Level Crossing Risk Assessment Guidance

Final Guide for Industry Use (version I), 5 July 2017

Developed for the NZ Transport Agency and KiwiRail by Stantec Ltd and ViaStrada Ltd

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Designers and road controlling authority staff are invited to provide feedback to NZ Transport Agency or KiwiRail regarding the application and content of this guide. In particular, feedback should be directed to:

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Cover Photo: Half-arm barrier crossing, Papanui, Christchurch (photo: Stantec)

Table of Contents

Executive summary 5
Glossary of terms used in this guide 6
1. Introduction 9
1.1. Background context 9
1.2. Document status and scope 9
1.3. Other relevant information 10
1.3.1. Relevant NZ legislation 10
1.3.2. Discussions with KiwiRail 11
2. Crossing design philosophy 12
2.1. Safe rail systems 12
2.1.1. Risk hierarchy 12
2.1.2. Frequency versus severity 12
2.2. New and existing crossings 12
2.2.1. New crossings 14
2.2.2. Existing crossings 14
2.2.3. LCSIA Criteria 14
3. Risk assessment 15
3.1. Introduction to risk assessment 15
3.1.1. When is an LCSIA required? 15
3.2. Risk assessment methodology 15
3.2.1. Selecting a LCSIA Safety Review Team 16
3.2.2. Existing conditions at the level crossing 16
3.2.3. Proposed protection measures at a new / upgraded level crossing 17
3.2.4. User survey counts post commissioning 17
3.3. Components of the Level Crossing Safety Score 17
3.3.1. ALCAM Score (30 points) 18
3.3.2. Crash and incident history analysis (10 points) 20
3.3.3. Site-specific safety score (SSSS) (10 points) 22
3.3.4. Locomotive and RCA engineers' risk assessment (10 points) 23
3.4. LCSS results 24
3.5. Different LCSIA report scenarios 24
3.5.1. 'Change in use' proposal – pre design phase 24
3.5.2. 'Change in use' proposal –design phase 25
3.5.3. New crossing facility 25
3.6. Predicting values of different LCSS elements for a 'change in use' activity 25
3.7. Determining required safety improvements 25
3.8. General safety review 26
3.9. *LCSIA Executive Summary Format* 26
3.10. Recommendation on approving new / upgraded crossings 27
3.11. Post LCSIA and updating databases 27

3.11.1. LCSIA database update ... 27
3.11.1. LXM database update ... 27
3.12. Safety audit of a level crossing project ... 28
3.13. Review periods of upgraded/new crossing facilities ... 28
4. References ... 29
4.1. Cited references ... 29
4.2. Acknowledgments ... 29
Appendices ... 30
A1 Pedestrian and cycle user count surveys ... 30
A1.1 Collecting pedestrian and cycle volumes ... 30
A1.2 User types to collect ... 31
A2 New Level Crossing Risk Assessment Process ... 32
A2.1 ALCAM score (30 points) ... 33
A2.2 Crash and incident history analysis (10 points) ... 34
A2.3 Site-specific safety score (SSSS) (10 points) ... 35
A2.3.1 Urban Roadway Crossing SSSS ... 35
A2.3.2 Pedestrian / Cyclist Crossing SSSS: ... 39
A2.4 Locomotive and RCA engineers' risk assessment (10 points) ... 41
A2.5 LCSS results ... 42
A3 Rural Site-specific safety score (10 points) ... 44
A4 ALCAM graduated scoring scales ... 47
A4.1 ALCAM road scoring ... 47
A4.2 ALCAM pedestrian scoring ... 48
A5 LCSIA Report Format ... 49

Executive summary

Level crossings in New Zealand should be constructed and managed using the same "safe system" approach that is applied to other transport infrastructure. Namely, it is important to remember that humans make mistakes (but shouldn't be disproportionately punished for them) and are vulnerable to injury (requiring a focus on harm minimisation). A shared responsibility is required to address safety (incl. rail operators, road controlling authorities, system users, etc.).

To help objectively assess level crossings, a new assessment process called the Level Crossing Safety Impact Assessment (LCSIA) has been developed for KiwiRail. A key component of this is a new risk scoring system called the Level Crossing Safety Score (LCSS). Together with the traditional ALCAM level crossing risk model score, the LCSS also looks at three additional data sources associated with crash risk: historical crash and incident data, safety observations made by locomotive engineers and road controlling authority (RCA) engineers, and a more detailed site assessment of the impact of the existing level crossing layout on cyclists/pedestrians and their interaction with it and the surrounding transport network. The risk assessment process will also enable the prioritisation of level crossing upgrades.

This guide does not by itself enable readers to conduct risk assessments; further training conducted by KiwiRail is necessary to be accredited, to ensure that the risk is assessed according to the methods summarised in this guide. The first accreditation workshop was held in June 2017. Accreditation lasts for a period of two years.

KiwiRail requires that an LCSIA is completed for ***all*** level crossings that are along or adjacent to a new cycleway or shared path, even when they do not explicitly cross over the rail corridor. Such new facilities would increase the volume of users crossing the rail corridor. This will help determine whether level crossings need to be upgraded and the appropriate treatments required. A LCSIA is also required prior to the completion of any planned upgrade to a level crossing. In a similar vein, a new facility installed nearby to a rail corridor that would likely increase the cycling / pedestrian / vehicle volume over a level crossing location, would constitute a 'change in use' activity for the crossing location and require an LCSIA.

This guide originates from an interim guide on risk assessment of level crossings and design of pedestrian / cycle level crossings. Training workshops, based on the interim guide, were conducted and industry feedback was sought. It was decided to separate the two main aspects covered in the interim guide into two separated documents. The other document is now called 'Rail Crossing Pedestrian/Cycle Design Guidance'.

This guide is endorsed by KiwiRail, the NZ Transport Agency and the RCA Forum and is consistent with the mandatory requirements of the NZTA *Traffic control devices manual* part 9.

The guide does **not** address legal or property matters. Councils wishing to upgrade level crossings or using level crossings or other parts of the rail corridor for cycleways or shared paths need to contact KiwiRail to find out about the application process (cycleways@kiwirail.co.nz).

Users of the guide and road controlling authority staff are invited to provide feedback to KiwiRail regarding the application and content of this guide. In particular, feedback should be directed to:

- Leah Murphy - Project Manager, Urban Cycleway Projects (Leah.Murphy@kiwirail.co.nz)
- Eddie Cook - Project Engineer, Level Crossings (Eddie.Cook@kiwirail.co.nz)

Glossary of terms used in this guide

AADT: Annual Average Daily Traffic; a determination of the overall average numbers of users per day throughout the year, which allows for typical differences in observed numbers due to seasonal and temporal variations (e.g. day of the week, time of the year, public holidays). Although commonly used for motor traffic, similar AADT values can also be estimated for pedestrian and cycle numbers.

Active controls (or active warning devices): traffic control devices that are actuated when a train is approaching the crossing point to warn road/path users not to enter the level crossing. They are generally fixed in place at the crossing point (e.g. bells, lights and barriers).

Active users: people who travel by a mode of transport that requires some human power input and provides some form of physical exercise. This includes people who walk (including those with a pushchair, wheelchair, walking stick or walking frame), cycle (including electric bikes) or ride devices such as skateboards, scooters or roller skates. The term is extended to include those who use mobility scooters or other low-powered mobility devices as these users have similar characteristics and use the same facilities. The nature of these modes means 'active users' are sometimes termed 'vulnerable users' although, in the case of trains, all crossing users are vulnerable to serious injury.

ALCAM: Australian Level Crossing Assessment Model – a safety assessment tool used to help prioritise treatment of level crossings according to their comparative safety risk.

Applicant: the organisation that has triggered a 'change in use' activity at a level crossing. KiwiRail require that a LCSIA is conducted to assess the safety risk of the 'change in use'.

CAS: Crash Analysis System; NZTA's national database for reported road crashes.

Cognitive impairment: any condition of the brain that results in difficulties comprehending and assessing the level crossing environment and the way information there is presented to users. This could include congenital or degenerative conditions, the results of serious head injuries, and limitations attributable to childhood development or temporary modifiers such as drugs and alcohol. (See vulnerable users).

Cycle path: A facility, separated from the roadway, intended for the sole use of cyclists.

Cycleway: A generic term to describe any network route that provides for cycling, on-road or off-road. Some cycleways may be shared with either pedestrians or motor vehicles. A cycleway may not necessarily have specific cycle facilities, e.g. neighbourhood greenways.

Flange(way) gap: the gap between the rail and the adjacent crossing surface, to allow the train wheels to pass, which can be a hazard for crossing users, especially those with ***wheeled devices***. This becomes more of an issue where the flange gap has widened over time.

Footpath: a facility provided solely for pedestrians, with cyclists and motor vehicles being excluded.

Grade separation: when two transport modes are accommodated separately at different vertical levels, thus spatially disassociated. In the context of this guide, grade separation refers to separation of active users from trains; this can be done either by underpasses or overbridges.

IRIS: Incident Recording Information System; KiwiRail's national database for recording train collisions and near-misses.

LCSIA: Level Crossing Safety Impact Assessment – a process developed in parallel with this guidance to assess the level of crash risk of existing and new/upgraded level crossings (for road and/or path users).

LCSS: Level Crossing Safety Score – the risk of crashes occurring at a level crossing, as used in the LCSIA.

Level crossing: a location where a road and/or path crosses a railway line at-grade (i.e. on the same level, without any grade separation). Sometimes referred to overseas as a "grade crossing".

Mobility impairment: any condition that hampers a person's ability to walk with the speed and agility that most able-bodied people can achieve. Some people may use a mobility device to assist them, e.g. wheelchair, walking frame, mobility scooter. (See vulnerable users).

NZTA: NZ Transport Agency

Path(way): a facility provided for active users but specifically not for motor vehicles (i.e. distinct from the roadway). Different subsets of path are footpath, shared path and cycle path.

Passive controls (or passive warning devices): traffic control devices that are static, constant and present all the time, i.e. regardless of whether a train is present/approaching or no trains are present (compare with active warning controls, which do distinguish between these two situations). For example, warning signs, path markings and rumble strips.

RCA: Road controlling authority; typically, a City or District Council (for local roads) or NZTA (for state highways). It may also include organisations that control other roads, such as Government departments (e.g. Department of Conservation) or private landowners.

Roadside crossing: a ***level crossing*** for ***active users*** located adjacent to a roadway level crossing (see Figure 1 and Figure 2).

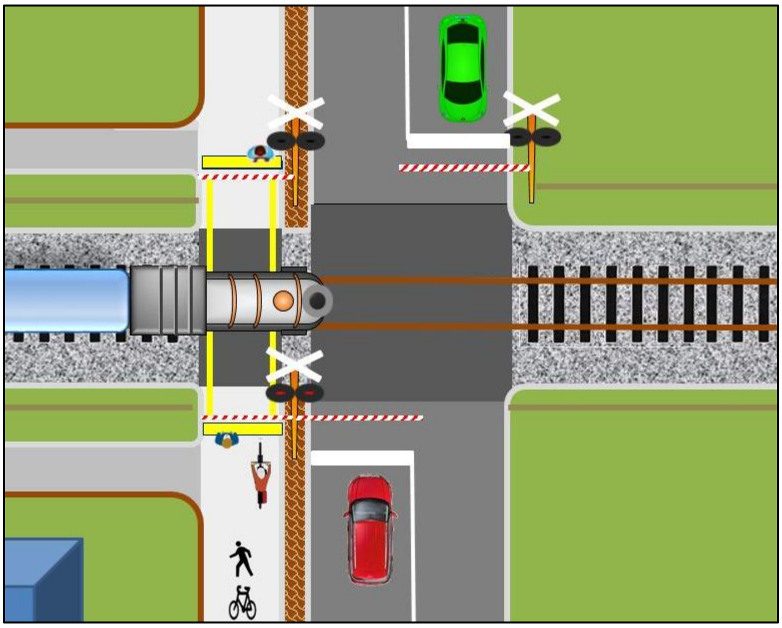

Figure 1: Single road-side crossing

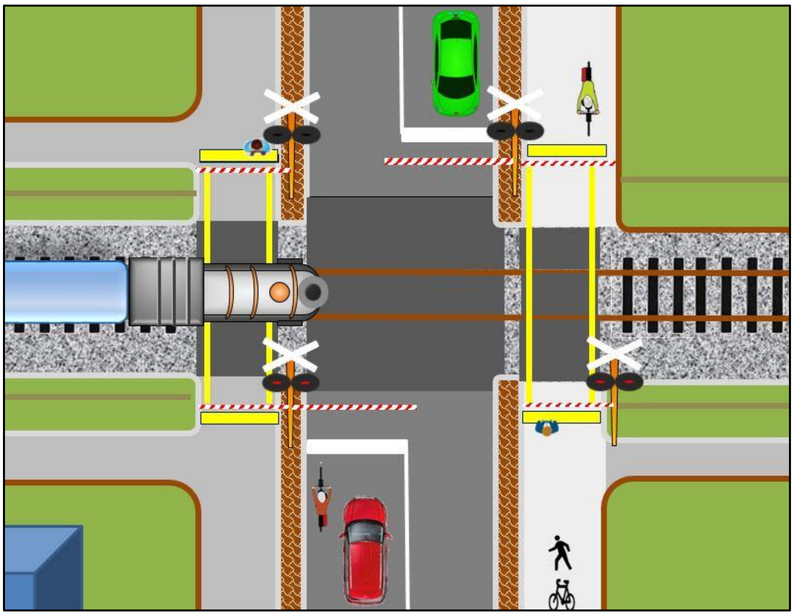

Figure 2: Two road-side crossings

Sensory impairment: a partial or total loss of one of the main human senses; usually either vision or hearing. This limits the ability of visual or audible devices to provide adequate warning to crossing users with such impairments. (See vulnerable users).

Shared path: a facility, separated from the roadway that is shared by pedestrians and cyclists.

SRT: Safety Review Team – the group of assessors involved to produce the LCSIA report. One of the SRT must be accredited by KiwiRail to conduct LCSIAs.

SSSS: Site specific safety score - one of the four assessments contained within the LCSIA that forms part of the overall LCSS of a level crossing. Requires the SRT to physically visit the site and audit the existing condition of the level crossing/s, using a prescribed set of parameters outlined in this guide.

Stand-alone crossing: a ***level crossing*** for ***active users*** where there is no adjacent road (see Figure 3).

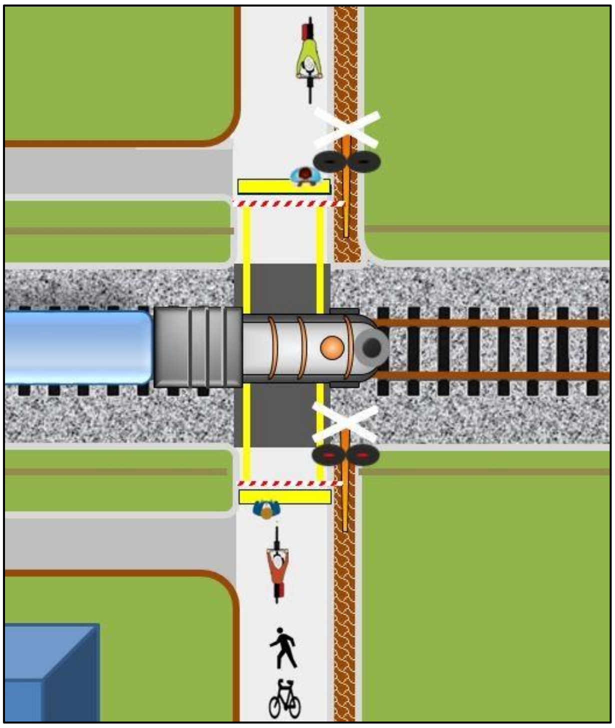

Figure 3: standalone crossing

Traffic: The users of a particular transport facility. This could be motor vehicles on a road, ***active users*** on a path or trains on a railway.

