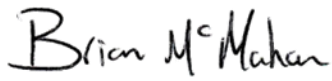
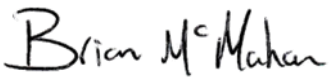
Dun Laoghaire to City Centre

Core Bus Corridor
Stage F Road Safety Audit

14 July 2017

Quality information

Prepared by	Checked by	Approved by
		
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	14/07/17	Draft issue	BMcM	Brian McMahon	Principal Engineer

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1. Introduction

1.1 Overview

AECOM has been commissioned by the National Transport Authority (NTA) to undertake a Road Safety Audit of a proposed Core Bus Corridor (CBC) scheme running from Monkstown to Dublin City Centre. This Stage F Audit will assess the safety implications of the scheme for all road users.

The Safety Audit Report indicates each of the problems identified, provides outline recommendations for solving the problems, presents the Audit Team Statement, and describes a schedule of documents reviewed. The members of the Audit Team were:

Audit Team Leader:

Brian McMahon, BE MSc CEng MIEI

Principal Engineer, AECOM

Audit Team Member:

Elaine Carroll, BEng CEng MIEI

Senior Engineer, AECOM

Audit Team Observer:

Jane Hennaghan, BEng MIEI

Consultant Engineer, AECOM

The audit comprises of an examination of the scheme drawings. The site visit took place on the 10th of July from 10am to 2pm, with the full route walked. On the day of the site visit the weather was dry. During the time of the site visits, there did not appear to be any circumstances that would suggest a deviation from normal traffic conditions. The traffic conditions on the local road network were busy. The site visits were undertaken between 10:00 and 14:00 (in daylight).

1.2 Road Safety Audit

This Safety Audit represents the response of an independent Audit Team to various aspects of the scheme. The recommendations contained therein are the opinions of the Audit Team, and are intended as a guide to the designers on how the scheme as designed can be improved to address issues of road safety.

Where a choice of routes is available, Stage F audits shall be carried out in two phases. Phase 1 shall be a comparative assessment of the routes from a road safety point of view. Once the route has been chosen, Phase 2 of the audit shall be carried out on the chosen route, in the standard problem and recommendation format. This audit has been undertaken as Phase 2 of the audit.

The following documents were provided by the Design Team:

- Dun Laoghaire to City Centre CBC – Proposed Scheme General Arrangement

The general arrangement plan drawings, with cross sections were provided to the audit team. Other drawings such as road markings and sign plans, road junction signalling and staging, drainage, lighting, landscaping, etc. have not been provided and therefore have not been included in this Stage F Road Safety Audit. The level of existing and predicted traffic volumes has not been provided. Future forecasts of pedestrian, cyclists, frequency of the buses, Dublin Bus or otherwise have not been provided.

The terms of reference of the Audit are as described in GE-STY-01024-07 (HD 19/15). The team has examined and reported only on the road safety implications of the scheme as presented and they have not examined or verified the compliance of the design to any other criteria.

The Safety Audit guidelines do not provide a facility for the Audit Team to classify individual problems according to their severity, and hence the level of priority to be attached to each. It is instead the task

of the design team and/or their representative to take a view on the validity of each of the recommendations, and decide on an appropriate course of action.

The response of the Design Team to the Safety Audit should be prepared in the form of a Safety Audit Feedback Form, accepting the changes proposed by the Audit Team or providing an alternative solution to the problem. The Feedback Form is then returned to the Audit Team for review and verification. A template for a Safety Audit Feedback Form is included as Appendix B.

1.3 Background

The Dun Laoghaire to city centre CBC scheme is one of a number of CBC schemes planned for the city. It is intended that CBC will provide a high quality transport system, with a dedicated CBC lane from start to finish of the route. The system will get priority at all junctions and road links. Dedicated cycle facilities are also provided alongside the proposed CBC route.

2. Site Description

2.1 Overview

The scheme comprises of a Core Bus Corridor system extending from Temple Hill in Seapoint, to Fitzwilliam Street Upper in Dublin City Centre. The scheme includes redistribution of road space, provision of new CBC facilities as well as pedestrian and cycle facility upgrades.

Location	Temple Hill to Fitzwilliam Street Upper
Classification	Regional and National Roads
Speed Limit	30 / 50 / 60 km/h
Local Authority Area	Dun Laoghaire Rathdown County Council/ Dublin City Council
Type of Road	Urban

