunnyridge Place increasing the safety risk for the pedestrians at this location due to the limited crossing facilities.

<sup>3</sup> Austroads Guide to Road Design, Part 4A Section 3.3 – 07 June 2017



Figure 3: Pram crossing facilities in poor condition across Frederick Street and Lilac Grove.

**Recommendation:**

To further reduce any crash risk for pedestrians at this intersection, the following recommendations may be considered

- Provide safe crossing facilities across Frederick Street and Lilac Grove so that all footpath users including users on mobility scooters, wheelchair users and visually impaired users can access the bus stops.
- Provide further speed reduction treatments, such as raised platforms approaching the intersection from Frederick Street approach to reduce the speeds approaching the bus stops to reduce the likelihood and severity of any pedestrian related crashes.
- Provide additional signage and pavement marking treatments such as 'SLOW' threshold markings approaching the curve for the westbound traffic to further reduce the speeds.

<i>Designer Response:</i>
<i>Safety Engineer:</i>
<i>Client Decision:</i>
<i>Action Taken:</i>

## 2.3 Minor – Limited Sight distance to the Zebra Crossing

Probability of crash occurring: Infrequent  
 Likelihood of Fatal/Serious injury: Very Unlikely  
**Outcome: Minor**

The proposed zebra crossing in front of the school access is located on the crest of the hill. Which means drivers approaching this crossing from Hillsborough Road would have limited visibility to the zebra crossing markings due to the road geometry. The approach speeds for this zebra crossing is estimated to be 30km/h-35km/h due to the raised table. Based on the principles set out in the Austroads guide for ‘Approach Sight Distance’ (ASD), the required ASD to the zebra crossing is calculated at 31m. At this location, the drivers have limited forward visibility to the zebra crossing ahead due to the road geometry. However, there are warning measures provided such as the advanced warning diamond pavement marking and the PW-30 to inform drivers of the zebra crossing ahead. During the school start and end periods, the kea crossing is in operation and there is a ‘clear way’ in operation. These further enhance the message to approaching drivers of the crossing facility ahead. Therefore, the likelihood of a crash occurring at this location is low. However, should a crash occur the severity of the crash is low given the approach speed to this crossing is low due to uphill gradient and the speed table approaching the crossing. On site it was noted that the belisha discs were not provided at this crossing and these signs provide additional warning of the pedestrian crossing ahead for approaching drivers. This issue was also similar in the westbound direction approaching the zebra crossing.

On site it was observed that some vehicles were breaching the ‘clear way’ conditions during the school start and end times. This could reduce the intended safety outcomes of this ‘clear way’ and potentially limit the sight distance.



Figure 4: Eastbound view at approximately 50m to the Zebra Crossing



Figure 5: Eastbound view at approximately 30m to the Zebra Crossing

<sup>4</sup> Austroads Guide to Road Design, Part 4A Section 3.2.1 – 07 June 2017

**Recommendation:**

The following recommendations may be considered to mitigate the risks identified above:

- Install belisha discs at the zebra crossing on both approaches on along Carlton Street and recommend gating these signs.
- Regular enforcement to be undertaken so that residents or school users don't park during the 'clear way operations'

<i>Designer Response:</i>
<i>Safety Engineer:</i>
<i>Client Decision:</i>
<i>Action Taken:</i>

## 2.4 Minor – Narrow footpath widths along the westbound carriageway

Probability of crash occurring: Occasional

Likelihood of Fatal/Serious injury: Very Unlikely

**Outcome: Minor**

The footpath width along the westbound carriageway was narrow with most sections being less than 1.5m with some sections being below 1m. Given this route is used by school children to walk to the school, some sections of the existing footpath widths are substandard. These narrow widths are substandard for mobility scooters, wheelchairs and prams. Inadequate widths will force some footpath users to use the traffic lanes increasing the risk of pedestrian crashes. SAT did not observe this behaviour on site, however there could be occasions that a footpath user may choose to use to traffic lane at pinch points. However, should a crash occur, given the speeds of the corridor are relatively low due to frequent speed tables, the severity of these crashes would be low.

It should be noted that this is an existing safety issue and may unlikely to be exacerbated due to running of buses along Carlton Street corridor with the exception of people using mobility aids not being able to access the bus stops as desired due to narrow footpath widths. At this stage SAT is not aware of the additional bus patronage expected along this corridor due to this bus route. However, SAT observed on site that a few people currently walk along the Carlton Street to access the bus stops on Hillsborough Road. Therefore, from that perspective, for these existing users the risk may be reduced related to walking on narrow footpaths as to the bus stops being closer on Carlton Street. However, consideration needs to be given to widen the footpaths near the bus stop locations to reduce conflicts between people waiting at the bus stop/exiting the bus and the footpath users.

There is a section of the footpath where the usable width is reduced to about 500mm due to the vegetation and the concrete wall near the corner of the Frederick Street/Carlton Street intersection (**Figure 6**). SAT was unable to ascertain the purpose of this concrete barrier other than likely reasoning being to deter/stop a vehicle mounting the footpath. SAT believes this concrete wall poses a hazard to road users as it is not delineated appropriately and reduce the usable width available for footpath users. This concrete wall is about 500mm wide and removal of this could provide wider footpath at this location. Given this location is where the first westbound bus stop is located, wider footpath is needed at this location to allow for safe access to all bus stop users.



Figure 6: Concrete wall and vegetation reducing the usable width of the footpath near the westbound bus stop near Frederick Street.

There is a section of the footpath where the usable width is reduced to about 500mm due to roadside barrier located along Frederick Street around the corner of the Frederick Street/Carlton Street intersection. This barrier appears have been to be provided to delineate the curve and to protect a vehicle losing control falling off the drop off at the apex of the curve. On site, the SAT noted that this barrier appears to be substandard. Further to that, this barrier reduces the useable width of the footpath for the users, especially for mobility scooters, wheelchairs or pram users.



Figure 7: Existing barrier reducing the usable width of the footpath

Further to that, there were a few sections along the westbound footpath that vegetation was reducing the width of the footpaths to well below 1m (**Figure 8**).



Figure 8: Overgrown vegetation reducing the usable width of the footpath.

**Recommendation:**

To further reduce any residual risk for footpath users due to narrow footpaths along Carlton Street the following recommendations may be considered

- Removal of the existing concrete wall at the corner of the Frederick Street/Carlton Street intersection to increase the usable width of the footpath at this location. To avoid any speeding vehicles losing control around the corner and tracking over the footpath, provide further speed reduction treatments, such as raised platforms approaching the intersection from Frederick Street approach.
- Review if a barrier or alternative treatment at this required at this location and consider removal of the barrier at the corner of the Frederick Street/Carlton Street intersection to increase the usable width of the footpath at this location or consider replacing the existing barrier with a new barrier system with narrower posts (i.e Nu-Guard). To avoid any speeding vehicles losing control around the corner and tracking over the footpath, provide further speed reduction treatments, such as raised platforms approaching the intersection from Frederick Street approach reduce the speeds approaching the curve.
- Maintenance team to investigate the overgrown vegetation along the corridor and remove overgrown vegetation to increase the useable width of the footpaths.
- Widening the footpath along the corridor so that a minimum of 1.8m wide continuous footpath is provided along corridor. SAT believes that this may be challenging given the proximity to property boundaries and other onsite constraints. One possible option could be to widen the footpath towards the roadside and remove on street parking. However, this may affect the residents who are currently utilising these parking spaces. Therefore, it is recommended that AT investigate options of localised widening where possible, predominantly near bus stops and locations where the footpath widths are currently very narrow.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<i>Client Decision:</i>
<i>Action Taken:</i>

## 2.5 Minor – Narrow footpath widths along the eastbound carriageway

Probability of crash occurring: Infrequent

Likelihood of Fatal/Serious injury: Very Unlikely

**Outcome: Minor**

The footpath width along the eastbound carriageway was narrow with most sections being less than 1.5m with some sections being below 1m. Given this route is used by school children to walk to school and the walking school bus, some sections of the existing footpath widths are substandard. There are also some short sections where properties adjacent to footpaths have drop offs creating minor fall hazard to footpaths users. Some sections of this narrow sections of the footpath may not be suitable for users on a mobility scooter or wheelchair users. Therefore, there is an existing safety risk for all footpath users along this side due to narrow widths and uneven surfaces.