TCDM Part 9: The relevant section of the NZTA *Traffic control devices manual* (Part 9) that deals with ***level crossings*** (NZTA 2012).

Vulnerable user: a person whose mode of transport provides little physical protection in the case of a crash with a vehicle/train, or simply falling and hitting the ground. ***Active users*** (see definition above) fall under this category although, in the case of train collisions, all road users are very vulnerable to serious injury. People with mobility, cognitive or sensory impairments are particularly vulnerable as they are less likely to be able to avoid a crash. They are generally more fragile thus likely to have a higher severity of injury in the case where a crash does occur. For the purposes of a LCSIA, school children are also classified as vulnerable, due to their poor risk perception and often distracted level crossing habits (i.e. mobile phone / music player use, talking amongst friends etc).

Warning devices: any combination of ***active or passive controls*** used to make approaching users aware of the level crossing and the presence of trains.

Wheeled device: a device for ***active transport*** that has one or more wheels. Including bicycles, wheeled recreational devices (skateboards, roller skates, kick-scooters etc.), wheelchairs (manual and electric), segways, and mobility scooters.

1. Introduction

1.1. Background context

In October 2016, the Transport Accident Investigation Commission (TAIC) added “safety for pedestrians and vehicles using level crossings” to its watch-list of pressing concerns (TAIC 2016). In particular, TAIC noted that the process for assessing risk at pedestrian crossings was not keeping pace with infrastructure changes and increasing patronage on metropolitan passenger trains.

The Australian Level Crossing Assessment Model (ALCAM) is the current model KiwiRail use to identify and quantify the extent of risk at level crossings.

The ALCAM assessment manual recommends that the ALCAM risk score should not be applied in isolation and does not preclude the need for sound engineering judgement. Any risk assessment and treatment also needs to consider other factors, including:

- Collision and near miss history.
- Engineering experience (both rail and road).
- Local knowledge of driver or pedestrian behaviour.
- Social and economic assessment.
- Standards and international best practice.

The design process was being negatively affected by the risk assessment philosophy. Designers were being questioned about the ability of their design plans to mitigate level crossing risk. Risk assessments conducted after the design phase were highlighting deficiencies in proposed safety devices to appropriately mitigate the risks. Subsequent redesigns to account for the risks were then necessary, which were a waste of resource and time.

As a result, a new risk assessment process was developed to assess the increased safety risk impacts of changes to a level crossing and how these might be mitigated. Importantly, the risk assessment process informs the design. The design should then commence after the risk assessment has been completed.

While this risk assessment process pertains to all types of level crossings for different transport modes (i.e. crossings involving pedestrian and / or cycle paths, as well as those involving roads), this guide was developed in conjunction with another guide (Rail Crossing Pedestrian/Cycle Design Guidance) that focuses specifically on the design of level crossings for pedestrian and cycle facilities. A rural road risk assessment process was created to compliment the urban road risk assessment, as there are quite different safety issues pertaining to each speed environment.

1.2. Document status and scope

This document is the first version of guidance on the risk assessment process, for immediate use by road controlling authorities in New Zealand. It has been internally reviewed by the project team and feedback incorporated from an industry stakeholder group (see section 4.2) and the first risk assessment accreditation workshop (June 2017). It is intended that further feedback will be obtained from those who use this guide, and any such feedback would be taken into consideration for future revisions of the guide.

For crossing risk assessments, this guide provides guidance for **all** types of level crossings, including those on the roadway, footpath and on cycle paths or shared paths. Whilst every effort has been made to consider most scenarios that could occur on site, in reality there are likely to be certain situations that do not fit the site specific safety scoring system devised. In such instances the assessing engineer must use their best judgement to devise a score. Such instances are of interest to KiwiRail to consider for use in future revisions of this guide.

This guide focuses on the risk assessment of **crossings** of the rail corridor; in general, it does not consider the planning and design of pedestrian/cycle pathways running ***along*** rail corridors. Any organisation that wishes to cross or use rail land for a cycleway or other shared path needs to obtain an appropriate agreement with KiwiRail. Please see KiwiRail's website for more information. The guide for applicants (KiwiRail 2015) outlines the full process.

1.3. Other relevant information

Throughout this guide, a number of other documents will be referenced, where they produce more detail on specific matters, or background evidence regarding treatments and design features discussed. A list of all these references can be found in Section 4.1.

1.3.1. Relevant NZ legislation

The Railways Act 2005 ("the Act") defines the main obligations of rail operators and other participants in the rail corridor. Its main purpose is to promote the safety of rail operations and to clarify the law relating to management of the railway corridor. Following recent updates, it now also incorporates aspects of the Health and Safety at Work Act 2015.

When considering the safety of rail operations in the Act, a key concept is that of **"reasonably practicable"**, which is defined as:

In this Act, unless the context otherwise requires, reasonably practicable, in relation to a duty to ensure health and safety or to protect property, means that which is, or was, at a particular time, reasonably able to be done in relation to ensuring health and safety or the protection of property, taking into account and weighing up all relevant matters, including—

(a) the likelihood of the hazard or the risk concerned occurring; and

(b) the degree of harm or damage that might result from the hazard or risk; and

(c) what the person concerned knows, or ought reasonably to know, about—

(i) the hazard or risk; and

(ii) ways of eliminating or minimising the risk; and

(d) the availability and suitability of ways to eliminate or minimise the risk; and

(e) after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

The Act also defines "level crossings" to include both where *"a railway line crosses a road on the same level"* or where *"the public is permitted to cross a railway line on the same level"*. The latter can therefore include crossings that are only accessible by people walking or cycling.

Behaviour around level crossings by users is prescribed in Part 9 of the Land Transport (Road User) Rule 2004. The general requirements are that:

- A person approaching or crossing a level crossing must keep a vigilant lookout for any approaching rail vehicle using the railway line.
- A driver *[including a cyclist]* must give way to a rail vehicle using the railway line that is approaching and within 800 m of the level crossing.
- A person must not walk or attempt to walk across a level crossing when there is a risk of that person being involved in a collision with a rail vehicle using the railway line.
- A person must not ride, drive, or attempt to ride or drive a vehicle or animal on or across a level crossing when there is a risk of that vehicle or animal being involved in a collision with a rail vehicle using the railway line.

1.3.2. Discussions with KiwiRail

When planning to install or upgrade an existing level crossing, it is important to make contact with KiwiRail early and often. A Level Crossing Safety Impact Assessment (LCSIA), Deed of Grant and Permit to Enter are ***required*** before any works can take place. KiwiRail will liaise with you about:

- Technical feedback on proposed design treatments (designs must be reviewed and approved by KiwiRail, at the 50%, 85% and 100% stages)
- Required rail corridor clearances (horizontal and vertical)
- Location of any assets or services within the rail corridor (e.g. fibre-optic cables)
- Previous site incidents or concerns identified by KiwiRail personnel
- Future rail corridor developments that need to be considered (e.g. double-tracking)
- Processes required to obtain the necessary approvals
- Opportunities for undertaking trials of new crossing treatments

Designers and road controlling authority staff are also welcome to provide feedback to KiwiRail regarding the application and content of this guide. In particular, feedback should be directed to:

- Leah Murphy - Project Manager, Urban Cycleway Projects (cycleways@kiwirail.co.nz or Leah.Murphy@kiwirail.co.nz)
- Eddie Cook - Project Engineer, Level Crossings (Eddie.Cook@kiwirail.co.nz)

2. Crossing design philosophy

2.1. Safe rail systems

Level crossings in New Zealand should be constructed and managed using the same "safe system" approach that is applied to other transport infrastructure. Namely, it is important to remember that:

- **Humans make mistakes** (but shouldn't be disproportionately punished for them)
- **Humans are vulnerable** to injury (leading to a focus on harm minimisation)
- **A shared responsibility is required** to address safety (incl. rail operators, road controlling authorities, system users, etc.)

Applying this thinking to level crossings involves considering the behavioural aspect of human interactions with crossings and applying appropriate infrastructure (e.g. engineering, vehicle technology) or non-infrastructure (e.g. education, enforcement) treatments to each site.

2.1.1. Risk hierarchy

A useful way of thinking about the options available to deal with a hazard is to work through the "risk hierarchy of controls", listed below. If a control is not practicable to achieve, then the next one in the hierarchy is considered:

- **Elimination:** The most effective treatment is to remove the hazard entirely (although one needs to check that the risk hasn't simply been transferred to a new location or the journey made more difficult)
- **Substitution:** Replacement of the hazard with an alternative that has a lower risk
- **Isolation:** Protection/guarding or relocation of the hazard to separate users from it
- **Engineering controls:** Making changes to the infrastructure or physical environment that reduces the likelihood of the hazard occurring or minimises the severity of the consequences if it does.
- **Administrative controls:** Policies, instructions and signs to inform users of the hazard and the expected behaviours
- **Personal protective equipment:** Clothing and other gear that provides protection for the user

Typically, those controls higher up the hierarchy are more effective and require less supervision or widespread participation by all parties.

2.1.2. Frequency versus severity

Normal risk assessment procedures for a hazardous event consider both the frequency (likelihood of an event occurring) and severity (the consequences if an event occurs), with risk being a product of both of these. In the case of collisions with trains, the consequences are typically very severe (serious injury, if not fatal) and there appears to be relatively little that can practically be done to reduce this (e.g. reduce speeds of trains). Therefore, much of the discussion in this guide centres on reducing the ***frequency*** of such collisions.

2.2. New and existing crossings

Development of level crossings in New Zealand will require differing philosophies, depending on whether they are existing or new crossings; these scenarios are discussed below. New risk assessment processes, described in Section 3, will help to inform the choice of different treatment options.

Figure 4 summarises the general process for implementing construction or modifications at new and existing crossing sites.

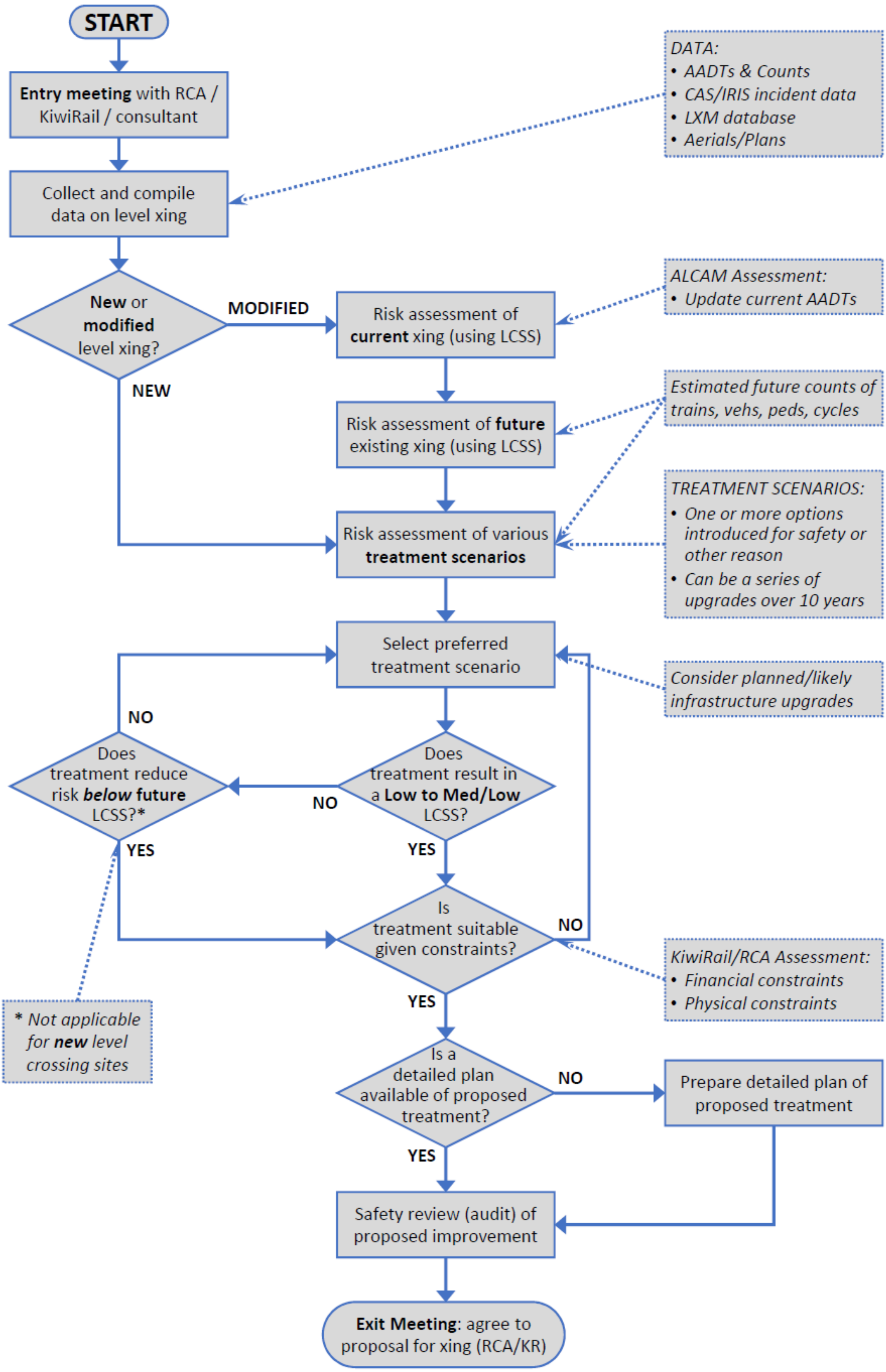

Figure 4: process for implementing new and modified existing level crossings

2.2.1. New crossings

In *TCDM Part 9* (NZTA, 2012), the provision of new level crossings is ***strongly discouraged***. Any new crossing ***must*** be designed with a **Low or Medium-Low LCSS risk** from the outset (refer to section 2.2.3 for details of the two criterion) – this may require grade separation. KiwiRail has an application guide and process for new level crossings (KiwiRail 2016c); the final decision about whether new level crossings will be allowed rests with KiwiRail.

KiwiRail's policy is that, generally, a new level crossing cannot be installed across the rail corridor unless an equivalent (or worse) risk level crossing is closed somewhere else. Adding completely new level crossings can only be done under exceptional circumstances, due to the potential for increased crossing risk and maintenance costs otherwise. This is consistent with the general principle to reduce the overall risk of level crossings across the rail network.

2.2.2. Existing crossings

The general principle for modifying an existing level crossing (whether they are directly or indirectly affected i.e. an adjacent new / upgraded facility runs across or parallel to the rail corridor) is that the proposed design / upgrade LCSS value is lower than the (updated) existing LCSS assessment. It is ***desirable*** to achieve a **Low or Medium-Low LCSS risk** where possible. This is the current KiwiRail policy; refer to section 2.2.3 for further discussion.

For existing crossings that already have a high risk (refer to the categorisations in Figure 5), every effort should be made to reduce the crossing risk at the time of any modifications. Ultimately this may require grade separation or crossing closure to mitigate the risk. However, as stated in section 1.3.1 (the Railway Act 2005), while promoting risk reduction it does acknowledge that an upgrade is not required if '*the cost is grossly disproportionate to the risk'.* This may be used to dismiss the need for grade separation or other expensive options at some locations.