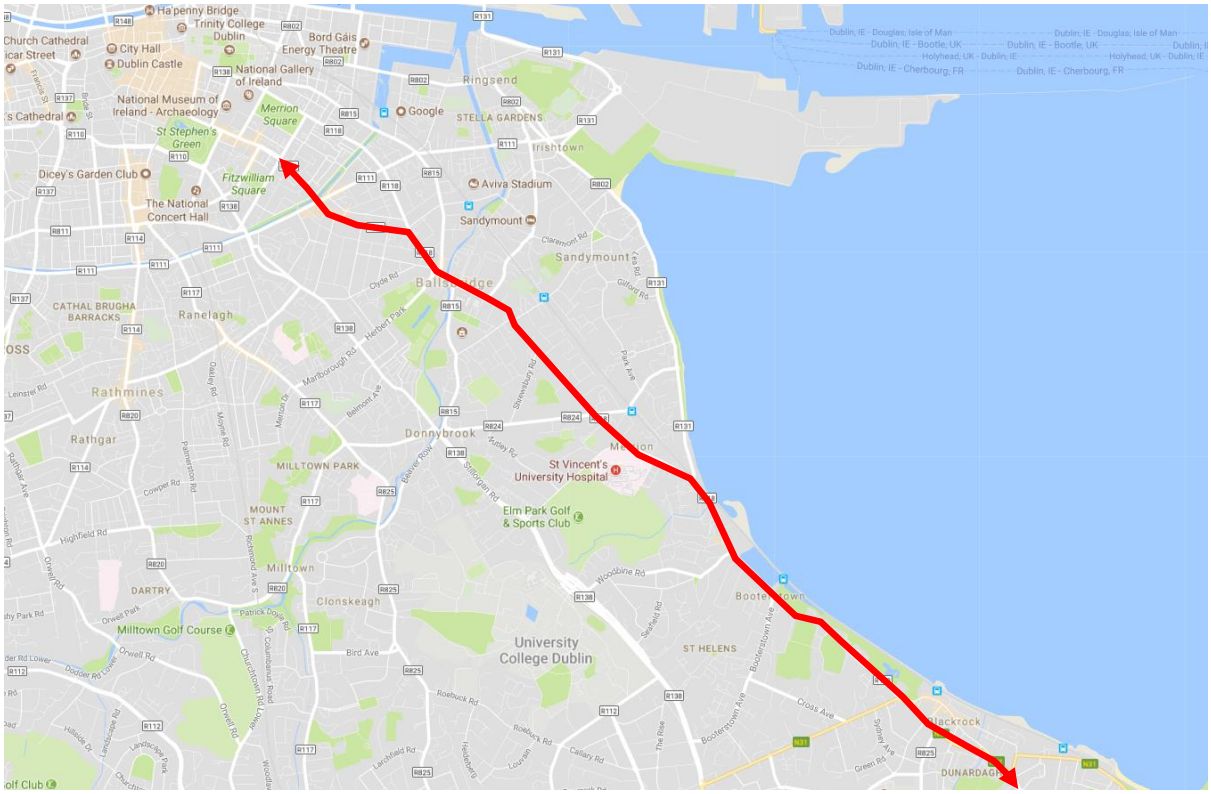

Figure 2.1 Temple Hill to Fitzwilliam Street Upper (Source: Google Maps)

2.2 Site Observations

Road Geometry

- The study area extends from Temple Hill in Seapoint, down the Frascati Road, the Rock Road, Merrion Road, passing through Ballsbridge, onto Pembroke Road before travelling to Baggot Street Upper and Lower, and terminating at Fitzwilliam Street Upper.
- There is an array of road types and geometries within the 7.2km route, ranging from busy urban streets, to dual carriageway roads.
- In addition to the CBC facilities proposed, the existing bus stop facilities are to be improved along the route.

Vehicular Traffic

- Traffic flows during the site visit appeared to be normal for each particular road for the time of day.
- The speed limit on the road network within the study area is 60 / 50 km/h, with traffic generally appearing to stay within this limit.

Pedestrians & Cyclists

- There are existing footpaths provided on both sides of the full route.
- There is a variety of existing cycle facilities along the route, from on-road, shared with bus, cycle tracks etc.
- Pedestrian and cyclists activity was busiest in the city centre and neighbourhood centres, such as Blackrock, Ballsbridge and Upper Baggot Street.

Street Lighting

- Street lighting is provided throughout the audit area. However, the level of lighting was not noted during the night time.

3. Departure from Standards

3.1 General

No departure from standards has been notified to the Audit Team.

4. Items Resulting from the Stage F Road Safety Audit

4.1 Overview

This Safety Audit has reported on issues relating to the proposed CBC scheme from Temple Hill in Seapoint to Fitzwilliam Street Upper. This is classified as a Stage F Road Safety Audit, as defined within the TII Road Safety Audit Guidelines.

While this is sufficient to provide a general overview of the key issues to be taken into account during the Stage F (Route Selection) design, it is not intended to provide a final schedule of safety issues associated with the scheme. Such would require a further review of the designs at Stage 1 (Preliminary Design), Stage 2 (Detailed Design) and Stage 3 (Completion of Construction).

The following information was not provided for Audit so therefore could not be commented upon:

- Signal Layout and Phasing;
- Signage Layout;
- Drainage and Services;
- Lighting; and
- Landscaping.

The report has been split into general issues that are common throughout the scheme, with specific areas highlighted.