It should be noted that this is an existing safety issue and will unlikely to be exacerbated due to running of buses along Carlton Street corridor with the exception that people using mobility aids being not being able to access the bus stops as desired due to narrow footpath width. At this stage SAT is not aware of the additional bus patronage expected along this corridor due to this bus route. However, SAT observed on site that a few people currently walk along the Carlton Street to access the bus stops on Hillsborough Road. Therefore, from that perspective, for these existing users the risk may be reduced related to walking on narrow footpaths as to the bus stops being closer on Carlton Street. However, consideration needs to be given to widen the footpaths near the bus stop locations reduce conflicts with bus stop users and footpath users.



Figure 9: Examples of narrow footpath sections along the eastbound direction on Carlton Street.

### Recommendation:

To further reduce any residual risk for footpath users due to narrow footpaths along Carlton Street the following recommendations may be considered:

- Widening the footpath along the corridor so that a minimum of 1.8m wide continuous footpath is provided along corridor. SAT believes that this may be challenging given the proximity to property boundaries and other onsite constraints. One possible option could be to widen the footpath towards the roadside and remove on road parking. However, this may affect the residents who are currently utilising these parking spaces. Therefore, recommends AT to investigate options of localised widening where possible, predominantly near bus stops and locations where the footpath widths are currently very narrow.



<i>Designer Response:</i>
<b>Safety Engineer:</b>
<b>Client Decision:</b>
<i>Action Taken:</i>

## 2.6 Minor – Inconsistent and poor centreline marking along the corridor

Probability of crash occurring: Infrequent  
 Likelihood of Fatal/Serious injury: Very Unlikely  
**Outcome: Minor**

At present, the current centreline markings along Carlton Street varies between double yellow no-overtaking lines, single yellow no-overtaking lines, single centre lines and no centreline markings. A centreline is used to define the portion of a two-way sealed roadway available for travelling in each direction. It also provides a simple and continuous form of delineation along the corridor. Therefore, providing a consistent and appropriate centreline along the corridor where there are currently no centrelines could enhance the safety of this corridor with better lane management. It was also observed on site that some of the existing centreline markings were faded and in poor condition.



Figure 10: Missing centreline marking along the corridor

### Recommendation:

The following recommendations may be considered to mitigate the risks identified above

- Auckland Transport to review the centreline marking along the corridor and provide appropriate centreline markings where there are currently no centreline markings provided.
- Review the condition of the existing centreline marking and remark to appropriate standards.
- Remove any redundant RRPMs within the centreline markings.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<b>Client Decision:</b>
<i>Action Taken:</i>

## 2.7 Minor – Conflict with vehicle exiting/entering Carlton Street from Hillsborough Road

Probability of crash occurring: Infrequent

Likelihood of Fatal/Serious injury: Very Unlikely

**Outcome: Minor**

The centreline at Carlton Street near the intersection of Hillsborough Road has been shifted to the left (towards the southern footpath) for the exit lane to operate as one lane and to provide sufficient vehicle tracking space for buses turning right into Carlton Street from Hillsborough Road.

During the PM peak, the traffic volumes exiting Carlton Street were higher and the queues extended beyond the school entrance. Majority of the vehicles were turning left out while some were turning right out.

The right-out movement took longer to find a gap and safely merge into Hillsborough Road. As the queues were building up, the left-turn out traffic were trying to squeeze around the vehicle that was waiting to turn right out. Hence, this exit lane on Carlton Street was still operating as two lanes instead of one in some instances. With the narrowing of the exit lane, some right turning vehicles were following the new centreline and some were following the old redundant centreline. In a scenario where a right-turn out vehicle was positioned at the old centreline, and a bus were to turn right into Carlton Street, there could be a minor chance of a conflict between the two vehicles. However, this would only occur if a vehicle was positioned at the incorrect centreline. SAT could not ascertain if this behaviour was due to the fact that the redundant centreline marking was still visible or due to the fact that vehicles were trying to stay as far right as possible to allow for the two-lane operation. Should a crash occur, the likelihood of a serious injury would be very unlikely as the bus turning speeds would be very low.



Figure 11: Vehicles exiting Carlton Street still operate as two lane and the right turn vehicle cross the new centreline.

Further to that, it was observed on site that at rare occasions, some left turn vehicles were driving over the footpath during the two-lane operation when the wait times were longer. This could pose a minor risk to any pedestrians on the footpath. However, should a crash occur, the likelihood of a serious injury would be very unlikely as the turning speeds would be very low (less than 15km/h).

**Recommendation:**

The following recommendations may be considered to mitigate the risks identified above:

- Remove all redundant pavement markings by water blasting and remove all redundant RRPMS at this intersection.
- Consider providing a median island and narrow the exit lane to prevent two-lane operation.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<b>Client Decision:</b>
<i>Action Taken:</i>

## 2.8 Minor – Vegetation obscuring signs

Probability of crash occurring: Infrequent  
 Likelihood of Fatal/Serious injury: Very Unlikely  
**Outcome: Minor**

A number of signs were blocked by overgrown vegetation along Carlton Street. This was predominantly noted on the westbound direction near the first bus stop and at the start of the first speed table. These signs are important for unfamiliar drivers on the corridor as these are the first signs to indicate the presence of speed tables along the corridor.



Figure 12: Advanced warning of the speed tables ahead and bus stop signs blocked by vegetation



Figure 13: Speed table sign blocked by vegetation

### Recommendation:

The following recommendations may be considered to mitigate the risks identified above

- Remove the overgrown vegetation and/or trim the trees that are obscuring the signs.
- The tree near the corner of Carlton Street/Frederick Street intersection would need regular maintenance to avoid tree shadowing effect of the bus stop location and to improve visibility around the curve.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<b>Client Decision:</b>
<i>Action Taken:</i>

## 2.9 Minor – Removal of redundant pavement markings and RRPMS

Probability of crash occurring: Infrequent  
 Likelihood of Fatal/Serious injury: Very Unlikely  
**Outcome: Minor**

As part of the Carlton Street Improvement Project, some pavement markings such as the taper markings for previous side island delineations, raised reflectorised pavement markers (RRPM) and previous centreline markings at Carlton Street near the Hillsborough intersection were removed. It appeared that these were removed by blacking out the existing lines (ghosting out). However, some of these redundant markings were still visible and it is likely that during low light conditions or wet conditions, these ghost lines and redundant RRPMS may confuse some drivers. The SAT observed on site that some drivers were still following the old centreline location on Carlton Street at the Hillsborough intersection which may position drivers in a conflict location.



Figure 14: Redundant centreline, RRPMS still visible on site and redundant table still visible on site.

