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Appendix O – KiwiRail Optioneering Summary

Summary of Options Assessment with KiwiRail

This section summarises the assessment of options considered to manage potential adverse effects of the Project on the existing North Island Main Trunk Railway (NIMTR) at-grade two-lane level crossing on Te Kowhai East Road.

In response to managing future traffic effects of the RSP, a Deed of Grant (Deed) was signed between HCC and KiwiRail on 23 September 2010 for the Te Kowhai Road East Road level railway crossing. The Deed authorises at-grade four-lane level crossing and associated increase in traffic, with an adjacent pedestrian and cycleway over the North Island Main Trunk Line at a point consistent with the existing Te Kowhai East Road crossing.

The Deed set the starting point for engagement with KiwiRail on the Project, i.e. upgrading the existing at-grade two-lane level to an at-grade four-lane level crossing at Te Kowhai East Road. Table 1 below sets out the chronology of the Project engagement and optioneering with KiwiRail.

Table 1: Chronology of KiwiRail engagement and optioneering

Chronology of KiwiRail engagement and optioneering	
At-grade four-lane option	In determining Project options for Te Kowhai East Road a number of network operation and safety deficiencies in the Deed option were identified by HCC. The proposed solution (signalising three intersections), aligned with rail operations, and pedestrian/cyclist crossing facilities and was determined by HCC as providing a better solution for network operations and safety. The proposed solution was subject to a Project safety audit which identified concerns to be addressed (including consideration of crossing grade separation) but also highlighted a separate level crossing safety audit would be desirable to complement the Project. At a meeting on 30 January 2020 the proposed solution was discussed with KiwiRail. They indicated the at-grade level crossing option is feasible. KiwiRail mentioned in an online meeting on 20 February 2020 that the proposed solution would require a Level Crossing Safety Impact Assessment (LCSIA) to be undertaken during detailed design (after the Project designation is confirmed). At two meetings on 6 July 2021 and 5 August 2021 HCC discussed the impacts of proposed options for access to the Sapphire Group property adjacent to the crossing to gain KiwiRail feedback. At an online meeting on 1 April 2022 HCC share updated plans. KiwiRail did not express particular concerns, and subject to an LCSIA prior to detailed design stage KiwiRail are supportive. KiwiRail acknowledged previous audit comments about grade separation, and while they are preferred, this is an existing crossing to be upgraded and acknowledge practicality constraints in grade separation in this location.

	HCC determined there was a potential risk that the LCSIA at detailed design stage could produce an outcome or a condition that could fundamentally change the transport network. HCC concluded it would be better to undertake a LCSIA using the preferred network design.
Level Crossing Safety Impact Assessment	At the time of preparing for the level crossing assessment HCC engaged with KiwiRail and discovered that they were undertaking a LCSIA of the existing crossing as part of a national audit programme. KiwiRail agreed to allow HCC to fund an additional LCSIA of the proposed solution, with the intent that two reports will be produced. This is intended to provide a clear direction covering both the existing at-grade two-lane layout and the proposed at-grade four-lane layout. In January 2023 on receipt of these audits HCC questioned some of the elements and figures used in the audits. On 15 March 2023, KiwiRail agreed to changes to some of these values and the reports are to be updated accordingly and supplied to HCC. HCC requested copies of the revised reports and KiwiRail endorsement of the audits. In email on 26 May 2023, KiwiRail indicated the draft reports are still undergoing internal review. However, the findings of the draft reports are as follows: • The existing crossing assessment finds that with minor improvements, the crossing will meet the next 10 years growth provisions and provides an acceptable safety outcome for KiwiRail. • The proposed solution assessment finds that it does not meet the required safety levels for KiwiRail and recommends consideration of closing or grade separating the crossing. It also identifies that both closing or grade separating the crossing will have significant costs or implications. • The report concludes that if HCC does not wish to pursue grade separation or closing the crossing then the next step in the KiwiRail process is to undertake a “So far as reasonably practical – SFAIRP” exercise. • This is an activity defined by KiwiRail facilitated by a rail expert nominated by KiwiRail that evaluates the practicality of these options compared to the at grade proposal. On 1 August 2023 HCC received confirmation from KiwiRail that the LCISA document is fit for purpose to be used in the SFAIRP exercise. Given the safety criteria which KiwiRail has established for itself under its LCSIA, HCC anticipates the report findings will remain unchanged for the 4-lane option and indicate that the level crossing does not meet KiwiRail’s safety provisions, recommending consideration of grade separation or closing the crossing.
“So far as is reasonably	On 21st July 2023 HCC requested the final LCSIA reports be issued so that the SFAIRP exercise can be commenced. This consists of engaging a facilitator that will: • Review the LCISA document.

practical" Assessment	• Receive additional supporting data provided by the applicant defining the impact and costs associated with both a grade separated and closing the crossing options. • Evaluate the risks against the practicality of these options. • Determine if its reasonably practical to implement of each option and produce a report for KiwiRail acceptance. HCC has engaged the facilitator to commence this work and is preparing the additional supporting data for both options. It is unlikely this exercise would be completed prior to lodgement of the Notice of Requirement. It is anticipated the facilitator will confirm the LCSIA audit has been undertaken correctly, agree with the findings of the audit process, and confirm the fatal return period of 1 in 464 years for the future score.
Grade Separation option - Overpass	The overpass option would require elevating Te Kowhai Road between Arthur Porter Drive and Te Rapa Road above the North Island Main Trunk Railway line. This would also require regrading and elevating the existing side roads for Tasman Road, Maahanga Drive and The Boulevard. In preparation for the SFAIRP exercise, HCC has developed a high-level concept design for grade separation with an overpass structure that includes extensive physical works within the Te Kowhai East Road and side roads, significant impacts on the amenity and access of surrounding land. A preliminary engineers estimate of this high-level concept design indicates the overpass option is financially unfeasible for HCC. The estimate only includes the physical build elements and excludes several other mitigation costs associated with concept. Using the draft audit documents, HCC completed its own high-level assessment following the KiwiRail SFARP process. HCC's assessment indicates a grade separation solution will not meet the "so far as is reasonably practicable" approach.
Closing at Grade rail crossing option	HCC is in the process of evaluating the impacts of closing the crossing to inform the SFAIRP exercise. This option would significantly change the form and function of Te Kowhai Road from being a Major arterial link for transport between the two distinct areas of land development either side of the NIMTR line. This corridor is a strategic corridor for the city's public transport system and forms a key part in its walking and cycling functions. The implication of redistributing trips to other routes has yet to be determined.
Next steps	HCC continues engagement with KiwiRail regarding the proposed at-grade four-lane solution. HCC has proposed several key risk mitigations to improve the safety of the at-grade level crossing, including but not limited to:

	• Introducing splitter islands at the adjacent intersections to improve vehicle separations and use of the level crossing, • Integrating the Tasman Road signalised intersection with the KiwiRail level crossing warning system (and KiwiRail progressing with improvements to this effect), • Pedestrian / cycle paths to include automatic safety gates in line with KiwiRail guidance (highest level of protection for an at-grade crossing), • Emergency escape shoulder introduced east of the level crossing. HCC is of the view that closure or grade separation of the rail crossing will be found not practical to implement when compared to the risk of fatal return period evaluated for the proposed four lane signalised preferred option. HCC's preferred option is that the level rail crossing remains and agreement with KiwiRail is reached to implement the best practice safety provisions together, to mitigate safety and operational risks. HCC expects the SFARIP exercise to confirm this outcome.
SFAIRP	A draft SFAIRP report was prepared, and the next step was to convene a meeting between the stakeholders, KiwiRail and HCC to consider the SFAIRP report with a view to agreeing on the conclusions. The objective of the SFAIRP review meeting was for all affected parties to consider and agree the conclusions of the SFAIRP report for Te Kowhai East Road Level Crossing. The meeting concluded that all parties agreed with the SFAIRP findings and that the level crossing will continue to remain open for this Project, the required safety mitigations (outlined in section 8 of the Final SFAIRP report) will be implemented. The Final SFAIRP dated 16 February 2024 is attached to Appendix O. Future discussions will be had with KiwiRail during the detailed design phase.

LCSIA Risk Assessment

Te Kowhai East Road

Hamilton City Council

Reference: P522481

Revision: 1

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aurecon

Bringing ideas to life

Document control record

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1 Executive Summary

As part of the Rotokauri Development Plan, Hamilton City Council plans to upgrade Te Kowhai East Road to four lanes. A signalised intersection with Tasman Road at the existing level crossing location, a Ped Up pedestrian only and Ped Down pedestrian and cycle crossing are proposed.

Aurecon has been commissioned by Hamilton City Council (HCC) to undertake LCSIAs for the three future road and pedestrian crossings at Te Kowhai East Road to evaluate the proposed 4-laning upgrade design. This LCSIA report is for the Road Crossing only. A separate report has been prepared for the Pedestrian Level Crossings. The HCC concept design for the future upgrade is provided in Appendix B of this report.

The Level Crossing Safety Score (LCSS) procedure assesses and scores the risk of each level crossing at each assessment stage of the project. The tables below detail the progression of the LCSS for the level crossings through the four stages of this LCSS while aiming to achieve the two KiwiRail LCSIA Risk Criteria.

Following issue of the LCSIA reports to Hamilton City Council, the rail volumes for all current and future scenarios were updated to assume 32 trains per day (taking the weekly average) at a speed of 80km/h.

1.1 Te Kowhai Road LCSIA

1.1.1 Te Kowhai East Road Top-Down Evaluation

The Top Down So Far As Is Reasonably Practicable (SFAIRP) evaluation of crossing closure or grade separation was undertaken with Hamilton City Council. The discussion is summarised in the table below.

Table 1-1. Top-down evaluation of Te Kowhai Road level crossing.

1. Can the level crossing be closed? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to close the crossing** as it services a significant road corridor and there is not a suitable alternative crossing within a reasonable distance that services this industrial area. Closing this crossing would impact network operations on Wairere Drive, road over rail bridge to the south. At the time of writing, the Ruffell Road level crossing to the north has been temporarily closed.
2. Can an existing level crossing on the same network be closed? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to close an alternative crossing** as there is not another level crossing on the network which can be closed without a significant impact on network operations or safety. At the time of writing the Ruffell Road level crossing to the north had been closed due to safety reasons.
3. Can the level crossing be grade separated? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to grade separate the crossing** as the cost of grade separation is grossly disproportionate to the risk, and there are geometric constraints that preclude grade separation. Grade separation would impact Tasman Road intersection, private access ways, and potentially also the roundabout to the east.

It was not considered reasonably practicable to close, or grade separate the level crossing; therefore, the LCSIA was completed.

The tables below detail the progression of the LCSS for the level crossing through the four stages of this LCSS while aiming to achieve the two KiwiRail LCSIA Criteria.

1.1.2 Te Kowhai Road Roadway LCSS

Table 1-2. Summary of the change in LCSS at Te Kowhai Road level crossing.

	Updated Existing	Change in Use	Proposed Design	Future Score
LCSS SCORE	**31 / 60**	**40 / 60**	**31 / 60**	**33 / 60**
LCSS RISK BAND	**MEDIUM**	**MEDIUM – HIGH**	**MEDIUM**	**MEDIUM**
CRITERION MET			**C1 FAIL, C2 MET**	**C1 and C2 FAIL**
FORM OF CONTROL	**HAB and FLBs**	**HAB and FLBs**	**Signalised coordinated intersection, HAB and FLBs**	**Signalised coordinated intersection, HAB and FLBs**

The recommendations made by the LCSIA Assessor for the level crossing to reduce the risk score were:

Table 1-3. LCSIA assessor recommendations for Te Kowhai Road level crossing.

No.	Recommendation	Category
1.	As per proposed design, upgrade to signalised intersection (Te Kowhai East Road/Tasman Road, will also be linked to the rail level crossing) with an escape lane.	Proposed Design / Criterion 2
2.	As per proposed design, the roundabouts to the east (The Boulevard/Te Kowhai East Road and Te Rapa Road/Church Road) to be converted to traffic signals. The controllers will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing.	Proposed Design / Criterion 2
3.	Median islands on the approaches to address the risk of impatient drivers driving around the controls.	Proposed Design / Criterion 2
4.	Mark crosshatching with long life road marking at the level crossing.	Criterion 2
5.	Mark ‘RAIL X’ on eastbound approach with long life road marking.	Criterion 2
6.	Adjust WX1 on left-hand side on eastbound approach so that it faces eastbound drivers (rather than the commercial accessway as current).	HCC maintenance
7.	Setup remote operation of FLB for HiRail vehicles and KiwiRail workers – to avoid having to give way to vehicles on Te Kowhai East Road.	KiwiRail maintenance
8.	Investigate the provision of streetlighting at the crossing to ensure approaching train drivers can see vehicles queueing or stacking across the crossing at night.	Investigation

1.1.3 Te Kowhai Road Roadway Discussion

The Updated Existing LCSS is Medium, and the Change in Use LCSS increases to the Medium – High risk band. The Proposed Design falls into the Medium risk band, meeting Criterion 2 but failing Criterion 1. The Future Score falls into the Medium risk band, failing both Criterion 1 and 2. Therefore, while the Proposed

Design achieves Criterion 2 (as required for an existing crossing), closure or grade separation is required to achieve Criterion 2 for the Future Score in 2042. This was with assuming no change in rail volumes from the current data (the weekly average of 32 trains per day).

The Te Kowhai East Road level crossing is on an urban Arterial Road with an AADT of 9,609, 4% of which are Heavy Commercial Vehicles. There are approximately 32 trains a day with a rail line speed of 100 km/h. However, if freight trains are coming from the Burbush yard, they must travel at a maximum speed of 25 km/h until the last wagon has left the yard. As most trains are travelling at 100 km/h, it was assumed that the 'typical' speed was 80 km/h for a train.

This speed restriction was brought up as the main concern of the Locomotive Engineer, as they believe the long downtimes and low speeds will encourage vehicles to drive around the HABs and in front of oncoming trains. For this reason, median islands on both approaches were recommended.

The crossing has HABs and FLBs on both approaches. The condition of the pavement is acceptable, and there is a rubber track panel on the level crossing. There are gated WX1 signs on both approaches, however, the WX1 on the left-hand side of the eastbound approach has been tilted towards a commercial accessway. It is recommended this be adjusted so it faces eastbound vehicles on Te Kowhai East Road, to give them appropriate advance warning.

There was also no 'RAIL X' pavement marking on the east approach. It was recommended this be installed using long life road marking to reduce the frequency of maintenance.

While on site a HiRail vehicle was observed crossing the road by waiting for vehicles to give way. The KiwiRail Signals Engineer noted that remote operation of the FLBs should be set up for KiwiRail workers so that they do not have to wait for vehicles to give way to them, as this is unusual and may lead to incidents. This was included as a recommendation for KiwiRail.

Both the RCA and KiwiRail representatives noted that long queues form due to the two roundabouts to the east of the crossing. Crosshatching was recommended with long life road marking to deter vehicles queueing over the crossing.

An investigation into streetlighting should be conducted to ensure the crossing is adequately lit.

As part of the Rotokauri Development Plan, Te Kowhai East Road will be upgraded to a four-lane carriageway with traffic signals installed to the Te Kowhai East Road/Tasman Road intersection. These traffic signals would be linked to the rail level crossing. Median islands and an escape lane are included in this design.

The roundabouts to the east (The Boulevard/Te Kowhai East Road and Te Rapa Road/Church Road) will be converted to traffic signals. The controllers will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing.

While these upgrades would significantly improve the safety of the rail level crossing, the ALCAM proposal score remained high due to the high road volumes in 2032 (opening day) and 2042 (future score).

The locomotive engineers risk score was also high due to concerns with these volumes (at least 11,826 vehicles per day). Their preference was for grade-separation.

A summary of the changes to the ALCAM risk band is presented in the following table.

Table 1-4. Summary of ALCAM changes at Te Kowhai Road level crossing.

	Updated Existing	Change in Use	Proposed Design	Future Score
ALCAM Risk Band	**High**	**High**	**High**	**High**
ALCAM risk score change (%)	**-**	**+ 14%**	**+ 8%**	**+ 11%**
Fatal Return Period	**510 years**	**446 years**	**472 years**	**464 years**

The Updated Existing ALCAM risk band was High and stayed at High for the Change in Use score, which increased the ALCAM risk score by 40% and increased the likelihood of fatal crash occurring.

The Proposed Design ALCAM risk band was High with an 8% increase to the risk score compared to the Updated Existing. The return period for fatal crashes decreased by 38 years, meaning a fatality is more likely than for the Updated Existing scenario. This is largely due to the increased volumes from the 2032 Opening Day compared to 2022 Updated Existing.

The Future Score ALCAM risk band was High with a 11% increase to the risk score compared to the Updated Existing. The return period for a fatality decreased by 46 years, meaning fatal crashes are more likely than the Updated Existing scenario.

There were no Red Flag issues raised at this road crossing for any of the assessment stages.

1.1.4 Recommended Road Crossing Improvements

As this is an existing facility upgrade (as per Section 3.2.2), the upgraded level crossing must meet Criterion 2. Achieving Criterion 1 is desirable but not mandatory. The Proposed Design falls into the Medium LCSS risk band, failing Criterion 1 but achieving Criterion 2. The Future Score falls into the Medium risk band, failing both Criterion 1 and 2.

To improve safety and not increase risk, all recommendations in the Proposed Design should be implemented. To achieve Criterion 2 in the Future Score scenario, grade separation or closing the crossing would be the safest solution. The ALCAM score remains high due to the estimated road volumes for 2032 and 2042, even with assuming no change in rail volumes.

1.1.5 Recommended ALCAM Updated in LXM

To assist KiwiRail with improvements to the ALCAM database, the following data should be considered to update the existing level crossing in LXM:

- Max train speed up and down updated from 110 km/h to 100 km/h for freight as per LE instruction
- Freight volumes updated from 17.48 train movements daily to 32 train movements daily as per current weekly average (2022)
- Half boom flashing lights updated to half boom flashing lights (duplicated)
- Bells/audible warning devices selected
- Nearby train station isn't in LXM – should be in the 'proximity to structure' section.

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2 Glossary

AADT	Annual Average Daily Traffic Volume
ALCAM	Australian Level Crossing Assessment Model
CAS	Crash Analysis System
CC	City Council
DC	District Council
FLB	Flashing Lights and Bells
HAB	Half-arm Barrier
HCV	Heavy Commercial Vehicle
km/h	kilometres per hour
LCSIA	Level Crossing Safety Impact Assessment
LCSS	Level Crossing Safety Score
LE	Locomotive Engineer
LX	Level Crossing
MOTSAM	Manual of Traffic Signs and Markings
NIMT	North Island Main Trunk
NSAAT	No Stopping At All Times
Waka Kotahi	New Zealand Transport Agency, Waka Kotahi
ORA	Operating Reporting Architecture
ppd	pedestrians per day
RCA	Road Controlling Authority
SFAIRP	So Far As Is Reasonably Practicable
SPAD	Signal Passed At Danger
SSSS	Site Specific Safety Score
SUP	Shared Use Path
TCD	Traffic Control Devices
TGSI	Tactile Ground Surface Indicators
vpd	vehicles per day

3 Introduction

3.1 Level Crossing Safety Impact Assessment (LCSIA)

While there are few crashes at level crossings compared with the rest of the road network, the consequences are often a serious injury or fatality. Thus, it is important that any level crossings be effectively investigated through a rigorous risk assessment process, the Level Crossing Safety Impact Assessment (LCSIA).

The LCSIA process was developed to assess the level of crash risk of existing and new / upgraded level crossings designs. Using a Level Crossing Safety Score (LCSS), the risk is scored out of 60, which takes into consideration the Australian Level Crossing Assessment Model (ALCAM) risk scores. This is broken down into the following sections:

- ALCAM score (30 points)
- Crash and Incident History score (10 points)
- Site Specific Safety Score (SSSS) (10 points)
- Engineer Risk score (10 points).

As can be observed, the ALCAM score is responsible for half of the LCSS. ALCAM is a tool used to identify key potential risks at level crossings and to assist in the prioritisation of crossings for upgrades. It is used to help decide the effective level of treatment required for a crossing.

3.2 LCSIA Criteria

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

- Criterion 1: the proposed design/upgrade of a crossing to achieve a “Low” or “Medium – Low” level of risk, as determined by the LCSS
- Criterion 2: the proposed design/upgrade of a level crossing to achieve a LCSS lower than the existing LCSS.

3.2.1 Proposed Facility

Where a new facility is proposed and no existing ALCAM assessment exists, the new crossing must meet Criterion 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.

3.2.2 Existing Facility Upgrade

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

3.3 Structure of Report

The structure of this report follows the structure as outlined in the Level Crossing Risk Assessment Guidance (Version 5, 2022) as set out by KiwiRail.

4 Background

4.1 Brief Project Outline

As part of the Rotokauri Development Plan, Hamilton City Council plans to upgrade Te Kowhai East Road to four lanes. The Tasman Road intersection with Te Kowhai East Road is proposed to be signalised, which will incorporate the Te Kowhai Road level crossing A new Ped Up level crossing is proposed for pedestrians only on the north side of the crossing. The existing Ped Down crossing on the south side of the crossing is proposed to have crossing facilities for pedestrians and cyclists. Aurecon has been commissioned by Hamilton City Council (HCC) to undertake LCSIAs for the three level crossings at Te Kowhai East Road. They are as follows:

Table 4-1. Crossing ID and Name

Crossing	ALCAM Number	ALCAM Crossing Name
Te Kowhai East Road	2474	Te Kowhai Road
Te Kowhai East Road Ped Up	4743	Te Kowhai Rd Ped Up
Te Kowhai East Road Ped Down	4744	Te Kowhai Rd Ped Down

This report relates to the road crossing (2474), the pedestrian up and down facilities (4743 and 4744) are contained within a separate report.