4.2 General Issues

4.2.1 Problem	
Location:	Throughout the Scheme
Summary:	Reduction to footpath widths
Description:	
In some locations the proposed width of the footpath has been reduced from the existing width. This may result in some pedestrians walking out on the cycle/road carriageway in conflict with moving vehicles resulting in a collision. In particular there is concern in relation to the following locations; • Chainage 575. The proposed box turn for cyclists results in a very narrow path for pedestrians, narrower than the existing width. Cyclists might be better accommodated at Toucan Crossings. • Chainage 1725. The footpath narrows at the bus layby. Land take should be proposed in order to sufficiently widen the footpaths at this location. • Chainage 1850-1900. At the RDS it is proposed to significantly reduce the width of the footpath. Land take may be required to maintain the existing pedestrian provision. • Chainage 3250. At the existing Tesco Development the footpath has been significantly reduced in width. • Chainage 4800. At the Rock Road the footpath is to be narrowed. Should the footpath and cycle track be positioned at the same level to allow comfort space for both. • Chainage 4800. At the Rock Road the footpath is to be narrowed. Consideration should be given to removing the car parking on this section of the road, and redistribute the space to pedestrian and cycle facilities. • Chainage 5000. At the Rock Road the footpath is to be narrowed. Consideration should be given to reducing the central median at this location, and redistribute the space to pedestrian and cycle facilities.	
***Recommendation*:**	
Ensure that appropriate footpath widths are provided throughout the scheme.	

4.2.2 Problem	
Location:	Throughout the Scheme
Summary:	Location of Bus Stops
Description:	
Some of the proposed bus stops are not located in the most appropriate locations in terms of accessibility to proposed pedestrian crossings. This may result in some pedestrians' crossing at inappropriate locations, leading to collisions with vehicular traffic. In particular there is concern in relation to the following locations; • Chainage 4325. Consideration should be given to locating the proposed bus stop closer to the office developments at chainage 4200.) • Chainage 4000. At this existing bus stop there is a strong desire line across to the office development on the western side of the road. Consideration should be given to relocating the bus stop closer to the proposed pedestrian crossing at chainage 3850.	
***Recommendation*:**	
Ensure that all the proposed bus stops are located in the most appropriate location. Dublin Bus should be consulted regarding these proposed locations.	

4.2.3 Problem	
Location:	Throughout the Scheme
Summary:	Type of Cycle Facility at the Bus Stops

Description:

At some bus stop locations National Cycle Manual (NCM) In-Line Bus Stops are used, while at other locations NCM Island Bus Stops or Bus Stops using Kneeling Bus Facility have been provided. There doesn't appear to be a consistency in the choice of design. There is concern regarding conflicts between buses and cyclists and cyclists and pedestrians at a number of locations.

In particular there is concern in relation to the following locations;

- Chainage 1700. A Kneeling Bus Facility in a bus layby has been retained at this location. There is a conflict between buses and cyclists as the bus weaves in and out of the cycle lane. There is little stacking space provided for buses.
- Chainage 3450 southbound. An In-Line Bus Stop has been proposed; however, how the cyclists and pedestrians conflict is to be mitigated is not clear.
- Chainage 5325 southbound. An In-Line Bus Stop has been proposed; however, how the cyclists and pedestrians conflict is to be mitigated is not clear. An Island Bus Stop may be a more suitable facility at this location given land take is available. Bus Lanes of 2.8m are proposed, given land take is proposed these should be widened to 3.0m.
- Chainage 5325 northbound. An In-Line Bus Stop in a bus layby has been proposed; however, how the cyclists and pedestrians conflict is to be mitigated is not clear. An Island Bus Stop may be a more suitable facility at this location given land take is available. Bus Lanes of 2.8m are proposed, given land take is proposed these should be widened to 3.0m.
- Chainage 5550 northbound. An In-Line Bus Stop has been proposed; however, how the cyclists and pedestrians conflict is to be mitigated is not clear.
- Chainage 5675 southbound. A bus stop is proposed entirely in the cycle lane and appears too narrow to accommodate the width of a bus.
- Chainage 5975 northbound. An Island Bus Stop is proposed; however, how the cyclists and pedestrians conflict is to be mitigated is not clear.
- Chainage 6475 southbound. An In-Line Bus Stop is proposed; however, how the proposed bus stop appears too short to accommodate the length of a bus.

***Recommendation*:**

A reassessment of the proposed bus stop facilities should be undertaken at the locations highlighted above.

4.2.4 Problem	
Location:	Throughout the Scheme
Summary:	Lack of provision of pedestrian crossings

Description:

Have all the pedestrian desire lines been identified on the route and if so have controlled pedestrian crossing facilities been provided. The lack of appropriate crossing facilities may result in pedestrians crossing at unsafe locations, in conflict with vehicular traffic which may result in collisions.