### Recommendation:

The following recommendations may be considered to mitigate the risks identified above:

- Remove all redundant pavement markings by water blasting and remove all redundant and old RRPMS along the corridor.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<b>Client Decision:</b>
<i>Action Taken:</i>



## 2.10 Minor – Safety issues at the Queenstown Road and Frederick Street Intersection

Probability of crash occurring: Infrequent

Likelihood of Fatal/Serious injury: Very Unlikely

**Outcome: Minor**

Queenstown Road and Frederick Street intersection is a three-leg roundabout with a mountable centre island and each leg has single lane entry and exit points. The 'No Exit' leg of Frederick Street connects to Seacliff Road, a few local shops such as cafes, convenience store, food take away and also the Bupa Hillsborough Care Home (which is a rest home and a hospital for elderly). This intersection is also part of the Hillsborough Primary School walking school bus route. There are some angle parks in front of the shops. The SAT noted the following safety issues at this roundabout:

- Median splitter island of each leg at this roundabout has pedestrian refuge islands with pram ramps. The existing pram ramp spaces are not sufficient for a mobility scooter or a wheelchair to wait.
- The refuge island gap to where pedestrians wait to cross typically needs to be between 1.8m with the minimum being 1.4m unless there are site constraints. It appears that at this intersection, the refuge island widths on the approach sides at Queenstown Road leg and the Frederick Street west leg are about 1.4m (which is in the minimum range). This may pose a risk for users of facilities such as mobility scooters waiting to cross at the middle of these islands not having sufficient widths to wait safely. Therefore, the current median refuges do not have adequate widths for a mobility scooter, pram, wheelchair or a group of pedestrians (e.g walking school bus students together).
- A high-level vehicle tracking for a bus (2-axel and 3-axel) was conducted using the 'AutoCAD Vehicle Tracking Software' at this roundabout. This shows that the right turn movement from Queenstown Road to Frederick Street is unlikely to encroach onto the pedestrian refuge as the buses are using the mountable roundabout in the centre. This high-level tracking also shows that bus wheel and body envelop do not encroach on to the footpath. However, the 500mm clearance used tracks closer to the pram crossing on the footpath side. It should be noted that this software is indicative only and, in some instances, previous projects have shown that the tracking software tends to be over-conservative regarding the space requirements. Therefore, SAT believes that as the encroachment is only on the clearance envelop, the risk of right turning bus conflicting with pedestrians waiting at the footpath pram ramp is low. It should be noted that bus turning speeds around constrained roundabouts are extremely low and less than 20km/h. Therefore, should a crash occur, the severity of the crash would be very unlikely to result in fatal or serious injury.
- A high-level vehicle tracking for a bus (2-axle and 3-axel) was also conducted for the left turn from Frederick Street to Queenstown Road. This shows that this movement is slightly more constrained compared to the right turn movement from Queenstown Road to Frederick Street. This high-level tracking shows the 500mm clearance tracks close to the pram crossing on the footpath and the median refuge. It should be noted that this software is indicative only and in some instances of previous projects have shown that the tracking software tends to be conservative regarding the space requirements. Therefore, the SAT believes as the encroachment is only the clearance envelop the risk of a right turning bus conflicting with a pedestrian waiting at the footpath pram ramp or refuge island is low (Note a school bus was observed to be travelling along this route and this bus didn't track over this median island).
- It was also noted on site that the existing inter-visibility between pedestrians waiting to cross Queenstown Road from Fredrick Street (northwest corner) was limited as the crossing was located further away from the intersection, and the fence and the utility cabinet blocks the sight distance. This is an existing safety issue and it unlikely to be further exacerbated due to the bus operation along this corridor.

**Recommendation:**

The following recommendations may be considered to mitigate the risks identified above:

- Widen the tram ramps and the median refuges at this intersection to provide adequate waiting space.
- Provide further speed reduction treatments, such as raised platforms approaching the roundabout from Frederick Street (west) and Queenstown Road to further reduced approach speeds to reduce severity of any pedestrian related crashes.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<i>Client Decision:</i>
<i>Action Taken:</i>

## 2.11 Minor – Higher kerb lip at the pedestrian refuge island on Queenstown Road

Probability of crash occurring: Infrequent  
 Likelihood of Fatal/Serious injury: Very Unlikely  
**Outcome: Minor**

A pedestrian refuge island is located approximately 60m west of the Queenstown Road/Hendry Avenue/SH20 Queenstown Road Northbound Off Ramp roundabout. This crossing location is signed as the safe crossing point for cyclists and pedestrians using the Southwestern Shared Path at this roundabout. It was noted on site that the kerb lip on the pram ramp crossings were higher and not flushed with the road surface. This higher kerb lip would cause a tripping hazard for the users, particularly for elderly users as a fall could cause minor injury. SAT also observed on site that a mobility scooter using this crossing was struggling go over this pram crossing due to high kerb lip. This kerb lip would also cause a hazard for cyclists as they would be travelling in an angle to turn onto the footpath which could create an imbalance.

It should be noted that this is an existing safety issues and will unlikely to be exacerbated due to running of buses along Carlton Street corridor.



Figure 15: Refuge Island and the higher kerb lip

### Recommendation:

To further reduce any residual risk for users of this crossing facility following recommendations may be considered

- Reduce the kerb lip height to improve the safety of all refuge island users.
- Provide cycle hold rails for cyclists waiting to cross at this location.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<i>Client Decision:</i>
<i>Action Taken:</i>

## 2.12 Minor – Poor pavement marking and road surface at the Hillsborough Road/Carlton Street Intersection

Probability of crash occurring: Infrequent  
 Likelihood of Fatal/Serious injury: Very Unlikely  
**Outcome: Minor**

The pavement surface of Hillsborough Road near the intersection of Carlton Street currently has high friction surfacing treatment. There is also an existing red colour surface treatment between the pedestrian cross walk lines at the midblock crossing near this intersection. The vehicle speeds along this section of Hillsborough Road could be higher during the off-peak periods, predominantly in the northbound direction due to downhill gradient of Hillsborough Road. Therefore, it is likely that these surface treatments have been installed previously to improve the safety of this intersection, to enhance the visibility to the mid-block crossing and reduce stopping distance of any braking vehicles approaching the midblock crossing/intersection.

However, on site, the current condition of the high friction surfacing was observed to be poor and worn, the red colour surfacing on the mid-block crossing has faded/peeled off with uneven surfaces and the current pavement markings are in poor condition. The poor condition could mean the additional safety benefits anticipated from these enhanced surface treatments will be diminished. The expected crash types are predominantly rear end type crashes which are generally considered low severity in injuries.

It should be noted that this is an existing safety issue and will unlikely to be exacerbated due to running of buses along Carlton Street corridor.



Figure 16: Poor conditions of the current high friction surfacing and red colour surface treatments between the pedestrian cross walk lines.

**Recommendation:**

The following recommendations may be considered to mitigate the risks identified above

- Auckland Transport to review the current condition of the high friction surfacing.
- Repair and renew the red colour surfacing between the pedestrian cross walk lines
- Re- mark all the pavement markings at this intersection

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<b>Client Decision:</b>
<i>Action Taken:</i>

## 2.13 Minor – Incorrect curve advisory sign and lack of curve advisory sign

Probability of crash occurring: Infrequent  
 Likelihood of Fatal/Serious injury: Very Unlikely  
**Outcome: Minor**

The advanced curve warning sign (PW-17) provided on the westbound direction along Frederick Street approaching the curve was incorrect. This was indicating a left-hand curve ahead instead of the right-hand curve ahead and it is inconsistent with the chevron curve indicator sign (PW-66) ahead.

There were also no advanced curve warning signs or curve indicator signs installed for the eastbound direction of Carlton Street approaching the curve.

It should be noted that this is an existing safety issue and will unlikely to be exacerbated due to running of buses along Carlton Street corridor.