4.2 Key Assumptions

- Traffic volumes for 2032 (opening day) and 2042 (10-year scenario) are based on linear growth estimates using 2019 traffic counts and 2051 traffic modelling provided by HCC
- Rail volumes for 2032 (opening day) and 2042 (10-year scenario) are assumed to be the same as the current rail volumes, which is 32 per day (weekly volumes) at a speed of 80km/h.
- The site visit undertaken on 27/05/2022 with KiwiRail and Hamilton City Council and the photos taken are deemed acceptable to use for this updated LCSIA.

4.3 Documents Provided

The following documents and information were provided for the LCSIA:

- Level Crossing Risk Assessment Guide (2022) Version 5, Waka Kotahi NZ Transport Agency and KiwiRail
- ORA data dated January 2010 – April 2022 from KiwiRail
- Signalling and Interlocking diagrams from KiwiRail
- Train frequency and speeds from KiwiRail
- Traffic counts (2019) from HCC
- Traffic network model volumes (2051) from HCC
- Rotokauri Arterials Designation plan of the level crossing layout from HCC.

4.4 Site Visit

A site visit was undertaken on the 27th of May 2022 with representatives from Aurecon, KiwiRail and Hamilton City Council. The table below lists the representatives present.

Table 4-2. Site Visit

Date and time	27/05/2022 10:00
KiwiRail Certified LCSIA Assessors from Aurecon	Bridget Feary, Lead Engineer Dinesh Fonseka, Transportation Engineer
KiwiRail Representatives	Ken Ashman, Signals Engineer Terry Herbert, Locomotive Engineer
Hamilton City Council Representatives	Simon Crowther, Senior Network Engineer Michael Thorne, Infrastructure Engineer Transport

4.5 LCSIA Assessor Independence

The LCSIA assessors have had no prior involvement with the change in use project at the Te Kowhai East Road level crossing.

4.6 Top-Down Evaluation

The first step in the evaluation of a level crossing prior to the LCSIA is a top-down evaluation of options to close or grade separate the crossing.

If the RCA agrees that the crossing can be closed an LCSIA assessment is not required.

The LCSIA report has been commissioned to investigate crossing risks and options as the report is intended to ensure the safety case for continued operation or closure is fully and independently investigated.

The RCA was asked So Far As is Reasonably Practicable (SFAIRP), can the crossing be closed; can an alternative crossing on the same network be closed; or can the crossings be grade separated.

4.6.1 Te Kowhai Road SFAIRP

In consultation with Hamilton City Council the SFAIRP assessment for Te Kowhai Road was:

1. Can the level crossing be closed? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to close the crossing** as it services a significant road corridor and there is not a suitable alternative crossing within a reasonable distance that services this industrial area. Closing this crossing would impact network operations on Wairere Drive, road over rail bridge to the south. At the time of writing, the Ruffell Road level crossing to the north has been temporarily closed.
2. Can an existing level crossing on the same network be closed? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to close an alternative crossing** as there is not another level crossing on the network which can be closed without a significant impact on network operations or safety. At the time of writing the Ruffell Road level crossing to the north had been closed due to safety reasons.
3. Can the level crossing be grade separated? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to grade separate the crossing** as the cost of grade separation is grossly disproportionate to the risk, and there are geometric constraints that preclude grade separation. Grade separation would impact Tasman Road intersection, private access ways, and potentially also the roundabout to the east.

It was not considered reasonably practicable to close, or grade separate the level crossing; therefore, the LCSIA was completed.

5 Te Kowhai Road LCSIA

5.1 Existing Conditions at the Level Crossing

The table below provides a summary of the key attributes relating to the level crossing.

Table 5-1 Existing conditions at Te Kowhai Road.

Crossing name	Te Kowhai Road Te Rapa
ALCAM reference	2474
Type (Road/Pedestrian)	Road
Crossing description	HAB and FLB
Environment (Rural/Urban)	Urban
Road geometry	Straight, flat. East of the Tasman Road T- intersection.
Posted speed limit	50 km/h
Jurisdiction	Hamilton City Council
AADT	9609 vpd
HCV	4%
Train volumes (per day)	16
Rail line speed	110 km/h

Te Kowhai Road level crossing (ALCAM 2474) is on Te Kowhai East Road in Te Rapa, Hamilton. The road intersects the North Island Main Trunk Line at KM548.1 at a 90-degree angle, as shown in the aerial image below. It is north of Rotokauri Railway Station.

Figure 5-1. Te Kowhai Road Te Rapa Level Crossing (ALCAM 2474). Image source: map.grip.co.nz/map and annotated by LCSIA Team.

Te Kowhai East Road services Te Rapa, an industrial and retail centre north of Hamilton City and east of State Highway 1. It has been designated an Arterial Road and significant growth in traffic volumes are expected as Rotokauri to the west, is developed. Immediately surrounding the level crossing are industrial sites, big box retail stores, car yards, and a fuel station. Te Rapa Road, Wairere Drive, and State Highway 1 are the main connections between Te Rapa and central Hamilton. The immediate area around the level crossing is zoned industrial. To the west is the Rotokauri Structure Plan area which is zoned as an employment zone between the industrial zone and SH1, and west of SH1 as residential land. Rotokauri is a growth cell with significant development planned and underway. The Rotokauri Transport Hub was opened in January 2021 south of the crossing and is a park and ride, rail station, bus interchange and pedestrian connection to The Base. A future Arterial Road is proposed west of SH1 which will connect to SH39 to the north, Te Kowhai East Road centrally and Te Wetini Drive to the south.

At the time of the site visit, the road was busy. A pedestrian level crossing on the south side of the road crossing was also being used by pedestrians, cyclists, and scooter riders. Tasman Road to the south of the crossing has separated cycle and footpaths on the west side and a shared use path on the east side for pedestrian and cyclist activity in the area as development occurs and in support of the Transport Hub.

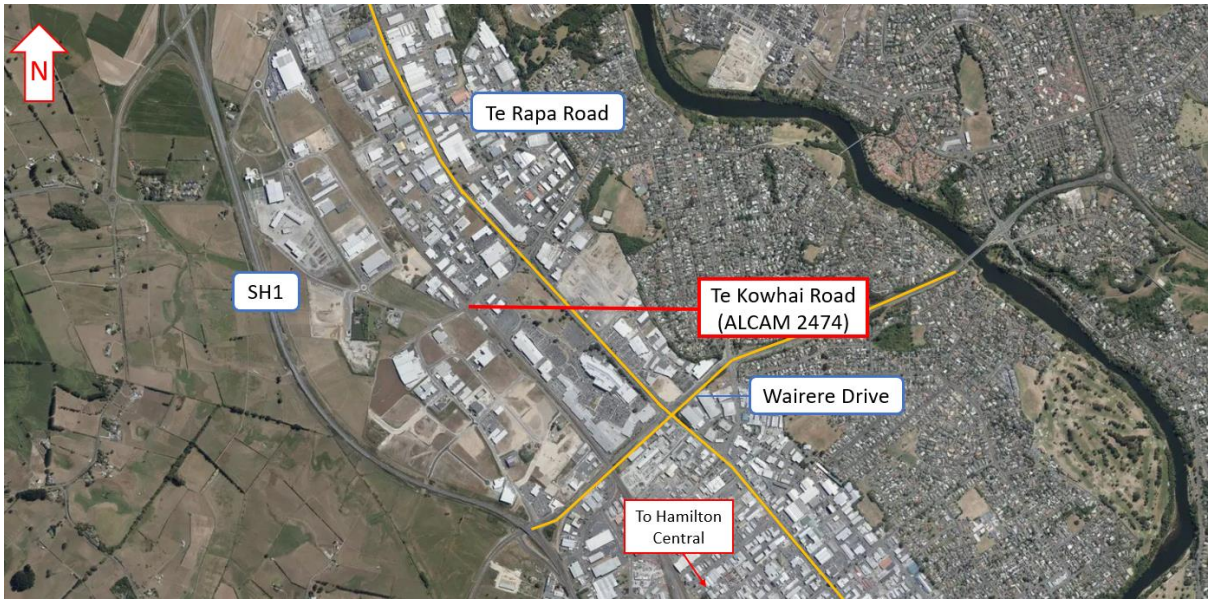


Figure 5-2. Te Kowhai Road Te Rapa Level Crossing in relation to key arterials and SH1 (approximate location marked up). Image source: map.grip.co.nz/map and annotated by LCSIA Team.

The level crossing surface is in good condition there is a slight dip across the crossing. The track surface and rubber panel is in good condition with small flange gaps and a level even surface.

Figure 5-3. Te Kowhai Road level crossing surface.

Figure 5-4. Te Kowhai Road level crossing surface dip is visible.

Figure 5-5. Debris and pooling water on the surface.

Figure 5-6. Road and Track Panel in good condition.

The crossing is controlled by half-arm barriers (HAB) and Flashing Lights and Bells (FLB).

Figure 5-7. HAB and gated FLB from eastern approach.

Figure 5-8. Westbound approach HAB and FLB.

As shown in Figure 5-8 above, the crossing is close to a Give Way controlled T-intersection with Tasman Road. There is also a four-leg roundabout on the eastern approach, approximately 150-160m north-east of the crossing. There are congestion issues to the east on the approaches to the Church Street Roundabout. HCC advised they were proposing metering signals at the roundabout to manage congestion.

Figure 5-9. Eastbound approach side road.

The perpendicular approach affords good sightlines north and south on both approaches.

Figure 5-10. Eastbound sightline north.

Figure 5-11. Eastbound sightline south.

Figure 5-12. Westbound sightline north.

Figure 5-13. Westbound sightline south.

The road markings are in good condition. There is no yellow cross-hatching on the rail crossing. The HCC representative confirmed during the site visit that HCC will be remarking the area soon and requested the LCSIA assessor advise of any new markings required for the road and pedestrian level crossing as soon as possible to enable them to be included in the re-marking programme.

Both approaches have gated WX1 advance warning signs. The eastbound approach did not have a 'RAIL X' pavement road marking likely due to the short distance between the crossing and Tasman Road. The WX1 sign on the left-hand side has been twisted towards a commercial accessway. The image below shows the advanced warning signs on the westbound approach. It has gated WX1s and 'RAIL X' pavement road marking.

Figure 5-14. Advanced gated steam-train signs and RAIL-X road marking.

Sunstrike is an issue at this site due to the road alignment. The image below is taken from the passenger seat approaching the crossing east bound.

Figure 5-15. Sunstrike during the site visit, while travelling east across Te Kowhai Road crossing.

There is a pedestrian level crossing on the Down track side of the road crossing. The crossing layout is shown in the images below. The pedestrian level crossing is not in the KiwiRail GIS or ALCAM LXM database. It has a pedestrian maze, TGSI limit line, and 'Look for Trains' signage. The HCC representative was unaware of which party installed this pedestrian level crossing. They assumed it may have been installed as part of the Rotokauri Transport Hub project. Street view images indicate it was installed between March and August 2018. This crossing has been allocated an ALCAM ID number, 4744 and has been assessed in a separate report.

Te Kowhai East Road runs east to west and is bisected by grade separated SH1 running north to south.

The KiwiRail Locomotive Engineer stated that while the crossing was in good condition, he was concerned with the queues that form due to long barrier-arm down times. These times are particularly long for freight trains leaving the nearby Burbush rail yard to the south, as the freight train has to maintain a speed of 25 km/h until the last wagon has left the yard. This results in queues stretching back through both Maahanga Drive and Te Rapa Road roundabouts on the westbound approach.

Future projects were discussed on site with the RCA representatives. As part of the Rotokauri Structure Plan it is planned to upgrade Te Kowhai East Road to four lanes, with a signalised intersection at the level crossing. The roundabouts to the west of the level crossing will be converted into signalised intersections.

While on site a HiRail vehicle was observed using the level crossing without triggering the track circuits. They instead waited at the edge of the road carriageway until vehicles on Te Kowhai East Road stopped to give way. It was noted by the KiwiRail Signals Engineer that remote-controlled operation of the crossing controls can be set up for KiwiRail workers, at a relatively low cost.

A night audit was not undertaken at this location. There is overhead street lighting on the northwest corner of the crossing only. Lack of lighting of the approaches could fail to illuminate waiting vehicles to the oncoming train. To determine if lighting is sufficient, a night audit should be conducted.

5.1.1 Key Existing Safety Issues

- There are frequent queues during peak hours along this road, which leads to cars queueing across the track. There is the potential for drivers to try to bypass the controls to avoid further delays
- Glare from the sun can blind approaching drivers
- There are long barrier-down times due to bi-directional freight trains. Freight trains leaving the Burbush yard operate at a maximum speed of 25km/h until the last wagon has left the yard. This may lead to impatient vehicles driving around the barriers to avoid long wait times
- The crossing is missing yellow cross hatching, a warning sign is twisted, and Rail X is only marked on one approach
- HiRail vehicles using the crossing without triggering track circuits – instead they waited for vehicles on Te Kowhai East Road to give way. This may increase the risk of an incident as drivers are not expecting vehicles on the rail line unless the crossing is activated
- The possibility of lack of visibility at night due to insufficient lighting. A night audit was not conducted to fully assess this issue and a review is recommended.

5.2 Proposed Design

The following design has been assessed for the opening day and future scenarios.

5.2.1 HCC four-lanes and signalised intersection

Hamilton City Council is currently in the process of designating the future 4-lane corridor for Te Kowhai East Road. A design has been undertaken for the level crossing to confirm land requirements and designation extents. The proposed design for construction by 2032, shown in Appendix B, maintains the existing half-arm barriers and flashing lights and bells controls at the crossing, with the addition of:

- Median traffic islands on both approaches
- Signalisation of the Te Kowhai East Road / Tasman Road intersection, incorporating the level crossing.
  - The road and rail signals will be linked, and road phasing incorporate a clearance phase and a train operating phase
- Roundabouts to the east at The Boulevard/Te Kowhai East Road and Te Rapa Road/Church Road converted to signalised intersections
  - It is intended these intersections will incorporate train clearance phasing to ensure when there is an approaching train, the controllers will give a green wave to help clear any potential queues at the rail level crossing.
- A 30m emergency escape shoulder zone for eastbound vehicles directly past the level crossing, which starts 10m after the crossing

5.2.2 General Improvements

In addition to the design proposal, the following improvements are recommended by the LCSIA Assessors to address existing safety issues at the crossing.

- Install yellow cross hatching markings through the crossing to reduce the likelihood of queueing
- Mark 'RAIL X' on all crossing approaches with long life road marking
- Set up remote operation of crossing controls for HiRail vehicles and KiwiRail workers – to avoid confusion for drivers on Te Kowhai East Road having to give way to rail vehicles when the crossing is not operating
- Investigate the provision of streetlighting at the crossing to ensure approaching train drivers can see vehicles queueing or stacking across the crossing at night and to provide lighting for the proposed pedestrian and cycle facilities.

5.3 ALCAM Score

The ALCAM risk scores and summary for the Te Kowhai Road crossing are shown in Table 5-2.

The following are updates required for LXM based on the Updated Existing proposal:

- Max train speed up and down updated from 110 km/h to 100 km/h for freight as per LE instruction
- Current Freight volumes updated from 17.48 train movements daily to 100 train movements weekly per LE instruction
- Half boom flashing lights updated to half boom flashing lights (duplicated)
- Bells/audible warning devices selected.

Table 5-2. ALCAM score for Te Kowhai Road crossing.

Stage	LCSS Risk Score	Risk Change	Comments
Updated Existing	24 / 30	-	This score is based on the existing level crossing, with two operational tracks. The AADT is currently 9,690 vehicles per day and train volumes are 32 per day (2022). **ALCAM risk score is 19.6 (0.00196) and the risk band is MEDIUM – HIGH**
Change in Use	25 / 30	+ 14%	This score is based on the updated existing level crossing with 2042 future traffic volumes of 12,181 vehicles per day (linear growth estimate between 2019 and 2051 volumes). Future train volumes are assumed to remain at 32 per day. **ALCAM risk score is 22.4 (0.00224) and the risk band is HIGH**
Proposed Design	25 / 30	+ 8%	This score is based on the HCC proposed design on opening day in 2032. The estimated AADT is 11,826 vehicles per day with estimated train volumes of 32 per day (2032). The proposed design includes upgrading to four-lanes, a signalised intersection linked to the rail crossing, installing median islands, an escape lane and other maintenance-related upgrades. **ALCAM risk score is 21.2 (0.00212) and the risk band is HIGH**
Future Score	25 / 30	+ 11%	This score is based on the proposed design with 2042 future traffic volumes of 12,181 vehicles per day (linear estimate between 2019 and 2051 volumes). Future train volumes are assumed to remain at 32 per day. The proposed design includes upgrading to four-lanes, a signalised intersection linked to the rail crossing, installing median islands, an escape lane and other maintenance-related upgrades. **ALCAM risk score is 21.5 (0.00215) and the risk band is HIGH**

5.4 Crash and Incident History Score

The crash and incident history score is based on the number of incidents reported in the KiwiRail ORA database and Waka Kotahi CAS database between 2012 to 2022. For the Te Kowhai Road crossing there were two near miss incidents reported in ORA, one for the road and one for pedestrians. The road incident is summarised below. There were no crashes reported in CAS.

Table 5-3. 10-year crash data, January 2012 - August 2022.

Database	Incident Number	Incident Date	Incident Type	Description
ORA	1910110	20/11/2019	Driving under barrier arms (near miss)	Alarm bells started ringing and a truck didn't stop, his cab was sitting on the down main and a train was approaching on the up main, the barriers started coming down onto the side of the truck and a signals person ran over and lifted the barrier for truck to reverse, instead he kept on driving.

The crash and incident history score is shown in Table 5-4.

Table 5-4 Crash and incident history score.

Incident Type	Rating	Number of Incidents	Score
Driving / walking through / under / around barrier arms (near miss)	3	1	3 x 1 = 3
Total Score		2	3 / 10

5.5 Site Specific Safety Score

The site-specific safety score (SSSS) aims to analyse elements of the level crossing layout that are either not well covered or missing from the ALCAM risk rating. To achieve a score out of ten, the SSSS is simply prorated down from a score out of thirty and then rounded to the nearest whole number.

If the level crossing triggers a red flag scenario, the SSSS is automatically scored as 24/30 (an overall 8/10). If the LCSIA assessor is not satisfied the calculated SSSS adequately portrays the risk of the level crossing (it has or understated the risk), they are able to provide a 'Modified' SSSS total score.

The Urban Road SSSS tables have been used to score the level crossing.

The SSSS score for the Te Kowhai Road level crossing is shown in Table 5-5.

Table 5-5. SSSS for Te Kowhai Road crossing.

Assessed Items	Updated Existing	Change in Use	Proposed Design	Future Score	Comments
Crossing Controls	2 / 5	2 / 5	1 / 5	1 / 5	Half-arm barriers with flashing lights and bells, and median islands.
Queueing	4 / 6	4 / 6	1 / 6	1 / 6	Occasional queues formed due to roundabouts on both departure sides of the crossing, scores 2+2. Proposed design has traffic signals linked to level crossing to help clear queues and escape lane

Assessed Items	Updated Existing	Change in Use	Proposed Design	Future Score	Comments
Short stacking / grounding out	0 / 10	0 / 10	0 / 10	0 / 10	Short stacking not possible, no evidence of grounding out.
Accessways / side roads and bisecting intersections	0 / 6	0 / 6	0 / 6	0 / 6	No accessways / side roads on RHS of the departure side.
Observed non-compliance	1 / 3	1 / 3	1 / 3	1 / 3	LE noted that they've had no non-compliance issues at this crossing. One incident reported, but issues likely due to queuing.
Total Score	7 / 30	7 / 30	3 / 30	3 / 30	
SSSS	2 / 10	2 / 10	1 / 10	1 / 10	
Red Flag Scenarios	-	-	-	-	

5.6 Engineers' Score

The engineers' risk score is a combination of LE and RCA Engineer's opinions of the crash risk at the level crossing, with a weighting of 2:1 in the favour of the LE. Opinions for this level crossing site were provided by the people mentioned in Section 2.4.

The engineer score for the Te Kowhai Road crossing is provided in Table 5-6.

Table 5-6. LE and RCA Score for Te Kowhai Road crossing.

	Updated Existing	Change in Use	Proposed Design	Future Score	Comments
Locomotive Engineer	2 / 10	7 / 10	6 / 10	7 / 10	No issues with crossing with current volumes but concerned with future road and rail volumes for 2032 and 2042. Also concerned with low-speed freight trains departing Burbush yard.
RCA Engineer	1 / 5	4 / 5	2 / 5	2 / 5	No issues with current volumes but concerned with forecast growth in road and rail.
Total	3 / 15	11 / 15	8 / 15	9 / 15	
Total for LCSS	**2 / 10**	**7 / 10**	**5 / 10**	**6 / 10**	

5.7 Level Crossing Safety Score

Table 5-7 summarises the resultant LCSS based on the above scores for the Te Kowhai Road crossing.

Additional design features were tested on LXM to check whether the ALCAM LCSS score (and subsequently the LCSS score) could be reduced to achieve Criterion 2. The following features were tested:

- Duplicated Active Warning signs
- Control of crossing (CCTV)
- CCTV surveillance

- Detectors in crossing conflict zone
- Train activated strobe light
- Overhead mounted (mast arm) traffic control
- Passive tactile advance warning (eg rumble strip)
- Active sign for second oncoming train warning

With these additional features selected, the ALCAM risk score reduced from 0.0052 to 0.00508 (reduction in ALCAM LCSS from 29/30 to 28/30). To achieve Criterion 2, the ALCAM risk score would need to reduce to 0.003 (26/30).

Table 5-7. LCSS for Te Kowhai Road crossing.