In particular there is concern in relation to the following locations;

- Chainage 800 – Wellington Road. There is an existing pedestrian crossing provided across the Pembroke Road which is removed from this scheme.
- Chainage 3500. There is an existing pedestrian crossing provided at the St. Vincent's Hospital entrance across the Merrion Road. However, this has been removed in the proposed drawings.
- Chainage 4000. At this existing bus stop there is a strong desire line across to the office development on the western side of the road. Pedestrians were observed waiting in the middle of the road carriageway where they were at risk of a collision with vehicular traffic.
- Chainage 5100. Willow Park School is located on the eastern side of the road carriageway. An assessment should be undertaken as to whether a pedestrian crossing is required at this location.
- Chainage 5375. Blackrock College is located on the eastern side of the road carriageway. An assessment should be undertaken as to whether a pedestrian crossing is required at this location.

***Recommendation*:**

Pedestrian crossing facilities should be provided where there is a strong pedestrian desire line to ensure that pedestrians can safely cross the road carriageway.

4.2.5 Problem	
Location:	Throughout the Scheme
Summary:	Reduction to Existing Junction Capacities

Description:

Some existing right turning lanes have been removed in order to provide sufficient width for the proposed bus lanes in both directions. Motorists wishing to turn right must stay within the straight-ahead lane in order to turn right. Motorists, in order to pass these vehicles, will undertake via the bus lane. This may result in rear-end collisions as all motorists in the queue turn left to underpass the right turning vehicle.

In particular there is concern in relation to the following locations;

- Chainage 4450. There is an existing short right turn lane for Trimleston Avenue. This road provided access to UCD and there were a number of motorists using the right turn lane during site observations.

***Recommendation*:**

Right turning lanes should be provided at heavy right turning demands to ensure that straight-ahead motorists do not have to continuously swerve into the CBC at one junction location. The proposed right turning lanes should cater to the anticipated number of right turners per signal cycle, resulting in land acquisition if required.

4.2.6 Problem	
Location:	Throughout the Scheme
Summary:	Poor minor arm crossing facilities for Pedestrians

Description:

As set out in the Design Manual for Urban Roads and Streets (DMURS), it is an objective of Smarter Travel (2009) that level grade crossings (i.e. those that are aligned with the height of footways) be provided for pedestrians across junctions.

At some locations along the route, it is proposed to provide level grade crossings, for example between chainages 3000 and 5950. However, dropped kerbs or ramps are proposed at other locations.

In particular there is concern in relation to the following locations;

- Chainage 250 – Herbert Street. There is a proposal for a 13m wide pedestrian crossing at this location with no level grade crossing.
- Chainage 775 – Wellington Road. There is a proposal for a 15m wide pedestrian crossing at this location with the pedestrian refuge island removed with no level grade crossing.
- Chainage 1150. Ramps are proposed rather than pedestrian level grade crossings.
- Chainage 1775. Ramps are proposed rather than pedestrian level grade crossings.
- Chainage 2000. Ramps are proposed rather than pedestrian level grade crossings.
- Chainage 2250. A level grade crossing has not been proposed.
- Chainage 2375. A level grade crossing has not been proposed.
- Chainage 2425 – Shrewsbury Road. Ramps are proposed rather than pedestrian level grade crossings.
- Chainage 2475 – Shrewsbury Park. Ramps are proposed rather than pedestrian level grade crossings.
- Chainage 2725 – A level grade crossing has not been proposed.
- Chainage 2775 – Merlyn Road. A level grade crossing has not been proposed.
- Chainage 2875 – Merlyn Park. A level grade crossing has not been proposed.
- Chainage 6340 – George's Avenue. A level grade crossing has not been proposed.
- Chainage 6575 – Sweetman's Avenue. A level grade crossing has not been proposed.
- Chainage 7100 – Temple Park Avenue. Ramps are proposed rather than pedestrian level grade crossings.
- Chainage 7275 – Temple Park Avenue. Ramps are proposed rather than pedestrian level grade crossings.
- Chainage 7275 – A level grade crossing has not been proposed.

***Recommendation*:**

Level grade crossings should be provided for pedestrians across junctions, throughout the scheme and are highly recommended in areas where pedestrian flows are high such as in centres. They are an effective measure for calming traffic and enforcing lower speeds. Pedestrian crossing distances should be shortened by reducing the corner radii.

4.2.7 Problem	
Location:	Throughout the Scheme
Summary:	Type of Cycle Facility

Description:

Cycle tracks offer cyclists greater protection from collisions with physical segregation by full kerb height between cyclist and motorised vehicles. They also reduce the road carriageway width thus helping to reduce motorists speeds. At some locations along the route it would appear that raised cycle tracks could be provided rather than cycle lanes.