Figure 17: Incorrect advanced curve warning sign

### Recommendation:

The following recommendations may be considered to mitigate the risks identified above

- Install the correct advance curve warning sign for this westbound approach. Include the concealed exit information or show the side road stub on the sign to warn drivers of the concealed exit.
- Install a new advanced curve advisory sign for the eastbound approach with a concealed exit sign or show the side road stub on the sign to warn drivers of the concealed exit.

<i>Designer Response:</i>
<b>Safety Engineer:</b>
<i>Client Decision:</i>
<i>Action Taken:</i>

## 2.14 Minor – Safety Issues at the Hillsborough Road/Littlejohn Street Intersection.

Probability of crash occurring: Occasional

Likelihood of Fatal/Serious injury: Unlikely

**Outcome: Minor**

Hillsborough Road/Littlejohn Street Intersection is a stop controlled 'T' Intersection. There are number of shops (bakery, liquor store, pharmacy and takeaways) located on the north corner of this intersection and the Hillsborough Medical Centre is located on the south corner of the intersection. There are a number of parking spaces associated with these commercial properties located near this intersection.

The following safety issues were identified at this intersection:

- The current pram ramps connecting the southern footpath to the northern footpath across Littlejohn Street are substandard, narrow and not orientated correctly. There are no tactile ground surface indicators (TGSi) for visually impaired footpath users. With the number of shops, medical centre, parking and bus stops near the intersection, the pedestrian crossing demand parking movements (short term occupancy) are high at this intersection. Therefore, these substandard crossing facilities pose a safety risk for footpath users, such as mobility scooters, prams and visually impaired users. Given there is an on-street parking space for mobility impaired users, the pram ramps are not adequate for these users.
- There were several right-angle on-street parking spaces located along the northern footpath. If a long vehicle, such as a truck was to be parked on one of these parking spaces, the intervisibility will be obstructed between a pedestrian waiting to cross at the northwest corner pram crossing and vehicles approaching on Littlejohn Street.
- There is limited CSD between pedestrians waiting at the south-west corner pram crossing and vehicles turning left on to Littlejohn Street from Hillsborough Road. This is due to the current pram crossing being located further west of Littlejohn Street and the vegetation. The CSD is also limited between pedestrians waiting to cross at this location and eastbound vehicles on Littlejohn Street due to on street parking.

These inadequate facilities and conditions noted above increase the likelihood of pedestrians related crashes at this intersection. However, the approach speeds at this intersection are estimated to be low approximately 30km/h due to side friction (narrowing of lane) created by on street parking and drivers slowing down stop at the intersection. Therefore, should a crash occur at this intersection, the severity would be low given the low approach speeds.

It should be noted that these are existing safety issues and unlikely to be exacerbated due to running of buses along Carlton Street corridor as 'Route 68' bus will not be running through this intersection.



Figure 18: Substandard pram ramps at Littlejohn Street Intersection



Figure 19: Limited sight distance for pedestrians crossing Littlejohn Street



Figure 20: View towards the Hillsborough Road Intersection from Littlejohn Street

**Recommendation:**

The following recommendations may be considered to mitigate the risks identified above related to pedestrians at this intersection.

- Provide standard pram crossings that are suitable for all type of users including the mobility scooter users and visually impaired users.
- Install a raised platform across Littlejohn Street approaching the intersection to further reduce approach speeds at this intersection.
- Review the on- street right angle parking at this location and consider changing them to parallel parking.

<i>Designer Response:</i>
<i>Safety Engineer:</i>
<i>Client Decision:</i>
<i>Action Taken:</i>



## 2.15 Comment - Vehicles overtaking a stationary bus near bus stops along Carlton Street

There are two new bus stops (one on each side) proposed at the eastern end of Carlton Street between Frederick Street and Sunnyridge Place. If a bus was stopped at these bus stops, some drivers may overtake the stationary bus. In order to understand the risk associated with this overtaking manoeuvre, the sight distance (forward visibility) between the overtaking vehicle and a possible oncoming vehicle was reviewed. The principles set out in the Austroads guide for 'Safe Intersection Sight Distance'<sup>5</sup> (SISD) were used to estimate the required sight distance. SISD was used as this reflects the ability for a driver of each vehicle to see an oncoming vehicle. The overtaking sight distance noted in the Austroads guide is not applicable for this scenario as it is used for high speed road environments (speeds more than 70km/h).

Approaching the westbound bus stop, Carlton Street has a slight uphill gradient after the curve at the Frederick Street intersection, with a crest vertical curve just after the first new speed table (near 98 Carlton Street). The approach speed for the westbound direction near this bus stop has been assessed to be approximately 40km/h to 45km/h. Approaching the eastbound bus stop, the approach speed has been assessed to be approximately 30km/h-35km/h due to the speed table. Using these assumptions, the sight distance required behind the bus stop for the westbound approach was calculated to be 70m and the eastbound was 65m. On site, the available sight distance over the crest vertical curve was estimated to be 80m for westbound direction and 90m for the eastbound direction (note that these on-site assessments are estimates only as no topography survey data was available to confirm the geometry of the road). This indicates that there is adequate sight distance/forward visibility on site for a vehicle overtaking the stationary bus behind the bus stops to see an oncoming vehicle around the curve. Hence, the likelihood of a head-on collision between a driver overtaking a stationary bus at this location is low.

Further to this, the relatively low speed of vehicles on Carlton Street at this location enables drivers to react to an oncoming vehicle, and the likelihood of a head-collision is further reduced. Vision Zero<sup>2</sup> on speed and head- crash risks note that vehicle occupants are protected up to 70 km/h in a head-on collision. Therefore, should a crash occur, the severity would probably be low as the operating speeds are relatively low at this location due to the speed table.

For the bus stops located (two stops with one on each side) at the eastern end of Carlton Street near the School/park, the approach speeds in both directions are estimated to be 30km/h due to the speed tables. On site, 'no-overtaking yellow' lines are installed between the bus stops, restricting drivers overtaking a stationary bus. Therefore, the likelihood of a head on crash occurring is low. The lower operating speeds also enables drivers to react to an oncoming vehicle to avoid a collision and reduce the severity of a crash.

<sup>5</sup> Austroads Guide to Road Design, Part 4A Section 3.2.2 – 07 June 2017



Figure 21: View behind the bus stop for the westbound direction – eastern end of Carlton Street



Figure 22: View behind the bus stop for the eastbound direction - eastern end of Carlton Street

**Recommendation:** To further reduce any residual risk of a head-on crash at these bus stops, the following recommendations may be considered:

- Provide no overtaking double yellow lines between the bus stops at the eastern end of Carlton Street. This may potentially discourage any drivers who intend to overtake the stationary bus and reduce the likelihood of a crash.
- Provide further speed reduction treatments, such as raised platforms approaching the intersection from Frederick Street (east) to reduce the approaching speed for the westbound direction.

## 2.16 Comment - Reduced sight lines at property accesses near the bus stops

The proposed bus stops are located in close proximity to property accesses. When a bus is stopped at the bus stop, the sight lines for drivers exiting these accesses may be temporarily obstructed. Drivers may still choose to turn even with reduced sight lines when exiting the access resulting in a collision with oncoming traffic. However, these accesses are predominantly residential with low traffic volumes, and the bus frequency limited to four buses per hour per direction and the bus is only parked for a few seconds, therefore the probability of a crash occurring is considered to be unlikely. However, should a crash occur, the likelihood of a fatal or serious injury crash is unlikely due lower operating speeds along the corridor.

Some of these locations already have existing on street parking near the accesses, where parked vehicles could obstruct sight lines for longer durations. As parking is prohibited at the bus stops, the visibility from these accesses could be improved for most of the time.