	Updated Existing	Change in Use	Proposed Design	Future Score	Comments
ALCAM score	24 / 30	25 / 30	25 / 30	25 / 30	Crossing currently has FLB + HAB, so median islands, signals and escape lane are proposed changes to controls
Crash and incident history score	3 / 10	6 / 10	0 / 10	1 / 10	With increased freight movements and therefore longer down-times, the likelihood of vehicles driving under barriers to cross in front of trains may increase (particularly at speeds of 25 km/h from the Burbush yard). A signalised intersection with median islands, an escape lane and controllers linked to nearby signals to clear queued vehicles should reduce the likelihood of an incident.
Site specific safety score	2 / 10	2 / 10	1 / 10	1 / 10	Score is low, main issue is queueing from the nearby roundabouts. This issue is mitigated with upgrading the roundabouts to signalised intersections with controllers set to green wave to help clear queued vehicles over the crossing.
Locomotive and RCA engineer risk score	2 / 10	7 / 10	5 / 10	6 / 10	Increase in risk score due to concerns with redirected road volumes and increase rail volumes.
LCSS SCORE	**31 / 60**	**40 / 60**	**31 / 60**	**33 / 60**	The Proposed Design meets Criterion 2, having an LCSS score equal to the Updated Existing. The Future Score fails both Criterion 1 and Criterion 2.
LCSS RISK BAND	**MEDIUM**	**MEDIUM – HIGH**	**MEDIUM**	**MEDIUM**	
CRITERION MET			**C1 FAIL, C2 MET**	**C1 and C2 FAIL**	
FORM OF CONTROL	**HAB and FLBs**	**HAB and FLBs**	**Signalised coordinated intersection, HAB and FLBs**	**Signalised coordinated intersection, HAB and FLBs**	

5.8 Recommendation

A summary of recommendations is shown below in Table 5-8.

Table 5-8. Te Kowhai Road key recommendations

No.	Recommendation	Category
1.	As per proposed design, upgrade to signalised intersection with an escape lane (Te Kowhai East Road/Tasman Road, will also be linked to the rail level crossing).	Proposed Design / Criterion 2

No.	Recommendation	Category
2.	As per proposed design, the roundabouts to the east (The Boulevard/Te Kowhai East Road AND Te Rapa Road/Church Road) to be converted to traffic signals. The controllers will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing.	Proposed Design / Criterion 2
3.	As per proposed design, install median islands on the approaches to address the risk of impatient drivers driving around the controls.	Proposed Design / Criterion 2
4.	Mark crosshatching with long life road marking at the level crossing.	Criterion 2
5.	Mark 'RAIL X' on all approaches with long life road marking.	Criterion 2
6.	Set up remote operation of FLB for HiRail vehicles and KiwiRail workers – to avoid having to give way to vehicles on Te Kowhai East Road.	KiwiRail maintenance
7.	Investigate the provision of streetlighting at the crossing to ensure approaching train drivers can see vehicles queueing or stacking across the crossing at night.	Investigation

The Updated Existing LCSS is Medium, and the Change in Use LCSS increases to the Medium – High risk band. The Proposed Design falls into the Medium risk band, meeting Criterion 2 but failing Criterion 1. The Future Score falls into the Medium risk band, failing both Criterion 1 and 2. Therefore, while the Proposed Design achieves Criterion 2 (as required for an existing crossing), closure or grade separation is required to achieve Criterion 2 for the Future Score in 2042. This was with assuming no change in rail volumes from the current data (the weekly average of 32 trains per day).

The Te Kowhai East Road level crossing is on an urban Arterial Road with an AADT of 9,609, 4% of which are Heavy Commercial Vehicles. There are approximately 32 trains a day with a rail line speed of 80 km/h. However, if freight trains are coming from the Burbush yard, they must travel at a maximum speed of 25 km/h until the last wagon has left the yard. As most trains are travelling at 100 km/h, it was assumed that the 'typical' speed was 80 km/h for a train.

This speed restriction was brought up as the main concern of the Locomotive Engineer, as they believe the long downtimes and low speeds will encourage vehicles to drive around the HABs and in front of oncoming trains. For this reason, median islands on both approaches were recommended.

The crossing has HABs and FLBs on both approaches. The condition of the pavement is acceptable, and there is a rubber track panel on the level crossing. There are gated WX1 signs on both approaches, however, the WX1 on the left-hand side of the eastbound approach has been tilted towards a commercial accessway. It is recommended this be adjusted so it faces eastbound vehicles on Te Kowhai East Road, to give them appropriate advance warning.

There was also no 'RAIL X' pavement marking on the east approach. It was recommended this be installed using long life road marking to reduce the frequency of maintenance.

While on site a HiRail vehicle was observed crossing the road by waiting for vehicles to give way. The KiwiRail Signals Engineer noted that remote operation of the FLBs should be set up for KiwiRail workers so that they do not have to wait for vehicles to give way to them, as this is unusual and may lead to incidents. This was included as a recommendation for KiwiRail.

Both the RCA and KiwiRail representatives noted that long queues form due to the two roundabouts to the east of the crossing. Crosshatching was recommended with long life road marking to deter vehicles queueing over the crossing.

An investigation into streetlighting should be conducted to ensure the crossing is adequately lit.

As part of the Rotokauri Development Plan, Te Kowhai East Road will be upgraded to a four-lane carriageway with traffic signals installed to the Te Kowhai East Road/Tasman Road intersection. These traffic signals would be linked to the rail level crossing. Median islands and an escape lane are included in this design.

The roundabouts to the east (The Boulevard/Te Kowhai East Road and Te Rapa Road/Church Road) will be converted to traffic signals. The controllers will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing.

While these upgrades would significantly improve the safety of the rail level crossing, the ALCAM proposal score remained high due to the high road volumes in 2032 (opening day) and 2042 (future score).

The locomotive engineers risk score was also high due to concerns with these volumes (at least 11,826 vehicles per day). Their preference was for grade-separation.

5.8.1 Recommended Improvements

As this is an existing facility upgrade (as per Section 3.2.2), the upgraded level crossing must meet Criterion 2. Achieving Criterion 1 is desirable but not mandatory. The Proposed Design falls into the Medium LCSS risk band, failing Criterion 1 but achieving Criterion 2. The Future Score falls into the Medium risk band, failing both Criterion 1 and 2.

To improve safety and not increase risk, all recommendations in the Proposed Design should be implemented. To achieve Criterion 2 in the Future Score scenario, grade separating or closing the crossing would be the safest solution. The ALCAM score remains high due to the estimated road and rail volumes for 2032 and 2042.

Appendix A – KiwiRail Comments / Scoring

Dinesh Fonseka

From: Dinesh Fonseka
Sent: Friday, 16 September 2022 2:21 PM
To: Dinesh Fonseka
Subject: FW: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

DISCLAIMER

From: Dinesh Fonseka
Sent: Wednesday, 31 August 2022 4:23 PM
To: Bridget Feary <Bridget.Feary@aurecongroup.com>
Cc: Ann Fosberry <Ann.Fosberry@aurecongroup.com>
Subject: RE: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

FYI

Had a call with Terry and he gave me these scores.

In terms of the proposed design, he expressed concern with long waiting times at the traffic lights, and would prefer grade separation.

Cheers,

Dinesh Fonseka
Engineer, Aurecon
T +64 09 5206019

DISCLAIMER

From: Dinesh Fonseka
Sent: Friday, 26 August 2022 3:30 PM
To: Terry Herbert <Terry.Herbert@kiwirail.co.nz>
Cc: Ken Ashman <Ken.Ashman@kiwirail.co.nz>; Bridget Feary <Bridget.Feary@aurecongroup.com>; Ann Fosberry <Ann.Fosberry@aurecongroup.com>
Subject: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

Hi Terry,

Hope you're well. We have been asked by HCC to update the LCSIA for Te Kowhai East Road to include their four-lane + signalling upgrade design, along with two Ped LCSIAs.

One of the ped crossings is existing (with a maze, if you recall) and the other will be a new one planned to be built (automatic gates + maze).

The proposed design year is 2032, with a 'future score' scenario in 2042. Because of this, we now need some new Locomotive Engineers risk scores from you.

There is added uncertainty with the ped crossings as we have no data on the potential pedestrian volumes – so I'll be asking for your scores for 100 and 500 pedestrians for each scenario.

Please fill in the highlighted scores on the far right column in the tables below. There are three tables for the Road, Ped Up and Ped Down crossings.

Feel free to give me a ring if you have any questions, I understand this is a lot of information all at once! I can be reached on 021026 10364.

ROAD CROSSING

Scenario	Description	Road and Rail Volumes	Risk Score
Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Two-lane carriageway • Half-arm barriers • Flashing lights and bells	• 12,181 vehicles per day • 59 trains per day	7 / 10
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Four-lane carriageway • Half-arm barriers • Flashing lights and bells • Traffic signal control linked to rail crossing • Median traffic islands • Emergency escape shoulder on the east side for eastbound traffic • Roundabouts to the east (The Boulevard/Te Kowhai East Road AND Te Rapa Road/Church Road) to be converted to traffic signals. The controllers will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing	• 11,826 vehicles per day • 48 trains per day	6 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Four-lane carriageway • Half-arm barriers • Flashing lights and bells • Traffic signal control linked to rail crossing • Median traffic islands • Emergency escape shoulder on the east side for eastbound traffic • Roundabouts to the east (The Boulevard/Te Kowhai East Road AND Te Rapa Road/Church Road) to be converted to traffic signals. The controller will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing	• 12,181 vehicles per day • 59 trains per day	7 / 10

PED DOWN (EXISTING PED CROSSING)

Scenario	Description	Pedestrian and Rail Volumes	Risk Score
Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Maze • 'Look for Trains' signage	• 100 pedestrians per day • 59 trains per day	3 / 10

Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	6 / 10
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 48 trains per day	1 / 10
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 48 trains per day	4 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 59 trains per day	1 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	4 / 10

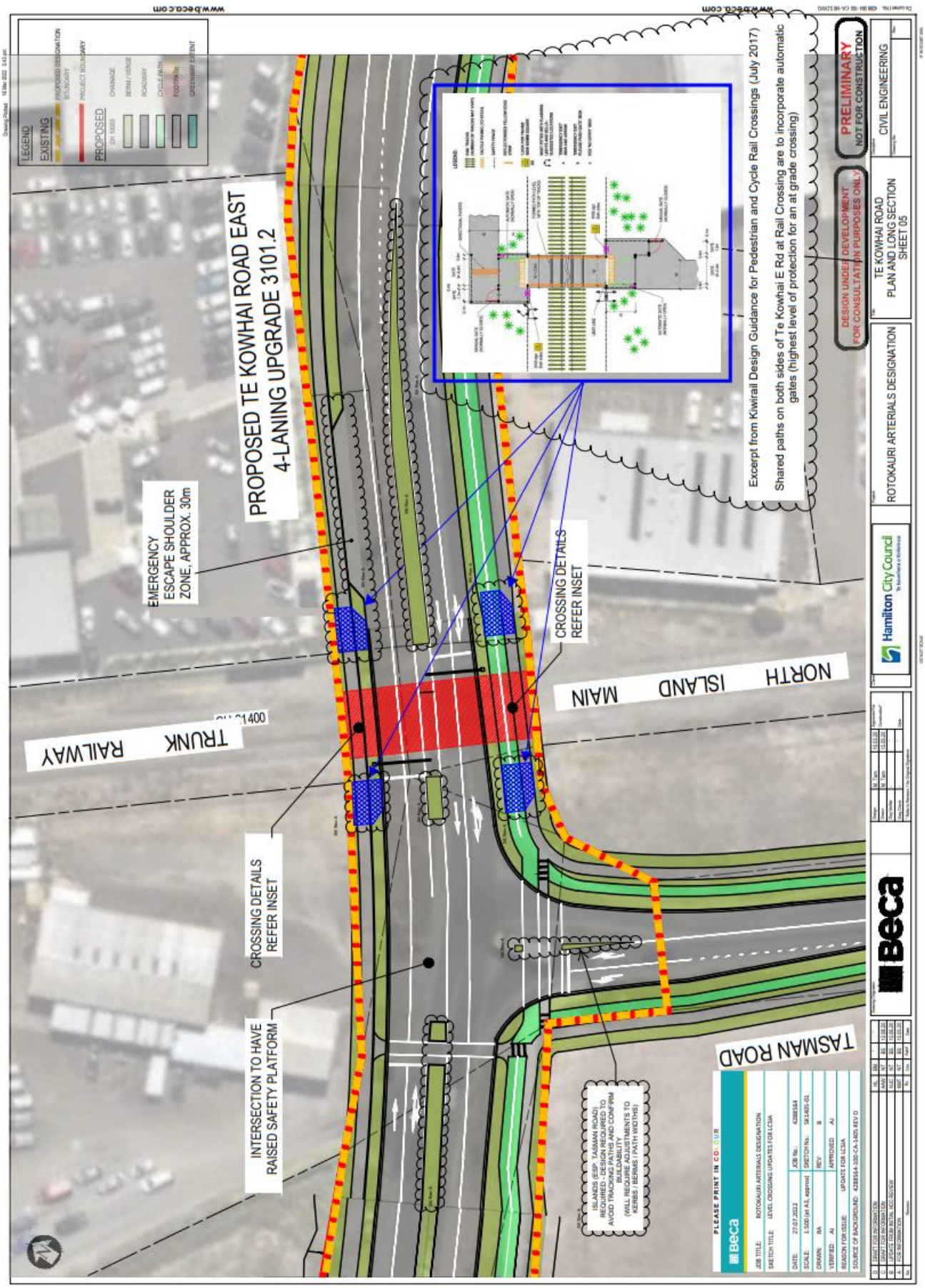
PED UP (NEW PED CROSSING)

Scenario	Description	Pedestrian and Rail Volumes	Risk Score
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 48 trains per day	1 / 10
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 48 trains per day	4 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 59 trains per day	1 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	4 / 10

Kind Regards,

Dinesh Fonseka
Engineer, Aurecon
T +64 09 5206019

Appendix B – HCC Concept Design



Appendix C – HCC Comments / Scoring

Dinesh Fonseka

From: Michael Thorne <Michael.Thorne@hcc.govt.nz>
Sent: Tuesday, 30 August 2022 9:22 AM
To: Dinesh Fonseka; Simon Crowther
Subject: RE: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

Hi Dinesh,

That is correct.

Michael.

From: Dinesh Fonseka <Dinesh.Fonseka@aurecongroup.com>
Sent: Tuesday, 30 August 2022 9:18 am
To: Simon Crowther <Simon.Crowther@hcc.govt.nz>
Cc: Michael Thorne <Michael.Thorne@hcc.govt.nz>
Subject: RE: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

Hi Simon,

Thanks for completing that. To confirm, road crossing scores are as follows:

Scenario	Risk Score
Change in Use – existing infrastructure with 2042 volumes	4 / 5
Proposed Design – upgraded design with 2032 volumes	2 / 5 (adjusted from 1/5)
Future Score – upgraded design with 2042 volumes	2 / 5

Kind Regards,

Dinesh Fonseka
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LCSIA Risk Assessment

Te Kowhai Road Pedestrian Level Crossings

Hamilton City Council

Reference: P522481

Revision: 1

2023-05-16

aurecon

Bringing ideas to life

Document control record

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Client contact		Michael Thorne	**Client reference**			
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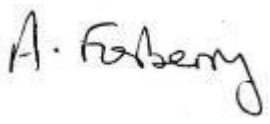
Current revision		**1**				

Approval			
Author signature		Approver signature	
Name	Dinesh Fonseka	Name	Ann Fosberry
Title	Engineer, Integrated Transport and Mobility	Title	Technical Director, Transport

1 Executive Summary

As part of the Rotokauri Development Plan, Hamilton City Council plans to upgrade Te Kowhai East Road to four lanes, with a signalised intersection at the existing level crossing location. The upgrade also includes two pedestrian crossings on either side of the road.

Aurecon has been commissioned by Hamilton City Council (HCC) to undertake LCSIAs for three crossings at Te Kowhai Road. This LCSIA report is for the Pedestrian Crossings only. A separate report has been prepared for the Road Level Crossing. The HCC concept design for the future upgrade is provided in Appendix B of this report.

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 detail the progression of the LCSS for the level crossings through the four stages of this LCSS while aiming to achieve the two KiwiRail LCSIA Criteria.

Following issue of the LCSIA reports to Hamilton City Council, the rail volumes for all current and future scenarios were updated to assume 32 trains per day (taking the weekly average) at a speed of 80km/h.

1.1 Te Kowhai Road Ped Down LCSIA

1.1.1 Te Kowhai East Road Ped Down Top-Down Evaluation

The Top Down So Far As Is Reasonably Practicable (SFAIRP) evaluation of crossing closure or grade separation was undertaken with Hamilton City Council. Their comments are shown in the table below.

Table 1-1. Top-down evaluation of Te Kowhai Road Ped Down level crossing.

1. Can the level crossing be closed? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to close the crossing** as: *"Prior to the installation of this pedestrian rail crossing, pedestrians had to walk alongside vehicular traffic.* *This created the risk of a pedestrian being sideswiped by a passing vehicle (particularly a risk of a strike by a large HCV) with the possibility the pedestrian could end up lying injured on the rail track unable to get up.* *Should a train be approaching immediately after the pedestrian is knocked over (and passing motorists have not yet had a chance to move the injured person) then there is a risk of a fatal injury.* *Therefore, the addition of the recent southside pedestrian rail crossing is a safety improvement over the previous combined vehicle and pedestrian rail crossing."* – Hamilton City Council
2. Can the level crossing be grade separated? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to grade separate the crossing** as: *"An overbridge would require pedestrians to walk up a 100m long ramp to a height of around seven metres which is likely to result in pedestrians simply crossing with vehicular traffic at grade, with the above-mentioned risks.* *An underpass would have a personal safety issue again leading to pedestrians crossing at grade.* *On this basis, that the new crossings are merely separating pedestrians from road traffic which carries a high proportion of heavy commercial vehicles, it is safer to separate vehicles from pedestrians rather than the previous status quo of pedestrians risking being knocked over on the crossing by passing large and wide vehicles."* – Hamilton City Council

It was not considered reasonably practicable to close, or grade separate the level crossing; therefore, the LCSIA was completed.

The tables below detail the progression of the LCSS for the level crossing through the four stages of this LCSS while aiming to achieve the two KiwiRail LCSIA Criteria.

1.1.2 Te Kowhai Road Ped Down LCSS

Table 1-2. Summary of the change in LCSS at Te Kowhai Road Ped Down level crossing.

	Update Existing	Change in Use	Proposed Design	Future Score
LCSS SCORE	**32 / 60**	**45 / 60**	**18 / 60**	**18 / 60**
LCSS RISK BAND	**MEDIUM**	**MEDIUM – HIGH**	**LOW**	**LOW**
CRITERION MET			**C1 and C2 MET**	**C1 and C2 MET**
FORM OF CONTROL	**Maze with adjacent bells**	**Maze with adjacent bells**	**Automatic gates**	**Automatic gates**

The recommendations made by the LCSIA Assessor for the level crossing to reduce the risk score were:

Table 1-3. LCSIA assessor recommendations for Te Kowhai Road Ped Down level crossing.

No.	Recommendation	Category
1.	As per proposed design, install automatic gates.	Proposed Design / Criterion 1
2.	Install appropriate rail corridor fencing to prevent users from walking around the automatic gates.	Criterion 1
3.	Install appropriate road corridor fencing to prevent users from accessing the road crossing.	Criterion 1
4.	Replace the crossing surface with a wider veloSTRAIL panel – addresses the narrow width of the existing crossing and the dip on the east side which is a tripping hazard.	Criterion 1
5.	Install a reflectorised yellow edge strip along the edges of the crossing surface to assist visually-impaired users of the crossing.	Maintenance
6.	Setup remote operation of FLB for HiRail vehicles and KiwiRail workers – to avoid having to give way to vehicles on Te Kowhai East Road.	KiwiRail maintenance
7.	Investigate the provision of streetlighting at the crossing to ensure approaching train drivers can see vehicles queueing or stacking across the crossing at night.	Investigation

1.1.3 Te Kowhai Road Ped Down Discussion

The Updated Existing LCSS is Medium, and the Change in Use LCSS increases to the Medium – High risk band. Both the Proposed Design and Future Score fall into the Medium – Low risk band, meeting Criterion 1 and 2. Therefore, if the recommendations are followed, the proposed design achieves Criterion 1 and 2. It should be noted that this was also while testing a high pedestrian estimate of 500 per day, with 100 vulnerable users and 100 cyclists. This means the LCSS of the pedestrian crossing may be lower if pedestrian volumes are less than 500 per day.

The Te Kowhai East Road Ped Down level crossing is on an urban Arterial Road with an AADT of 9,609, 4% of which are Heavy Commercial Vehicles. There are approximately 32 trains a day with a rail line speed of 100 km/h. However, if freight trains are coming from the Burbush yard, they must travel at a maximum speed

of 25 km/h until the last wagon has left the yard. As most trains are travelling at 100 km/h, it was assumed that the 'typical' speed was 80 km/h for a train.

This speed restriction was brought up as the main concern of the Locomotive Engineer, as they believe these long downtimes and low speeds will encourage pedestrians to walk in front of approaching trains.

As part of the Rotokauri Development Plan, Te Kowhai East Road will be upgraded to a four-lane carriageway with traffic signals installed to the Te Kowhai East Road/Tasman Road intersection. The existing shared path will become a 2-way cycle way and footpath and the ped down level crossing will be upgraded to automatic gates, with the maze removed.

Appropriate rail and road corridor fencing were included as part of the recommendations to improve the effectiveness of the automatic gates. Without it, users would be able to walk around the automatic gates and in front of oncoming trains.

There were also maintenance recommendations to replace the crossing surface with veloSTRAIL. This addresses the narrow width of the existing crossing and the dip on the east side which presents a tripping hazard.

A reflectorised yellow edge strip along the edge lines of the crossing surface was also recommended to assist visually impaired users of the pedestrian crossing.

While on site a HiRail vehicle was observed crossing the road by waiting for vehicles to give way. The KiwiRail Signals Engineer noted that remote operation of the FLBs should be set up for KiwiRail workers so that they don't have to wait for vehicles to give way to them, as this is unusual and may lead to incidents. This was included as a recommendation for KiwiRail.

An investigation into streetlighting should be conducted to ensure the crossing is adequately lit.

A summary of the changes to the ALCAM risk band is presented in the following table. This is with estimated pedestrian counts of 500 – the max estimate tested.