In practice, due to their higher train frequencies and vehicle / pedestrian / cycle numbers, most level crossings in the Auckland and Wellington metropolitan service areas would fall into this category.

Existing crossings that have been programmed for upgrades by road or rail authorities also require a LCSIA. The LCSIA informs the design process and calculates the reduction in risk achieved by the upgrade.

2.2.3. LCSIA Criteria

There are two criteria applicable to level crossings, which differ depending on whether the crossing is a new crossing facility or an upgrade to an existing crossing facility.

- **Criteria 1:** the proposed design / upgrade of a crossing to achieve a "Low" or "Medium-Low" level of risk, as determined by the LCSS.
- **Criteria 2:** the proposed design / upgrade of a level crossing to achieve a LCSS lower than the existing LCSS[1].

New proposed facility:

Where a new facility is proposed and no existing ALCAM assessment exists, the new crossing must meet ***Criteria 1***. This will ensure that any new infrastructure constructed over/within the railway corridor is safe for all users and the risk of death or serious injury is low. Where user exposure is high, then it may not be possible to achieve a "low" risk without grade separation.

Existing facility upgrade:

If ***Criteria 1*** cannot be met, the upgraded level crossing must achieve ***Criteria 2***, to ensure the upgraded facility does not increase the level of risk for existing and new users. Achieving ***Criteria 1*** is desirable but not mandatory for an upgrade project.

[1] For every assessment of a change to an existing crossing, an existing LCSS will be produced in order to confirm whether the proposed changes would raise or lower the level crossing safety when compared to the existing scenario. This includes an 'updated existing' ALCAM that factors in the latest AADT volumes of any applicable users and updates the current conditions found on site.

3. Risk assessment

3.1. Introduction to risk assessment

Traditionally, the ALCAM risk model developed in Australia has been the sole method of risk assessment of existing and modified railway level crossings. The ALCAM model has been updated over time and now identifies many of the key risk factors at level crossings. ALCAM attempts to model a complex reality, and hence it does not include every safety issue.

To broaden the assessment, a new process of assessing risk of level crossings has been developed by KiwiRail; this is called the Level Crossing Safety Impact Assessment (LCSIA), which includes a new risk scoring system, the Level Crossing Safety Score (LCSS). This new system looks at three additional data sources associated with crash risk (historical crash and incident data, safety observations made by locomotive engineers and Road Controlling Authority (RCA) engineers, and a more detailed site assessment of the impact of the surrounding transport network and land-use) and brings these together with the ALCAM score.

3.1.1. When is an LCSIA required?

The intention of the LCSIA process is to better understand the crash risk at level crossings and the safety issues that need to be addressed for any ‘change of use’ activity. This process is done to make the crossing safer for all road users, including pedestrian types (e.g. young, elderly, disabled and able-bodied), cyclists, motorcyclists, and drivers of trucks and private motor-vehicles.

‘Change of use’ activities in this context are classified as any activity that changes the risk profile of the level crossing. Some examples of this would include;

- any new development i.e. commercial activity, housing subdivision etc., that would increase vehicle and / or pedestrian volumes over a level crossing.
- any road intersection upgrade in close proximity to the level crossing.
- an upgrade of an existing pedestrian crossing into a new cycleway and/or shared path over the crossing.
- a new (or upgrade to an existing) footpath / shared path / cycleway that runs parallel to the rail corridor and would induce an increased volume of users connecting on and off the facility via any existing road and / or pedestrian crossings.
- the closure of one level crossing which in turn places an increased demand on a nearby existing level crossing.
- an increase in the volume of trains, as a passenger rail network expands.

The above list is not exhaustive and there are likely to be other scenarios whereby KiwiRail requires the applicant to undertake a LCSIA. Please contact KiwiRail to confirm whether or not a project requires a LCSIA.

Local authorities should take careful note of any proposed new developments that could increase user volumes over a nearby level crossing. The local authority should request that a LCSIA is performed on the level crossing using the projected traffic volumes from any Integrated Transport Assessments, submitted with the consent application. This way, if the increase in user volumes for vehicles or pedestrians does trigger the need for a higher form of control at the level crossing, the local authority should request a development contribution to allow them to programme the level crossing for an upgrade.

3.2. Risk assessment methodology

The elements of the LCSIA methodology include:

- Selecting the appropriate team to undertake the assessment.
- An assessment of current conditions at the level crossing (for existing crossings). This requires a site visit to understand the current site conditions and how the surrounding area

interacts with the level crossing. Site conditions are recorded to update some elements of the ALCAM database where necessary.

- Details on the proposed 'change in use' activity to the level crossing, whether they be physical changes or changes in traffic volumes e.g. a new development nearby.
- Conduct a site visit to perform the Site Specific Safety Score (SSSS) element of the LCSS.
- The LCSS is calculated to update the existing crossing conditions and for the proposed design / upgrade.
- Details on safety issues at the existing crossing (including maintenance issues) and proposed design / upgrade.
- A list of improvements / modifications to the proposed design / upgrade is then provided. An LCSS score is then undertaken to assess these further modifications.
- A final recommendation on the necessary changes required at the crossing in order to achieve ***Criteria 1*** or ***Criteria 2*** (refer section 2.2.3).

Further guidance on the type of LCSIA to perform (depending on what phase the applicant's proposal is at) is provided in section 3.5.

3.2.1. Selecting a LCSIA Safety Review Team

The Safety Review Team (SRT) should consist of two people, with at least one of the assessors being a KiwiRail accredited[2] LSCIA person, meaning they are experienced in the following disciplines: road safety, ALCAM[3], or designing for walking and cycling. The SRT must be approved by the KiwiRail Project Engineer for Level Crossings (currently Eddie Cook, 2017). The SRT must have had no involvement with the project prior to the LCSIA.

Separately, any proposed level crossing treatment should also involve consultation with other key stakeholders; refer to the 'Design Guidance for Pedestrian / Cycle Level crossings' for further guidance. Ideally at each site inspection there should also be a Road Controlling Authority Engineer and a KiwiRail representative who is familiar with the crossing location e.g. a signals maintenance engineer. If KiwiRail are able to provide a locomotive engineer to site, then that provides further insight for the SRT to put into the report, highlighting known problems at the crossing location.

KiwiRail held the first LCSIA accreditation course in June 2017, however practitioners will also require ongoing practical assessment work to develop their experience. Less experienced practitioners are also encouraged to take part in a LCSIA as an observer, to help develop the capability within the industry. The accreditation of any practitioner has a two year duration (standard KiwiRail certification period). Recertification processes are yet to be determined and KiwiRail will notify any accredited LCSIA person in advance of any specific requirements to retain accreditation.

KiwiRail plans to hold additional courses, however such timings have yet to be determined.

3.2.2. Existing conditions at the level crossing

The following information ***must*** be provided for the existing site

- Location diagram
- Aerial photo of the current site
- Photos of the site showing the current problems and any key points of interest
- Description of the site layout and roads / intersections/paths in close proximity to level crossing
- Current traffic, pedestrian, cyclist and train volumes.

[2] A list of accredited engineers is available by contacting Eddie Cook (Eddie.Cook@kiwirail.co.nz)

[3] The assessor has an understanding of the ALCAM process and requirements. At this point in time it is not possible that the assessor is also ALCAM accredited.

Applicants are strongly advised to contact their LCSIA assessment team to understand the survey count requirements before collecting data themselves. There is a requirement to understand the demographic of both the pedestrians and cyclists currently using the crossing. This is due to ALCAM being sensitive to the percentage of certain user types i.e. school children, elderly etc. A video survey of the existing site is highly recommended so that these user types can be accurately accounted for. Refer to Appendix A1 for further information.

In relation to the last bullet point, KiwiRail ***require*** that the most current vehicular, pedestrian and cyclist counts for each project are obtained. This will enable a baseline exposure risk to be set for the ALCAM assessments. A great many of the pedestrian counts currently recorded in ALCAM are set at the default number of 100 users, so it is crucial to use an accurate AADT.

Understanding the existing risk of the level crossing is important, as the actual ALCAM risk score might be higher than the one published by the official ALCAM database. This would provide a better opportunity for the proposed crossing to score lower than the existing situation. In some instances, the pedestrian user counts in ALCAM are thought to be too low, hence masking the real risk of the crossing.

3.2.3. Proposed protection measures at a new / upgraded level crossing

The LCSIA informs the design process and recommends what level and type of control devices are required to meet either ***Criteria 1*** or ***Criteria 2***. As well as any additional protection measures that the applicant may consider to further reduce the risk at the crossing. The additional protection measures are not mandatory, and can be defined as 'nice to have' measures.

3.2.4. User survey counts post commissioning

Following the LCSIA process, the applicant is required to conduct applicable road / pedestrian user surveys after the new facility has been opened / commissioned, i.e. a new shared path, a new level crossing, or when a new development (that triggered the 'change in use') has reached 50% occupancy. Surveys for new cycleway / shared path facilities should be captured at the following time periods after the facility has opened; 6 months, 2 years and then every 3 years thereafter. KiwiRail can amend these frequencies at their own discretion, as they may not be applicable in all instances. For further information, refer to section 3.13.

This is required to confirm how accurate the initial predicted user volumes were. In some instances, the new users attracted to the level crossing may be increasing at a faster growth rate than was predicted. This has been the case for one of the Major Cycle Routes in Christchurch, where user numbers in the short time post commissioning exceeded five-year projections.

The updated user count will also confirm that the correct form of control was installed, particularly where the ALCAM risk score was near a threshold that would trigger a change in the form of control required.

3.3. Components of the Level Crossing Safety Score

The risk of pedestrian and motor vehicle crashes are assessed using the Level Crossing Safety Score (LCSS). The maximum score (60 points) signifies a very unsafe crossing. This score consists of the following components:

- ALCAM Score (30 points),
- Crash and incident history (10 points),
- A site-specific safety score (SSSS) (10 points), and;
- Locomotive and RCA Engineers' risk assessment (10 points).

Further details on these components are provided within this section. Separate assessments are undertaken for the individual vehicle and pedestrian crossings. Based on these scores, the crossing is placed into risk bands as shown in Figure 5, which correspond to a risk description ranging from HIGH to LOW.

A desktop LCSS is available for most level crossings. As an interim approach, KiwiRail is developing a desktop LCSS for most, if not all, level crossings in New Zealand using an abbreviated scoring system. However, **it is generally expected that future LCSS assessments will involve on-site assessment** for accurate data collection and to understand local conditions, with desktop assessments only used in exceptional circumstances. If a practitioner is undertaking a desktop LCSS, the site-specific safety score is completed via aerials and Google Streetview (if available). For new crossings and modified level crossings the LCSS ***must*** involve a site visit.

The following sections explain how the individual components which make up the overall LCSS are derived, with more detail provided in Appendix A2. The overall ranking of the crossing is based on the sum of the four components.

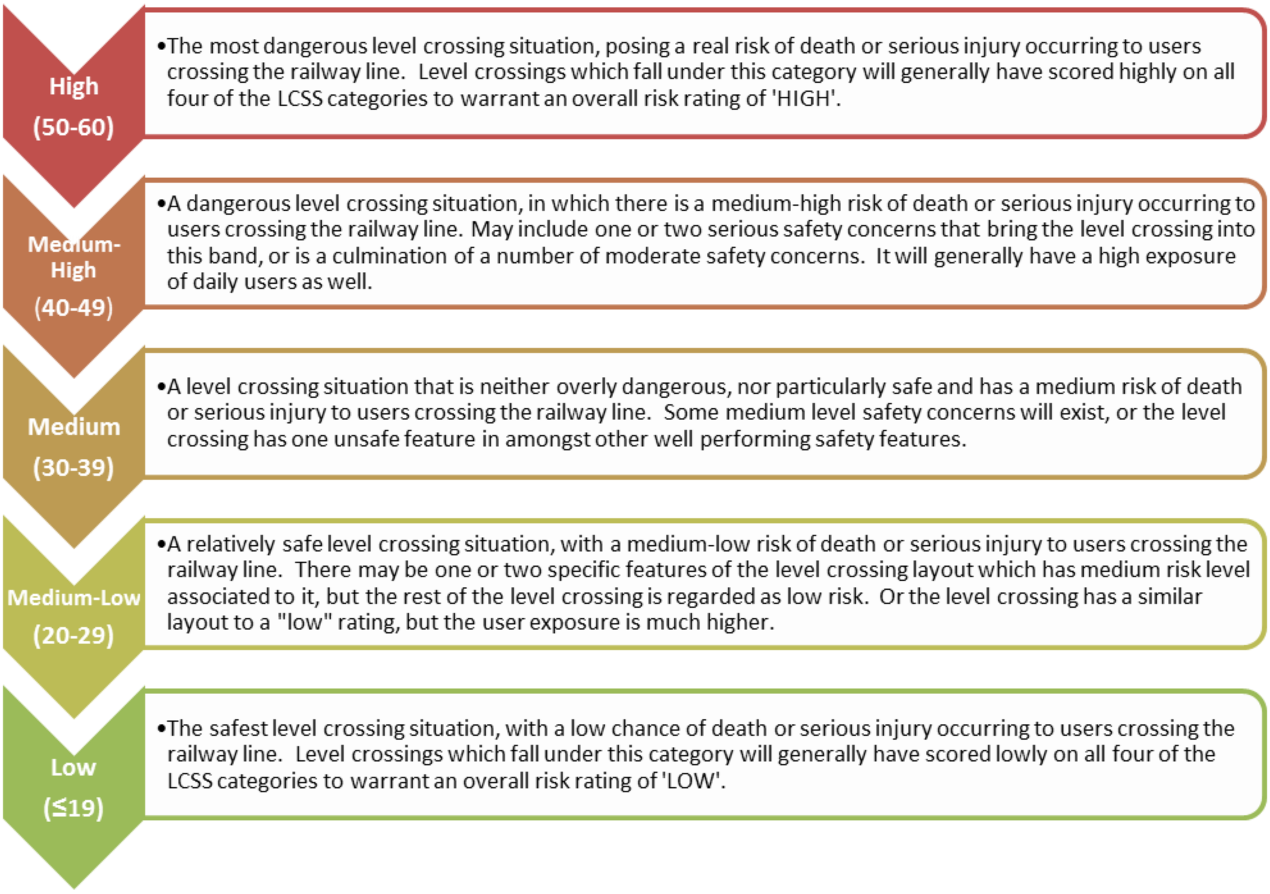

Figure 5: Level crossing safety score risk bands

3.3.1. ALCAM Score (30 points)

The ALCAM risk score and risk band come from the LXM (Level Crossing Management System) database, which includes scores and risk bands for all public and most private level crossings in Australia and New Zealand. There are five ALCAM risk bands and the associated LCSS scores are presented in Table 1. As the ALCAM scoring systems for road and pedestrian crossings are very different, there is a separate graduated scoring system for each. These systems are outlined in Appendix A4.

Table 1: ALCAM likelihood risk bands

ALCAM Jurisdiction Risk Band	LCSS (points)
High	**25-30**
Medium High	**19-24**
Medium	**13-18**
Medium Low	**7-12**
Low	**1-6**

The "**Jurisdiction**" risk band results presented in LXM, only reflect the risk for the level crossings in the New Zealand jurisdiction. The "**Global**" risk band specified in LXM is for all level crossings across New Zealand and Australia, and should not be used for scoring purposes.

It must also be noted that the risk band must be applied to "**All Control Classes**", so that risk band stated is one that has been generated by comparing against all level crossings of the same type (i.e. road or pedestrian). The ALCAM risk band of the "**Same Control Class**" should be ignored.