Figure 23: View to the left from the property access near the bus stop on the westbound direction near school



Figure 24: View to the right from the access near the bus stop on the westbound direction near school indicating that parking already limits the sight distance to the right.

## 2.17 Comment - Vehicles crossing the centrelines due to parked cars

At some locations along Carlton Street, due to existing on-street parking, it is difficult for vehicles to pass each other without either one vehicle slowing down or giving way for the oncoming vehicle to pass. Site observations indicated that vehicles already undertake these manoeuvres along the corridor, at some locations, vehicles do cross the centreline to shy away from the parked vehicles, where required they slow down and give way to the oncoming vehicles. One of the key factors of safe passing is the adequate forward visibility for the drivers to make a decision to slow down and give way to oncoming vehicles. Site observations did not indicate any locations where the forward visibility was severely limited for drivers that they have to make drastic movements such as pulling into driveway or side road to avoid head on collision.

It was also observed that on-street parking spaces were underutilised during the daytime. The FTN is expected to add approximately 100 buses a day along Carlton Street. This is only a 3% increase in the overall daily traffic volume. Therefore, only a negligible increase in vehicle passing is expected along the corridor due to the FTN. Hence, it is unlikely that the bus operations would result in an increase in unsafe vehicle passing along Carlton Street. It should be noted that given the frequency of the speed tables along the corridor, the operating speeds were observed to be low. Even if a driver wanted to speed up, they are unable to do so due to the closely spaced speed tables. Therefore, should a crash occur, the severity of a head on-crash would be unlikely to result in death or serious injury as it is unlikely the speeds would increase to up to 70km/h.

## 2.18 Comment – Vegetation and debris near the bus stop


The westbound direction bus stop at the corner of Carlton Street/ Frederick Street Intersection is more prone to having vegetation and dead leaves accumulated due to a large tree. It is likely that channel will be blocked by the accumulation of this debris and could result in ponding on that corner and may affect the bus stop users. Therefore, it is recommended that regular maintenance and clearance be undertaken at this location to avoid any ponding related issues.





Figure 25: Accumulated debris near the bus stop blocking the channel.

### 3 Audit Statement

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed or modified to improve safety. The problems identified have been noted in this report.

Signed:  ..... Date: 2 March 2020  
**Rob Mason, [BE (Civil, Hons)]**  
 [Technical Director] - Beca Ltd  
 RSA - Lead Road Safety Auditor

Signed:  ..... Date: 2 March 2020  
**Rojina Baisyet, [BE (Civil)]**  
 [Senior Associate], Beca Ltd  
 RSA – Road Safety Auditor

Signed:  ..... Date: 2 March 2020  
**Madusha Jayawardhena, [BE (Civil)/BCom]**  
 [Senior Engineer], Beca Ltd  
 RSA – Road Safety Auditor

**Designer:** Name..... Position.....  
 Signature..... Date.....

**Safety Engineer:** Name..... Position.....  
 Signature..... Date.....

**Client:** Name..... Position.....  
 Signature..... Date.....

**Project Manager:** Name..... Position.....  
 Signature..... Date.....

**Action Completed:** Name..... Position.....  
 Signature..... Date.....

**Project Manager to distribute audit report incorporating decision to designer, Safety Audit Team Leader, Safety Engineer and project file.**  
**Date: 2 March 2020**