Table 1-4. Summary of ALCAM changes at Te Kowhai Road Ped down level crossing.

	Updated Existing	Change in Use	Proposed Design	Future Score
ALCAM Risk Band	**Medium – High**	**High**	**Medium**	**Medium**
ALCAM risk score change (%)	**-**	**+ 413%**	**- 56%**	**- 56%**

The Updated Existing ALCAM risk band was Medium – High increased to High for the Change in Use score, which increased the ALCAM risk score by 413%.

The Proposed Design ALCAM risk band was Medium with a 56% decrease to the risk score compared to the Updated Existing. The Future Score ALCAM risk band was the same as the Proposed Design due to assuming the same rail volumes. The ALCAM risk score was significantly reduced with installation of automatic gates.

There were no Red Flag issues raised at this road crossing for any of the assessment stages.

1.1.4 Recommended Ped Down Crossing Improvements

As this is an existing facility upgrade (as per Section 3.2.2), the upgraded level crossing must meet Criterion 2. Achieving Criterion 1 is desirable but not mandatory. The Proposed Design and Future Score fall into the Medium – Low LCSS risk band, meeting both Criterion 1 and 2.

Therefore, implementing all recommendations in the Proposed Design will satisfy Criterion 1 and 2 for Opening Day (2032) and the Future Score (2042). This was also achieved with a pedestrian estimate of 500 per day.

1.2 Te Kowhai Road Ped Up LCSIA

1.2.1 Te Kowhai East Road Ped Up Top-Down Evaluation

The Top Down So Far As Is Reasonably Practicable (SFAIRP) evaluation of crossing closure or grade separation was undertaken with Hamilton City Council. Their comments are shown in the table below.

Table 1-5. Top-down evaluation of Te Kowhai Road Ped Up level crossing.

1. Can the level crossing be grade separated? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to grade separate the crossing** as: *"An overbridge would require pedestrians to walk up a 100m long ramp to a height of around seven metres which is likely to result in pedestrians simply crossing with vehicular traffic at grade, with the above-mentioned risks.* *An underpass would have a personal safety issue again leading to pedestrians crossing at grade.* *On this basis, that the new crossings are merely separating pedestrians from road traffic which carries a high proportion of heavy commercial vehicles, it is safer to separate vehicles from pedestrians rather than the previous status quo of pedestrians risking being knocked over on the crossing by passing large and wide vehicles."* – Hamilton City Council

It was not considered reasonably practicable to close, or grade separate the level crossing; therefore, the LCSIA was completed.

The tables below detail the progression of the LCSS for the level crossing through the four stages of this LCSS while aiming to achieve the two KiwiRail LCSIA Criteria.

1.2.2 Te Kowhai Road Ped Up LCSS

Table 1-6. Summary of the change in LCSS at Te Kowhai Road Ped Down level crossing.

	Proposed Design	Future Score
LCSS SCORE	**18 / 60**	**18 / 60**
LCSS RISK BAND	**LOW**	**LOW**
CRITERION MET	**C1 and C2 MET**	**C1 and C2 MET**
FORM OF CONTROL	**Automatic gates**	**Automatic gates**

The recommendations made by the LCSIA Assessor for the level crossing to reduce the risk score were:

Table 1-7. LCSIA assessor recommendations for Te Kowhai Road Ped Up level crossing.

No.	Recommendation	Category
1.	As per proposed design, install automatic gates.	Proposed Design / Criterion 1
2.	Install appropriate rail corridor fencing to prevent users from walking around the automatic gates.	Criterion 1
3.	Install appropriate road corridor fencing to prevent users from accessing the road crossing.	Criterion 1

No.	Recommendation	Category
4.	Install TGSI marking at the ends and a reflectorised yellow edge strip along the edges of the crossing surface to assist visually-impaired users of the crossing.	Maintenance

1.2.3 Te Kowhai Road Ped Up Discussion

Both the Proposed Design and Future Score fall into the Medium – Low risk band, meeting Criterion 1 and 2. Therefore, if the recommendations are followed, the proposed design shall achieve Criterion 1 and 2. It should be noted that this was also while testing a high pedestrian estimate of 500 per day, with 100 vulnerable users. This means the LCSS of the pedestrian crossing may be lower if pedestrian volumes are less than 500 per day.

The Te Kowhai East Road Ped Up level crossing is planned to be installed on Te Kowhai East Road. There are approximately 32 trains a day with a rail line speed of 100 km/h. However, if freight trains are coming from the Burbush yard, they must travel at a maximum speed of 25 km/h until the last wagon has left the yard. As most trains are travelling at 100 km/h, it was assumed that the 'typical' speed was 80 km/h for a train.

This speed restriction was brought up as the main concern of the Locomotive Engineer, as they believe these long downtimes and low speeds will encourage pedestrians to walk in front of approaching trains.

As part of the Rotokauri Development plan, Te Kowhai East Road will be upgraded to a four-lane carriageway with traffic signals installed to the Te Kowhai East Road/Tasman Road intersection. The ped up level crossing will be installed with automatic gates.

Appropriate rail and road corridor fencing are recommended to improve the effectiveness of the automatic gates. Without it, users would be able to walk around the automatic gate and in front of oncoming trains.

A summary of the changes to the ALCAM risk band is presented in the following table.

Table 1-8. Summary of ALCAM changes at Te Kowhai Road Ped Up level crossing.

	Proposed Design	Future Score
ALCAM Risk Band	**Medium – Low**	**Medium – Low**
ALCAM Risk Score	**116,303**	**116,303**

The Proposed Design had an ALCAM Risk Score of 116,303 and fell into the Medium – Low ALCAM risk band. The Future Score had the same score due to assuming the same rail volumes. It also fell into the Medium – Low ALCAM risk band.

There were no Red Flag issues raised at this road crossing for any of the assessment stages.

1.2.4 Recommended Ped Down Crossing Improvements

As this is a proposed facility (as per Section 3.2.1), the level crossing design must meet Criterion 1. The Proposed Design and Future Score fall into the Medium – Low LCSS risk band, meeting both Criterion 1 and 2.

Therefore, implementing all recommendations in the Proposed Design will satisfy Criterion 1 and 2 for Opening Day (2032) and the Future Score (2042). This was also achieved with a pedestrian estimate up to 500 per day.

Contents

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2 Glossary

AADT	Annual Average Daily Traffic Volume
ALCAM	Australian Level Crossing Assessment Model
CAS	Crash Analysis System
CC	City Council
DC	District Council
FLB	Flashing Lights and Bells
HAB	Half-arm Barrier
HCV	Heavy Commercial Vehicle
km/h	kilometres per hour
LCSIA	Level Crossing Safety Impact Assessment
LCSS	Level Crossing Safety Score
LE	Locomotive Engineer
LX	Level Crossing
MOTSAM	Manual of Traffic Signs and Markings
NIMT	North Island Main Trunk
NSAAT	No Stopping At All Times
WK	Waka Kotahi
ORA	Operating Reporting Architecture
ppd	pedestrians per day
RCA	Road Controlling Authority
SFAIRP	So Far As Is Reasonably Practicable
SPAD	Signal Passed At Danger
SSSS	Site Specific Safety Score
SUP	Shared use Path
TCD	Traffic Control Devices
TGSI	Tactile Ground Surface Indicators
vpd	vehicles per day

3 Introduction

3.1 Level Crossing Safety Impact Assessment (LCSIA)

While there are few crashes at level crossings compared with the rest of the road network, the consequences are often a serious injury or fatality. Thus, it is important that any level crossings be effectively investigated through a rigorous risk assessment process, the Level Crossing Safety Impact Assessment (LCSIA).

The LCSIA process was developed to assess the level of crash risk of existing and new / upgraded level crossings designs. Using a Level Crossing Safety Score (LCSS), the risk is scored out of 60, which takes into consideration the Australian Level Crossing Assessment Model (ALCAM) risk scores. This is broken down into the following sections:

- ALCAM score (30 points)
- Crash and Incident History score (10 points)
- Site Specific Safety Score (SSSS) (10 points)
- Engineer Risk score (10 points).

As can be observed, the ALCAM score is responsible for half of the LCSS. ALCAM is a tool used to identify key potential risks at level crossings and to assist in the prioritisation of crossings for upgrades. It is used to help decide the effective level of treatment required for a crossing.

3.2 LCSIA Criteria

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

- Criterion 1: the proposed design/upgrade of a crossing to achieve a “Low” or “Medium – Low” level of risk, as determined by the LCSS
- Criterion 2: the proposed design/upgrade of a level crossing to achieve a LCSS lower than the existing LCSS.

3.2.1 Proposed Facility

Where a new facility is proposed and no existing ALCAM assessment exists, the new crossing must meet Criterion 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 islow. Where user exposure is high, then it may not be possible to achieve a “Low” risk without grade separation.

3.2.2 Existing Facility Upgrade

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

3.3 Structure of Report

The structure of this report follows the structure as outlined in the Level Crossing Risk Assessment Guidance (Version 5, 2022) as set out by KiwiRail.

4 Background

4.1 Brief Project Outline

As part of the Rotokauri Development Plan, Hamilton City Council plans to upgrade Te Kowhai East Road to four lanes. The Tasman Road intersection with Te Kowhai East Road is proposed to be signalised, which will incorporate the Te Kowhai Road level crossing. A new Ped Up level crossing is proposed for pedestrians only on the north side of the crossing. The existing Ped Down crossing on the south side is proposed to have crossing facilities for both pedestrians and cyclists. Although it is existing it has not been previously recorded in LXM. Aurecon has been commissioned by Hamilton City Council (HCC) to undertake LCSIAs for the three level crossings at Te Kowhai East Road. They are as follows:

Crossing	ALCAM Number	ALCAM Crossing Name
Te Kowhai East Road	2474	Te Kowhai Road
Te Kowhai East Road Ped Up (North)	4743	Te Kowhai Rd Ped Up
Te Kowhai East Road Ped Down (South)	4744	Te Kowhai Rd Ped Down

This report relates to the pedestrian up and down facilities (4743 and 4744), the road crossing (2474), is contained within a separate report.

4.2 Key Assumptions

- Rail volumes for 2032 (opening day) and 2042 (10-year scenario) are assumed to be the same as the current rail volumes, which is 32 per day (weekly volumes) at a speed of 80km/h.
- Pedestrian volume forecasts for 2032 and 2042 were not available. As such a range of values from 100-500 pedestrians per day have been used for the evaluation to undertake sensitivity testing on the risk scores
- The site visit undertaken on 27/05/2022 with KiwiRail and Hamilton City Council and the photos taken are deemed acceptable to use for this updated LCSIA.

4.3 Documents Provided

The following documents and information were provided for the LCSIA:

- Level Crossing Risk Assessment Guide (2022) Version 5, Waka Kotahi NZ Transport Agency and KiwiRail
- ORA data dated January 2010 – April 2022 from KiwiRail
- Signalling and Interlocking diagrams from KiwiRail
- Train frequency and speeds from KiwiRail
- Traffic counts (2019) from HCC
- Traffic network model volumes (2051) from HCC
- Rotokauri Arterials Designation plan of the level crossing layout upgrade from HCC.

4.4 Site Visit

A site visit was undertaken on the 27th of May 2022 with representatives from Aurecon, KiwiRail and Hamilton City Council. The table below lists the representatives present.

Table 4-1. Site Visits

Date and time	27/05/2022 10:00
KiwiRail Certified LCSIA Assessors from Aurecon	Bridget Feary, Lead Engineer Dinesh Fonseka, Transportation Engineer
KiwiRail Representative/s	Ken Ashman, Signals Engineer Terry Herbert, Locomotive Engineer
Hamilton City Council Representative/s	Simon Crowther, Senior Network Engineer Michael Thorne, Infrastructure Engineer Transport

4.5 LCSIA Assessor Independence

The LCSIA assessors have had no prior involvement with the change in use project at the Te Kowhai East Road level crossing.

4.6 Top-Down Evaluation

The first step in the evaluation of a level crossing prior to the LCSIA is a top-down evaluation of options to close or grade separate the crossing.

If the RCA agrees that the crossing can be closed an LCSIA assessment is not required.

The LCSIA report has been commissioned to investigate crossing risks and options as the report is intended to ensure the safety case for continued operation or closure is fully and independently investigated.

The RCA was asked So Far As is Reasonably Practicable (SFAIRP), can the crossing be closed; can an alternative crossing on the same network be closed; or can the crossings be grade separated.

4.6.1 Te Kowhai Road Ped Down SFAIRP

In consultation with Hamilton City Council the SFAIRP assessment for Te Kowhai Road Ped Down Level Crossing was:

1. Can the level crossing be closed? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to close the crossing as:** *"Prior to the installation of this pedestrian rail crossing, pedestrians had to walk alongside vehicular traffic.* *This created the risk of a pedestrian being sideswiped by a passing vehicle (particularly a risk of a strike by a large HCV) with the possibility the pedestrian could end up lying injured on the rail trac**k** unable to get up.* *Should a train be approaching immediately after the pedestrian is knocked over (and passing motorists have not yet had a chance to move the injured person) then there is a risk of a fatal injury.* *Therefore, the addition of the recent southside pedestrian rail crossing is a safety improvement over the previous combined vehicle and pedestrian rail crossing."* – Hamilton City Council

2. Can the level crossing be grade separated? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to grade separate the crossing** as: *"An overbridge would require pedestrians to walk up a 100m long ramp to a height of around seven metres which is likely to result in pedestrians simply crossing with vehicular traffic at grade, with the above-mentioned risks.* *An underpass would have a personal safety issue again leading to pedestrians crossing at grade.* *On this basis, that the new crossings are merely separating pedestrians from road traffic which carries a high proportion of heavy commercial vehicles, it is safer to separate vehicles from pedestrians rather than the previous status quo of pedestrians risking being knocked over on the crossing by passing large and wide vehicles."* – Hamilton City Council

It was not considered reasonably practicable to close, or grade separate the level crossing; therefore, the LCSIA was completed.

4.6.2 Te Kowhai Road Ped Up SFAIRP

In consultation with Hamilton City Council the SFAIRP assessment for Te Kowhai Road Ped Up was completed:

1. Can the level crossing be grade separated? What are the reasons the RCA has for pursuing/not pursuing this option?	**It is not reasonably practicable to grade separate the crossing** as: *"An overbridge would require pedestrians to walk up a 100m long ramp to a height of around seven metres which is likely to result in pedestrians simply crossing with vehicular traffic at grade, with the above-mentioned risks.* *An underpass would have a personal safety issue again leading to pedestrians crossing at grade.* *On this basis, that the new crossings are merely separating pedestrians from road traffic which carries a high proportion of heavy commercial vehicles, it is safer to separate vehicles from pedestrians rather than the previous status quo of pedestrians risking being knocked over on the crossing by passing large and wide vehicles."* – Hamilton City Council

It was not considered reasonably practicable to close, or grade separate the level crossing; therefore, the LCSIA was completed.

5 Te Kowhai Road Ped Down LCSIA

5.1 ALCAM Survey

The Te Kowhai Road Ped Down level crossing was built in 2018 but was not officially recorded in the LXM database with an ALCAM ID Number. To enable the LCSIA risk assessment, a desktop ALCAM survey was undertaken to establish crossing conditions and sighting. The ALCAM survey data was entered into LXM by KiwiRail to establish the crossing in the database and enable calculation of ALCAM risk scores.

The crossing has a sighting restriction in Quadrant 1 Up Right Sightline. The required sight distance is 325m and the sight distance achieved is 155m due to the presence of a rail signal within the sightline.

5.2 Existing Conditions at the Level Crossing

The table below provides a summary of the key attributes relating to the ped down level crossing.

Table 5-1 Existing conditions at Te Kowhai Road Ped Down.

Crossing name	Te Kowhai Road Te Rapa
ALCAM reference	4744
Type (Road/Pedestrian)	Pedestrian
Crossing description	Maze and adjacent bell
Environment (Rural/Urban)	Urban
Road geometry	Straight, flat. East of the Tasman Road T- intersection.
Posted speed limit	50 km/h
Jurisdiction	Hamilton City Council
Pedestrian volumes (per day)	100 (estimate)
Train volumes (per day)	38
Rail line speed	100 km/h

Te Kowhai Road Ped Down level crossing (ALCAM 4744) is on the south side of Te Kowhai East Road in Te Rapa, Hamilton. The road intersects the North Island Main Trunk Line at KM548.1 at a 90-degree angle, as shown in the aerial image below. It is north of Rotokauri Railway Station.

Figure 5-1. Te Kowhai Road Ped Down Level Crossing (ALCAM 4744). Image source: map.grip.co.nz/map and annotated by LCSIA Team.

Te Kowhai East Road services Te Rapa, an industrial and retail centre north of Hamilton City and east of State Highway 1. It has been designated an Arterial Road and significant growth in traffic volumes is expected as Rotokauri to the west is developed. Immediately surrounding the level crossing are industrial sites, big box retail stores, car yards, and a fuel station. Te Rapa Road, Wairere Drive, and State Highway 1 are the main connections between Te Rapa and central Hamilton. The immediate area around the level crossing is zoned industrial. To the west is the Rotokauri Structure Plan area which is zoned as an employment zone between the industrial zone and SH1 and west of SH1 as residential land. Rotokauri is a growth cell with significant development planned and underway. The Rotokauri Transport Hub was opened in January 2021 south of the crossing and is a is a park and ride, rail station, bus interchange and pedestrian connection to The Base. A future Arterial Road is proposed west of SH1 which will connect to SH39 to the north, Te Kowhai East Road centrally and Te Wetini Drive to the south.

At the time of the site visit, the road was busy and the Ped Down pedestrian level crossing on the south side of the road crossing was being used by pedestrians, cyclists, and scooter riders. Tasman Road to the south of the crossing has separated cycle and footpaths on the west side and a shared use path on the east side for pedestrian and cyclist activity. The crossing will support the growth of walking and cycling in the area as development occurs and supports use of the Transport Hub. Future development of the area is proposed to include segregated cycle lanes, footpaths and shared use paths connecting the crossing to the Rotokauri development area.

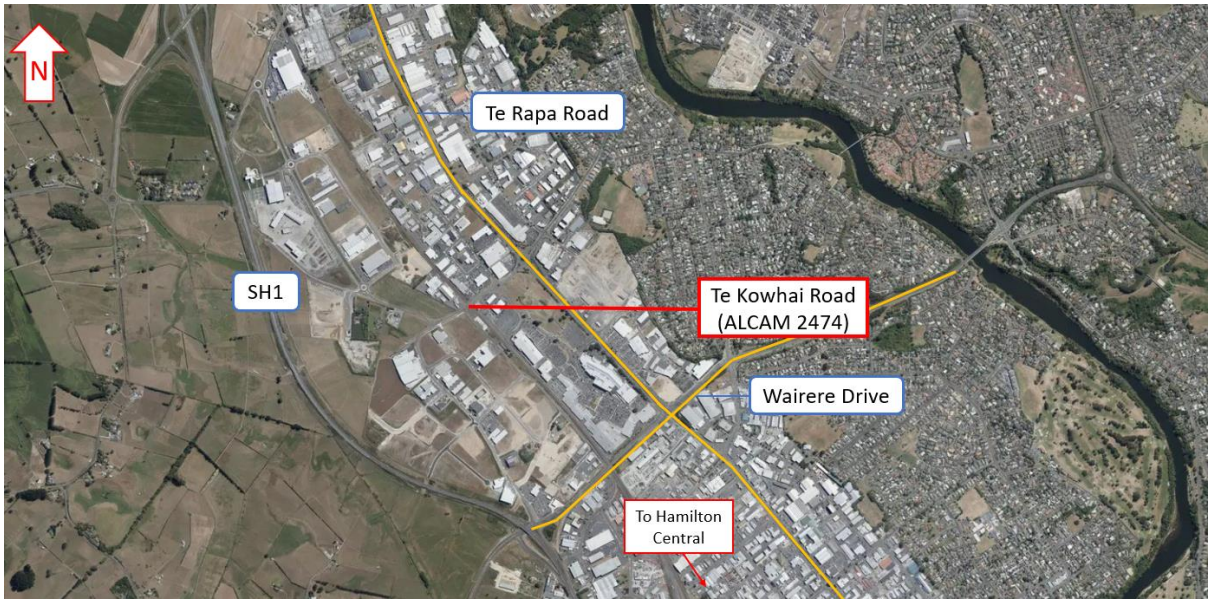


Figure 5-2. Te Kowhai Road Te Rapa Level Crossing in relation to key arterials and SH1 (approximate location marked up). Image source: map.grip.co.nz/map and annotated by LCSIA Team.

The pedestrian level crossing is shown in the images below. It has a pedestrian maze, Tactile Ground Surface Indicators (TGSI), limit line, and 'Look for Trains' signage. The HCC and KiwiRail representatives were unaware which party installed this pedestrian level crossing. They assumed it may have been installed as part of the Rotokauri Transport Hub project. Street view images indicate it was installed between March and August 2018.

Key issues identified with the crossing are shown in the images below:

- The crossing does not meet the KiwiRail minimum standard of controls for a multi-track pedestrian level crossing of gates
- There is no rail fencing beyond the pedestrian maze
- There is some minor damage to the pedestrian fence with scrapes on the post
- The asphalt crossing does not meet current path width requirements and has a dip which creates a trip hazard on the east side
- There are no tactile markings to define the edges of the crossing pathway and no crossing limit lines.

Figure 5-3. Te Kowhai Road pedestrian down crossing maze. West approach.

Figure 5-4. Minor damage to the pedestrian maze fence – rivet has broken.

Figure 5-5. Pedestrian surface has flange gaps. The edge does not have tactile markings.

Figure 5-6. Track condition.

Future projects were discussed on site with the RCA representatives. As part of the Rotokauri Structure Plan it is planned to upgrade Te Kowhai East Road to four lanes, with a signalised intersection at the level crossing. The roundabouts to the west of the level crossing will be converted into signalised intersections.