Separate assessments are made for roadway (vehicle) and pedestrian / cycle crossings. Many vehicle crossing locations have one or more adjoining pedestrian/cycle crossings. There are also instances of isolated pedestrian/cycle-only crossings, particularly at train station locations in the urban commuter rail network and parts of the NZ Cycle Trail network. Note that ALCAM does not currently refer explicitly to the numbers of cyclists in the calculations; cyclists are simply counted with the vehicles or pedestrians (or partly both) depending on how the cyclist crosses the rail corridor.

ALCAM risk scores for roadway crossings are calculated by using equation 1 (reflecting the expected average number of fatalities per year):

$$\textbf{ALCAM Risk Score} = \text{Infrastructure Factor} \times \text{Exposure Factor} \times \text{Consequence Factor}$$

Equation 1: Roadway ALCAM risk score

ALCAM risk scores for pedestrian crossings are calculated by using equation 2[4]:

$$\textbf{ALCAM Risk Score} = \text{Infrastructure Factor} \times \text{Exposure Factor}$$

Equation 2: Pedestrian ALCAM risk score

The vehicle ALCAM score should be updated using the most recent vehicular, pedestrian, cyclist and train counts. Any site characteristics observed that may have changed since the initial ALCAM assessment was completed, can be used to update the site characteristics as they currently stand. The updated ALCAM score and risk band should then be used as the new baseline condition, as some of the original assessments were undertaken as far back as 2008.

Where no off-road cycle facility (or shared path) is provided across the railway line, generally cyclists are considered vehicles and subject to the same form of control as motor vehicles (e.g. barrier arms across the roadway). In places where cyclists may not be on the roadway (e.g. where there is a shared path, or cyclists cut onto the footpath to avoid the barrier arms across the roadway) then they should also be assessed in the pedestrian crossing evaluation.

[4] The assumption is that all pedestrian incidents are fatal, hence the consequence factor is set at 1.0. However this is not strictly correct, based on actual collision data.

The pedestrian ALCAM risk score and risk band should also be updated with the most recent pedestrian and train volumes. This is particularly important when an assumed value (e.g. an assumed value of 100 pedestrians per day) has previously been used previously. As with the roadway assessment, any site characteristics should be updated and the updated score used as the new baseline score and risk band. Any pedestrian / cyclist surveys will be invaluable to confirm the correct proportions of user types using the crossing.

Where a cycle path or shared path is provided, cyclists should be included with pedestrians as ALCAM does not currently distinguish between the two. However, the analyst should be aware that cyclists can be exposed to greater risks due to their higher travel speeds, which requires longer sight distances (refer to section 4 of the 'Rail Crossing Pedestrian / Cycle Design Guidance) and means they cannot stop or change direction as quickly as a pedestrian. Also, like other wheeled devices, cycle wheels can get caught in wide / deep flange gaps (or dependant on the crossing angle) or riders may slip on the rail tracks, a risk unique to two wheeled devices.

In order to check the future risk of the level crossing based on projected user volumes, a fourth ALCAM assessment should be undertaken (changes based on the modified score) by adjusting the road user volume for the applicable ALCAM assessment. If the ALCAM risk score / band increases, then the SRT will apply higher levels of control in order to reduce the risk to an acceptable level. Rather than conducting a full LCSS on the future user volumes, the SRT can conclude in their report the impact the future user volumes have on the ALCAM risk and whether that would change the form of control necessary to mitigate the increased risk.

Improvements to the physical control type of a level crossing site will generally have a greater impact at reducing the ALCAM risk score than other measures. For a pedestrian crossing these are usually automatic gates (including emergency egress), and flashing lights & bells. As opposed to signage, lighting or adjacent controls (i.e. road adjacent road). For a road crossing this means the installation of half arm barriers. Note that ALCAM attributes negligible benefit in having half arm barriers with duplicated lights (although any flashing lights installed for the far-side adjacent pedestrian crossing approach, may be applicable to the road crossing as well).

In any regard, it is up to the assessor to become familiar with the additional forms of control, signage and delineation, that lower the ALCAM risk score at a particular crossing type. This can be tested at each assessment, by selecting different items to see their effect at reducing the ALCAM risk score. It does not take very long to do such 'checks' in the 'Proposals mode' of LXM.

Assessors will require a login to access the LXM model to calculate risk bands and risk scores for change in use conditions. Accredited LCSIA Assessors will be supplied with a login profile by KiwiRail.

KiwiRail can provide individual LXM training sessions for accredited users upon request. The training would show how a 'change of use' condition can be modelled in LXM 'Proposals' mode to calculate the effect on the ALCAM risk score and risk bands. This training is not extensive and would require approximately two hours of participation.

3.3.2. Crash and incident history analysis (10 points)

This score is based on the number of crashes in the New Zealand CAS system, and KiwiRAP collective risk score, as well as the number of crashes and incidents reported in the KiwiRail IRIS database. If the KiwiRAP score is not available in SafetyNET or the urban KiwiRAP websites, the SRT can undertake their own calculation of the collective and personal risk of the preceding five years, otherwise it can be excluded and element scored based on CAS and IRIS data alone.

Please note that if there is a train vs vehicle / pedestrian fatal crash at the crossing, 10/10 points would be automatically scored for the Crash and Incident history element, regardless of the sum of the CAS, IRIS and KiwiRAP scores.

The scoring system for this element is shown in Table 2;

Table 2: Crash and incident scoring process

Scenario	IRIS Data	CAS Data	KiwiRAP Data	Total score
Shared path / pedestrian crossing	100% weighting (1 - 10 scale)	N/A	N/A	100% of the IRIS score
Road Score (when KiwiRAP score is available / calculated)	50% weighting (1 - 10 scale)	25% weighting (1 - 5 scale)	25% weighting (1 - 5 scale)	Sum the totals out of 20 and divide by 2 for score out of 10.
Road score (when KiwiRAP data is not available)	67% weighting (1 - 10 scale)	33% weighting (1 - 5 scale)	N/A	Sum the totals out of 15 and divide by 1.5 for a score out of 10

If the total score results in a decimal value, this should be rounded up to the nearest whole number.

- **CAS scoring scale** (10-year crash history):

  The CAS crashes must relate to a crash with a train or a crash with the nearby rail infrastructure. Crashes that occur at the level crossing but are not caused by interaction with a train or rail infrastructure must be excluded i.e. rear-end crashes.

  The points scored are not cumulative, i.e. two non-DSi crashes and one serious crash does not equate to 2 + 4 = 6 points. The most severe injury takes precedent.

  - 0 POINTS: no crashes,
  - 1 POINT: one non-DSi crash,
  - 2 POINTS: two non-DSi crashes,
  - 3 POINTS: three non-DSi crashes,
  - 4 POINTS: four non-DSi crashes; **or** one serious injury crash.
  - 5 POINTS: five or more non-DSi crashes; **or** two (or more) serious injury crashes; **or** one serious injury crash plus >3 non-DSi crashes.

- **IRIS scoring scale**: (10 year incident history)

  One point is scored for each IRIS incident that has occurred in the past ten years. Incidents must relate to the level crossing user type, i.e. pedestrian IRIS incidents do not count towards the road score. Any site that has more than ten incidents will be scored a 10. Any recorded crashes are also treated as an incident count. IRIS incidents relating to trespassers or self-harm should be excluded from the IRIS scoring (if any are included, the SRT should let KiwiRail know).

- **KiwiRAP scale**:

  The KiwiRAP collective risk band is used for this score. Ideally the Collective Risk score calculated for a 500 m section of road is adopted, where this is not available, the Collective Risk band as presented by SafetyNET or Urban KiwiRAP is adopted.

  - 1 POINT: for a low, medium-low or medium collective risk rating on the road the level crossing is situated on,

    or,

    for a low, medium-low or medium collective risk rating on a road that intersects in close proximity to the crossing, i.e. a short-stacking level crossing road may not have a KiwiRAP score, however the main road forming the intersection does.
  - 2 POINTS: for a medium-high collective risk on a road which intersects in close proximity to the crossing, e.g. a short stacking intersection that intersects with a state highway.

- 3 POINTS: for a high collective risk on a road which intersects in close proximity to the crossing.
- 4 POINTS: for a medium-high collective risk rating on the road that the level crossing is situated on.
- 5 POINTS: for a high collective risk rating on the road that the level crossing situated on.

As train versus vehicle / pedestrian crashes are relatively rare events (when compared to other crash types), there is often a lack of crash data available in CAS. It is even less likely for a train versus pedestrian / cycle crash to be recorded. However, the SRT should take note of all crashes at the location, in case any were induced by short stacking or queuing vehicles impacting other vehicles as they tried to clear the tracks for an oncoming train.

The IRIS data is most likely to yield more results on most other occasions than CAS (due to capturing incidents not involving a motor vehicle), and therefore will likely be the stronger guide on the score for this category.

Every quarter KiwiRail will send out (to accredited practitioners) the most up to date IRIS database results to then apply to a LCSIA report.

3.3.3. Site-specific safety score (SSSS) (10 points)

This site-based score aims to analyse elements of the layout that are not well covered or missing from the ALCAM risk rating. In the future, desktop assessment scores will be developed for all crossings in New Zealand, based on aerial photos and KiwiRAP data. However, even if a desktop score is available, a site-based assessment ***must*** be undertaken for each level crossing.

Details of the crossing scoring schemes can be found in Appendices A2.3.1, A2.3.2 and A3. There are scoring schemes for urban and peri-urban settings, where speed limits are posted at 70 km/h and below. A scoring scheme for rural road level crossings is also provided (speed limits > 70 km/h). The rural SSSS is not considered to specifically relate to cycleway facilities, it has been created with higher speed roads in mind.

It is acknowledged, that there are some subjective ratings required within the SSSS, with some scoring narratives for individual sections enabling different interpretations by different assessors. The reason why some of these were left more open to interpretation was that to use finite numbers, may imply a certain amount of accuracy / certainty that is otherwise not known (when comparing all crossings / situations nationally). Therefore it has been left to the SRT to determine the appropriate score. The SRT should describe the rationale for their risk ratings carefully and what information was used to establish the rating of each element in the SSSS.

Where other scoring narratives do have finite numbers or percentages, these have been created purely in order to create a point of difference between one score and the next for a particular category.

The SSSS for each individual crossing is assessed out of 35 points, then divided by 3.5 in order to get the total score out of 10 that is used in the final LCSS. Any scores (after the division by 3.5) that are not whole numbers, are simply ***rounded up*** to the nearest whole number;

(i.e. 19/3.5 = 5.4 ∴ 6/10).

If the SRT is not satisfied that the calculated SSSS adequately portrays the risk of the level crossing (i.e. over or understates the risk), they are able to provide a ‘Modified’ total score. When the total score is modified, this should be peer reviewed by an external assessor (at the expense of the applicant) to ensure that the risk change is warranted and not a case of trying to manipulate a final LCSS score that meets ***Criteria 1*** or ***Criteria 2***.

3.3.4. Locomotive and RCA engineers' risk assessment (10 points)

This score reflects the level of risk that locomotive engineers (train drivers) and RCA engineers give to each railway crossing compared with other crossings they encounter regularly. Where possible this relative risk score should be determined by a number of different practitioners involved with the crossing. In the case of locomotive engineers this may be the opinion of several drivers that use each line. In the case of the RCA engineers, they should also consider the experience of the public (including drivers, pedestrians and cyclists), either through surveys or through an interest group representative (e.g. AA for motor vehicles and CAN for cyclists). It is expected that for each council (and then each region) a ranking of the worst crossings for vehicles and pedestrians will be developed. This will be refined over time. The worst and best sites in each area will be given a high score and low score respectively.

In the first instance, every attempt should be made to contact a KiwiRail representative to assist with getting the locomotive engineers score. If for any reason this is not possible, the locomotive engineers' ranking can be based on the findings of the TrackSAFE (2014) report 'Worst Level Crossing Survey Report', which surveyed the locomotive engineers from KiwiRail, Tranz Metro and Transdev Auckland to identify which level crossings they perceived to be the worst in their region. The survey had a 10% response rate, with over 100 responses received. This survey will be repeated at least every five years. Consideration needs to be given to any crossings that have been upgraded since the report, as this is likely to change the ranking. The SRT should not rely on this report to complete the Locomotive Engineer scoring and are strongly encouraged to engage with KiwiRail representatives.

A minimum of three weeks' notice should be provided to KiwiRail and Road Controlling Authority personnel for attendance at a site specific visit to the level crossing.

KiwiRail are undertaking a similar study of RCA engineers to establish a ranking. Once this ranking is available for a region it is to be used alongside the locomotive engineers' ranking, to better assist the scoring of this element.

The SRT should request the existing ranking score from each engineer, as well as their scoring based on the proposed changes at the site. If the SRT has further modifications to the proposed design that are significant and would warrant further reassessment of ranking by the two engineers, then this should be requested as well. If any modifications are minor in nature, then further correspondence is probably not required if it is unlikely to affect scoring.

If the ranking scores provided by the two engineers are of contrasting views (> 2 points difference for existing or proposed), the SRT should enquire with the two parties (if possible) as to why this is the case and include in the final report. Typically a lifting in the type / quality of the control at a site, will tend to drop 2 points from an engineer's score (based on experience to date).

If for any reason the SRT is unable to get an existing score from one of the two engineers, the score provided by the one engineer should be doubled, rather than adopting any type of 'default score' for the other engineer. Where correspondence and scoring is not forthcoming for the proposed and modified scores, the SRT can make assumptions on how much the changes could reduce the risk perception of each party. The LCSIA report should clearly state that the risk score changes for one or both of the engineers has been assumed by the SRT. A drop in risk score between phases of analysis, should generally not be more than 2 points, most commonly 1 point.

This is a reminder to ensure that the assessment team asks the attending RCA Engineer for their score at the site visit and follow up later if additional scores are required. If a Locomotive Engineer is available to attend site, again ensure their scores are captured and also ask questions about any issues they come across relating to the site. Such insights can be used to inform other aspects of the LCSIA and possibly raise other problems that had not been previously considered.

3.4. LCSS results

The overall ranking of the existing pedestrian crossing(s) is then calculated by adding together all four risk rating elements. Table 3 provides an example of the combined LCSS score table.

Table 3: Overall LCSS results

Assessed Item	Score	Comments
ALCAM score	/ 30	
Crash and incident history score	/ 10	
Site specific safety score	/ 10	
Locomotive / RCA engineer risk score	/ 10	
LCSS RISK SCORE	**/ 60**	**……. LCSS risk band rating**

3.5. Different LCSIA report scenarios

There are a few different 'change in use' scenarios that may arise, when an accredited LCSIA assessor has been engaged to perform a LCSIA. The subsequent sections explain what approach the SRT should follow when writing their LCSIA report.

In all instances, the applicant must provide the LCSIA SRT with the existing user volumes and types, the estimated volume of new users attracted to the facility shortly after opening, and the expected growth rate for the ten year period post opening. For further information on pedestrian and cycle counts, refer to Appendix A1.