Appendix B –  
Responses to Hillsborough Action Group Queries

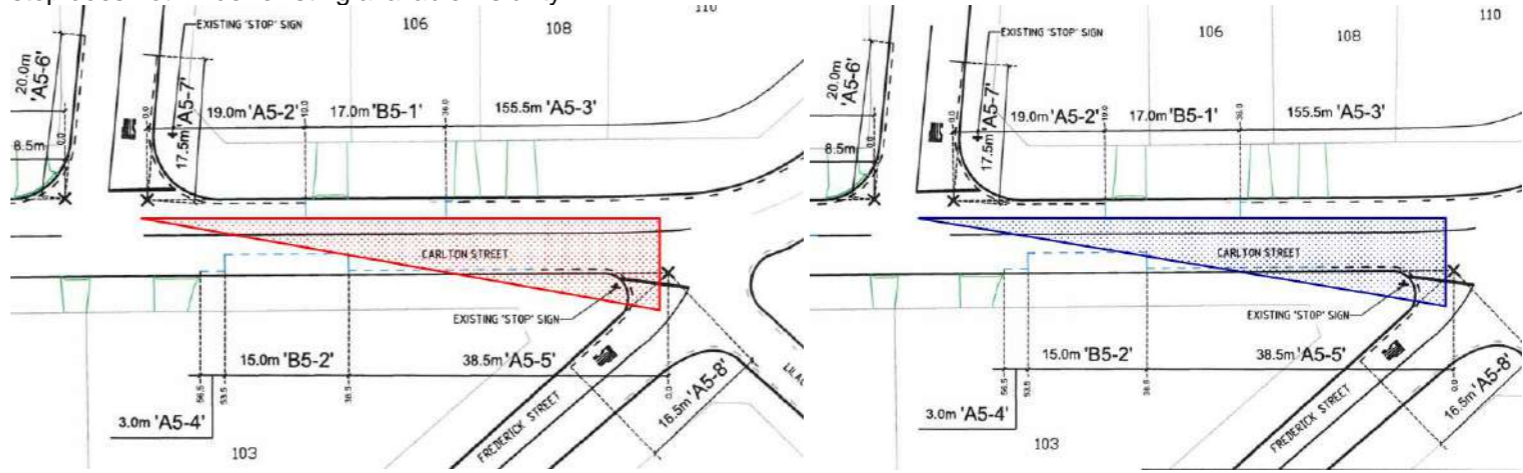
B

**Safety Risks & questions raised by Hillsborough Community on introduction of FTN**

Issue & identified Safety Risk:	Questions:	Response
<p><b>Pedestrian crossing</b> (Frederick Street Roundabout/ Queenstown Road) - part of accessible journey for FTN to be used by visitors/family to BUPA Care home (1 of 6 identified reasons for selecting the route) &amp; part of AT Walking School Bus (WSB) route.</p>	<p>Q.1 Is the current location of the unmarked pedestrian crossing &amp; pedestrian refuge safe to support an independent accessible journey for people with limited mobility including people reliant on mobility aids: wheelchair, walking frames and walking sticks and those with sensory impairments hearing loss and low vision based in change to road usage to an FTN?</p>	<p>The risk related to pedestrians crossing the road is generally related to the inter-visibility between the pedestrian and the approaching vehicle. It is important that the driver of a vehicle has sufficient forward visibility to be able to react in time if a pedestrian step out onto the road (stopping sight distance). It is also important for a pedestrian to be able to observe an approaching vehicle so they can determine if it is safe to cross (crossing sight distance). The crossing sight distance for pedestrians at some locations is not achieved, however the stopping sight distance is achieved approaching the crossings.</p> <p>The layout of the roundabout also presents some safety risks. The layout of the pram ramp, and the width of the median refuge islands are inadequate for people using prams, mobility scooters, walking frames or wheelchairs. Tactile ground surface indicators (TGSIs) are provided at the pram ramps to provide guidance to visually impaired users, although there are no TGSIs provided at the median refuge islands.</p> <p>Vehicle tracking for a bus (2-axle and 3-axle) was conducted using the 'AutoCAD Vehicle Tracking Software' at this roundabout. This shows that the turning movements from Queenstown Road to Frederick Street (vice versa) is unlikely to encroach on to pedestrian refuge as the buses are using the mountable roundabout in the centre. This high-level tracking also shows that bus wheel and body envelop does not encroach on to the footpath. However, the 500mm clearance used tracks closer to the pram crossing and/or median refuge. It should be noted that this software is indicative only and in some instances of previous projects have shown that the tracking software tends to be over conservative regarding the space requirements. The encroachment is only the clearance envelope the risk of turning bus is minor for pedestrians waiting at the footpath pram ramp. It should be noted that bus turning speeds around constrained roundabouts are extremely low and less than 20km/h. Therefore, should a crash occur, the severity of the crash would be very unlikely to result in fatal or serious injury. Note a school bus was observed to be travelling along this route and this bus didn't appear to track over the median island or footpath.</p> <p>Roundabouts inherently reduce the approach speed of vehicles as they are required to negotiate low radius curves. This being a compact roundabout, approaching drivers naturally lower their speeds at this location. Therefore, should a crash occur, the severity of a crash is likely to be low and unlikely to result in death or serious injury. This is supported by the recorded crash history where there have only been two non-injury crashes over the last five years (2014-2018).</p>
<p><b>Pedestrian crossing</b> (Frederick Street/ Carlton Street intersection) - part of accessible route for FTN to be used by visitors/family to BUPA Care home (1 of 6 identified reasons for selecting the route) particularly when traffic builds up at this intersection at peak times and requires pedestrians (including small children) to navigate through queued vehicles.</p>	<p>Q.2. Is the current location of the unmarked pedestrian crossing &amp; pedestrian refuge safe to support a safe journey for a WSB route based in change to road usage to a FTN?</p>	<p>As noted, Q1 above, the pram crossings across Queenstown Road have limited sight distance and the refuge island space is insufficient for a group of school children to wait in the middle of the road.</p> <p>While the pedestrian crossing does have existing safety issues, it is unlikely that the existing safety issues at this roundabout would be further exacerbated due to the introduction of an FTN.</p>
	<p>Q.3 Is the current location of the unmarked pedestrian crossing safe to provide an independent accessible journey for people with limited mobility including people reliant on mobility aids: wheelchair, walking frames and walking sticks and those with sensory impairments hearing loss and low vision and for all children independently walking to school?</p>	<p>The Carlton Street/Frederick Street intersection currently does not have any midblock pedestrian crossing facilities across Frederick Street and only has some pram crossings across Lilac Grove and Frederick Street. These pram ramps are substandard, narrow and not orientated correctly. The surface conditions are uneven and inconsistent. The gradient of the pram ramp and the footpath along Frederick Street towards Carlton Street is not suitable for mobility scooters or wheelchairs. The pram ramps do not have TGSIs which provide guidance to the visually impaired users. The usable width of the footpath approaching the intersection along Frederick Street is narrowed by the W-section guardrail and Carlton Street is narrowed by a concrete wall. Therefore, the footpath is not suitable for mobility scooters, wheelchairs or prams.</p> <p>There are visibility restrictions at this intersection due to the acute geometry. The crossing sight distance is not achieved for a pedestrian waiting on the northern kerb wanting to cross Frederick Street (west) for vehicles turning right from Carlton Street. However, drivers turning right from Carlton St maybe able to observe a pedestrian crossing from north to south given that the turning traffic speeds would be low, therefore ability to stop in time.</p> <p>The operating speed on the westbound approach to the intersection appears to exceed 30km/h, which is more than the survivable speed for a vulnerable road user crash.</p> <p>Therefore, the existing crossing facilities are substandard at this intersection and are considered unsafe for pedestrians including people with limited mobility and impairment.</p>



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<p><b>Pedestrian crossing</b> (School Kea Crossing/ Carlton Street) - part of accessible route for FTN, WSB (2 routes).</p>	<p>Q.4. Is the proposed non-signalised Zebra pedestrian crossing safe to provide an independent accessible journey for people with limited mobility including people reliant on mobility aids: wheelchair, walking frames and walking sticks and those with sensory impairments hearing loss and low vision?</p> <p>Q.5. Is the proposed non-signalised Zebra pedestrian crossing safe to provide a safe journey as part of the WSB route and as a safe crossing for children using park when the crossing not monitored?</p>	<p>Users of a zebra crossing facility have right of way and any vehicles approaching this facility must give way to these users. This places the onus on the driver to observe a pedestrian and come to a stop to enable them to cross. In order to achieve a safe crossing, there must be no permanent obstruction to visibility of all the crossing for an approaching driver from a safe stopping distance at a safe operating speed for the road.</p> <p>In this instance, there is limited sight distance to the crossing for the eastbound direction as it is located on top of a vertical crest curve. There is sufficient signage and an advanced diamond marking proposed to be installed on the approach (on site, it was observed that the belisha discs are yet to be added) providing advanced warning to the drivers of the crossing facility ahead. Furthermore, this crossing is installed on a raised table and there are adjacent raised tables provided to further reduce the approaching speeds to the crossing. There is sufficient width at this crossing for people with mobility aids to use this crossing. TGSIs are not present at this location to safely guide visually impaired users.</p> <p>As noted on Q.4, there is limited sight distance to this crossing facility for the eastbound direction on Carlton Street due to the uphill gradient and vertical crest of the road which could pose a safety risk for children using this crossing during unmonitored times. However, there is sufficient signage and markings installed on the approach to this crossing (Belisha Discs needs to be added) providing advanced warning to the drivers of the crossing facility ahead. Additionally, this crossing is installed on a raised table and there are adjacent raised tables provided to further reduce the approach speeds. Therefore, should a crash occur severity of the crash would unlikely to result in death or serious injury.</p>
<p><b>Footpaths along FTN</b> - width, gradient, cross fall and condition of footpaths.</p>	<p>Q.6 Are existing footpaths safe to support an independent accessible journey for people with limited mobility including people reliant on mobility aids: wheelchair, walking frames and walking sticks and those with sensory impairments hearing loss and low vision given footpaths have no berms and no 'margin for error'?</p> <p>Q.7 Are existing footpaths used for independent accessible and safe journeys wide enough to allow people with double buggies, mobility scooters and those reliant on mobility aids: wheelchairs, walking frames to safely pass each other?</p> <p>Q.8 On scheduled days where refuse &amp; recycle bins are put out for collection what risk management plans will be employed to assure provision of both the independent accessible and safe journey?</p>	<p>Responding to queries Q.6, Q.7 and Q.8 were excluded from the scope of this safety review.</p>
<p><b>Bus stops</b> Location of eastbound bus stop close to Hillsborough Park entrance. Location of westbound bus stop at lower end of Carlton Street. Absence of bus shelters and seating</p>	<p>Q.9 Will buses stopped at westbound bus stop reduce visibility of pedestrians including children crossing Hillsborough Park car park entry?</p>	<p>A bus stopped at this bus stop will reduce the visibility for pedestrians crossing Hillsborough Park carpark entry to any vehicles turning into the park. However, this risk is considered low for the following reasons:</p> <ul style="list-style-type: none"> <li>• The peak of the children being at this location is likely to be 30-45 minutes during the morning and 30minutes end of the school.</li> <li>• The likelihood of a bus stopped at this location would be less than 3 times during school start and end periods. Therefore, the probability of a bus reducing the visibility for children for the right turning vehicles are low.</li> <li>• The speed of vehicles turning into the access is expected to be low, providing greater time to observe a pedestrian</li> </ul> <p>Prior to installation of the bus stop, on-street parking was permitted throughout the day, and large SUV's, vans or trucks could have created an obstruction for long periods. This may also have been a particular issue at school drop off and pick up times when parents would possibly have been parked. In these instances, the visibility would have been also reduced. However, with new the bus stop and no-stopping markings, the visibility for any children at this location has been improved for majority of the time other than the short duration where a bus has stopped.</p>