This plan includes upgrading this existing ped down level crossing with automatic gates to accommodate a footpath and cycle lane, with a second, new pedestrian crossing being installed on the Ped Up, side of the crossing to accommodate pedestrians, with automatic gates.

While on site a HiRail vehicle was observed using the level crossing without triggering the track circuits. They instead, waited at the edge of the road carriageway until vehicles on Te Kowhai East Road stopped to give way. It was noted by the KiwiRail Signals Engineer that remote-controlled operation of the crossing controls can be set up for KiwiRail workers, at a relatively low cost.

A night audit was not undertaken at this location. There is overhead street lighting on the northwest corner of the crossing only. Lack of lighting of the approaches could fail to illuminate waiting vehicles to the oncoming train. To determine if lighting is sufficient, a night audit should be conducted.

5.2.1 Key Existing Safety Issues

- Second train coming risk on a multi-track crossing
- There is no rail fencing beyond the pedestrian maze. This means users can walk around the maze with relative ease
- There is some minor damage to the pedestrian fence with scrapes on the post
- The asphalt crossing does not meet current path width requirements and has a dip which creates a trip hazard on the east side
- There is no reflectorised yellow edge strip to define the edges of the crossing pathway and no crossing limit lines.
- HiRail vehicles using the crossing without triggering track circuits – instead waited for vehicles on Te Kowhai East Road to give way. This may increase the risk of an incident as drivers are not expecting vehicles on the rail line unless the crossing is activated
- The possibility of lack of visibility at night due to insufficient lighting. A night audit was not conducted to fully assess this issue and a review is recommended.

5.3 Proposed Design

5.3.1 HCC Proposed Design (2032) – Automatic gates

The HCC proposed design for 2032 is to install automatic gates to accommodate a 2-way off road cycle lane and a footpath. The maze will be removed due to space constraints with the adjacent four-lane carriageway upgrade and signalised intersection. Refer to Appendix B for the Designation Plan design.

5.3.2 General Improvements

In additional to the proposed design, the following improvements are recommended by the LCSIA assessors to address safety issues at the crossing.

- Install appropriate rail corridor fencing to prevent users from walking around the automatic gates
- Install appropriate road corridor fencing to prevent pedestrian access to the road crossing
- Replace the crossing surface with a wider veloSTRAIL panel – this provides a flange gap free crossing for cyclists, addresses the narrow width of the existing crossing and the dip on the east side which is a trip hazard
- Install signs and markings to the requirements of TCD Part 9 and the KiwiRail Design Guidance for Pedestrian and Cycle Rail Crossings
- Setup remote operation of crossing controls for HiRail vehicles and KiwiRail workers – to avoid confusion for drivers on Te Kowhai East Road having to give way to rail vehicles when the crossing is not operating
- Investigate the provision of streetlighting at the crossing to ensure approaching train drivers can see pedestrians using the crossing at night.

5.4 ALCAM Score

The ALCAM risk scores and summary for the Te Kowhai Ped Down Level crossing are shown in Table 5-2. Pedestrian volumes were tested at 500 peds per day to assess the level at which the Proposed Design and Future Scores would fail Criterion 1 and 2.

The following are updates required for LXM based on the Updated Existing proposal:

- Max train speed up and down updated from 110 km/h to 80 km/h for freight.
- Current Freight volumes updated from 17.48 train movements daily to 30 train movements daily.

Table 5-2. ALCAM score for Te Kowhai Ped Down Level crossing.

Stage	LCSS Risk Score	Risk Change	Comments
Updated Existing	18 / 30	-	This score is based on the existing level crossing, with two operational tracks. The estimated pedestrian volume was assumed to be 100 per day, train volumes are 32 per day (2022). **ALCAM risk score is 266,562 and the risk band is MEDIUM**
Change in Use (500 peds)	27 / 30	+ 413%	This score is based on the existing level crossing infrastructure with an estimated 500 pedestrians per day and future train volumes of 32 per day (2042). **ALCAM risk score is 1,367,444 and the risk band is HIGH**
Proposed Design (500 peds)	11 / 30	- 56%	This score is based on the HCC proposed design on opening day in 2032. The estimated pedestrian volume is 500 per day with estimated train volumes of 32 per day (2032). The proposed design includes automatic gates and rail and road corridor fencing. There are no mazes due to space constraints. **ALCAM risk score is 116,850 and the risk band is MEDIUM – LOW**
Future Score (500 peds)	11 / 30	- 56%	This score is based on the HCC proposed design future score in 2042. The estimated pedestrian volume is 500 per day with estimated train volumes of 32 per day (2042). The proposed design includes automatic gates and rail and road corridor fencing. There are no mazes due to space constraints. **ALCAM risk score is 116,850 and the risk band is MEDIUM – LOW**

5.5 Crash and Incident History Score

The crash and incident history score is based on the number of incidents reported in the KiwiRail ORA database and Waka Kotahi CAS database between 2012 to 2022. For the Te Kowhai Road ped down crossing there was one incident reported in ORA at the crossing, which was recorded against the road crossing.

Table 5-3. 10-year crash data, January 2012 - August 2022.

Database	Incident Number	Incident Date	Incident Type	Description
ORA	EVT2002142	8/09/2020	NCPN - Near Collision Person	LE trainee of 222 advised that they had a near miss with a person at Te Kowhai Road, Hamilton. Train Control called police immediately. LE and trainee checked length of train to see if they could see any sign of person. Police also checked around the area. Nothing found. Clearance given by police at 0208 hours. Train delayed 50 minutes. Police event no P 043 589 673.

CAS does not include records of incidents on the footpath unless there was a vehicle involved, so there are no CAS records to review for this pedestrian level crossing.

The crash and incident history score is tabulated below.

Table 5-4 Crash and incident history score.

Incident Type	Rating	Number of Incidents	Score
Pedestrian Near Miss	2	1	2 x 1 = 2
Total Score		2	2 / 10

5.6 Site Specific Safety Score

The site-specific safety score (SSSS) aims to analyse elements of the level crossing layout that are either not well covered or missing from the ALCAM risk rating. To achieve a score out of ten, the SSSS is simply prorated down from a score out of thirty and then rounded to the nearest whole number.

If the level crossing triggers a red flag scenario, the SSSS is automatically scored as 24/30 (an overall 8/10). If the LCSIA assessor is not satisfied the calculated SSSS adequately portrays the risk of the level crossing (it has or understated the risk), they are able to provide a 'Modified' SSSS total score.

The Pedestrian Crossing SSSS tables have been used to score the level crossing.

The SSSS score for the Te Kowhai Ped Down level crossing is shown in Table 5-5.

Table 5-5. SSSS for Te Kowhai Ped Down Level crossing.

Assessed Items	Updated Existing (100 peds)	Change in Use (500 peds)	Proposed Design (500 peds)	Future Score (500 peds)	Comments
Crossing Type	6 / 10	6 / 10	1 / 10	1 / 10	Good visibility, warning bells and 'look for trains' signs present. Score reduces to 1/10 with automatic gates.
Distraction / Inattention	3 / 5	3 / 5	1 / 5	1 / 5	Distraction reduced with installation of automatic gates.
Flange gap wheel entrapment	3 / 5	3 / 5	0 / 5	0 / 5	Small but poorly maintained flange gaps. Reduced to 0 with installation of veloSTRAIL.
Volume of 'vulnerable' users	1 / 6	3 / 6	3 / 6	3 / 6	Assumed 20 vulnerable users for the Update Existing scenario, and 100 for the other three scenarios. For other estimated pedestrian volumes: 100 peds → 20 vulnerable users → 1 / 6 200 peds → 40 vulnerable users → 2 / 6 300 peds → 60 vulnerable users → 3 / 6 400 peds → 80 vulnerable users → 3 / 6 500 peds → 100 vulnerable users → 3 / 6
Cycle patronage	1 / 4	2 / 4	2 / 4	2 / 4	Assumed 20 cyclists for the Updated Existing scenario, and 100 for the other three scenarios. For estimated pedestrian volumes: 100 peds → 20 cyclists → 1 / 4 200 peds → 40 cyclists → 1 / 4 300 peds → 60 cyclists → 2 / 4 400 peds → 80 cyclists → 2 / 4 500 peds → 100 cyclists → 2 / 4
Total Score	14 / 30	17 / 30	7 / 30	7 / 30	
SSSS	5 / 10	6 / 10	2 / 10	2 / 10	
Red Flag Scenarios	-	-	-	-	

5.7 Engineers' Score

The engineers' risk score is a combination of LE and RCA Engineer's opinions of the crash risk at the level crossing, with a weighting of 2:1 in the favour of the LE. Opinions for this level crossing site were provided by the people mentioned in Section 2.4.

The engineer score for the Te Kowhai Road crossing is provided in Table 5-6.

Table 5-6. LE and RCA Score for Te Kowhai Ped Down Level crossing.

	Updated Existing	Change in Use	Proposed Design	Future Score	Comments
Locomotive Engineer	6 / 10	6 / 10	4 / 10	4 / 10	Risk largely dependent on estimated pedestrian volumes and increasing rail volumes. Lower risk with automatic gates.
RCA Engineer	4 / 5	4 / 5	2 / 5	2 / 5	Risk greatly reduced with installation of automatic gates.
Total	10 / 15	10 / 15	6 / 15	6 / 15	
Total for LCSS	**7 / 10**	**7 / 10**	**4 / 10**	**4 / 10**	

5.8 Level Crossing Safety Score

Table 5-7 summarises the resultant LCSS based on the above scores for the Te Kowhai Ped Down Level crossing.

Table 5-7. LCSS for Te Kowhai Ped Down crossing.

	Update Existing	Change in Use (500 peds)	Proposed Design (500 peds)	Future Score (500 peds)	Comments
ALCAM score	18 / 30	27 / 30	11 / 30	11 / 30	Proposed recommendations do little to change scores.
Crash and incident history score	2 / 10	5 / 10	1 / 10	1 / 10	With increased freight movements and therefore longer down-times, the likelihood of pedestrians walking in front of approaching trains may increase (particularly at speeds of 25 km/h from the Burbush yard). Automatic gates with appropriate rail and road corridor fencing will significantly reduce the likelihood of near miss incidents.
Site specific safety score	5 / 10	6 / 10	2 / 10	2 / 10	Score is low, main issue is queueing from the nearby roundabouts. This issue is mitigated with upgrading the roundabouts to signalised intersections with controllers set to green-wave to help clear queued vehicles over the crossing.
Locomotive and RCA engineer risk score	7 / 10	7 / 10	4 / 10	4 / 10	Decrease in risk score due to installation of automatic gates.
LCSS SCORE	**32 / 60**	**45 / 60**	**18 / 60**	**18 / 60**	Both the Proposed Design and Future Score meets Criterion 1 and 2.
LCSS RISK BAND	**MEDIUM**	**MEDIUM – HIGH**	**LOW**	**LOW**	
CRITERION MET			**C1 and C2 MET**	**C1 and C2 MET**	
FORM OF CONTROL	**Maze with adjacent bells**	**Maze with adjacent bells**	**Automatic gates**	**Automatic gates**	

5.9 Recommendation

A summary of recommendations is shown below in Table 5-8.

Table 5-8. Te Kowhai Road key recommendations

No.	Recommendation	Category
1.	As per proposed design, install automatic gates.	Proposed Design / Criterion 1
2.	Install appropriate rail corridor fencing to prevent users from walking around the automatic gates.	Criterion 1
3.	Install appropriate road corridor fencing to prevent users from accessing the road crossing.	Criterion 1
4.	Replace the crossing surface with a wider veloSTRAIL panel – addresses the narrow width of the existing crossing and the dip on the east side which is a tripping hazard.	Criterion 1
5.	Install a reflectorised yellow edge strip along the edges of the crossing surface to assist visually-impaired users of the crossing.	Maintenance
6.	Setup remote operation of FLB for HiRail vehicles and KiwiRail workers – to avoid having to give way to vehicles on Te Kowhai East Road.	KiwiRail maintenance
7.	Investigate the provision of streetlighting at the crossing to ensure approaching train drivers can see vehicles queueing or stacking across the crossing at night.	Investigation

5.9.1 Discussion

The Updated Existing LCSS is Medium, and the Change in Use LCSS increases to the Medium – High risk band. Both the Proposed Design and Future Score fall into the Medium – Low risk band, meeting Criterion 1 and 2. Therefore, if the recommendations are followed, the proposed design achieves Criterion 1 and 2. It should be noted that this was also while testing a high pedestrian estimate of 500 per day, with 100 vulnerable users and 100 cyclists. This means the LCSS of the pedestrian crossing may be lower if pedestrian volumes are less than 500 per day.

The Te Kowhai East Road Ped Down level crossing is on an urban Arterial Road with an AADT of 9,609, 4% of which are Heavy Commercial Vehicles. There are approximately 32 trains a day with a rail line speed of 100 km/h. However, if freight trains are coming from the Burbush yard, they must travel at a maximum speed of 25 km/h until the last wagon has left the yard. As most trains are travelling at 100 km/h, it was assumed that the 'typical' speed was 80 km/h for a train.

This speed restriction was brought up as the main concern of the Locomotive Engineer, as they believe these long downtimes and low speeds will encourage pedestrians to walk in front of approaching trains.

As part of the Rotokauri Development Plan, Te Kowhai East Road will be upgraded to a four-lane carriageway with traffic signals installed to the Te Kowhai East Road/Tasman Road intersection. The existing shared path will become a 2-way cycle way and footpath and the ped down level crossing will be upgraded to automatic gates, with the maze removed.

Appropriate rail and road corridor fencing were included as part of the recommendations to improve the effectiveness of the automatic gates. Without it, users would be able to walk around the automatic gates and in front of oncoming trains.

There were also maintenance recommendations to replace the crossing surface with veloSTRAIL. This addresses the narrow width of the existing crossing and the dip on the east side which presents a tripping hazard.

A reflectorised yellow edge strip along the edge lines of the crossing surface was also recommended to assist visually impaired users of the pedestrian crossing.

While on site a HiRail vehicle was observed crossing the road by waiting for vehicles to give way. The KiwiRail Signals Engineer noted that remote operation of the FLBs should be set up for KiwiRail workers so that they don't have to wait for vehicles to give way to them, as this is unusual and may lead to incidents. This was included as a recommendation for KiwiRail.

An investigation into streetlighting should be conducted to ensure the crossing is adequately lit.

5.9.2 Recommended Improvements

As this is an existing facility upgrade (as per Section 3.2.2), the upgraded level crossing must meet Criterion 2. Achieving Criterion 1 is desirable but not mandatory. The Proposed Design and Future Score fall into the Medium – Low LCSS risk band, meeting both Criterion 1 and 2.

Therefore, implementing all recommendations in the Proposed Design will satisfy Criterion 1 and 2 for Opening Day (2032) and the Future Score (2042). This was also achieved with a pedestrian estimate up to 500 per day.

6 Te Kowhai Road Ped Up LCSIA

6.1 ALCAM Survey

The Te Kowhai Road Ped Up level crossing is proposed, so does not currently exist in the LXM database. To enable the LCSIA risk assessment, a desktop ALCAM survey was undertaken to establish crossing conditions and sighting. The ALCAM desktop survey data was entered into LXM by KiwiRail to establish the crossing in the database and enable calculation of ALCAM risk scores.

The crossing has a sighting restriction in Quadrant 1 Up Right Sightline. The required sight distance is 325m and the sight distance achieved is 155m due to the presence of a rail signal within the sightline.

6.2 Existing Conditions at the Level Crossing

As this is a proposed facility, there is no existing level crossing at the site. However, there is an adjacent road crossing and pedestrian crossing on the opposite side of the road.

The proposed pedestrian up crossing (ALCAM 4743) is on the northern side of Te Kowhai East Road in Te Rapa, Hamilton. The road intersects the North Island Main Trunk Line at KM548.1 at a 90-degree angle, as shown in the aerial image below. It is north of Rotokauri Railway Station.

Figure 6-1. Proposed location of Te Kowhai Road Ped Up Level Crossing (ALCAM 4743). Image source: map.grip.co.nz/map and annotated by LCSIA Team.

Te Kowhai East Road services Te Rapa, an industrial and retail centre north of Hamilton city and east of State Highway 1. It has been designated an Arterial Road and significant growth in traffic volumes are expected as Rotokauri to the west is developed. Immediately surrounding the level crossing are industrial sites, big box retail stores, car yards, and a fuel station. Te Rapa Road, Wairere Drive, and State Highway 1 are the main connections between Te Rapa and central Hamilton. The immediate area around the level crossing is zoned industrial. To the west is the Rotokauri Structure Plan area which is zoned as an employment zone between the industrial zone and SH1 and west of SH1 as residential land. Rotokauri is a growth cell with significant development planned and underway. The Rotokauri Transport Hub was opened in January 2021 south of the crossing and is a is a park and ride, rail station, bus interchange and pedestrian

connection to The Base. A future Arterial Road is proposed west of SH1 which will connect to SH39 to the north, Te Kowhai East Road centrally and Te Wetini Drive to the south.

At the time of the site visit, the road was busy and the ped down level crossing on the south side of the road crossing was also being used by pedestrians, cyclists, and scooter riders. Tasman Road to the south of the crossing has separated cycle and footpaths on the west side and a shared use path on the east side for pedestrian and cyclist activity in the area as development occurs and in support of the Transport Hub. No walking or cycling activity was observed in the north shoulder as there are no footpaths currently on the north side of Te Kowhai East Road.

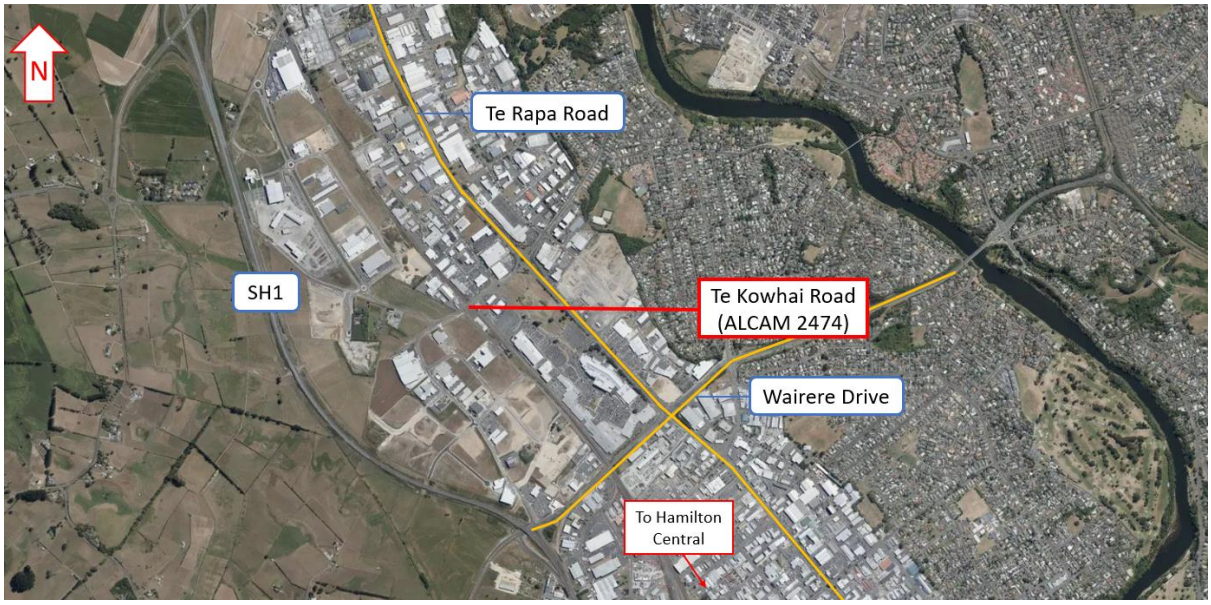


Figure 6-2. Te Kowhai Road Te Rapa Level Crossing in relation to key arterials and SH1 (approximate location marked up). Image source: map.grip.co.nz/map and annotated by LCSIA Team.

6.3 Proposed Design

6.3.1 HCC Proposed Design (2032) – Automatic gates

The HCC proposed design for 2032 is for a footpath on the northern side of the road with automatic gates. There will be no maze due to space constraints with the adjacent road four-lane carriageway upgrade and signalised intersection.

6.3.2 General Improvements

In additional to the proposed design, the following improvements are recommended by the LCSIA assessors to address safety issues at the crossing.

- Install appropriate rail corridor fencing to prevent users from walking around the automatic gates
- Install appropriate road corridor fencing to prevent pedestrian access to the road crossing
- Install signs and markings to the requirements of TCD Part 9 and the KiwiRail Design Guidance for Pedestrian & Cycle Rail Crossings
- Install 'Look for Trains' signage.

6.4 ALCAM Score

The ALCAM risk scores and summary for the Te Kowhai Pedestrian Up crossing are shown in Table 6-1. No forecast pedestrian volumes were available so sensitivity testing of the scores was undertaken to evaluate a

range of volumes. Pedestrian volumes were tested at 500 per day to determine at what volume the Proposed Design and Future Scores would fail Criterion 1 and 2.

Table 6-1. ALCAM score for Te Kowhai Ped Up Level crossing.

Stage	LCSS Risk Score	Comments
Proposed Design (500 peds)	11 / 30	This score is based on the HCC proposed design on opening day in 2032. The estimated pedestrians are 500 per day with estimated train volumes of 32 per day (2032). The proposed design includes automatic gates and rail and road corridor fencing. There are no mazes due to space constraints. **ALCAM risk score is 116,303 and the risk band is MEDIUM – LOW**
Future Score (500 peds)	11 / 30	This score is based on the HCC proposed design future score in 2042. The estimated pedestrians are 500 with estimated train volumes of 32 per day (2042). The proposed design includes automatic gates and rail and road corridor fencing. There are no mazes due to space constraints. **ALCAM risk score is 116,303 and the risk band is MEDIUM – LOW**

6.5 Crash and Incident History Score

As this is a proposed design, there is no crash and incident history. Estimates have been made for the proposed design and future score based on the proposed design controls of automatic gates.