3.5.1. *'Change in use' proposal – pre design phase*

In this scenario the applicant proposes a new facility (i.e. shared path, cycleway etc.) and has not started the design phase. Instead the applicant may have a preferred route that will cross or run adjacent to the rail corridor. The LCSIA should comprise of the following format;

- **Updated Existing** – an update of the conditions found at site and user volumes / proportions,
- **Proposed Design 1** – the SRT applies the applicable treatments in order to achieve ***Criteria 2*** and the assessment must include the initial increase of new users attracted to the upgraded facility.
- **Proposed Design 2** – the SRT applies the applicable treatments to attempt to achieve ***Criteria 1***, to make the crossing as safe as possible (i.e. the 'Rolls Royce' option short of grade separation). For a pedestrian crossing this is likely to mean automatic gates (including emergency egress with latch), if they were not required for ***Proposed Design 1***. If this was the case, then it is possible that ***Proposed Design 2*** is not required. The assessment must also include the initial increase of new users attracted to the upgraded facility.
- **Future Score** – this assessment is based on the proposed design which achieves ***Criteria 2*** *(which in most occasions will be* ***Proposed Design 1)***, with the SRT applying the applicable growth factor to user volumes (that includes the initial new users) over the 10 year period post opening. The purpose of this is to outline to KiwiRail what the possible future implications are of accepting the design which achieves Criteria 2.

Conducting an LCSIA at this phase of design is the preferred approach for KiwiRail. The intention of the LCSIA was always to inform the design phase of the necessary levels of control in order to meet ***Criteria 1*** or ***Criteria 2***.

3.5.2. ‘Change in use’ proposal –design phase

In this scenario the applicant proposes a new facility (i.e. shared path, cycleway etc.) and has a design that the SRT can critique, instead of informing the design upfront (as in the pre-design phase). The LCSIA should comprise of the following format;

- **Updated Existing** – an update of the conditions found at site and user volumes / proportions.
- **Proposed Design –** the SRT applies the treatments strictly as proposed by the applicant’s design. The assessment must include the initial increase of new users attracted to the upgraded facility.
- **SRT Modified** – the SRT applies additional treatments not included in the ***Proposed Design***, in order to achieve ***Criteria 2***, (if not achieved by the ***Proposed Design)***. The assessment must also include the initial increase of new users attracted to the upgraded facility. If the ***Proposed Design*** met ***Criteria 2***, the number of changes made by the SRT may only be minimal. The SRT should include a section in the report which outlines any safety concerns the SRT has with the ***Proposed Design***.
- **Future Score –** this assessment is based on ***SRT Modified***, with the SRT applying the applicable growth factor to user volumes (that includes the initial new users) over the 10 year period post opening.

3.5.3. New crossing facility

In this scenario the applicant proposes a brand new crossing facility (i.e. shared path, cycleway etc.) where no crossing currently exists. The LCSIA should comprise of the following format;

- **Updated Existing –** an update of the conditions found at site and user volumes / proportions.
- **Proposed Design –** the SRT applies the necessary treatments in order to achieve ***Criteria 1***. The assessment must also include the initial increase of new users attracted to the upgraded facility.
- **Future Score –** this assessment is based on ***Proposed Design***, with the SRT applying the applicable growth factor to user volumes (that includes the initial new users) over the 10 year period post opening.

3.6. Predicting values of different LCSS elements for a ‘change in use’ activity

It is accepted that scoring the ‘Crash and Incident history’ in the LCSS for the proposed ‘change in use’ activity is difficult, as it is based on historical data. The SRT has to use their best engineering judgement to assess the effect that the ‘change in use’ has on ‘Crash and Incident history’, whether that is positive or negative. Whilst this is subjective, a preference for a conservative reduction in risk advised (1 or 2 points out of 10), unless substantial improvements are made (e.g. automatic gates a pedestrian crossing). Commentary on how the SRT applied the scores is important to help others reading the report understand how the new scores were created.

3.7. Determining required safety improvements

The same LCSS process used to score the existing crossing, is then used to assess the various safety improvement options. Various upgrade options can be modelled in LXM to calculate the percentage reduction in risk of each option. The aim is to identify an upgrade option that meets the relevant ***Criteria 1*** or ***Criteria 2*** requirement for that project. Additional safety treatments may be necessary in order to meet the two criteria mentioned in section 2.2.3.

In many cases, the upgrade option will also include other changes not directly associated with improving the safety of the level crossing, e.g. a major upgrade to the adjoining intersection, or the provision of a new on-road cycle path over the railway line. These changes may impact on the safety of the level crossing and need to be evaluated alongside the safety changes to the level crossing itself (e.g. installation of barrier arms). Overall, the intention should still be to reduce the safety risk of any crossing so that it meets the necessary criteria.

Appendix A2 provides an example (Ferry Road, Marlborough) of how the LCSS process is applied.

3.8. General safety review

In a similar approach to a safety audit, the LCSIA safety review team are to identify any safety issues at the current crossing, relating to the interaction with the rail infrastructure. At this stage, the LCSIA safety review is not considered to be a replacement for formal safety audit. But in the future, it may be altered to meet all the requirements of a safety audit. A design safety audit should take place prior to construction, with the safety auditors referring to the safety issues raised in the LCSIA and consideration given as to whether the designers have sufficiently addressed the LCSIA issues.

The general safety review is to include all safety issues ranging from missing or damaged signs through to concerns with the layout of the level crossing and surrounding road. For example, queues of vehicles waiting to turn right into a major access or side-road that extend across the level crossing may not have been identified through the ALCAM site inspection process, but have significant safety implications on the crossing. Any maintenance issues will be communicated to KiwiRail and the relevant RCA within the LCSIA report. It should be noted whether a new design is likely to address each issue. More substantial issues need to be discussed with KiwiRail, following the site visit.

All significant safety issues identified by the SRT during the site visit, must be included as required suggestions to the upgrade project, in order to meet ***Criteria 1*** or ***Criteria 2***. Significant issues include vegetation blocking view lines, poor level crossing surfacing, large flange gaps, incorrect or missing signage, etc. Should the KiwiRail Level Crossing Safety Manager agree to do otherwise, such exceptions ***must*** be clearly documented with the adequate justification. If the applicant has any identified safety issues that cannot be addressed by the design, the reasons as to why this is the case must be clearly stated. The reasons for unaddressed issues will also need to be discussed with KiwiRail and the relevant Road Controlling Authority.

When a proposed layout is recommended, this should also be assessed during the site visit. Where plans are available the proposed layout(s) can be assessed. In addition to identifying safety issues, the SRT can also suggest possible changes to the design to address these issues.

Any recommended changes to the proposed design should be rated in the same manner as in a safety audit, along with a decision-tracking process whereby the designer, safety engineer, the RCA and KiwiRail can agree on whether or not the change should be made.

3.9. LCSIA Executive Summary Format

KiwiRail desire a consistent executive summary format for all LCSIA reports. To enable this, a template example is provided in Appendix A5 that accredited LCSIA assessors should adopt. The format can be adjusted to fit the style of a LCSIA assessor's company and minor changes to the wording is permitted. But the consistent flow of the format should be adhered to.

Suggestions of changes can be made to KiwiRail and may be adopted for future. Any changes would be released within an updated guidance document or communicated directly to accredited LCSIA assessors.

3.10. Recommendation on approving new / upgraded crossings

The SRT will conclude their report by stating the necessary form of control required, in order to keep the safety risk at acceptable levels required to achieve the relevant ***Criteria 1*** or ***Criteria 2***. The SRT will also provide their final discussion on the additional recommended treatments that must occur (mandatory) and those which are ‘nice to have’ treatments.

3.11. Post LCSIA and updating databases

When the LCSIA is complete and is ready to submit to KiwiRail for review, the assessor must also submit a spreadsheet that provides a snapshot of data from the LCSIA report to update the LCSIA database[5] and updates that should be included in LXM. Accredited LCSIA assessors will be supplied with the standard spreadsheet format that must be submitted.

3.11.1. LCSIA database update

The LCSIA database is a web based tool, which provides data on every public road and pedestrian crossing in New Zealand. It includes any relevant ALCAM scores and information from all previously completed LCSIA reports. The applicable LCSIA values are taken from the spreadsheet submitted to KiwiRail by assessor alongside the LCSIA report.

3.11.1. LXM database update

Within the LCSIA process, one of the four elements is the ALCAM risk score. To understand the most current existing ALCAM risk (vs. the published ALCAM risk score in LXM), the assessor will create an updated existing Proposal in LXM. The need to create such a proposal is mainly due to the age of some of the original ALCAM assessments which can be older than 10 years and the requirement to include the current user volumes taken from a recent survey. There can also be some changes to the physical elements of the crossing and train volumes that also need to be included.

Some of the information used to create the updated existing score in LXM, should then be utilised to update the real LXM database so that the real risk is captured in the system. While it is no replacement for an updated ALCAM assessment of the site, it will help increase the number of sites in LXM that have up to date information. This is particularly true for the volume of pedestrians at a crossing and the proportion of users, both of which have a very large bearing on the final ALCAM risk score. As more and more ALCAM risk scores are updated, the thresholds of the risk bands will alter, as LXM keeps a certain percentage of crossings within each risk band. The following information should be provided at the end of the LCSIA report in a section titled ‘LXM Update’;

- Daily user volumes over the crossing, as well as the peak hour value,
- The proportion of school children, elderly, wheeled pedestrians, or disabled pedestrians using the crossing based on the survey counts,
- Any characteristics of the crossing that appear to be incorrect, i.e. LXM says there is no adjacent road activity for a pedestrian crossing, which is clearly wrong as the pedestrian crossing is adjacent to a road.
- An update to the form of control, i.e. there are ‘Look for Trains’ signs and delineation marking on a pedestrian crossing which has never been uploaded into LXM.

Sometimes the age of the initial ALCAM assessment is so old that in the time since the assessment, additional characteristics or data has been included in the ALCAM process, so the crossing in LXM never had that particular element assessed and has received a default value. This is not always apparent to those conducting a proposal in LXM, so some changes can be suggested for change if the SRT is unsure.

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[5] At the time of print of this guide, the LCSIA database was still in development. None-the-less, spreadsheets must still be submitted so that the database is up to date upon release.

3.12. Safety audit of a level crossing project

KiwiRail require that any safety audit of a proposed project that includes interaction with a level crossing, must include at least one accredited LCSIA assessor that has had no prior involvement with the project. This is required whether the safety audit is at the design stage or post construction. The same accredited LCSIA assessor can be used throughout the various safety audit phases of a project.

3.13. Review periods of upgraded/new crossing facilities

The applicant must account for follow up user volume surveys, to capture whether any predicted user volumes are increasing such that a change in control type is required. For shared path / cycleway projects, sometimes the demand of a new facility exceeds the growth rate predicted in the LCSIA report. Therefore if the LCSS future score assessment was predicting that a higher level of control was required to account for the future growth and this estimated volume was going to be achieved sooner than expected, then the upgrade to the higher level of control must be bought forward. Subsequently, if the growth rate is slower, any change in control can be postponed till the 'trigger' volume is met.

For this reason the applicant must complete a new user survey (complete with proportions of user types) six months after the opening of the facility, as a quality check on the predicted volumes. A further survey is required two years after opening to review whether a change in control is required. Subsequent surveys and reviews must be completed in three yearly cycles thereafter. KiwiRail can amend these frequencies at their own discretion, as they may not be applicable in all instances.

4. References

4.1. Cited references

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4.2. Acknowledgments

We would like to acknowledge the assistance of the following stakeholders involved via a reference group:

- Representatives from the Active Modes Infrastructure Group (Christchurch, Auckland, Whangarei, Palmerston North)
- Representative from rail operator (Transdev)
- Representatives from walking/cycling/mobility sectors (Cycle Action Network, Living Streets Aotearoa, Blind Foundation, CCS Disability Action)
- Christchurch City Council, Auckland Transport and KiwiRail for the supply of various level crossing plans
- Staff from the PELOTON Major Cycleway design consortium, working on behalf of Christchurch City Council
- Staff from KiwiRail and the NZ Transport Agency

Appendices

A1 Pedestrian and cycle user count surveys

Pedestrian and cycle user count surveys that are required to update the existing daily pedestrian and/or vehicle counts in ALCAM, as required for an LCSIA. The data collected is also used to score some elements of the Site Specific Safety Score (SSSS). The use of video analysis at a crossing is strongly encouraged to identify the demographic of each user type and help identify any unsafe crossing behaviour by pedestrians, cycles and motorists.

While there is not a specific ALCAM model for cycles, they must be included within the pedestrian or vehicle models, depending on the type of facilities provided. Where cyclists cross the level crossing on a separated cycle path, shared path or footpath, their volume should be added to the pedestrian volume for that specific crossing. Where there is no facility or a marked on-road cycle lane exists, cyclists are included in the vehicle count. There are some situations where cyclists may illegally use the footpath, rather than the road. This may be picked up from video analysis, or expected when the pedestrian crossing has a lower level of constraint than the vehicle crossing (e.g. a half-arm barrier for the vehicle crossing and no control on pedestrian crossing). In that situation, a sensitivity test should be undertaken on the impact on the pedestrians ALCAM score of cyclists using the pedestrian crossings. It is useful to collect information on any current illegal behaviour of cyclists (and pedestrians) at a crossing for use in the LCSIA report.

A1.1 Collecting pedestrian and cycle volumes

When collecting pedestrian and cycle count data it is important to understand how pedestrian and cyclist flows vary across a day and based on the weather. Daily pedestrian and cycle counts in urban areas often show three peak periods, morning peak (typically 7:00am to 9:00am), school afternoon peak (3:00pm to 4:00pm) and commuter afternoon peak (4:30pm to 6:30pm). In some commercial areas, there is also often a noticeable mid-day / lunch-time peak. Hence it is important to collect counts that cover the various peak periods. Sites near educational facilities must be surveyed during term time, to identify the maximum volumes likely. Pedestrian and cycle daily counts can also vary considerably due to weather, especially due to rainfall. Hence counts should only be collected on fine days, with no rain forecast.

Given the daily variation in such user counts, it is preferred that counts are collected over two days for urban locations, from 7:00am through to 7:00pm. The minimum requirement is that one full day survey is conducted. Pedestrian and cycle counts should be collected at all sites, even where cycle numbers are low. It is also important to record observations of pedestrians that are distracted (by headphones and mobile phones), impaired (e.g. visually, mobility and intoxicated) and those using wheelchairs, mobility scooters and small wheeled devices, including skateboards and roller blades. Just a note is sufficient rather than detailed counts. This ‘type’ and ‘behaviour’ information will be utilised in the site-specific safety score and also may help inform the design. Also whether a cyclist is a school aged child or not.

The origins and destinations of cyclists and pedestrians at the level crossing should also be collected where a shared path or cycleway runs parallel to a railway line, or there are multiple approach paths / roads. The percentage splits of the user movements over the crossing, can then be applied to the future user forecasts. It is also important to note whether cyclists travel over the level crossing via the roadway or a pedestrian crossing (which in some cases will be a shared path or cycle path, but most of the time will be a footpath only). As a proportion of the existing on-road cyclists might be expected to transfer onto the new crossing facility in the future, rather than remain on road (as they look for more protection, as the road width can sometimes decrease over a level crossing).

For rural towns where the pedestrian and cyclist volumes are fewer than 50 a day, no count is required.

These counts can then be scaled up to daily estimates using the procedure in the cycle planning guide (NZTA 2016) and in a new estimation tool that has been developed by KiwiRail for estimating daily pedestrian counts. These estimated pedestrian and cycle daily counts will be used along with the most recent vehicle volume counts to update exposure data for the pedestrian and vehicle models in ALCAM. At this stage, it should be assumed that a cycle is equivalent to a pedestrian in the pedestrian model.