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	<p>Q.10 What is the impact on safety of a bus stopped at westbound bus stop with reduced visibility for vehicles turning right and left out of Frederick Street onto Carlton Street?</p>	<p>The principles set out in the Austroads guide for 'Safe Intersection Sight Distance'<sup>1</sup> (SISD) were used to estimate the required sight distance. SISD reflects the intervisibility distance between drivers on Carlton Street and driver waiting on Frederick Street for an opportunity to enter Carlton Street. The SISD required towards Carlton Street for traffic exiting Frederick Street was calculated to be 65m and onsite this was observed to be approximately 60m. This indicates that currently there is insufficient sight distance towards Carlton Street for vehicles exiting Frederick Street.</p> <p>As seen below the red hatching shows the achieved visibility and the blue hatching shows the required visibility. The westbound bus stop does not hinder existing available visibility.</p> 
	<p>Q.11 What provisions have been made to provide shelter and seating at bus stops for the comfort of people who are mobility impaired, older people &amp; anyone pregnant?</p>	<p>Responding to query Q.11 was excluded from the scope of this safety review.</p>
<p><b>Narrow Road Corridor along FTN</b> - opportunities for vehicles to pass safely.</p>	<p>Q.12 AT's risk management plan is reliant on vehicles "pulling into side roads, gaps and driveways" to facilitate traffic movement along the FTN route due to the road being narrow. Are there adequate safe passing opportunities given change of road usage and introduction of +42,300 heavy vehicle traffic/annum?</p> <p>Q.13 Are there adequate safe passing opportunities for heavy vehicle traffic to pass other heavy vehicle traffic along the FTN route moving in the opposite direction?</p>	<p>Traffic volumes along a transport corridor is typically referenced as an 'Annual Average Daily Traffic' (AADT) Volume. The AADT for Carlton Street is 3,227<sup>2</sup> and the FTN will result in approximately 100 new buses per day, an increase of approximately 3%. During the morning peak period, the traffic volume is 800 vehicles and hour. This represents the period where opposing vehicles are more common and passing is a greater problem. During this period, there will only be an additional 8 buses per hour for a 15min FTN (or 12 buses per hour for a 10 min FTN).</p> <p>At present, it can be difficult for vehicles to pass each due to on street parking, and vehicles are required to slow down and move out of the path of oncoming vehicles to pass. This was observed on site, and vehicles were also observed crossing the centreline to shy away from the parked cars. One of the key factors of safe passing is the adequate forward visibility so, the drivers can make a decision to slow down and give way to oncoming vehicles. Given the reduced speed resulting from the speed tables, forward visibility was considered adequate for drivers to observe an approaching vehicle along the corridor. This would remain the case with the implementation of the FTN. It was also observed that there were less vehicles parked on-street during the daytime.</p> <p>In the event of a heavy vehicle approaching a bus, there are opportunities to pass where yellow lines have been provided. Given the speed of vehicles is low, this becomes more of an operational issue than a safety issue as it is unlikely to result in a crash.</p>

<sup>1</sup> Austroads Guide to Road Design, Part 4A Section 3.2.2 – 07 June 2017

<sup>2</sup> Based on an Auckland Transport traffic data survey (7 day, July 2019).

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<p><b>Centreline Road Markings</b></p>	<p>Q.14 Are centreline markings that June 2018 WSP Opus Bus Tracking Report recommended be retained to eliminate the likely risk of serious injury or death adequate to facilitate safe movement of all traffic including proposed volumes of heavy vehicle traffic?</p>	<p>A centreline is used to define the portion of a two-way road available for travelling in each direction. It also provides a simple and continuous form of delineation for drivers and helps drivers correctly position themselves in the lane. In some situations, absence of a centreline could result in head on crashes, particularly when drivers tend to shy away from on street parking.</p> <p>In urban environments where speed tables are present, the likelihood of head on crashes and the severity of a crash resulting in death or serious injury is extremely low due to low speed environment. Head on crashes are more likely to result in death of serious injury where the impact speeds are more than 70km/h.</p> <p>Provision of a centreline would help to reduce the likelihood of a head on crash, although it would not prevent that crash resulting in a death on serious injury unless the speed is managed. For this project, the number of speed tables has been increased and the spacing therefore reduced, making it unlikely for a driver to reach speeds up to 70km/h.</p>
<p><b>Unmarked Cycle crossing</b> (across Queenstown Road from Hendry Ave)</p>	<p>Q.15 Is the current location of the unmarked cycle crossing adequate to provide a safe route for cyclists including children cycling to local schools?</p>	<p>There are no cycle or pedestrian crossing facilities provided across Queenstown Road/Hendry Avenue roundabout. Instead, the users are advised to use the median refuge located 60m west of the roundabout across Queenstown Road. This facility has adequate sight distance in each direction. The median refuge island width is approximately 1.5m which would be considered inadequate for a cyclist to wait safely at the middle. Therefore, while the location of the refuge is considered appropriate for a crossing point, the median refuge island maybe considered substandard for cyclists.</p> <p>However, there are several minor improvements that could be made to this refuge island to improve the safety of the crossing. There are signs advising pedestrians to use this median refuge crossing. This sign could be modified to say 'Pedestrians and Cyclists' to reduce any ambiguity. Also, this refuge island pram crossings could add cycle hold rails to support cyclists waiting at this location to cross. The pram crossing kerb lip on the western side is high and creates a tripping hazard.</p>
<p><b>Vehicles Mounting Pavement</b> (bend in the road Frederick Street/Carlton Street)</p>	<p>Q.16 How will proposed road infrastructure manage speed and prevent vehicles mounting the pavement which forms part of both the accessible route and safe journey for WSB route?</p>	<p>Vehicle tracking undertaken does not indicate that buses track over the footpath at this location. The new speed table is located closer to this location compared to the previous speed table location further reducing the speeds approaching the intersection for the eastbound direction. Therefore, it is unlikely the FTN will change any existing risks related to vehicles mounting the pavement.</p>
<p><b>Speed Calming</b> - replacement of speed humps to 'bus-friendly' speed tables.</p>	<p>Q.17 Will the change in speed calming devices with shallow approach ramps increase vehicle speeds along Carlton Street and the FTN route? Q.18. And if so by what % increase? Q.19 And if so, what does the % increase in speed equate to in safety threshold. 10% reduction in safety? 30% reduction in safety?</p>	<p>Responding to queries Q., 17 Q.18 and Q.19 were excluded from the scope of this safety review.</p>
<p><b>On Street Parking</b></p>	<p>Q. 20 What impact would the removal or absence of current on street parking to one side or to both sides of Queenstown Road and Carlton Street have on vehicle speeds along the FTN route and/or increased road usage as an attractive 'short cut'?</p>	<p>Auckland Transport have advised that there are 130 on street parking spaces available along Carlton Street and that the project has resulted in the removal of 12 parking spaces. This is not considered to have a significant effect on operating speeds.</p> <p>Removal of parking on one or both sides of the road is unlikely to change the operating speed along the corridor due to the presence of the speed humps. As travel time would not be reduced, it would appear reasonable to expect that the attractiveness of the route as a short cut would also remain unchanged.</p>
<p><b>Vision Zero Approach</b> - road design that acknowledges people make mistakes.</p>	<p>Q.21 With the FTN route located next to a primary school and park and on an active bike route would there be a negative impact to 'survivability' of children and cyclists (i.e. children running across the road without looking, High School students on cellphones or cyclists knocked off bikes by vehicles exiting driveways between parked cars)?</p>	<p>The 'survivability' of a vulnerable road user crash is predominantly a factor of the impact speeds or vehicle speeds. Lower speeds mean the drivers would have enough time to react and should a crash occur, the impact energy would be low resulting in lower severity. The impact speeds less than 30km/h are considered 'survivable' for vulnerable road user crashes. The Carlton Street section of the FTN includes eight speed tables spaced no more than 110m apart, reducing the likelihood of a high-speed crash. Hence, the inclusion of increased traffic calming is considered consistent with Vision Zero principles.</p>