6.6 Site Specific Safety Score

The site-specific safety score (SSSS) aims to analyse elements of the level crossing layout that are either not well covered or missing from the ALCAM risk rating. To achieve a score out of ten, the SSSS is simply prorated down from a score out of thirty and then rounded to the nearest whole number.

If the level crossing triggers a red flag scenario, the SSSS is automatically scored as 24/30 (an overall 8/10). If the LCSIA assessor is not satisfied the calculated SSSS adequately portrays the risk of the level crossing (it has or understated the risk), they are able to provide a 'Modified' SSSS total score.

The Pedestrian Crossing SSSS score for the Te Kowhai Road Pedestrian Up level crossing is shown in Table 6-2.

Table 6-2. SSSS for Te Kowhai Ped Up Level crossing.

Assessed Items	Proposed Design	Future Score	Comments
Crossing Type	1 / 10	1 / 10	Score is 1/10 with automatic gates.
Distraction / Inattention	1 / 5	1 / 5	Distraction reduced with installation of automatic gates.
Flange gap wheel entrapment	2 / 5	2 / 5	Not specified in the design. Assumed to be small and well-maintained flange gaps.
Volume of 'vulnerable' users	3 / 6	3 / 6	Assumed to be 100 (20% of estimated pedestrians of 500). For other pedestrian estimates: 100 peds → 20 vulnerable users → 1 / 6 200 peds → 40 vulnerable users → 2 / 6 300 peds → 60 vulnerable users → 3 / 6 400 peds → 80 vulnerable users → 3 / 6

Assessed Items	Proposed Design	Future Score	Comments
Cycle patronage	0 / 4	0 / 4	There should be no cyclists because it's a footpath crossing only (cycleway proposed on the Ped Down crossing).
Total Score	7 / 30	7 / 30	
SSSS	2 / 10	2 / 10	
Red Flag Scenarios	-	-	

6.7 Engineers' Score

The engineers' risk score is a combination of LE and RCA Engineer's opinions of the crash risk at the level crossing, with a weighting of 2:1 in the favour of the LE. Opinions for this level crossing site were provided by the people mentioned in Section 2.4.

The engineer scores for the Te Kowhai Road Ped Up level crossing are provided in Table 6-3.

Table 6-3. LE and RCA Score for Te Kowhai Road Ped Up Level crossing.

	Proposed Design	Future Score	Comments
Locomotive Engineer	4 / 10	4 / 10	Risk largely dependent on estimated pedestrian volumes and increasing rail volumes. Lower risk with automatic gates.
RCA Engineer	2 / 5	2 / 5	Risk greatly reduced with installation of automatic gates.
Total	6 / 15	6 / 15	
Total for LCSS	**4 / 10**	**4 / 10**	

6.8 Level Crossing Safety Score

Table 6-4 summarises the resultant LCSS based on the above scores for the Te Kowhai Ped Up Level crossing.

Table 6-4. LCSS for Te Kowhai Ped Up Level crossing.

	Proposed Design	Future Score	Comments
ALCAM score	11 / 30	11 / 30	Proposed recommendations do little to change scores.
Crash and incident history score	1 / 10	1 / 10	Automatic gates with appropriate rail and road corridor fencing results in a low likelihood of incidents.
Site specific safety score	2 / 10	2 / 10	Score is low with automatic gates and no cyclists.
Locomotive and RCA engineer risk score	4 / 10	4 / 10	Score reflects concern with high estimated future ped and rail volumes.
LCSS SCORE	**18 / 60**	**18 / 60**	Both the Proposed Design and Future Score meet Criterion 1 and 2.
LCSS RISK BAND	**LOW**	**LOW**	
CRITERION MET	**C1 and C2 MET**	**C1 and C2 MET**	
FORM OF CONTROL	**Automatic gates**	**Automatic gates**	

6.9 Recommendation

A summary of recommendations is shown below in Table 6-5.

Table 6-5. Te Kowhai Ped Up Level Crossing key recommendations

No.	Recommendation	Category
1.	As per proposed design, install automatic gates.	Proposed Design / Criterion 1
2.	Install appropriate rail corridor fencing to prevent users from walking around the automatic gates.	Criterion 1
3.	Install appropriate road corridor fencing to prevent users from accessing the road crossing.	Criterion 1
4.	Install signs and markings to TCD Part 9 and KiwiRail Design Guidance for Pedestrian and Cycle Rail Crossings	Maintenance

6.9.1 Discussion

Both the Proposed Design and Future Score fall into the Medium – Low risk band, meeting Criterion 1 and 2. Therefore, if the recommendations are followed, the proposed design shall achieve Criterion 1 and 2. It should be noted that this was also while testing a high pedestrian estimate of 500 per day, with 100 vulnerable users. This means the LCSS of the pedestrian crossing may be lower if pedestrian volumes are less than 500 per day.

The Te Kowhai East Road Ped Up level crossing is planned to be installed on Te Kowhai East Road. There are approximately 32 trains a day with a rail line speed of 100 km/h. However, if freight trains are coming from the Burbush yard, they must travel at a maximum speed of 25 km/h until the last wagon has left the yard. As most trains are travelling at 100 km/h, it was assumed that the ‘typical’ speed was 80 km/h for a train.

This speed restriction was brought up as the main concern of the Locomotive Engineer, as they believe these long downtimes and low speeds will encourage pedestrians to walk in front of approaching trains.

As part of the Rotokauri Development plan, Te Kowhai East Road will be upgraded to a four-lane carriageway with traffic signals installed to the Te Kowhai East Road/Tasman Road intersection. The ped up level crossing will be installed with automatic gates.

Appropriate rail and road corridor fencing are recommended to improve the effectiveness of the automatic gates. Without it, users would be able to walk around the automatic gate and in front of oncoming trains.

6.9.2 Recommended Improvements

As this is a proposed facility (as per Section 3.2.1), the level crossing design must meet Criterion 1. The Proposed Design and Future Score fall into the Medium – Low LCSS risk band, meeting both Criterion 1 and 2.

Therefore, implementing all recommendations in the Proposed Design will satisfy Criterion 1 and 2 for Opening Day (2032) and the Future Score (2042). This was also achieved with a pedestrian estimate up to 500 per day.

Appendix A – KiwiRail Comments / Scoring

Dinesh Fonseka

From: Dinesh Fonseka
Sent: Friday, 16 September 2022 2:21 PM
To: Dinesh Fonseka
Subject: FW: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

DISCLAIMER

From: Dinesh Fonseka
Sent: Wednesday, 31 August 2022 4:23 PM
To: Bridget Feary <Bridget.Feary@aurecongroup.com>
Cc: Ann Fosberry <Ann.Fosberry@aurecongroup.com>
Subject: RE: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

FYI

Had a call with Terry and he gave me these scores.

In terms of the proposed design, he expressed concern with long waiting times at the traffic lights, and would prefer grade separation.

Cheers,

Dinesh Fonseka
Engineer, Aurecon
T +64 09 5206019

DISCLAIMER

From: Dinesh Fonseka
Sent: Friday, 26 August 2022 3:30 PM
To: Terry Herbert <Terry.Herbert@kiwirail.co.nz>
Cc: Ken Ashman <Ken.Ashman@kiwirail.co.nz>; Bridget Feary <Bridget.Feary@aurecongroup.com>; Ann Fosberry <Ann.Fosberry@aurecongroup.com>
Subject: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

Hi Terry,

Hope you're well. We have been asked by HCC to update the LCSIA for Te Kowhai East Road to include their four-lane + signalling upgrade design, along with two Ped LCSIAs.

One of the ped crossings is existing (with a maze, if you recall) and the other will be a new one planned to be built (automatic gates + maze).

The proposed design year is 2032, with a 'future score' scenario in 2042. Because of this, we now need some new Locomotive Engineers risk scores from you.

There is added uncertainty with the ped crossings as we have no data on the potential pedestrian volumes – so I'll be asking for your scores for 100 and 500 pedestrians for each scenario.

Please fill in the highlighted scores on the far right column in the tables below. There are three tables for the Road, Ped Up and Ped Down crossings.

Feel free to give me a ring if you have any questions, I understand this is a lot of information all at once! I can be reached on 021026 10364.

ROAD CROSSING

Scenario	Description	Road and Rail Volumes	Risk Score
Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Two-lane carriageway • Half-arm barriers • Flashing lights and bells	• 12,181 vehicles per day • 59 trains per day	7 / 10
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Four-lane carriageway • Half-arm barriers • Flashing lights and bells • Traffic signal control linked to rail crossing • Median traffic islands • Emergency escape shoulder on the east side for eastbound traffic • Roundabouts to the east (The Boulevard/Te Kowhai East Road AND Te Rapa Road/Church Road) to be converted to traffic signals. The controllers will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing	• 11,826 vehicles per day • 48 trains per day	6 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Four-lane carriageway • Half-arm barriers • Flashing lights and bells • Traffic signal control linked to rail crossing • Median traffic islands • Emergency escape shoulder on the east side for eastbound traffic • Roundabouts to the east (The Boulevard/Te Kowhai East Road AND Te Rapa Road/Church Road) to be converted to traffic signals. The controller will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing	• 12,181 vehicles per day • 59 trains per day	7 / 10

PED DOWN (EXISTING PED CROSSING)

Scenario	Description	Pedestrian and Rail Volumes	Risk Score
Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 59 trains per day	3 / 10

Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	6 / 10
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 48 trains per day	1 / 10
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 48 trains per day	4 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 59 trains per day	1 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	4 / 10

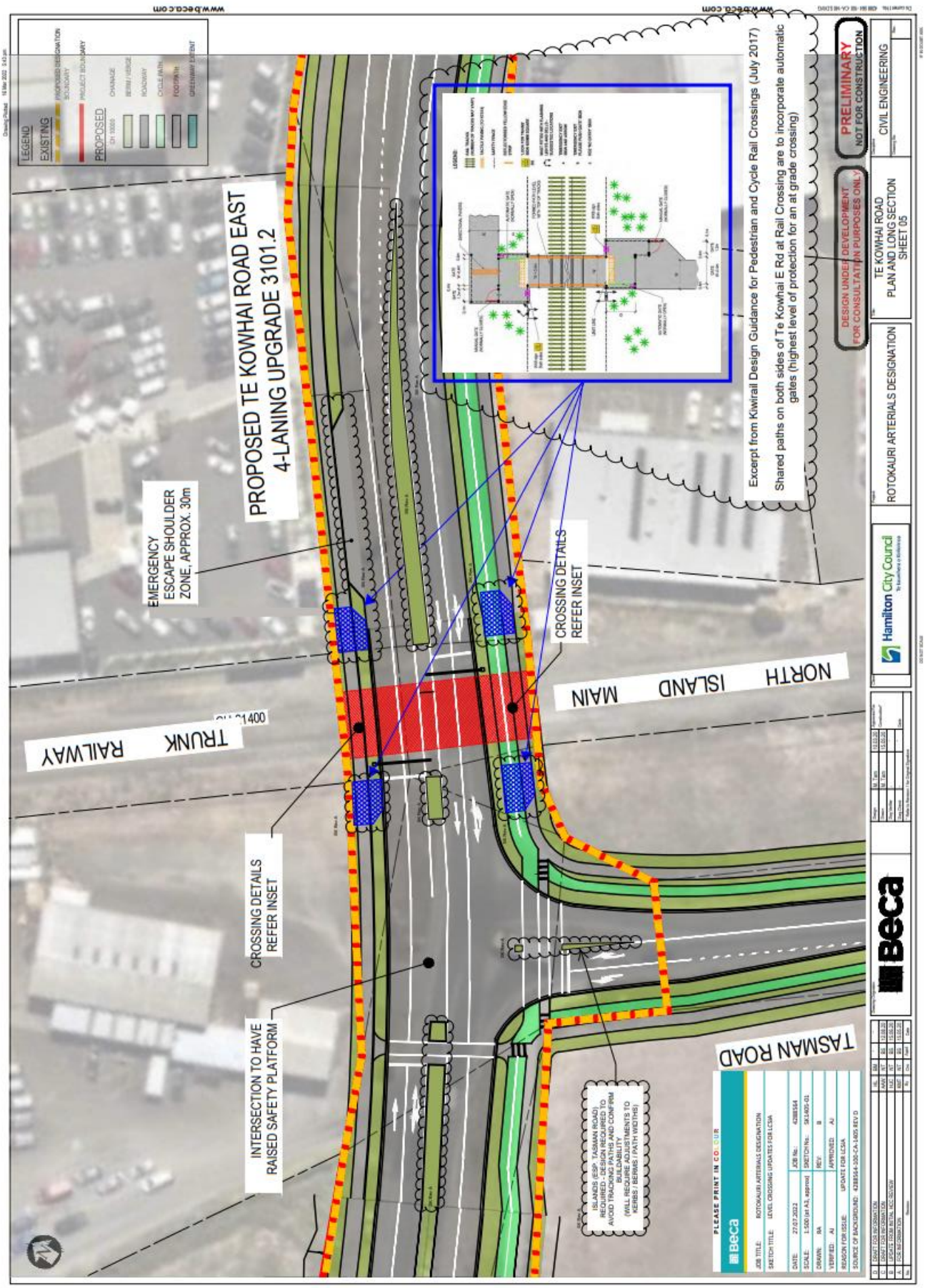
PED UP (NEW PED CROSSING)

Scenario	Description	Pedestrian and Rail Volumes	Risk Score
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 48 trains per day	1 / 10
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 48 trains per day	4 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 59 trains per day	1 / 10
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	4 / 10

Kind Regards,

Dinesh Fonseka
Engineer, Aurecon
T +64 09 5206019

Appendix B – HCC Concept Design



Appendix C – HCC Comments / Scoring

Dinesh Fonseka

Subject: FW: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

From: Simon Crowther <Simon.Crowther@hcc.govt.nz>
Sent: Monday, 29 August 2022 2:48 pm
To: Michael Thorne <Michael.Thorne@hcc.govt.nz>
Subject: RE: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

Hi Michael,

I've had a go, do you agree with my assessments?

Happy to discuss.

Cheers

Simon

Simon Crowther
Senior Network Engineer (Safety) | City Transportation

DDI: (07) 838 6500 | Mob: (021) 415 142 | Email: simon.crowther@hcc.govt.nz

Hamilton City Council

Hamilton City Council | Private Bag 3010 | Hamilton 3240 | www.hamilton.govt.nz

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From: Michael Thorne <Michael.Thorne@hcc.govt.nz>
Sent: Friday, 26 August 2022 4:16 pm
To: Simon Crowther <Simon.Crowther@hcc.govt.nz>
Cc: Dinesh Fonseka <Dinesh.Fonseka@aurecongroup.com>
Subject: FW: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

Hi Simon,

HCC has asked KiwiRail/Aurecon to assess the proposed design, i.e. the Te Kowhai East Road designation as part of the LCSIA Aurecon undertook a few months ago. Although we discussed it in detail on site it appears Aurecon had not specifically recorded this.

As RCA Safety Engineer could you score the crossings (ped on both sides and road) for the designation design which will include automatic pedestrian gates on both the north and south side footpaths. With automatic gates there is no need for a maze, due to space constraints we are not providing any.

If you need anything further let me know.

Regards,

Michael.

From: Dinesh Fonseka <Dinesh.Fonseka@aurecongroup.com>
Sent: Friday, 26 August 2022 3:40 pm
To: Michael Thorne <Michael.Thorne@hcc.govt.nz>
Cc: Bridget Feary <Bridget.Feary@aurecongroup.com>; Ann Fosberry <Ann.Fosberry@aurecongroup.com>
Subject: LCSIA - Locomotive Engineer Risk Scores - Te Kowhai East Road - Road and Ped

Hi Michael,

Hope you're well. We are updating the LCSIA for Te Kowhai East Road to incorporate the 4-lane + signalised intersection design, as well as completing two Ped LCSIAs.

One of the ped crossings is existing (with a maze, if you recall) and the other will be a new one planned to be built (automatic gates + maze).

The proposed design year is 2032, with a 'future score' scenario in 2042. Because of this, we now need some new RCA Engineer risk scores from you.

There is added uncertainty with the ped crossings as we have no data on the potential pedestrian volumes – so I'll be asking for your scores for 100 and 500 pedestrians for each scenario.

Please fill in the highlighted scores on the far right column in the tables below. There are three tables for the Road, Ped Up and Ped Down crossings.

We estimated AADT for 2032 and 2042 using a linear growth rate in AADT between 2019 and 2051.

Train volume estimates were collected from KiwiRail.

Feel free to give me a ring if you have any questions, I understand this is a lot of information all at once! I can be reached on 02102610364.

ROAD CROSSING

Scenario	Description	Road and Rail Volumes	Risk Score
Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Two-lane carriageway • Half-arm barriers • Flashing lights and bells	• 12,181 vehicles per day • 59 trains per day	4 / 5
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Four-lane carriageway • Half-arm barriers • Flashing lights and bells • Traffic signal control linked to rail crossing • Median traffic islands • Emergency escape shoulder on the east side for eastbound traffic • Roundabouts to the east (The Boulevard/Te Kowhai East Road AND Te Rapa Road/Church Road) to be	• 11,826 vehicles per day • 48 trains per day	1 / 5

	converted to traffic signals. The controllers will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing		
Future Score – upgraded design with 2042 volumes	Upgraded design • Four-lane carriageway • Half-arm barriers • Flashing lights and bells • Traffic signal control linked to rail crossing • Median traffic islands • Emergency escape shoulder on the east side for eastbound traffic • Roundabouts to the east (The Boulevard/Te Kowhai East Road AND Te Rapa Road/Church Road) to be converted to traffic signals. The controller will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing	• 12,181 vehicles per day • 59 trains per day	2 / 5

PED DOWN (EXISTING PED CROSSING)

Scenario	Description	Pedestrian and Rail Volumes	Risk Score
Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 59 trains per day	3 / 5
Change in Use – existing infrastructure with 2042 volumes	Existing infrastructure • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	4 / 5
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 48 trains per day	1 / 5
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 48 trains per day	2 / 5
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 59 trains per day	1 / 5
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	2 / 5

PED UP (NEW PED CROSSING)

Scenario	Description	Pedestrian and Rail Volumes	Risk Score
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 48 trains per day	1 / 5
Proposed Design – upgraded design with 2032 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 48 trains per day	2 / 5
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **100** pedestrians per day • 59 trains per day	1 / 5
Future Score – upgraded design with 2042 volumes	Upgraded design • Automatic gates with emergency egress • Maze • 'Look for Trains' signage	• **500** pedestrians per day • 59 trains per day	2 / 5

Kind Regards,

Dinesh Fonseka
Engineer, Aurecon
T +64 09 5206019

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Wynyard Quarter, Auckland New Zealand 1010
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KiwiRail

FILE COPY
COPY

Wellington Railway Station
Bunny Street
PO Box 593
Wellington
Tel (04) 498 3309
Fax (04) 473 1460
E-mail: crystal.giles@kiwirail.co.nz

File Ref: G89164

23 September 2010

RECEIVED
27 SEP 2010
HAMILTON CITY COUNCIL

Hamilton City Council
Private Bag 3010
Hamilton 3240

ATTN: Tahl Lawrence

6th floor

Dear Sir/Madam

I can advise that your Deed of Grant for the occupation of the railway land at Te Rapa has now been completed. I have therefore enclosed a copy for your records.

If you have any queries please do not hesitate to contact me.

Yours faithfully

CGiles

Crystal Giles
Lease Administrator

DATED 14 August 2010

NEW ZEALAND RAILWAYS CORPORATION

TO

HAMILTON CITY COUNCIL

GRANT for a public right of way and level crossing at
Te Kowhai Road
Te Rapa

Gra5nt No.**G89164**

THIS DEED made the fourteenth day of August two thousand and ten between NEW ZEALAND RAILWAYS CORPORATION being a body corporate constituted under the New Zealand Railways Corporation Act 1981 at Wellington (hereinafter with its successors and assigns referred to as "the Grantor") of the one part AND HAMILTON CITY COUNCIL (hereinafter referred to as "the Grantee" which expression shall include the successors and permitted assigns of the Grantee) of the other part and in consideration of the payments to be made as hereinafter provided and subject to the terms, covenants and conditions herein contained expressed or implied and on the part of the Grantee to be observed and performed THE GRANTOR hereby GRANTS to the Grantee for the term of one (1) year from the first (1) day of August two thousand and ten unless sooner determined under any of the provisions hereinafter contained and so on from year to year unless or until determined under any of the said provisions a public right of way on railway land and a public level crossing at Te Rapa over the line of the North Island Main Trunk railway line at approximately 548.100 kilometres on the railway metrage as shown on plan G89164_1-2 marked in yellow and to be constructed in general accordance with the layout shown in attached plans Hamilton 1, 2, 3. and in conjunction with KiwiRail engineers.

AND the Grantee hereby covenants with the Grantor as follows:

1 (a) TO pay to the Grantor during the continuance of this Agreement the annual rental of ($300.00) plus GST.

(b) The annual grant fee shall be reviewed each review date and will be increased annually in line with the upwards movement of the applicable Capital Goods Price Goods Index (CGPI).

2 THE Grantee will at the cost of the Grantee and to the entire satisfaction of the Grantor provide cattlestops, fencing and drain pipes at the said right of way and crossing and the Grantee will also bear the cost of forming, draining, metalling and sealing the carriageways and of forming kerbing and channelling footpaths where such are required on the railway land for a distance of five metres (5m) outside the centre of any line of rails so crossed.

3 THE Grantee shall at the cost of the Grantee and to the entire satisfaction of the Grantor fence, form, metal, seal, reinstate and maintain the approaches to the said right of way and crossing.

4 THE said cattlestops, fencing and drains, kerbing, carriageways and footpaths within the limits of the said five metres (5m) referred to in Clause 2 hereof shall thereafter be maintained at the cost of the Grantee.

5 THE Grantee shall at the cost of the Grantee do all such works as the Grantor may require to improve the view of the railway from the said right of way and level crossing and shall and will during the continuance of the this Agreement maintain such improved view to the entire satisfaction of the Grantor PROVIDED THAT if the Grantor shall decide that the whole or any part of such work shall be done by (5 metres either side of rail track) or under the supervision of the railway workmen then the Grantee shall pay to the Grantor the cost of such work or supervision on demand.