A1.2 User types to collect

The ALCAM pedestrian model is very sensitive to the proportion of certain user types (i.e. school children, elderly, physically / intellectually / sensory disabled, cyclists / wheelchairs / prams), therefore it is very important the volume of each user type is captured. ALCAM has three bands of proportions that can be applied to each user type;

- Low < 25%
- Medium 25% - 45%
- High > 45%

The Low band is considered to have quite a high upper threshold of 25%, such that some of the user types are never likely to equate to 25% of the total volume of users. Therefore it is recommended that the following user types in Table 4 are collected;

Table 4: Pedestrian user types that should be counted

CYCLISTS		PEDESTRIANS						
School children	Other	Pram	Wheelchair	Elderly	School children (walking)	School children (scooters/skateboard)	Disabled	Other

By capturing these user types, the split between cyclists and pedestrians can be calculated. As can the separate percentages of wheeled pedestrians (i.e. cyclists, pram, wheelchair and scooters) or school children (i.e. cyclists, walking, scooters). The group classified as ‘Other’, relates to all other adult users of the level crossing.

A2 New Level Crossing Risk Assessment Process

This appendix provides an example of how to apply the LCSS process to a proposed upgrade project. Dispersed within the example are the SSSS scoring tables, which outline how to score the current risk of a level crossing when out on the site visit (see Appendices A2.3.1, A2.3.2 and A3).

In this example the applicant has completed previous investigations that have determined the most appropriate form of intersection control for this location. Those suggestions form the ***Proposed Design*** LCSS, to which a ***SRT Modified*** LCSS is then conducted that aims to enhance and inform the safety of the design, whilst attempting to achieve ***Criteria 2*** and id possible, ***Criteria 1.***

Example: Ferry Road (Spring Creek, Marlborough)

The Ferry Road level crossing is located approximately 5 km north of Blenheim in Spring Creek. A plan view of the site is shown in Figure 6.

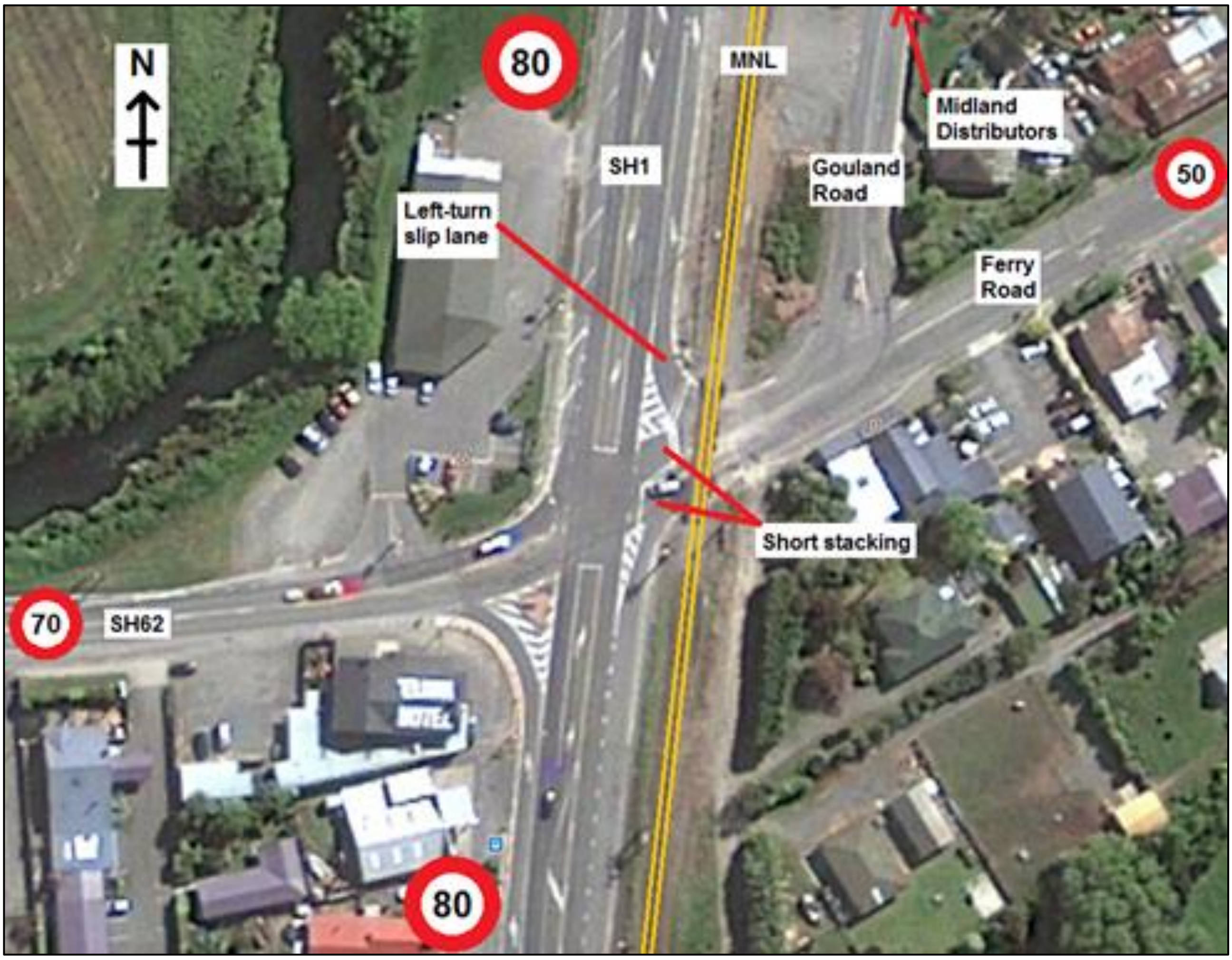

Figure 6: Overview of existing Ferry Road railway crossing site

There are two crossing points at Ferry Road, one for vehicles and one for pedestrians. ALCAM risk scores exist for the road crossing and the southern pedestrian crossing. No formal pedestrian crossing is provided to the north of the roadway crossing and hence no ALCAM score.

The changes of the proposed design were to;

- change the intersection to a roundabout control,
- install half-arm barriers on the level crossing, and
- formalise two pedestrian crossings that on-road cyclists could use in order to by-pass the roundabout (if they desired).

The existing southbound merge lane was one feature of the existing site that would remain.

A2.1 ALCAM score (30 points)

The ALCAM risk score systems are located in Appendix A4, to assist

Ferry Road roadway ALCAM score:

The published ALCAM risk score for the roadway crossing is 47 (calculated as 0.00466) and the ALCAM risk band was 'HIGH' for all control classes[6] in the jurisdiction[7]. This was calculated based on a vehicle volume (AADT) of 1,280 vehicles and 10 trains per day.

UPDATED EXISTING SCORE:

The AADT was updated to 1,717 vehicles, along with changes to the heavy vehicle percentage and other updates on site conditions that had changed since the original ALCAM assessment of 2009. This increased the ALCAM risk score up to 56 and the risk band remained HIGH. This rating now becomes the new baseline existing ALCAM risk score for the LCSS (i.e. ignore the published ALCAM score).

The existing level crossing has no facility for cyclists. Cycle volumes were assumed to be very low (relative to other vehicles) and hence have been ignored in the analysis. The location is peri-urban with no other cycle links nearby that would suggest a high cycle demand, there were also no cyclists sighted during the site visit.

PROPOSED DESIGN SCORE:

Changes due to the proposed design reduced the risk score down to 13, which is in the MEDIUM-HIGH ALCAM risk band. The main benefit is derived from the installation of half-arm barriers.

SRT MODIFIED SCORE:

There were no other changes that the SRT recommended which further reduced the ALCAM risk score[8]. Therefore the ALCAM risk score remained at 13 and the risk band remained MEDIUM-HIGH.

ALCAM score	Updated Existing	Proposed Design	SRT Modified	Comments
Road	26/30	20/30	20/30	The proposed design has lowered the safety risk at Ferry Road for vehicles.

Ferry Road southern pedestrian ALCAM score:

The published ALCAM risk score for the southern pedestrians crossing was 305k (305,046) and the risk band was 'MEDIUM' for all control classes in the jurisdiction. This is calculated based on a daily pedestrian volume of 100 and 10 trains per day.

UPDATED EXISTING SCORE:

The ALCAM risk score and band should be updated when more recent pedestrian and train volumes are available. This is particularly important when a default value (e.g. an assumed value of 100 pedestrians per day) is used by ALCAM. Refer to Appendix A1 for additional guidance on pedestrian and cycle user counts. As with the roadway assessment, the updated existing score should be used as the new baseline ALCAM risk score and risk band.

In this example the pedestrian volume was dropped to 50 per day (based on limited site observations). This dropped the ALCAM risk score to 153k and risk band to 'MEDIUM-LOW'.

PROPOSED DESIGN SCORE:

[6] Do not use the risk score for the particular control class that the crossing operates under. The assessment needs to take the risk profile against all passive and active control types across NZ.

[7] As stated in section 3.3.1, use only the 'Jurisdiction' rating and not the 'Global' rating, as this includes crossings from Australia as well as NZ.

[8] If a suggested modification to the proposed design does not alter the ALCAM risk score, it does not mean that it should not be recommended. Instead the suggestion may change the scoring of the SSSS, or simply provides a solution that enhances site safety i.e. safety for workers who conduct operations and maintenance.

As there were no changes in the proposed design, the ALCAM risk score remains at 153k and in the MEDIUM-LOW risk band.

SRT MODIFIED SCORE:

The SRT requested that a flashing light was visible for each approach to the pedestrian crossing, which reduced the ALCAM risk score to 133k, but the risk band remained at MEDIUM-LOW.

ALCAM SCORE	Updated Existing	Proposed Design	SRT Modified	Comments
Pedestrian	10/30	10/30	9/30	Low pedestrian volumes means low exposure to trains and lower risk overall.

Where a separate cycleway or shared path is provided then cyclists should be included with pedestrians. However, the SRT should be aware that cyclists can be exposed to greater risks due to their higher travel speeds, which requires longer sight distances and means they cannot stop or change direction as quickly as a pedestrian.

A2.2 Crash and incident history analysis (10 points)

This score is based on the number of crashes in the New Zealand CAS system, the number of incidents reported in the KiwiRail IRIS database and the KiwiRAP collective risk score. Table 2 in section 3.3.2 shows how this score is currently determined.

Ferry Road crash and incident history score:

The following tables present the crash data from IRIS, CAS and KiwiRAP.

IRIS Data: The 10-year (2007 -2016) IRIS data recorded at the Ferry Road crossing in Table 5.

Table 5: IRIS data for Ferry Road

Incident type	Number	Comments
CLV – Collision Light Road Vehicle	2	Bells and lights working on both occasions. No impact between train and vehicle was recorded, however they were scored as CLV incidents.
NCLV – Near Collision Light Road Vehicle	6	On one instance the vehicle was only 30 m in front of the train when it crossed. Others relate to vehicles failing to stop, including one bus.
NCHV – Near Collision Heavy Road Vehicle	2	Train required to emergency brake in one instance, the other involved a train clipping the rear end of a 4x4 (vehicle drove off).
DRV – Damage by light road Vehicle (including Bridge strikes)	1	Flashing light pole was struck
NCLV – Near Collision Person	4	Four instances of pedestrians crossing too close ahead of the train.
TOTAL	**15**	

There were 11 road events meaning the road score is 10/10. There were four pedestrian IRIS events recorded, therefore the score is 4/10.

CAS Data: The 10-year (2007 -2016) CAS data recorded at the Ferry Road crossing in Table 6.

Table 6: CAS data for Ferry Road

Incident type	Number	Comments
Hit object	1	Vehicle hit a flashing light pole. Alcohol a factor in crash (minor injury).
TOTAL	**1**	

With one recorded minor injury crash, the CAS score is 1/5.

KiwiRAP Data: The sections of SH1 north and south of the intersection are a HIGH collective risk, therefore the road score is 3/5 (if the HIGH collective risk had been on Ferry Road, it would have scored a 5/5).

UPDATED EXISTING SCORES:

The road score is 10/10 (IRIS) + 1/5 (CAS) + 3/5 (KiwiRAP) = 14/20 = 7/10 overall.

The pedestrian score is 4/10 (IRIS) = 4/10 overall.

PROPOSED DESIGN SCORES:

The proposed design reduces the risk of short stacking by constructing a roundabout and the installation of half-arm barriers MEDIUM-HIGH. The SRT reduced the score by two points to 5/10, as there is still a short stacking risk.

The pedestrian score remained unchanged at 4/10, as there were no major changes proposed for the pedestrian crossing.

SRT MODIFIED SCORES:

The SRT recommended yellow hatched marking over the level crossing and to ensure that the SH1 approaches both had excellent visibility of flashing lights at the crossing. The SRT further reduced the score by one additional point to 4/10.

The pedestrian score was reduced to 2/10, as the SRT recommended that flashing lights were included for both approaches, where previously there was only the existing flashing lights for the eastern approach vehicles that also alerted pedestrians approaching from the same direction.

Crash & Incident History	Updated Existing	Proposed Design	SRT Modified	Comments
Road	7/10	5/10	4/10	A combination of the proposed design and the recommended modifications, should reduce the future crash risk.
Pedestrian	4/10	4/10	2/10	Flashing lights on all approaches, combined with low pedestrian volumes, means score drops.

A2.3 Site-specific safety score (SSSS) (10 points)

This site-based score aims to analyse elements of the layout that are not well covered or missing from the ALCAM risk rating. In the future, desktop assessment scores will be developed for all crossings in New Zealand, based on aerial photos and KiwiRAP data. However, even if a desktop score is available, a site-based assessment ***must*** be undertaken for each level crossing.

Once the SSSS has been calculated out of 35 points, it is adjusted to a 10 point scale by dividing the total by 3.5. The resulting number should be ***rounded up*** to the nearest whole number for the purposes of reporting in the final LCSS (i.e. 19/3.5 = 5.4 ∴ 6/10).

A2.3.1 Urban Roadway Crossing SSSS

The following tables outline the process of an urban (or peri-urban) roadway crossing site-specific safety score (posted speed limit <70 km/h). Each table provides a narrative on how to allocate a risk score for each category.

Whilst every best effort has been made to capture the vast majority of level crossing situations in the following narratives, it is accepted there will be occasions where a site does not fit within any of these narratives. When this occurs, the SRT is expected to provide their best estimate of how to score the risk based on the scale of scores provided. An explanation of the risk score chosen should be provided within the report.

Where a ‘Red Flag’ possibility is indicated in the following tables it means that the highest risk score is instantly given to the category. Refer to tables for specific instances of ‘Red Flags’.

Category 1: Queuing

Score	Scenario
0	No bisecting intersection, therefore no queues can develop.
1-2	There is one bisecting intersection, but queues back to the level crossing are infrequent i.e. 5 - 25% of time during peak hours.
2-4	There is a bisecting intersection which induces queues back to level crossing 25 - 50% of time during peak hours.
4-7	There is a bisecting intersection which induces queues back to level crossing 50 - 75% of time during peak hours.
7-9	There is a bisecting intersection which induces queues back to level crossing 75 - 100% of time during peak hours.
9-10	There is a bisecting intersection either side of level crossing, where each induces queues back to the level crossing 50 - 100% of time during peak hours. Two queues above 75% will score a 10 or if one crossing is close to 100%, otherwise score a 9.

(NB: the score should be pro-rated according to where it sits within a particular range)

Category 2: Adjoining Major Commercial Accessways / Side-Roads & Bisecting Intersections

This category is split in two, depending whether it is a major commercial accessway / side road, or a bisecting intersection. Major commercial accessways / side roads are captured in the 1-5 range, with bisecting intersection scoring beginning at the 5-10 range. Bisecting intersections are defined as ones where a limit line is introduced for the vehicles travelling on the same road as the level crossing, i.e. priority T-junction / crossroads, traffic signals or roundabout. They also need to be close enough that they generate an interaction with the level crossing.