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	Q.22 What specific risk management strategies have been employed so that road usage changes +42,300 heavy vehicles supports the Vision Zero approach given even at lower speeds heavy vehicles will take longer to come to a stop and consequences potentially more severe than cars travelling at the same speed for children?	While the provision of an FTN will result in an increase in AADT of approximately 3% (100 buses per day), the additional speed tables will provide a lower speed environment for the 3,000+ vehicles per day that are already using the route. This includes any heavy vehicles that may also use Carlton St.  Therefore, the provision of more speed tables and the associated speed reduction will reduce the speeds of all vehicles on the road and is considered to mitigate the impacts of the additional bus numbers. The reduced speed is aligned with Vision Zero principles.
<b>Road usage Change</b> - Introduction of a minimum of +42,300 heavy vehicle traffic/ annum.	Q.23 Will road infrastructure support introduction of heavy vehicle traffic and to what capacity - i.e. google maps identifying route as a 'short cut' between Penrose & Hillsborough Road?	Our pavement engineers have reviewed the Road Assessment and Maintenance Management database (RAMM) as well as the increase in the heavy vehicles due to the buses and have advised that the change does not translate to a significant increased demand for pavement structure. As for Google maps identifying this as a 'short cut' route, we do not have visibility of the assumptions used for the algorithm. Therefore, unable to provide a comment on this question.
<b>Environmental Factors</b> - Sunstrike, heavy rain	Q.24 With orientation of the road and prevalence for severe sunstrike along parts of FTN and for some residents exiting or entering driveways how has this risk been managed within the designed road infrastructure?	The sun strike generally occurs for a short duration of the day. The FTN will only add 8 buses per hour for a 15min FTN (or 12 buses per hour for a 10 min FTN). Therefore, the increased probability of an FTN related crash occurring due to sun strike is extremely low. The Carlton Street Road section of the FTN includes eight speed tables spaced no more than 110m apart, making it difficult for a driver to speed along this section. Hence, severity if any sun strike related crashes between oncoming vehicles along this section of Carlton Street are likely to be low.
	Q.25 Given gradient of Carlton Street and prevalence of speed tables to increase risk of flooding what will the effect of heavy rain downpours have on speed and stopping distances and/or mitigate aquaplaning?	The new speed tables have channels incorporated on either side and therefore they will not change the current risk of flooding along this corridor due to the FTN. The gradient of Carlton St is such that the water will run off promptly and the presence of standing water is unlikely.
<b>Roundabout</b> (top of Queenstown Road)	Q.26 What are the safety implications for cyclists and motorbikes entering roundabout from Carlton Street/Frederick Street given A T indicate +42,300 heavy vehicles entering roundabout from Queenstown Road will be required to drive over rather than around the roundabout to navigate the turn into Frederick Street?	This is a compact roundabout and is designed for the buses to track over the mountable centre island of this roundabout. Due to constrained lane widths, cyclists and motorbikes would be positioned at the centre of the traffic lane behind other vehicles when entering the roundabout. Buses tracking over the mountable centre island is not expected to increase the risk to cyclists and motorbikes entering the roundabout.
<b>Intersection</b> (Carlton Road/ Hillsborough Road)	Q.27 Is the design of this intersection adequate to support heavy vehicle traffic safely navigate into and out of this intersection at peak traffic periods when traffic is queued to turn both right and left along Hillsborough Road?	There is adequate visibility for vehicles exiting and entering at the Hillsborough Road/Carlton Street intersection from all approaches. With Hillsborough Road being high traffic volume, for a vehicle turning right out, finding a gap where both directions are clear can be challenging, and this presents the highest risk. As the buses do not turn right out of this intersection, the FTN is unlikely to exacerbate this existing right turn out risk at this intersection. The traffic volume turning left from Carlton St will increase slightly due to the FTN (4 buses per hour). There is adequate vehicle tracking, therefore the FTN is unlikely to exacerbate any existing left-out safety risks at this intersection.  To allow for better bus tracking for the right turn into Carlton Street, the centreline on Carlton Street has been moved slightly and some on street parking has been removed. This has narrowed the exit lane width on Carlton Street to operate as one exit lane instead of two. It was observed on site that drivers still use this as a two-lane exit and some right turn drivers cross the centreline while waiting to turn. This may have been a result of the fact that the old centreline marking is still visible. This could increase the risk of a collision between a bus turning right into Carlton Street and a vehicle waiting to turn right at the incorrect location (if they have crossed the already moved centreline). However, should a crash occur, the severity of the crash would be low given the low vehicle turning speeds.
	Q.28 What is the risk of vehicles mounting the pavement when navigating the intersection and what are safety impact/ risk management plan given this forms part of the accessible journey and safe journey for the WSB.	As for the right turn into Carlton Street, to allow for better bus tracking, the centreline on Carlton Street has been moved slightly and some on street parking has been removed. Therefore, the right turn in bus is unlikely to track over the footpath.  This change to the centreline has narrowed the exit lane width on Carlton Street to operate as one exit lane instead of two by moving the centreline. It was observed on site that some drivers still use this as a two-lane exit. It is likely that during peak periods, the left-turn out movement may slightly track over the corner of the footpath while trying to squeeze around the vehicle waiting to turn right out.

Issue & identified Safety Risk:	Questions:	Response
	Q.29 Is the design of the intersection and road adequate to support heavy vehicle traffic passing in opposite directions to safely navigate into and out of this intersection at peak travel times?	Refer to the response on Q.27
<b>Signalised Pedestrian Crossing</b> (Littlejohn/ Hillsborough Road) - Persistent Red Light Running	Q.30 What strategies have been employed to eliminate the persistent red light running at this crossing used by WSB route, intermediate and High School children given this crossing has already seen at least one child fatality and has the significant likelihood to result in death or serious injury?	The NZTA Crash Analysis Database (CAS) at this intersection do not show any record of a child fatality at this location as referenced in this question over the ten-year period between 2010-2019. Although our site visits did not observe any red-light behaviour on site, the risk of red-light running is an inherent risk at any signal control intersection/mid-block crossing. Red light running incidents typically occur due to drivers not having enough visibility to the traffic signal aspects or not being able to control their speeds to stop safely or sometimes deliberately. On site, the visibility to the signal aspects is adequate. Red colour surfacing has been installed on the signalised pedestrian cross walk to further provide visual cues of the mid-block crossing, and High Friction Surfacing (HFS) has been already installed at this intersection to reduce the stopping distance of a breaking vehicle. The current condition of this (HFS) appear to be poor (surface cracking and worn off) and therefore may not perform as intended. The FTN is unlikely to exacerbate any existing risks at this intersection due to red light running.
	Q.31 Will there be any loss to visibility of this pedestrian crossing with introduction of FTN and buses queued to enter Carlton Street particularly during peak travel times?	The signalised midblock crossing located between Carlton Street and Littlejohn Street has adequate visibility to the signals. With introduction of FTN, the visibility to the signals would not be hindered given that there are signals overhead. Therefore, no adverse impact to visibility to the crossing facilities due to FTN operating.