6 IF at any time in order to protect persons, vehicles and animals using the said crossing the Grantor or any railway employee acting on behalf of the Grantor considers it necessary or advisable to provide crossing keepers, gates, bells, signals, notice boards or other safety appliances or to replace any existing safety appliance with any other type of safety appliance or to remove the said right of way and crossing to another site the Grantee shall bear the cost and maintenance of any such works PROVIDED THAT if the Grantee decides not to provide the aforesaid crossing keepers, gates, bells, signals, notice boards or other safety appliances or to remove the said right of way and crossing the Grantor or the Grantee may terminate this Agreement in accordance with the provisions of Clause 10 hereof.

7 IF at any time the Grantor or any railway employee acting on behalf of the Grantor deems it necessary to provide guard rails at the said right of way and crossing the Grantee shall bear the cost of the provision, erection and maintenance of the said guard rails.

8 THE Grantor will at the cost of the Grantee maintain any warning devices provided for the protection of the public safety.

PROVIDED ALWAYS and it is hereby agreed and declared:

9 THAT trains may pass without warning at any time during the day or night and that the said right of way and level crossing shall be used at the risk of the persons making use thereof and it is further expressly agreed that the Grantee will save harmless and keep fully indemnified the Grantor, the Minister of Railways, and the Government of New Zealand from and against all damage to railway property and from and against all claims, costs, petitions, suits, actions and demands whatsoever which may be made for or on account of any accident or injury to any person or for damage to any property arising out of or caused or contributed to either directly or indirectly by the use of the right of way and level crossing by the Grantee or the servants, agents, workmen, invitees or licencees of the Grantee.

10 THAT this Agreement is at all times subject to the provisions of Section 35 of the New Zealand Railways Act 1981 and the Railways Act 2005 and any amendment thereof AND that this Agreement may be determined at any time by three calendar months' notice in writing by either party hereto AND ALSO that on the determination of the within right the Grantee shall if required by the Grantor pay to the Grantor the cost of reinstating the railway land to the same good order and condition as it was before this right was created.

11 THAT when any notice is to be given it shall be sufficient in cases where the notice is to be given by the Grantor that such notice be signed by some person acting under the express or implied authority of the Grantor and sent by letter or facsimile addressed to the Grantee at the then or last known office or place of business of the Grantee.

12 THAT no covenants whatever shall be implied herein on the part of the Grantor.

13 THAT all powers and remedies herein contained or implied in favour of the Grantor may be exercised by the Minister or the Chief Executive, New Zealand Railways Corporation.

14 a) By an agreement dated 28 September 1990, ("Facilities Agreement") Clear Communications Limited ("Clear") has certain ownership, access, and other rights in respect of a Fibre Optic System (the "System") located within Railway land together with System extension rights. Where the System exists and if future System extensions are constructed on or under the land to which this Grant relates, then Clear's rights shall take precedence over the Grantee's rights.

b) Where this Grant conflicts with Clear's rights under the Facilities Agreement, the Grantee acknowledges that this Grant shall be subordinate to and shall not derogate from, those rights.

c) The Grantee covenants and agrees as follows:

i) not to interfere with or disturb the System;

ii) not to do anything which might cause increased maintenance or operating expenses of the System, or reduce the System's efficiency;

iii) to indemnify Clear for any liability, claim, damage or loss (excluding economic or consequential loss or loss of revenue) arising out of installation maintenance or use by the Grantee of its facilities or of failure to comply with these requirements;

iv) to reimburse Clear its costs of any relocation which Clear carries out to meet the Grantee's requirements;

v) that Clear shall be entitled to seek injunctive relief restraining any actual or threatened breach of this Grant by the Grantee causing interference with or disturbance to the System;

vi) that for the purposes of the Contracts (Privity) Act 1982, Clear is designated to benefit under this Grant in respect of its rights under the Facilities Agreement.

d) In respect of the two metre strip centred on the fibre optic cable of the System, the Grantee shall have no right of entry (except for normal use in passing over the strip without obstructing it) or excavation or subterranean activities, without notifying and obtaining the consent of the Grantor and Clear.

15 SPECIAL CONDITIONS

This crossing will meet all of the specifications that are required by ONTRACK signals engineers. All costs associated for this work at this crossing are to be funded by Hamilton City Council.

Dated 14 August **2010**

SIGNED for and on behalf of
NEW ZEALAND RAILWAYS CORPORATION
By: Neil Davies, NATIONAL LEASE MANAGER
New Zealand Railways Corporation
Pursuant to a power delegated to him
Under Section 10(A) of the New
Zealand Railways Corporation Act 1981.

Signature of Witness:

Name of Witness: Kevin Jones

Occupation: Lease Administrator (Northern)

Address: Wellington

THE COMMON SEAL of Hamilton City Council

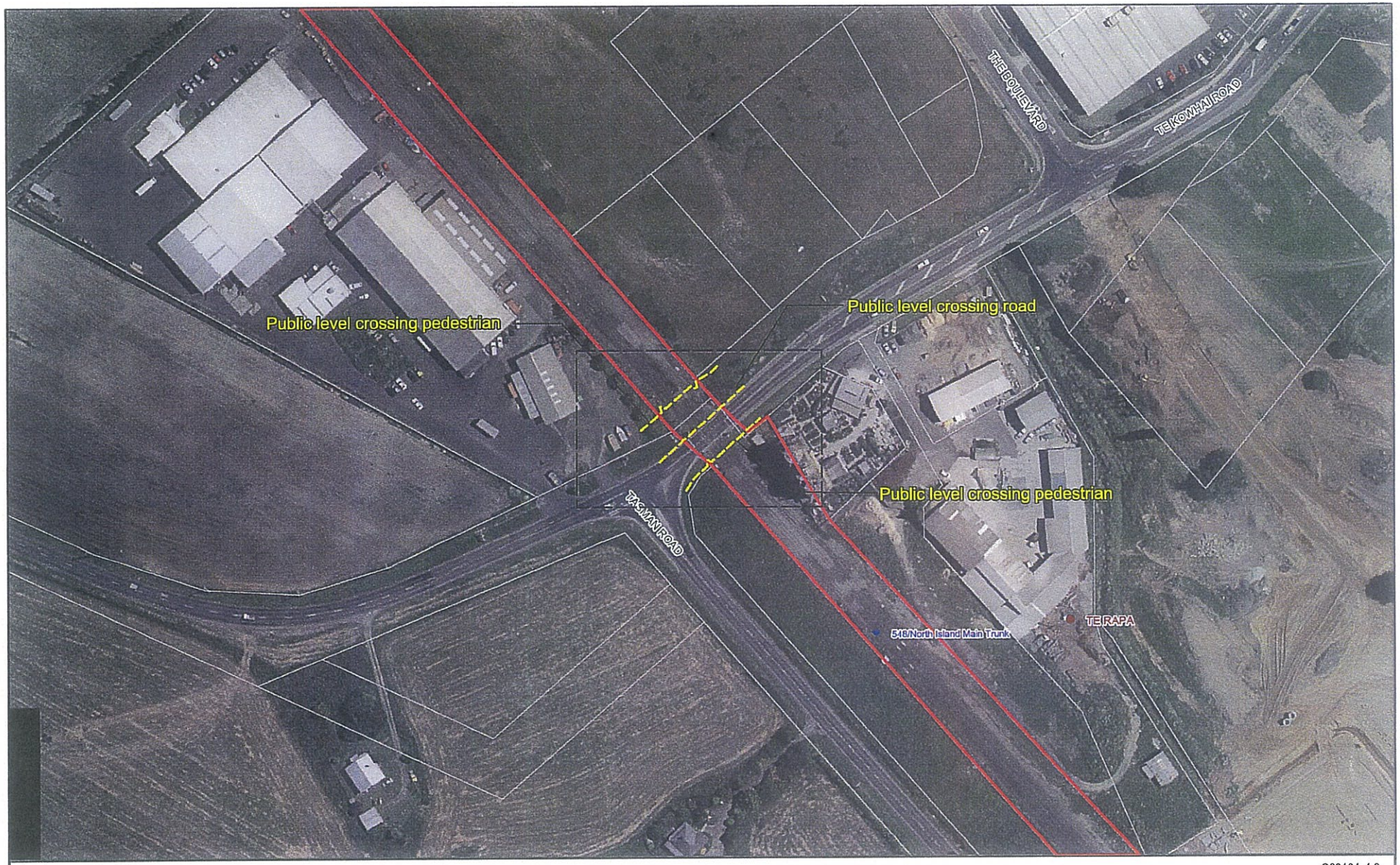
was hereunto affixed in the presence of:

John R. Gower, QSM
Justice of the Peace
City Councillor
Hamilton, N.Z.

~~MAYOR~~/COUNCILLOR:

~~COUNCILLOR~~:
Deputy Chief Executive.

THE COMMON SEAL OF THE HAMILTON CITY



Printed: 16/07/2010
Produced by: Noel Sevilla

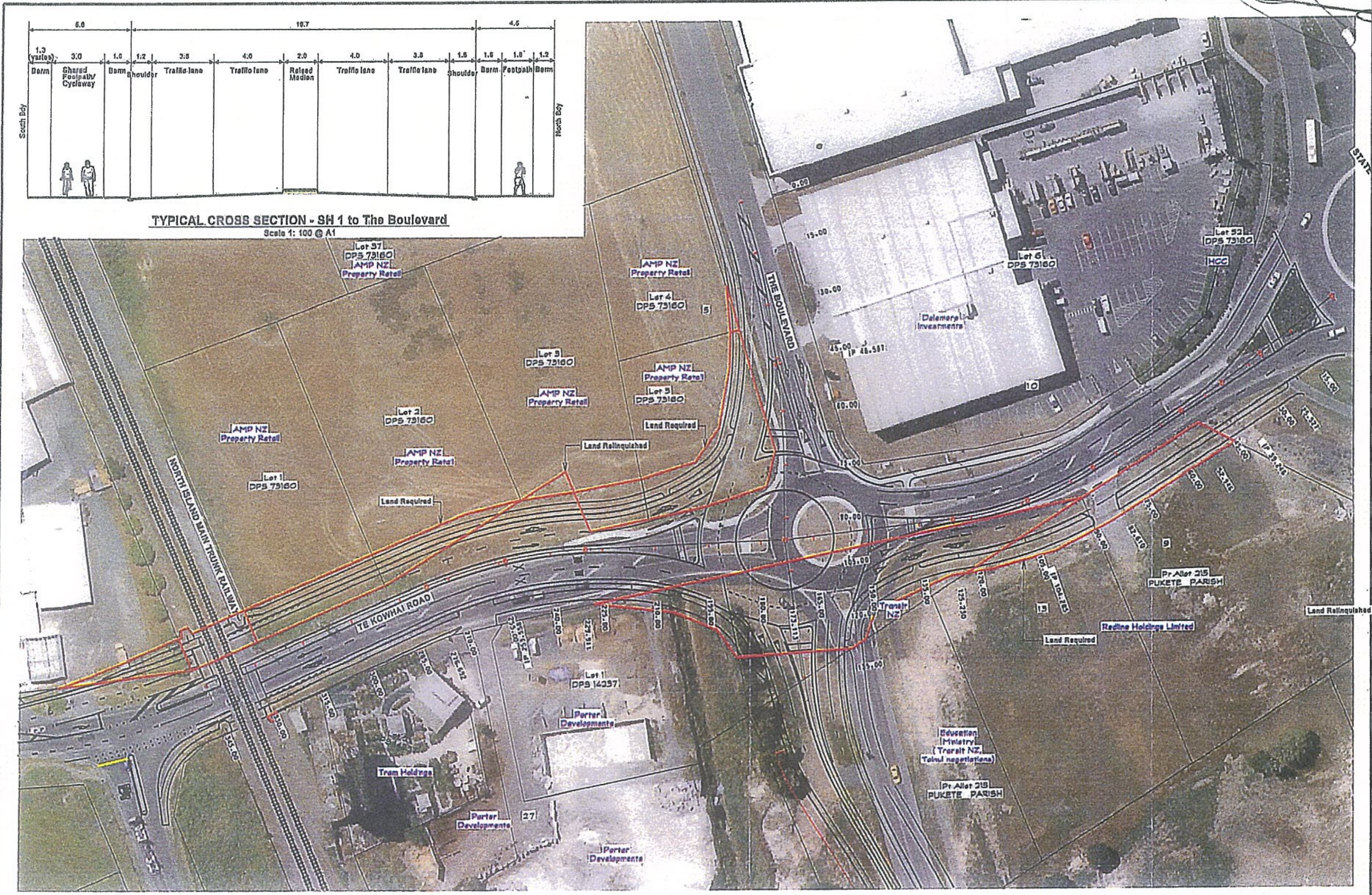
KiwiRail

Public Level Crossings Grant at Te Rapa

Scale 1 : 2000[A4]

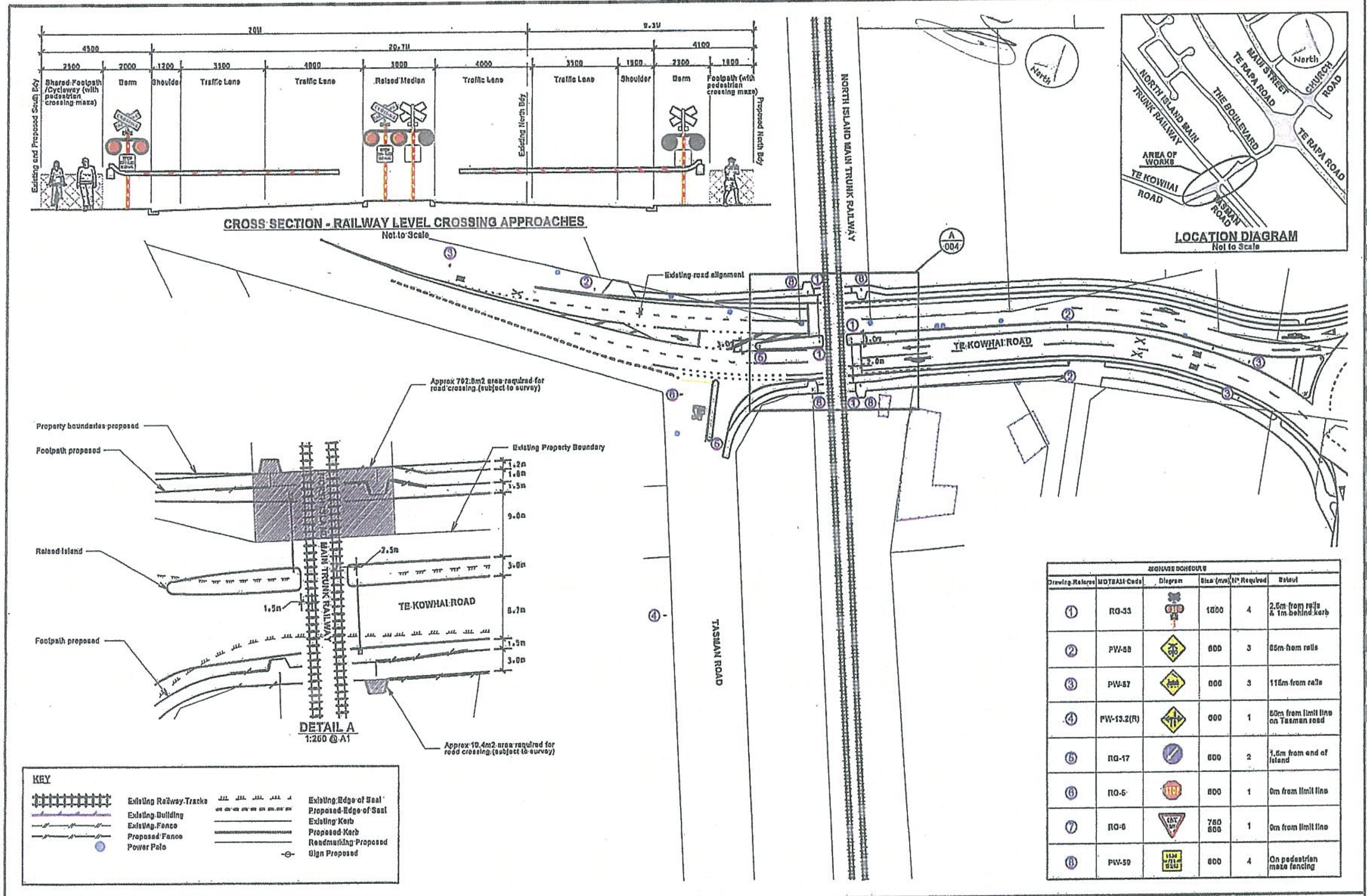
G89164_1-2

Hamilton 1



PROJECT SERVICES PROJECT SERVICES MANAGER C. UARDON DATE	TRANSPORTATION	Hamilton City Council Te kaunihera o Kirikiriroa Private Bag 3010, Hamilton, New Zealand Phone 07 838 6699 www.hamilton.co.nz	TE KOWHAI ROAD FOUR LANING GENERAL ARRANGEMENT & TYPICAL CROSS SECTION	1:500 @ A1 Moturiki Datum	Plan No. DRAFT

Hamilton 2

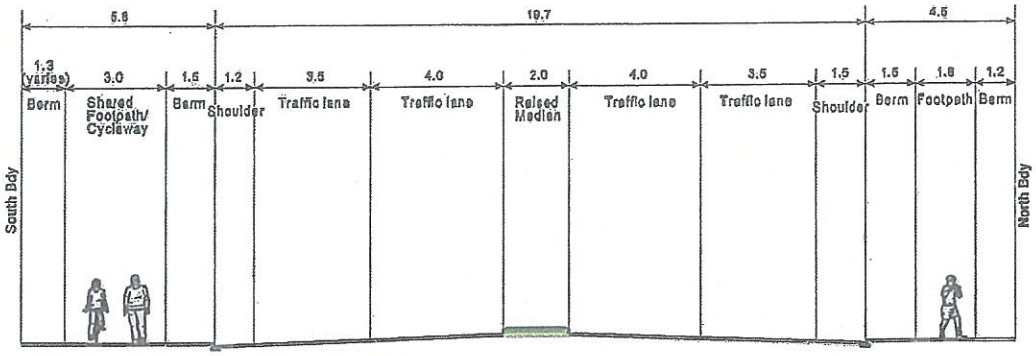


SIGNAGE SCHEDULE

Drawing Reference	MOTSAM Code	Diagram	Size (mm)	No. Required	Setout
①	RG-33		1000	4	2.5m from rails & 1m behind kerb
②	PW-58		600	3	65m from rails
③	PW-57		600	3	115m from rails
④	PW-13.2(R)		600	1	50m from limit line on Tasman road
⑤	RG-17		600	2	1.5m from end of island
⑥	RG-5		600	1	0m from limit line
⑦	RG-6		750 600	1	0m from limit line
⑧	PW-59		600	4	On pedestrian maze fencing

PROJECT SERVICES PROJECT SERVICES MANAGER C. WARDON DATE:	SURVEY / DESIGN / DRAWN A. Cat / PROJECT VERIFICATION / AMENDMENTS	TRANSPORTATION	Hamilton City Council Te kaunihera o Kirikiriroa Private Bag 3010, Hamilton, New Zealand Phone 07 838 6699 www.hamilton.co.nz
TE KOWHAI ROAD FOUR LANING NIMT LEVEL CROSSING SETOUT PLAN	SCALE 1:500 @ A1	Moturiki Datum	Plan No. ST/T052-004

Hamilton 3.



TYPICAL CROSS SECTION - SH 1 to The Boulevard

Scale 1: 100 @ A1

PROJECT SERVICES						TRANSPORTATION
PROJECT SERVICES MANAGER			Date	Checked	Date	
	SURVEY					
	DESIGN					
	DRAWN	Production Team				CHECKED
	PROJECT VERIFICATION					
	AMENDMENTS					APPROVED FOR ISSUE
C. MARDON DATE						

Memorandum

To:	Tony Denton	**Date:**	15 September 2023
From:	Craig Richards / Shania Rajanayagam	**Our Ref:**	4288564-727269281-3979
Copy:			
Subject:	Te Kowhai East Road SFARP		

1 Introduction

Te Kowhai East Road is a two-lane Arterial Road which intersects the double-tracked North Island Main Trunk Line (NIMT) at KM548. As part of enabling urban growth in the Rotokauri Growth Cell, Hamilton City Council (HCC) intends to upgrade Te Kowhai East Road to four lanes plus facilities for walking and cycling. The Tasman Road intersection with Te Kowhai East Road is proposed to be signalised, which will incorporate the Te Kowhai East Road level crossing. A new Ped Up level crossing is proposed for pedestrians only on the north side of the railway crossing. The existing Ped Down crossing on the south side of the crossing is proposed to have crossing facilities for pedestrians and cyclists. Figure 1-1 shows the existing layout of the Te Kowhai East Road rail crossing.