In particular there is concern in relation to the following locations;

- Chainage 0-325. Baggot Street Upper. There is an opportunity to provide a raised cycle track northbound given the lack of parking and accesses.
- Chainage 600-1100. Pembroke Road. There is an opportunity to provide a raised cycle track with bevelled kerbs across existing accesses along the northbound section.
- Chainage 1200-1450. Pembroke Road. There is an opportunity to provide a raised cycle track with bevelled kerbs across existing accesses along both the northbound and southbound sections.
- Chainage 1925-2100. Merrion Road. There is an opportunity to provide a raised cycle track northbound given the lack of parking and accesses.
- Chainage 2150-3000. Merrion Road. There is an opportunity to provide a raised cycle track with bevelled kerbs across existing accesses along both the northbound and southbound sections.

***Recommendation*:**

The type of cycle facility, whether cycle lane or raised cycle track, should be reviewed as highlighted in the above road links.

4.3 Specific Areas

4.3.1 Problem	
Location:	Baggot Street
Drawing:	Sheet 1 of 20
Summary:	Removal of Existing Central Median.

Figure 1: Existing Trees in the Central Median on Baggot Street

Description:

It is proposed to remove the existing trees on Baggot Street. However, according to DMURS, the placing of street trees can have "a traffic calming effect…where trees are planted in continuous rows and their canopies overhang, at least in part, the vehicular carriageway".

Given the wide width of the street, the removal of the existing trees may encourage motorists to speed excessively using this route, increasing the risk of and severity of collisions.

***Recommendation*:**

Consideration should be given to retaining the trees along the central median, to provide a traffic calming effect along this section of Baggot Street, which is part of the newly introduced 30km/h zone.

4.3.2 Problem	
Location:	Pembroke Road
Drawing:	Sheet 4 of 20
Summary:	Cyclists yielding to buses.

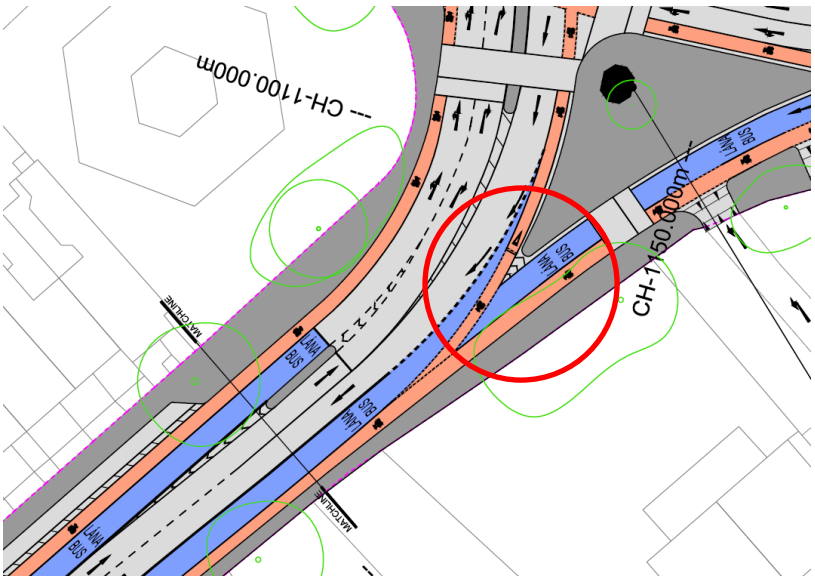

Figure 2: Cyclists Yielding to Buses

Description:

A left slip road joins the main road at the Pembroke Road / Northumerland Road / Landsdowne Road junction. Currently traffic yields on the left slip road. It is proposed in these proposals that buses have right of way and that cyclists yield. However, cyclists on the main road would not anticipate that they have to yield which means that they may proceed at the same time as the bus resulting in a collision to a vulnerable road user.

***Recommendation*:**

Yield markings must be provided on the left slip lane to ensure that drivers give way to cyclists on this approach.

4.3.3 Problem	
Location:	Pembroke Road
Drawing:	Sheet 4 of 20
Summary:	Potential Bus/cyclist collision area

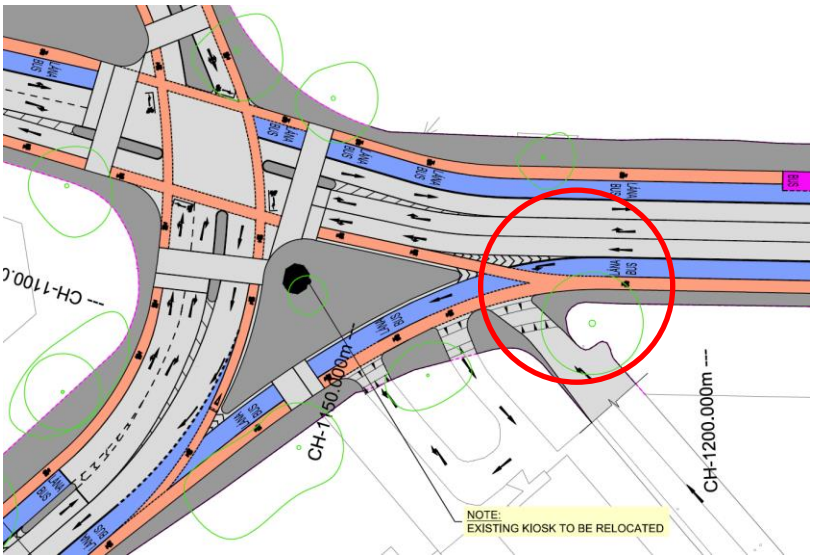

Figure 3: Cyclists Yielding to Buses

Description:

A left slip road joins the main road at the Pembroke Road / Northumerland Road / Landsdowne Road junction. However, a cycle lane cuts across the bus lane which would put cyclists at risk of collisions with buses turning left.

***Recommendation*:**

Yield markings must be provided on the bus lane to ensure that drivers give way to cyclists who are proceeding straight on while buses are turning right.

4.3.4 Problem	
Location:	Merrion Road
Drawing:	Sheet 10 of 20
Summary:	Narrow Cycle Track

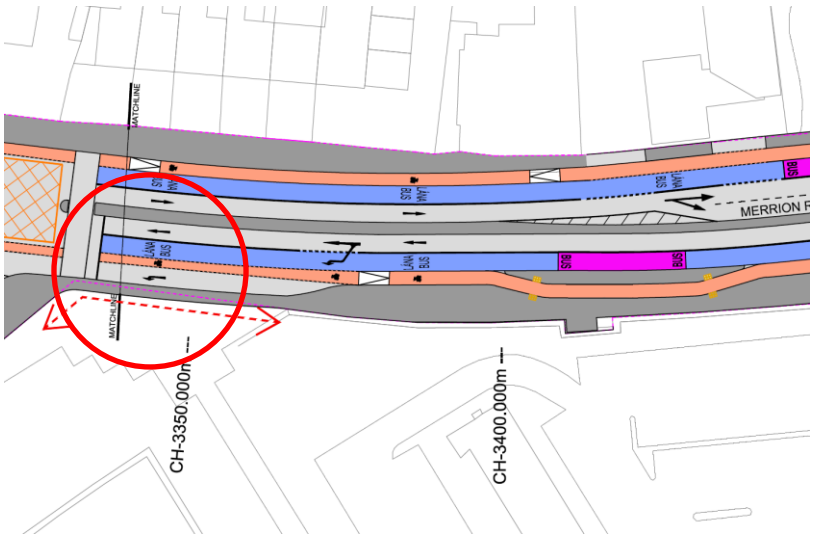

Figure 4: Narrow Cycle Lane

Description:

The cycle lane on the approach to the Merrion Road / Nutley Lane junction is very narrow. This results in less road carriageway space for cyclists which could result in a collision with passing vehicles.

***Recommendation*:**

The cycle lane width on the approach to this junction should be provided in accordance with the National Cycle Manual.

4.3.5 Problem	
Location:	Rock Road
Drawing:	Sheet 13/14 of 20
Summary:	Cycle Buffer Not Provided

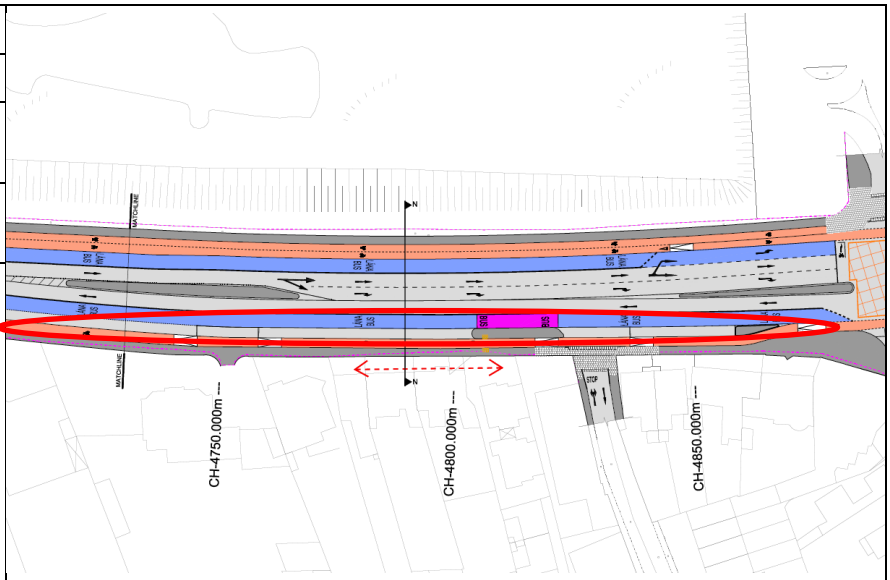

Figure 5: No buffer proposed between car parking and cycle track

Description:

Parking is proposed to be retained on the Rock Road northbound carriageway. This parking does not have a buffer to the cycle track on the inside. Passengers may open their doors unexpectedly resulting in the collision of passing cyclists.