Score	Scenario
In all assessments of major commercial accessway/side roads, it must be located on the right-hand side of the road on the departure side of the level crossing. This means right-turning vehicles are waiting adjacent to the centreline and obstructing vehicles behind it which may queue back over the level crossing (due to; no right turn bay, flush median or room to undertake the vehicle is provided). Left turning vehicles for a major commercial accessway/side road will not cause a queue back to the level crossing (on most instances), so this should not be assessed, unless the safety reviewer observes a compelling reason during the site visit.	
0	No major commercial accessway / side road or intersection on either side of the level crossing.
1	There is a commercial accessway or side road on the departure side (on the right-hand side of road), with a low chance of queues forming back to / over level crossing.
2	There is a major commercial accessway or side road on the departure side, with occasional queues forming back to / over level crossing.
3	There is a major commercial accessway or side road on the departure side, with frequent queues forming back to /over level crossing.
+1 to +3	Where there is a second major commercial accessway or side road on the other departure, score again from 1 – 3 and combine scores, i.e. one low level chance of queues and the other with a frequent chance of queues = 1 + 3 = 4/10.

(NB: the table continues on the following page)

The higher scores in this category focus solely on a bisecting intersection either side of the level crossing along with their complexity and / or Level of Service (LoS). The complexity of an intersection considers how easy or difficult the intersection is for users to negotiate i.e. is there a lot of distraction, poor sight lines, multiple approaches / lanes etc. A busy intersection is classed by the LoS the intersection generally provides for road users during peak hours.	
5	There is one bisecting intersection (on one side of the crossing) that it is not very busy or complex in nature.
6	There is one bisecting intersection nearby that it is moderately busy and/or moderately complex in nature.
7	There is one bisecting intersection nearby that it is very busy and/or very complex in nature.
Range (6-10)	Where there is a second intersection/side road/commercial accessway on the other side of the level crossing, score as follows; +1 for low volume / low complexity; or low likelihood of queues (for commercial accessway / side road only) +2 for relatively busy / moderately complex intersection; or occasional likelihood of queues (for commercial accessway / side road only) +3 for very busy / complex intersection; or frequent likelihood of queues (for commercial accessway / side road only)
10	**Red Flag Scenario:** If a level crossing has an accessway located in between the half-arm barriers and the railway line, this is an instant score of 10 (maximum value). This means the accessway is unprotected by the half-arm barriers.

If there is a major commercial accessway on one departure and a bisecting intersection on the other departure, the score out of 10 is a combination of the two (see 6-10 range).

Category 3: Short Stacking/Grounding Out

Score	Scenario
0	No intersections in close proximity to level crossing. Or; No evidence of grounding out visible.
1	<26m HCV short stacking length, but is a rare occurrence due to low HCV traffic volumes.
2	<26m HCV short stacking length, but there are mitigating reasons that reduce the risk of train impact, i.e. escape areas that can be accessed by the predominant HCV traffic movements or signage to advising HCV against using this route.
3	<26m HCV short stacking length, roundabout intersection with low opposing traffic volumes.
4	<26m HCV short stacking length, priority controlled intersection no escape area, with low opposing traffic volumes.
5	<26m HCV short stacking length, priority controlled intersection with delays due to adjoining road traffic, no escape area, no signage to ban using intersection, with low opposing traffic volumes.
6	Evidence of scrape marks on the road surface, where a HCV has made contact, or if possible evidence is visible on the railway tracks. Use this score when there is no known history of grounding out occurring.
+3	If a scenario falls within 3-5 range, add three more points for a moderate AADT volume of the priority road, i.e. a road that can sometimes have platoons of vehicles, but there are generally some gaps to enter traffic stream
+5	If a scenario falls within 3-5 range, add five more points for a high AADT volume of the priority road i.e. very busy road during peak hours, with few gaps to enter traffic stream.
10	**Red Flag Scenario:** If grounding out is known to have occurred at the level crossing previously and no changes to the road have occurred since, or, if a short stacking crash has occurred in the past ten years.

Category 4: Observed non-compliance with level crossing signs and warning systems

Score	Scenario
0	No non-compliance issues at an active or passive warning system
1	Rare to low level non-compliance issues at an active warning system with good visibility
2	Rare to low level non-compliance issues at a passive warning system with good visibility
3	Some non-compliance issues at an active or passive warning system with moderate visibility
4	Frequent non-compliance issues at an active warning system with poor visibility
5	Frequent non-compliance issues at a passive warning system with poor visibility

Non-compliance include examples of, but is not limited to;

- Driving around barrier arms
- Queuing on yellow hatched markings
- Ignoring specific signage relative to the level crossing (i.e. banning vehicles of certain length)
- Ignoring bells and flashing lights at a level crossing

Ferry Road roadway SSSS example:

Table 7 assesses the site specific safety score of the roadway crossing over the railway line.

Table 7: SSSS assessment of the roadway level crossing at Ferry Road

Assessed Item	Updated Existing	Proposed Design	SRT Modified	Comments
Vehicle queues back from a bisecting intersection	2/10	2/10	2/10	Rare on Ferry Road, however the short queue space can allow for a small queue of light vehicles to form.
Adjoining major commercial accessways and bisecting complex intersections.	7/10	6/10	6/10	By constructing a roundabout, the complexity of the intersection has reduced and is easier for the heavy vehicles to negotiate.
Short stacking / grounding out	10/10	3/10	3/10	Proposed design constructs a roundabout that retains the southbound merge lane which can act as an escape area. So the ability of a heavy vehicle to force its way into SH1 and clear of the tracks, is less risky than the priority controlled T-junction.
Observed compliance with level crossing signs and warning systems	3/5	3/5	3/5	With the ability to form queues of small vehicles back over the tracks still, the compliance may not change.
TOTAL SCORE	**22/35**	**14/35**	**14/35**	
SSSS	**7/10**	**4/10**	**4/10**	Score to take forward to LCSS
MODIFIED SCORE	**-**	**-**	**-**	

When the total score is modified[9], this should be peer reviewed by an external assessor (at the expense of the applicant) to ensure that the risk change is warranted and not a case of trying to manipulate a final LCSS score that meets ***Criteria 1*** or ***Criteria 2***.

[9] Where the assessor believes the SSSS does not accurately reflect the level of risk to users at the level crossing and changes the overall score out of 10 to a higher or lower value.

A2.3.2 Pedestrian / Cyclist Crossing SSSS:

The following tables outline the process of a pedestrian / cyclist crossing Site Specific Safety Score. Each table provides a narrative on how to allocate a risk score for each category.

Whilst every best effort has been made to try and capture the vast majority of crossing situations in the following narratives, it is accepted there will be occasions where a site does not match any of these narratives. When this occurs, the SRT is expected to provide their best estimate of how to score the risk based on the scale of scores provided. An explanation of the risk score should be provided within the report.

Category 1: Crossing type

Score	Scenario
1	Automatic gates are in operation at the crossing.
2	Good visibility with flashing lights facing all approaches.
3	Acceptable visibility with flashing lights facing all approaches.
4	Poor visibility with flashing lights facing all approaches.
5	Good visibility, warning bells and “look for trains” signs present
6	Acceptable visibility, warning bells and “look for trains” signs present
7	Poor visibility, warning bells and “look for trains” signs present
8	Good visibility and only “look for trains” signs present
9	Acceptable visibility and only “look for trains” signs present
10	Poor visibility and only “look for trains” signs present, or there is no form of warning at all for users.
-1	If a maze or chicane is present at the crossing, deduct one point from the above score.

NB: Score the level crossing based on its weakest link, i.e. if only one approach has flashing lights facing pedestrians, the score should be based on the approach that does not.

Category 2: Flange gap wheel entrapment for wheeled pedestrians

Score	Scenario
0	No flange gaps, so wheel entrapment for wheeled pedestrians is not a concern. Wheeled pedestrians include, but not limited to; wheelchair users, mobility scooters, prams or buggies, or rollerblade/scooter/roller skates/skateboards.
2	Small and well maintained flange gaps that a wheeled pedestrian is unlikely to become trapped. Crossing is perpendicular to the rail tracks.
3	Small and well maintained flange gaps that a wheeled pedestrian is unlikely to become trapped. Crossing is not perpendicular to the rail tracks.
4	Wide or deep flange gaps that a wheeled pedestrian could become trapped, **OR** is a trip hazard to walking pedestrians. Crossing has higher pedestrian volumes, so a fellow pedestrian may assist them to safety.
5	Wide or deep flange gaps that a wheeled pedestrian could become trapped, **OR** is a trip hazard to walking pedestrians. Crossing has low pedestrian numbers so a fellow pedestrian is unlikely able to assist them to safety.

Category 3: Volume of "vulnerable" users (i.e. visually impaired, school children, physically disabled, elderly, intoxicated users)

Score	Scenario
0	No vulnerable users
1	Very low vulnerable user numbers per day <10
2-4	2= 11-20 vulnerable user numbers per day 3= 21-35 vulnerable user numbers per day 4 = 36-50 vulnerable user numbers per day
5-6	5= 51-75 vulnerable user numbers per day 6 = 76-100 vulnerable user numbers per day
7-9	7 = 101-140 vulnerable user numbers per day 8 = 141-170 vulnerable user numbers per day 9 = 171-200 vulnerable user numbers per day
10	+ 200 vulnerable user numbers per day
-50%	If the crossing is supervised by an adult during the peak school children crossing periods, the score can be halved (and rounded up) to provide a benefit for this duty of care.

NB: Although ALCAM does score the risk level of vulnerable users, the low category's upper threshold is set very high and unrealistic in some instances (refer to Appendix A1.2), this category further assessed in the SSSS.

Category 4: Distraction/Inattention

Score	Scenario
0	Rural area with no pedestrians i.e. only a very low number of people on a walk along the roadside.
1	Peri-urban with crossings provided, but very low user numbers. Assumes that distraction / inattention must occur from time to time.
2	Peri-urban with crossings provided, but higher user numbers of cyclists due to a popular cycle route / trail. Assumes that distraction / inattention must occur from time to time.
3	Urban with no evidence of distraction / inattention. Assumes that distraction / inattention must occur from time to time.
4	Urban with some evidence of distraction / inattention, will assume that it is actually higher.
5	Urban with strong evidence of distraction / inattention, again assumes that it is higher

NB: Scoring of the proposed or SRT Modified sites can reduce on the existing score, if the proposed site installs devices that would raise awareness of trains to the crossing users. This is to capture some benefit for reducing the likelihood of distraction.

Category 5: Cycle Patronage

Score	Scenario
0	No evidence of cyclists using the crossing.
1-2	A handful to low number of cyclists using the crossing; 1 = < 20 cyclists per day. 2 = 21 - 50 cyclists per day.
3	A medium number of cyclists using the crossing; i.e. 50 – 100 cyclists per day.
4-5	A major cycle route that crosses the rail line or a high number of school aged cyclists; 4= 101 – 200 cyclists per day. 5= > 200 cyclists per day.

Ferry Road pedestrian SSSS example:

Table 8 assesses the existing safety score of the pedestrian crossing over the railway line.

Table 8: Assessment of the existing southern pedestrian level crossing at Ferry Road

Assessed Item	Updated Existing	Proposed Design	SRT Modified	Comments
Crossing type and visibility	5/10	5/10	2/10	Only flashing lights facing one approach for existing and the proposed design. SRT requests flashing lights on both approaches.
Flange gap wheel entrapment	3/5	3/5	3/5	Currently the flange gaps are made worse by the skew crossing angle. Unlikely to be altered in the upgrade.
Proportion of vulnerable users	2/10	2/10	2/10	Spoke with staff at local diary and learnt that very few school children use the crossing, as the bus drops them off beyond the crossing.
Distraction/ Inattention	2/5	2/5	2/5	Peri-urban location with some IRIS records, so a relatively low level of inattention or non-compliance.
Cycle Patronage	0/5	1/5	1/5	No evidence of cyclists, but the proposed design states that SH1 on-road cyclists who wish to bypass the roundabout, should go via the pedestrian crossings on Ferry Road.
TOTAL SCORE	**12/35**	**13/35**	**10/35**	
SSSS	**4/10**	**4/10**	**3/10**	Score to take forward to LCSS
MODIFIED SCORE	-	-	-	

A2.4 Locomotive and RCA engineers' risk assessment (10 points)

This score reflects the level of risk that locomotive engineers (train drivers) and RCA engineers score each railway crossing compared with other crossings they encounter regularly. Where possible this relative risk score should be determined by a number of different practitioners involved with the crossing.

Ferry Road Example

UPDATED EXISTING SCORE:

The RCA Engineer rated the road crossing a 5/5 risk and the southern pedestrian crossing a 2/5 risk. Their main concern was around the volume of heavy traffic and the short staking scenario.

The Locomotive Engineer rated the road crossing a 5/5 risk and the southern pedestrian crossing a 3/5 risk. As per the RCA Engineer, their main concern was around the short stacking.

Road Score = 5 + 5 = 10/10

Pedestrian Score = 2 + 3 = 5/10

PROPOSED DESIGN SCORE:

Due the proposed construction of a roundabout and the subsequent improved ability for heavy vehicles to escape the short stacking scenario, the RCA Engineer rated the proposed road crossing a 3/5 risk and rated the southern pedestrian crossing a 2/5 risk.

The Locomotive Engineer rated the road crossing a 4/5 risk and the southern pedestrian crossing a 2/5 risk. They still had reservations about the short stacking of right turning heavy vehicles and the queuing of small vehicles back across the tracks.

Road Score = 3 + 4 = 7/10

Pedestrian Score = 2 + 2 = 4/10

SRT MODIFIED SCORE:

The RCA and Locomotive Engineers' were not consulted on the modified changes. The SRT believed that their recommended modifications reduced the road risk score by one further point to 6/10. However the risk of short stacking and queuing is still ever present.

The pedestrian score was reduced to 2/10, due to the recommended flashing lights for each approach and the low pedestrian volumes involved.

RCA and LE Risk Score	Updated Existing	Proposed Design	SRT Modified	Comments
Road	10/10	7/10	6/10	A combination of the proposed design and the recommended modifications, lowered the score for the engineers.
Pedestrian	5/10	4/10	2/10	Flashing lights on all approaches, combined with low pedestrian volumes, means score drops.

A2.5 LCSS results

The ranking of the roadway and pedestrian crossings is then calculated by adding together all four risk ratings. For the Ferry Road example, refer to Table 9 and Table 10 for the combined LCSS scores for the roadway and pedestrian level crossing on Ferry Road[10].

Table 9: Overall LCSS for the Ferry Road roadway level crossings

Scored Items	Updated Existing	Proposed Design	SRT Modified	Comments
ALCAM score	26/30	20/30	20/30	The half-arm barriers help to reduce the ALCAM score. Aside from grade separation, other remedial treatments are limited.
Crash and incident history score	7/10	5/10	4/10	
Site specific safety score	7/10	4/10	4/10	
Locomotive & RCA engineer risk score	10/10	7/10	6/10	
LCSS SCORE	**50/60**	**36/60**	**34/60**	**This crossing has a lower LCSS risk score than the existing, achieving Criteria 2.**
LCSS RISK BAND	**High**	**Medium**	**Medium**	

Table 10: Overall LCSS for the Ferry Road southern pedestrian level crossing

Scored Items	Updated Existing	Proposed Design	SRT Modified	Comments
ALCAM score	10/30	10/30	9/30	Installing flashing lights for both approaches improves safety for all pedestrians.
Crash and incident history score	4/10	4/10	2/10	
Site specific safety score	4/10	4/10	3/10	
Locomotive & RCA engineer risk score	5/10	4/10	2/10	
LCSS SCORE	**23/60**	**22/60**	**16/60**	**This crossing has a lower LCSS risk score than the existing, achieving Criteria 2.**
LCSS RISK BAND	**Medium Low**	**Medium Low**	**Low**	

[10] Note that some scores have been intentionally altered from the original assessment.