Recommendation:

If there isn't the width to provide the buffer the parking should be removed from the design. Alternatively, if the parking is to remain, road markings should be provided on the cycle track to provide the space for a car door to be opened, reducing the effective width of the cycle track by 0.8m

4.3.6 Problem	
Location:	Willow Park
Drawing:	Sheet 15 of 20
Summary:	Potential Rear End Collisions and Read End Collisions.

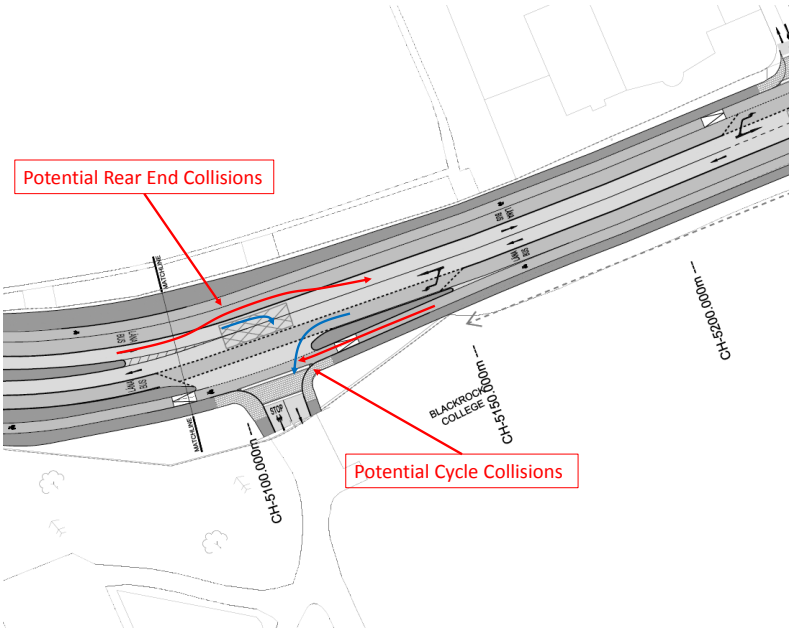

Figure 6: Proposed Willow Park School Access

Description:

A right turn ghost island has not been provided at the turn into Willow Park, but the room to accommodate this facility is already available across the road carriageway. Motorists wishing to turn right must stay within the straight-ahead lane in order to turn right. Motorists in order to pass these vehicles will undertake via the bus lane. This may result in rear-end collisions as all motorists in the queue turn left to underpass the right turning vehicle.

Furthermore, the available road width has been used by providing islands between the bus lane and cycle lane. However, this results in a separation of motorists and cyclists, where some motorists who turn left into the school may not have observed the cyclists on the left which results in a collision.

Recommendation:

Right turning lanes should be provided at heavy right turning demands to ensure that straight-ahead motorists do not have to continuously swerve into the CBC at one junction location.

The islands separating the bus lane and the cycle track on the approach to the school should be removed to re-establish off road cyclists back on road in advance of minor junction, providing time for vehicles and cyclists to observe each other and accommodate each other's movements at the conflict point.

4.3.7 Problem	
Location:	Rock Road
Drawing:	Sheet 16 of 20
Summary:	Cycle Buffer Not Provided

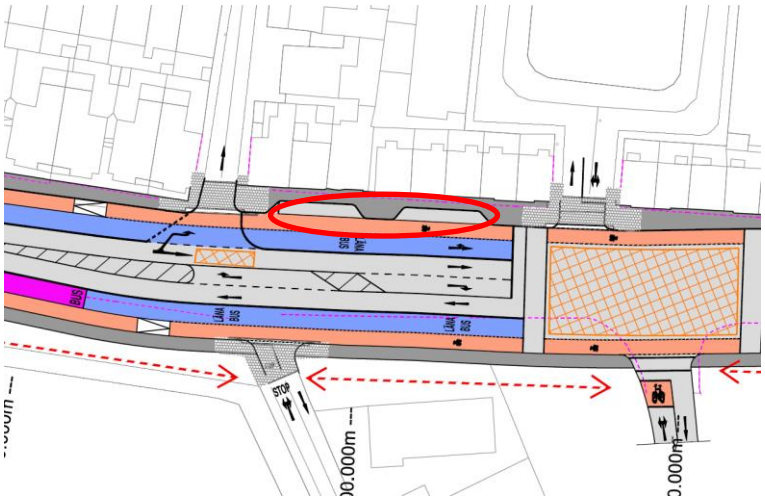

Figure 7: No buffer proposed between car parking and cycle lane

Description:

Parking is proposed to be retained on the Rock Road southbound carriageway. This parking does not have a buffer to the cycle lane on the outside. Drivers may open their doors unexpectedly resulting in the collision of passing cyclists.

***Recommendation*:**

If there isn't the width to provide the buffer the parking should be removed from the design.

4.3.8 Problem	
Location:	Temple Hill
Drawing:	Sheet 20 of 20
Summary:	Short Bus Lane

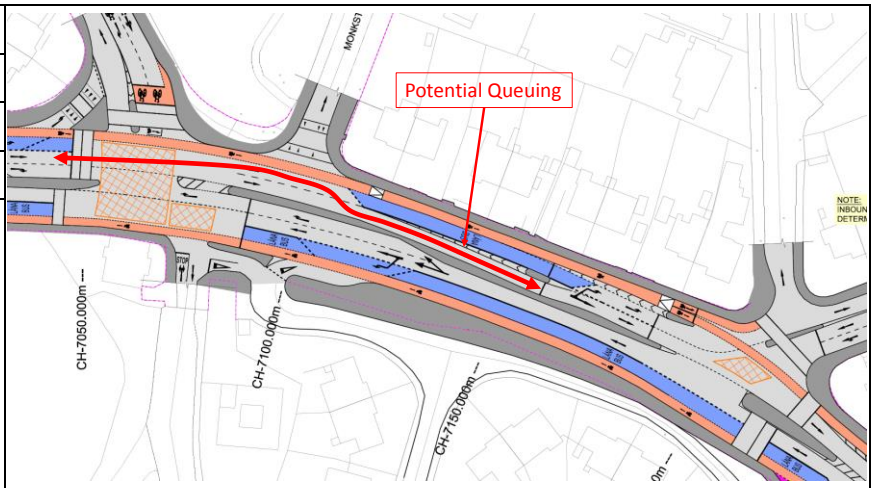

Figure 8: Short Bus Lane on Temple Hill

Description:

A short bus lane is proposed on Temple Hill. This bus lane may result in greater queuing and longer delays for bus journeys. It may lead to driver frustration and aggressive driving manoeuvres leading to collisions.

***Recommendation*:**

The short bus lane should be reviewed and removed from the design if it is predicted to cause delays and congestion on the road network.

4.4 Observations

4.4.1 At the proposed Pembroke Road / Herbert Park / Shelbourne Road Junction there does not appear to be sufficient width to allow both minor arms to run in the same stage. Any junction modelling or junction staging should reflect this.

4.4.2 The straight-ahead and left road marking at Chainage 4475 should be Left Turn Only Except Bus.

4.4.3 A left turn only is proposed at the St. Helen's Road junction at Chainage 4525, but it may be difficult to enforce this.

4.4.4 There is currently a right turn ban into the DART station at the Rock Road / Booterstown Avenue Junction. The provision of a right turn lane will reduce capacity at this junction which should be reflected in any junction modelling.

4.4.5 The current staging at the Frascati Road / Temple Road junction has a stage with only the Frascati Road right turn running. This reduces the capacity of this junction and results in driver frustration.

4.4.6 A stop line is missing from the bus lane at Chainage 7000.

4.4.7 The STOP road markings should be removed from the signal controlled junction at Chainage 7075.

5. Audit Team Statement

I certify that the site was visited and that this audit has been carried out in accordance with the Transport Infrastructure Ireland Road Safety Audit Guidelines GE-STY-01027-01 (HA 19/15) and Standard GE-STY-01024-07 (HD 19/15).

The Road Safety Audit has been carried out with the sole purpose of identifying any features of the design that could be removed or modified in order to improve the safety of the scheme.

No one on the audit team has been involved with scheme design.

AUDIT TEAM LEADER: SENIOR ROAD SAFETY AUDITOR

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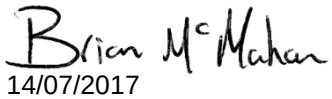
Signed 
Date 14/07/2017

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Signed 
Date 14/07/2017

OTHERS INVOLVED:

Jane Hennaghan was an Observer for this Road Safety Audit.

Appendix A Documents Submitted to the Audit Team

The following documents were submitted as part of the Road Safety Audit:

Document No.	Rev.	Description	Date
NA	NA	Dun Laoghaire to City Centre CBC Sheets 1 to 20	No date.

Appendix B Safety Audit Feedback Form

NOTE: THE TEXT BELOW REPRESENTS AN EXAMPLE OF A SAFETY ADUIT FEEDBACK FORM. THE SAFETY AUDIT FEEDBACK FORM SHOULD BE COMPLETED BY THE DESIGN TEAM IN RESPONSE TO THE ISSUES RAISED IN THIS AUDIT AND SUBMITTED TO THE OVERSEEING ORGANISATION AS A SUPPLEMENT TO THE SAFETY AUDIT REPORT.

	To be Completed by Designer			**To be Completed by Audit Team Leader**
Paragraph No. in Safety Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Describe alternative measure(s). Give reasons for not accepting recommended measure	Alternative measures or reason accepted by auditors (yes/no)

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