The SRT should then close with commentary around where each crossing type assessed meet the applicable KiwiRail criteria. They would also state which suggestions they have for the modified design must be performed (usually they are critical at reducing the LCSS to meet the necessary criteria) and which other suggestions are nice to have if possible (but not compulsory).

A3 Rural Site-specific safety score (10 points)

The following tables outline the assessment of a rural roadway crossing (≥ 70 km/h posted speed limit) site-specific safety score. Whilst every best effort has been made to capture the vast majority of level crossing situations in the following narratives, it is accepted there will be occasions where a site does not fit within any of these narratives. When this occurs, the SRT is expected to provide their best estimate of how to score the risk based on the scale of scores provided. An explanation of the risk score should be provided within the report.

Where a 'Red Flag' possibility is indicated in the following tables it means that the highest risk score is instantly given to the category. Refer to tables for specific instances of 'Red Flags'.

Category 1: Side road and intersection proximity

This category is split in two, depending whether it is a side road or an intersection. Side roads are captured in the 1-5 range, with intersection scoring beginning at the 5-10 range. Bisecting intersections are defined as ones where a limit line is introduced for the vehicles travelling on the same road as the level crossing, i.e. priority T-junction / crossroads, traffic signals or roundabout. They also need to be close enough that they generate an interaction

Score	Scenario
In all assessments of major commercial accessway/side roads, it must be located on the right-hand side of the road on the departure side of the level crossing. This means right-turning vehicles are waiting adjacent to the centreline and obstructing traffic behind it which may queue back over the level crossing (no right turn bay, flush median or room to undertake the vehicle is provided). Left turning vehicles for a major commercial accessway/side road will not cause a queue back to the level crossing (on most instances), so this should not be assessed, unless the safety reviewer observes a compelling reason during the site visit.	
0	No side road or intersection either side of the level crossing at all.
1	There is a side road on the departure side (on the right-hand side of road), with a low chance of queuing forming back to level crossing.
2	There is a side road on the departure side, with occasional queues forming back to level crossing.
3	There is a side road on the departure side, with frequent queues forming back to level crossing.
+1 to +3	Where there is a second side road on the other departure side, score again from 1 - 3 and combine scores, i.e. one low level chance and a frequent chance of queuing = 1+3=4/10.
The higher scores in this category focus solely on a bisecting intersection either side of the level crossing along with their complexity and/or Level of Service (LoS). The complexity of an intersection considers how easy or difficult the intersection is for users to negotiate i.e. is there a lot of distraction, poor sight lines, multiple approaches/lanes etc. A busy intersection is classed by the LoS the intersection generally provides for road users during peak hours.	
5	There is an intersection nearby that it is not very busy and/or not complex in nature.
6	There is an intersection nearby that it is moderately busy and/or moderately complex in nature.
7	There is an intersection nearby that it is very busy and/or moderately complex in nature.
+1 to +3	Where there is a second side road on the other side of the level crossing, again score from 1 - 3 and combine scores, i.e. one low level chance and a frequent chance of queuing = 1+3=4.
10	As this assessment is for rural speed environments, it is very unlikely that an intersection would be located on either side of the level crossing (more likely in urban speed environment). If this was to occur, then score 10.

Category 2: Horizontal and vertical alignment of crossing

Score	Scenario
This category is out of total of 10 points, with each sub-category subtotal combined to provide the overall score. The horizontal and vertical alignment is the main focus, however it can have an influence on the forward visibility of the associated signage and the available safe stopping distance.	
+1 to +4	Horizontal and vertical alignment +0 The crossing is on a level profile and the road approaches are on a consistent perpendicular alignment. +2 Adequate (but acceptable) horizontal and/or vertical alignment on the approaches to the level crossing. +4 Horizontal approaches are on a poor horizontal alignment and/or vertical alignment. This makes checking for approaching trains difficult, or visibility of the road beyond the level crossing is compromised.
+1 to +3	Forward visibility of advanced warning signage and flashing lights/level crossing +0 Excellent forward visibility of signage and/or level crossing +1 Adequate (but acceptable) forward visibility of signage and/or level crossing +3 Compromised forward visibility of signage and/or level crossing, means that level crossing “surprises” the road user.
+1 to +3	Safe stopping distance +0 Plenty of forward visibility for a vehicle travelling at the posted speed to stop safely if a train was approaching the crossing. +1 Adequate (but acceptable) forward visibility for a vehicle travelling at the posted speed to stop safely if a train was approaching the crossing. +3 Compromised forward visibility that means a vehicle travelling at the posted speed limit cannot stop safely if a train was approaching the crossing.

Category 3: Road surface condition

Score	Scenario
0	Road surface in excellent condition, no deterioration and in near new condition.
1	Very minor issues with the road surface, but not enough to warrant maintenance intervention.
3	Pavement in average condition, isolated areas require maintenance intervention.
5	Pavement condition is in a poor state, surface is flushed or breaking up. Heavy maintenance intervention is required to reinstate surface to acceptable condition.
-1*	Deduct one point where rubber panels are used across the railway crossing, these reduce the need for continued maintenance of the sealed surface.

* NB: That zero is still the lowest score that can be achieved for Category 3.

Category 4: Short Stacking/Queuing/Grounding Out

<table>
<tr><th>Score</th><th>Scenario</th></tr>
<tr><td>0</td><td>No intersections in close proximity to level crossing, or no evidence of grounding out visible.</td></tr>
<tr><td>1</td><td><26m HCV short stacking length, but is a rare occurrence due to low HCV traffic volumes or signage that bans HCV from using the level crossing.</td></tr>
<tr><td>2</td><td><26m HCV short stacking length, but there are mitigating reasons that reduce the risk of train impact, i.e. escape areas that can be accessed by the predominant HCV traffic movements.</td></tr>
<tr><td>3</td><td><26m HCV short stacking length, roundabout intersection with low opposing traffic volumes.</td></tr>
<tr><td>4</td><td><26m HCV short stacking length, priority controlled intersection no escape area, with low opposing traffic volumes.</td></tr>
<tr><td>5</td><td><26m HCV short stacking length, priority controlled intersection with delays due to adjoining road traffic, no escape area, no signage to ban on using intersection, with low opposing traffic volumes.</td></tr>
<tr><td>+3</td><td>If a scenario falls within 3-5 range, add three more points for a moderate AADT volume of the priority road, i.e. a road that can sometimes have platoons of vehicles, but there is generally some gaps to enter traffic stream</td></tr>
<tr><td>+5</td><td>If a scenario falls within 3-5 range, add five more points for a high AADT volume of the priority road i.e. very busy road during peak hours, with few gaps to enter traffic stream.</td></tr>
<tr><td colspan="2">If short stacking is not possible at the level crossing, but vehicle queues can form back from a nearby intersection, use the +3 and +5 approach to score the crossing depending on how busy the opposing traffic stream on the priority road is.</td></tr>
<tr><td>10</td><td>Red Flag Scenario: If grounding out is known to have occurred at the level crossing previously and no changes to the road have occurred since.</td></tr>
<tr><td>10</td><td>Red Flag Scenario: If a short stacked HCV has been hit by a train at the level crossing in the past 10 years.</td></tr>
<tr><td>10</td><td>Red Flag Scenario: If a queued vehicle has been struck by a train at the level crossing in the past 10 years.</td></tr>
</table>

A4 ALCAM graduated scoring scales

The ALCAM road and pedestrian risk scores are on two very different scales[11], therefore each requires its own scoring system.

A4.1 ALCAM road scoring

The ALCAM risk score of a road crossing returns a value to below 0.03 (to 16 decimal places), so scores are commonly multiplied by 10,000 and reported as whole numbers, such as the scores in Table 11. The threshold column outlines why an ALCAM risk score can fall within either side of two risk bands, as the multiplication by 10,000 and rounding provides a whole number.

Table 11: ALCAM road crossing LCSS Scores

ALCAM Risk Band	ALCAM Risk Score	ALCAM LCSS Score	Threshold
HIGH	>200	30	
	161-200	29	
	121-160	28	
	81-120	27	
	41-80	26	
	21-40	25	>20.9
MEDIUM HIGH	20-21	24	<20.9
	18-19	23	
	16-17	22	
	14-15	21	
	13	20	
	12	19	>12.1
MEDIUM	12	18	<12.1
	11	17	
	10	16	
	9	15	
	8	14	
	7	13	>6.8
MEDIUM LOW	7	12	<6.8
	6	11	
	5	10	
	4	9	
	3	8	
	2	7	>1.7
LOW	2	6	<1.7
	1	3	

[11] As at 30 June 2017 the highest road crossing score was approximately 0.021, whereas the highest pedestrian crossing score was approximately 37,250,000.

A4.2 ALCAM pedestrian scoring

ALCAM distributes approximately 20% of all pedestrian crossing scores into each risk band. Therefore, as more and more recorded pedestrian volumes and proportions are recorded into LXM, the risk score of these crossings will change and so will the thresholds of the risk bands. Therefore updates to the scoring bands presented in Table 12 are expected once KiwiRail's pedestrian volume surveys of 2017/18 are completed. Practitioners will be notified of any changes to Table 12.

Table 12: ALCAM pedestrian crossing LCSS Scores

ALCAM Risk Band	ALCAM Risk Score	ALCAM LCSS Score
HIGH	> 6,300,000	30
	3,290,000 - 6,300,000	29
	2,350,000 - 3,289,999	28
	1,170,000 - 2,349,999	27
	757,000 - 1,169,999	26
	624,238 - 756,999	25
MEDIUM HIGH	574,000 - 624,237	24
	523,000 - 573,999	23
	473,000 - 522,999	22
	422,000 - 472,999	21
	371,000 - 421,999	20
	320,955 - 370,999	19
MEDIUM	300,000 - 320,954	18
	280,000 - 299,999	17
	260,000 - 279,999	16
	240,000 - 259,999	15
	220,000 - 239,999	14
	198,682 - 219,999	13
MEDIUM LOW	181,300 - 198,681	12
	163,900 - 181,300	11
	146,500 - 163,900	10
	129,000 - 146,500	9
	111,600 - 129,000	8
	94,215 - 111,600	7
LOW	78,500 - 94,214	6
	63,000 - 78,500	5
	47,000 - 62,999	4
	31,000 - 46,999	3
	15,700 - 30,999	2
	< 15,700	1

A5 LCSIA Report Format

EXECUTIVE SUMMARY FORMAT:

KiwiRail require the executive summary format to be consistent for all LCSIA reports submitted by accredited. The following format has been approved by KiwiRail. Report writers are encouraged to keep their format consistent with this approach, however minor alterations to the text are permitted.

EXAMPLE FORMAT:

Springfield Council are planning to design a new shared path facility parallel to the Eastern rail corridor. For this reason KiwiRail requested that a Level Crossing Safety Impact Assessment (LCSIA) was conducted, to assess the safety the proposed changes have on the railway crossing. The Level Crossing Safety Score (LCSS) procedure assesses and scores the risk of each crossing point at each assessment stage of the project. The tables below details the progression of the LCSS for the level crossings through the four stages of the LCSIA.

Two proposed designs are assessed for each site. Proposed Design 1 aims to achieve KiwiRail Criteria 2, by providing a lower LCSS than the Updated Existing LCSS. Proposed Design 2 aims to achieve KiwiRail Criteria 1, of a Low or Medium-Low LCSS. The Future Score is an assessment based on the proposed design which achieves Criteria 2, to show how the risk increases in time.

Main Street Roadway LCSS:

- *Summary of LCSS changes at Main Street level crossings*

Crossing	Updated Existing	Proposed Design 1	Proposed Design 2	Future Score
Main Street level crossing	**45/60**	**42/60**	**36/60**	**39/60**
	Medium High	**Medium High**	**Medium**	**Medium**

There were three suggestions made by the Safety Review Team (SRT) for the Main Street level crossing to further reduce the risk score in order to achieve Criteria 2, these were;

1. XXXX
2. XXXX
3. XXXX

Main Street Roadway Conclusion:

The Main Street level crossing has an existing LCSS of 45/60 (MEDIUM-HIGH LCSS risk band), with the Proposed Design 1 LCSS lower at 42/60 (MEDIUM LCSS risk band). Therefore the upgrade does achieve Criteria 2.

The existing ALCAM risk band was HIGH and reduced to MEDIUM-HIGH after the Proposed Design 1 suggestions, with the ALCAM risk score reducing by 23%. The return period for predicted fatal crashes has increased by 125 years to 375 years (from 250 years).

The LCSS for Proposed Design 1 and Proposed Design 2 do not achieve the desirable Criteria 1. Grade separation would be required to achieve Criteria 1.

Main Street Pedestrian LCSS:

- *Summary of LCSS changes at Main Street pedestrian level crossings*

Crossing	Updated Existing	Proposed Design 1	Proposed Design 2	Future Score
Northern pedestrian crossing	**46/60** **Medium High**	**35/60** **Medium**	**28/60** **Medium Low**	**34/60** **Medium**
Southern pedestrian crossing	**38/60** **Medium**	**29/60** **Medium Low**	**18/60** **Low**	**22/60** **Medium Low**

There were four suggestions made by the SRT for the pedestrian crossings to further reduce the risk score in order to achieve Criteria 2, these were;

4. XXXX
5. XXXX
6. XXXX
7. XXXX

Main Street Pedestrian Conclusion:

The northern pedestrian crossing has an existing LCSS of 46/60 (MEDIUM-HIGH LCSS risk band), with the Proposed Design 1 LCSS lower at 35/60 (MEDIUM LCSS risk band). Therefore the upgrade does achieve Criteria 2. The existing ALCAM risk band was HIGH and remained at HIGH after the Proposed Design 1 suggestions, despite this the ALCAM risk score still reducing by 42%.

The southern pedestrian crossing has an existing LCSS of 38/60 (MEDIUM LCSS risk band), with the Proposed Design 1 LCSS lower at 29/60 (MEDIUM-LOW LCSS risk band). Therefore the upgrade does achieve Criteria 2. The existing ALCAM risk band was MEDIUM-HIGH and reduced to MEDIUM after the Proposed Design 1 suggestions, with the ALCAM risk score reducing by 38%.

Proposed Design 2 of the northern crossing and Proposed Design 1 of the southern crossing achieves the desirable Criteria 1. The northern crossing only meets Criteria 1 when it has automatic gates installed (Proposed Design 2). The southern crossing has a much lower user volume, so if automatic gates were not installed on this side, close monitoring of the site would need to take place once the new shared path facility is operational, to ensure that users have not migrated from the northern crossing in order to avoid the automatic gates recommended for that crossing.

Recommended Improvements

Recommendations 1, 2, 4, 5 and 6 (as stated above) should occur alongside the new shared path design in order to meet Criteria 2, whilst Recommendations 3 and 7 are nice-to-have options that would enhance the facility, but are not critical.

Future User Volume Surveys:

The applicant is required to conduct additional user volume (and proportion of user types) surveys two years after the opening of the facility and review whether a change in control is required. Subsequent surveys and reviews must be completed in three yearly cycles thereafter.