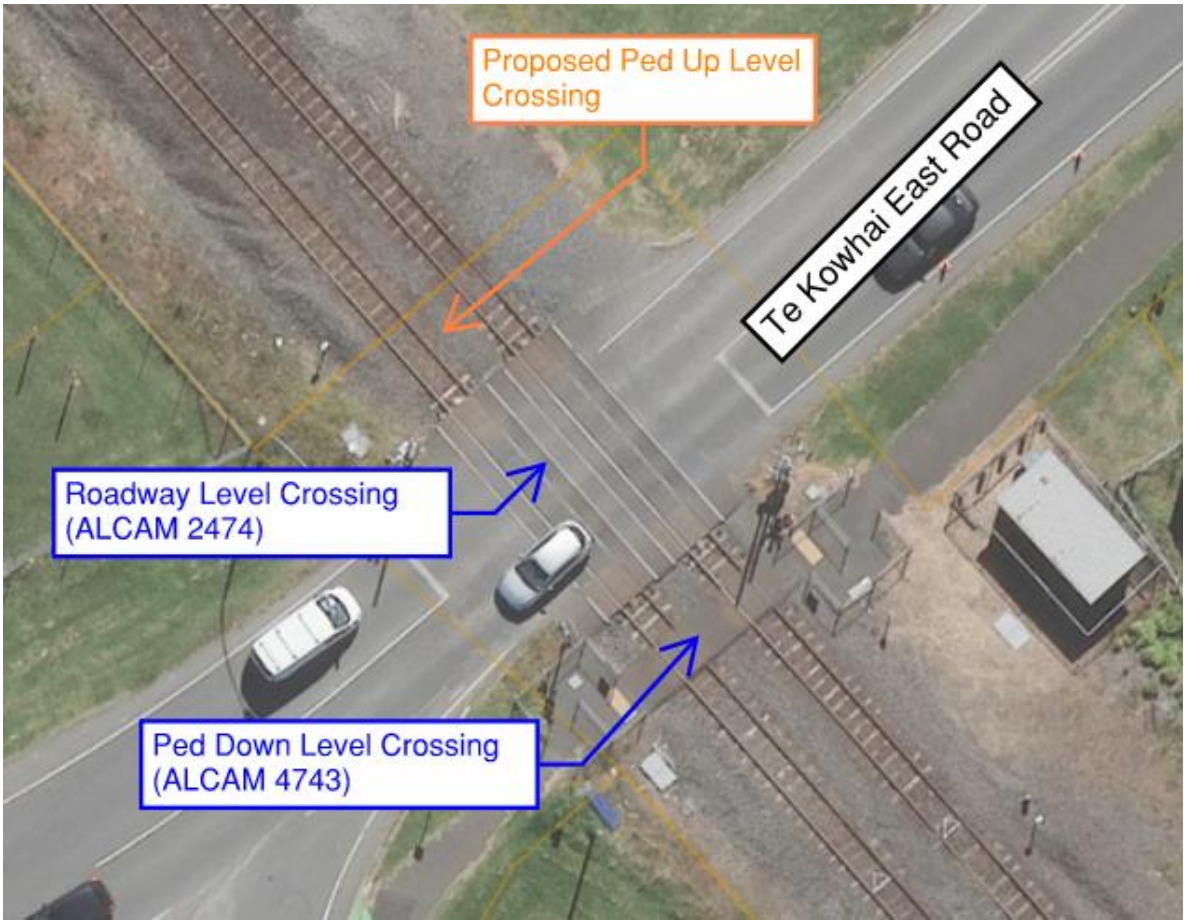


Figure 1-1: Existing Layout of Te Kowhai East Road Rail Crossing

This memorandum has been provided to supplement the so far as reasonably practicable (SFAIRP) process outlined in KiwiRail's Level Crossing Risk Assessment Guidance (Version 5, 2022). The

effect of full closure of the Te Kowhai East Road roadway level crossing (ALCAM 2474) has been assessed.

2 Background

Beca Limited (Beca) was commissioned by HCC to undertake an Integrated Transport Assessment (ITA) to accompany the Rotokauri Arterial Designation Notice of Requirement. The purpose of the ITA was to ensure that the transportation effects of the designation are well considered, and an emphasis on safety and accessibility by all transport modes was incorporated. Rotokauri is a proposed residential and industrial growth area which is situated in the northwest fringe of Hamilton. The Rotokauri development area forms a key part of the future urban growth strategy for Hamilton and will provide for an eventual population of between 16,000 and 20,000 people. This future urban area connects to the areas east of the railway lines using Wairere Drive, Te Kowhai East Road and Ruffell Road.

Aurecon Limited (Aurecon) was commissioned by KiwiRail and HCC to undertaken LCSIAs for the Te Kowhai Road roadway, existing pedestrian and proposed new pedestrian crossings to evaluate the proposed development and four-lane design. As part of the LCSIA process, a top-down evaluation was performed on the road which includes an evaluation of closure or grade separation. HCC identified that it is not reasonably practicable to close the crossing as it services a significant road corridor and there is no suitable alternative crossing within a reasonable distance that services this area. It also identified that it is not reasonably practicable to close an alternative crossing as there is not another level crossing on the network which can be closed without a significant impact on the network operations or safety. It also identified it is not reasonably practicable to grade separate the crossing as the cost of grade separation is disproportionate to the risk, and there are geometric constraints that preclude grade separation.

There are two criteria applicable to level crossings:

- **Criterion 1** - requires the Proposed Design and Future Score of a level crossing to achieve a Low or Medium-Low level of risk as determined by the Level Crossing Safety Score (LCSS)
- **Criterion 2** - requires the Proposed Design and Future Score of a level crossing to achieve an LCSS number (out of 60) lower than, or equal to, the Updated Existing LCSS number.

The LCSS risk bands for LCSIA conducted for the Te Kowhai East Road roadway crossing are shown below in Table 2-1.

Table 2-1: Summary of the LCSS at Te Kowhai Road roadway level crossing (retrieved from: LCISA Risk Assessment Te Kowhai East Road, Aurecon, 16 May 2023)

	Updated Existing	Change in Use	Proposed Design	Future Score
LCSS	31 / 60	40 / 60	31 / 60	33 / 60
LCSS Risk Band	Medium	Medium-High	Medium	Medium
Criterion Met	-	-	C1 Fail C2 Met	C1 Fail C2 Fail
Form of Control	Half arm barriers and flashing lights and bells	Half arm barriers and flashing lights and bells	Signalised coordinated intersection with half arm barriers and flashing lights and bells	Signalised coordinated intersection with half arm barriers and flashing lights and bells

It should be noted that the following assumptions were made for the latest LCSIA completed by Aurecon:

- Traffic volumes for 2032 (Proposed Design and opening day) and 2042 (Change in Use and Future Score) are based on linear growth estimates using 2019 traffic counts and 2051 traffic modelling provided by HCC's Waikato Regional Transport Model (WRTM); and
- Rail volumes for 2032 (Proposed Design and opening day) and 2042 (Change in Use and Future Score) are assumed to be the same as the current rail volumes, which is 32 per day (weekly volumes) at a speed of 80km/h.

3 Assumptions

The following assumptions have been used to form the basis of this assessment:

- Traffic volumes have been extracted from the Waikato Regional Transportation Model (WRTM) for 2031 and 2041
- Split of traffic redistribution assumed to be 50/50 between the two other crossings in the area for all analysis. Sensitivity of other traffic redistribution splits between the two other crossings have been included; and
- The location of closure is approximately 15m away from the existing level crossing, resulting in Tasman Road being fully operational and access to STIHL Shop Te Rapa remains.

4 Te Kowhai East Road

4.1 Site Description

Te Kowhai East Road is one of three level crossing locations in this area, along with Wairere Drive and Ruffell Road (currently closed due to safety concerns), connecting industrial land on both sides of the railway lines as shown in Figure 4-1 below.

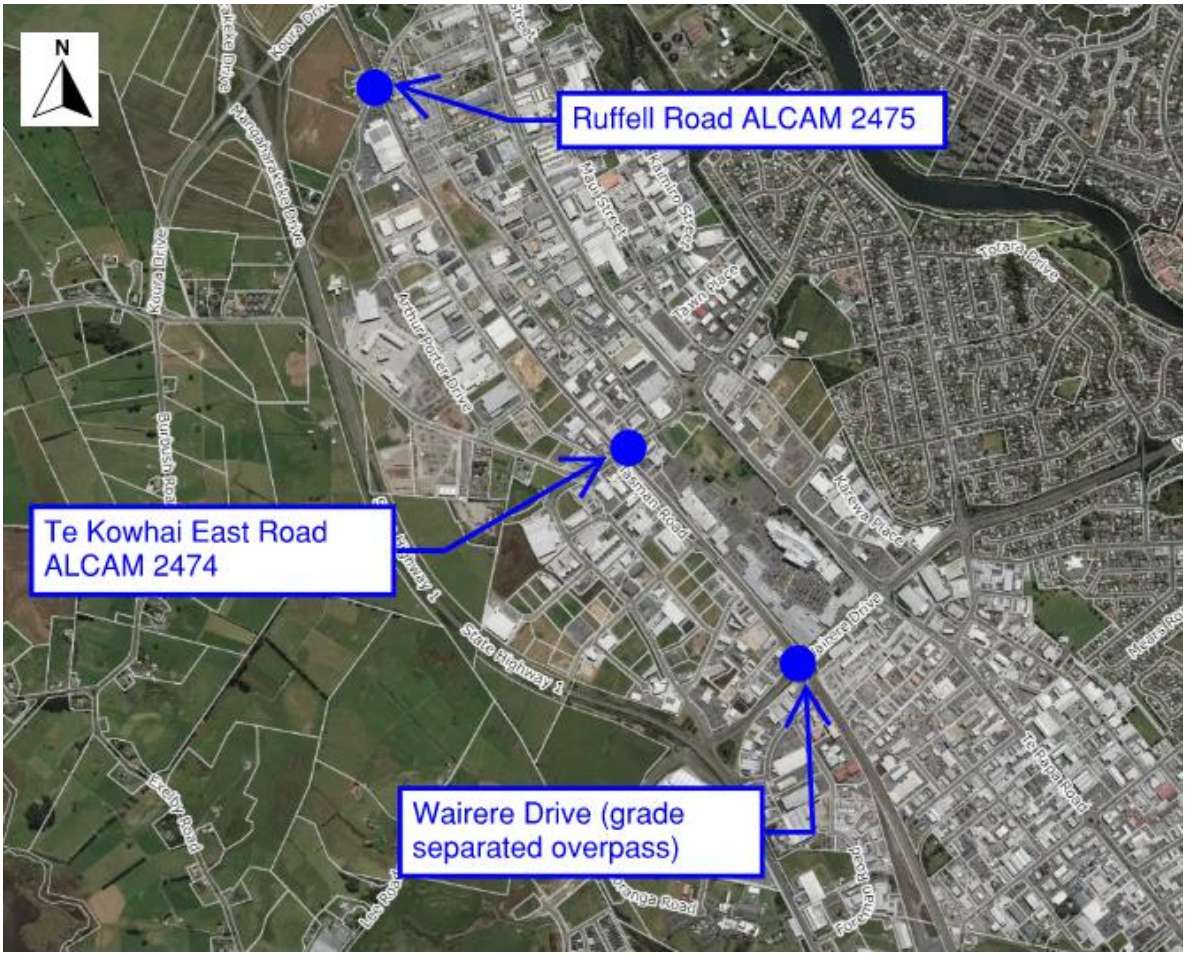


Figure 4-1: Location of level crossings

Te Kowhai East Road services Te Rapa, an industrial and retail centre north of Hamilton City and east of SH1C. It has been designated as an Arterial Road and significant growth in traffic volumes is expected as Rotokauri to the west is developed. Immediately surrounding the level crossing are industrial sites, large retail stores, car yards and a fuel station.

There are plans to increase the width of Te Kowhai East Road to make it a four-lane major arterial road as part of the Rotokauri Arterial ITA. The cost of this is approximately **$25,360,000**[1]**.**

4.2 Traffic Volumes

Existing annual average daily traffic (AADT) volumes along Te Kowhai East Road are noted as 9,690 vpd with 4% heavy commercial vehicles (HCV).

The predicted traffic volume along Te Kowhai East Road across the level crossing is 11,890 in 2031 and 13,780 in 2041 as extracted from the WRTM.

[1] All costs sourced via HCC.

Table 4-1: WTRM traffic flows through intersections along Te Kowhai East Road in 2031 and Table 4-2: WRTM traffic flows through intersections along Te Kowhai East Road in 2041 show the traffic volumes through the key intersections along Te Kowhai East Road close to the level crossing in 2031 and 2041.

Table 4-1: WTRM traffic flows through intersections along Te Kowhai East Road in 2031

Intersection	AM 2hr Peak	IP 2hr Peak	PM 2hr Peak	AADT
Arthur Porter Drive / Te Kowhai Road	365	687	962	5,341
Tasman Road / Te Kowhai East Road	1,052	1,496	2,242	11,901
The Boulevard / Te Kowhai East Road / Maahanga Drive	2,312	3,146	4,573	24,999

Table 4-2: WRTM traffic flows through intersections along Te Kowhai East Road in 2041

Intersection	AM 2hr Peak	IP 2hr Peak	PM 2hr Peak	AADT
Arthur Porter Drive / Te Kowhai Road	839	1,008	1,478	8,084
Tasman Road / Te Kowhai East Road	1,352	1,739	2,438	13,808
The Boulevard / Te Kowhai East Road / Maahanga Drive	2,699	3,482	4,879	27,641

5 Implications of Closing Te Kowhai East Road Roadway Level Crossing

5.1 Road Volumes and Sensitivity Testing

The closure of the Te Kowhai East Road level crossing would require traffic to re-route to either Wairere Drive or Ruffell Road due to these being the only existing crossings in the same area as the Te Kowhai East Road crossing. Table 5-1: Surrounding road level crossing traffic volumes in 2031 and Table 5-2: Surrounding road level crossing traffic volumes in 2041 show the traffic volumes for Wairere Drive and Ruffell Road at the railway crossing locations in 2031 and 2041. The Ruffell Road numbers are combined between the Ruffell Road level crossing and a proposed new crossing as an extension of Koura Drive.

Table 5-1: Surrounding road level crossing traffic volumes in 2031

Road	AM 2hr Peak	IP 2hr Peak	PM 2hr Peak	AADT
Wairere Drive	3,728	3,917	4,058	30,599
Ruffell Road	728	466	925	4,127

Table 5-2: Surrounding road level crossing traffic volumes in 2041

Road	AM 2hr Peak	IP 2hr Peak	PM 2hr Peak	AADT
Wairere Drive	3,741	3,939	4,199	30,845
Ruffell Road	1,502	1,423	1,961	11,541

It is noted that there is no predicted increase in traffic volume on Wairere Road in WRTM between 2031 and 2041. It is assumed that this is because there is no additional capacity above this based on the number of lanes existing on Wairere Drive across the railway lines and speed of the road.

The closure of the Te Kowhai East Road level crossing would result in the diversion of this traffic to one of the two alternative crossings at Wairere Drive and Ruffell Road.

Sensitivity testing has been conducted based on the following redistribution scenarios:

- 100% of traffic diverted to Wairere Drive, 0% of traffic diverted to Ruffell Road
- 80% of traffic diverted to Wairere Drive, 20% of traffic diverted to Ruffell Road
- 50% of traffic diverted to Wairere Drive, 50% of traffic diverted to Ruffell Road
- 20% of traffic diverted to Wairere Drive, 80% of traffic diverted to Ruffell Road; and
- 0% of traffic diverted to Wairere Drive, 100% of traffic diverted to Ruffell Road.

5.2 Wairere Drive Rail Overpass (Bridge 5464)

The crossing at Wairere Drive is a two-lane separated crossing with a traffic volume of approximately 20,000 vehicles per day at present and is expected to rise to approximately 31,000 in 2031 and 2041. If the crossing at Te Kowhai East Road is closed the following vehicle volumes are assumed to be redistributed via Wairere Drive based on scenarios listed in Section 5.1.

Table 5-3: Sensitivity testing of traffic redistribution on Wairere Drive rail overpass

Redistribution	2031 AADT	2041 AADT
100% Wairere Drive / 0% Ruffell Road	43,000	45,000
80% Wairere Drive / 20% Ruffell Road	40,600	42,200
50% Wairere Drive / 50% Ruffell Road	37,000	38,000
20% Wairere Drive / 80% Ruffell Road	33,400	33,800
0% Wairere Drive / 100% Ruffell Road	31,000	31,000

The capacity of Wairere Drive is constrained on both sides by major intersections with Te Rapa Road and SH1C and is often near capacity during busy times of the day. There would be a need to increase the capacity of the Wairere Drive rail overpass through the provision of an additional lane in each direction to accommodate the potential increase in traffic volume in 2031 and 2041.

Detailed network traffic modelling would be necessary to determine the impacts to surrounding intersections, however it is apparent that the existing intersections either side of the overbridge already have four lane approaches and slip lanes on most arms. So increasing capacity to accommodate redistributed traffic volumes is likely to necessitate grade separation which would have significant cost.

The cost of upgrading the Wairere Drive overpass to four lanes is **$14,762,000**. This does not include any potential upgrades to the intersections either side of the overpass due to the impact an increase in traffic volumes may have on adjacent intersections which would incur an additional cost.

5.3 Ruffell Road Roadway Level Crossing (ALCAM 2475)

The Ruffell Road level crossing is currently temporarily closed due to safety concerns at the intersection (Ruffell Road / Onion Road) next to the level crossing. The safety concerns related to the Ruffell Road level crossing were around the alignment of the intersection and the proximity to level crossing. The closure has meant vehicles can only access Onion Road from Ruffell Road and vice versa instead of having the option to cross the railway lines. The traffic volume of this level crossing before it closed was approximately 2,000 per day and it is expected to rise to approximately 4,100 in 2031 and approximately 11,500 in 2041 (if reopened). If the crossing at Te

Kowhai East Road is closed the following vehicle volumes are assumed to be redistributed via Ruffell Road based on scenarios listed in Section 5.1.

Table 5-4: Sensitivity testing of traffic redistribution on Ruffell Road level crossing

Redistribution	2031 AADT	2041 AADT
100% Ruffell Road / 0% Wairere Drive	16,100	25,500
80% Ruffell Road / 20% Wairere Drive	13,700	22,700
50% Ruffell Road / 50% Wairere Drive	10,100	18,500
20% Ruffell Road / 80% Wairere Drive	6,500	14,300
0% Ruffell Road / 100% Wairere Drive	4,100	11,500

Should Te Kowhai East Road level crossing be closed, and Wairere Drive not widened, there is a need to reopen the Ruffell Road crossing to provide an additional connection to complement the Wairere Drive rail overpass. To address safety and capacity issues at Ruffell Road level crossing a grade separated crossing facility would be necessary. A grade separated facility at Ruffell Road has been considered as part of longer term planning studies which show a connection between Koura Drive and Te Rapa Road. The separation of this crossing would need to be bought forward to provide adequate connections across the railway line. In the short term the realignment of Onion Road may need to be brought forward to allow for the Ruffell Road level crossing to be reopened.

The cost of upgrading the Ruffell Road level crossing and realigning Onion Road is **$21,887,000**. It should be noted that the Ruffell Road level crossing was previously equipped with half-arm barriers and flashing lights and bells (before temporary closure) which are the minimum protection requirements for a roadway crossing; however, it currently falls within the High ALCAM risk band and is unlikely to meet Criterion 1 for 2031 and 2041 scenarios. An LCSIA recommended to be completed on the Ruffell Road level crossing to assess the effects of future traffic volumes. To mitigate this risk, the proposed Koura Drive overpass would need to be implemented as a longer-term solution, providing a northern crossing facility with the permanent closure of Ruffle Road level crossing. The indicative cost for the Koura Drive overpass is **$71,584,000**.

5.4 Arthur Porter Drive / Te Rapa Road Intersection

Arthur Porter Drive is currently a two-lane road which connects Wairere Drive, Te Kowhai East Road and Ruffell Road, running north-south. Te Rapa Road is currently a four-lane road between Te Kowhai East Road and Wairere Drive and a two-lane road between Te Kowhai East Road and Ruffell Road.

Table 5-5: Surrounding road traffic volumes in 2031

Roads	AM	IP	PM	AADT
Arthur Porter Drive (North of Te Kowhai East Road)	307	174	366	1,578
Arthur Porter Drive (South of Te Kowhai East Road)	180	448	560	3,399
Te Rapa Drive (North of Te Kowhai East Road)	2,324	1,797	3,209	15,352
Te Rapa Drive (South of Te Kowhai East Road)	2,758	2,124	3,223	17,771

Table 5-6: Surrounding road traffic volumes in 2041

Roads	AM	IP	PM	AADT
Arthur Porter Drive (North of Te Kowhai East Road)	313	146	335	1,380
Arthur Porter Drive (South of Te Kowhai East Road)	318	477	680	3,760
Te Rapa Drive (North of Te Kowhai East Road)	2,539	2,119	3,346	17,674

Roads	AM	IP	PM	AADT
Te Rapa Drive (South of Te Kowhai East Road)	2,662	2,083	3,065	17,335

With the potential closure of Te Kowhai East Road this would likely increase traffic volumes on Arthur Porter Drive and Te Rapa Drive by 12,000 in 2031 and 14,000 in 2041 split between north and south movements.

There may be a need to increase the width of both Arthur Porter Drive and Te Rapa Drive to accommodate the potential increase in traffic with the closure of the Te Kowhai East Road to provide the necessary capacity to people accessing the area.

5.5 Journey Distance

The closure of the Te Kowhai East Road roadway level crossing would require trips that use this crossing to use one of the two alternative crossings above which would increase the journey time, kilometres travelled and associated emissions for many trips. The distance along Te Kowhai East Road between the intersection with Arthur Porter Drive and the roundabout with The Blvd and Maahanga Drive is 400m. The distance between these two intersections if Te Kowhai East Road is closed and the route chosen is Wairere Drive is 3.2km and 4.4km for using Ruffell Road. This is an increase of 2.8km for the route using Wairere Drive and 4km for the route using Ruffell Road.

5.6 Rotokauri Transport Hub

HCC has recently completed a new bus hub on Tasman Road which connects to Te Rapa Shopping Centre and Rotokauri Rail Station. This relies on Te Kowhai East Road due to the connection to Tasman Road and Te Kowhai East Road being the main public transport connection to the bus hub. If the Te Kowhai East Road level crossing is closed, buses will have to reroute to either the Wairere Drive crossing or Ruffell Road crossing to connect to the bus hub. Figure 5-1: Hamilton Bus Network shows the bus network across Hamilton. The Orbiter bus route uses the Te Kowhai East Road rail crossing. There are 4 buses per hour each direction across the Te Kowhai East Road crossing between 5am and 10pm.

If a grade separated solution is considered for Te Kowhai East Road, then this bus route would have to bypass Tasman Road due to the proximity of the existing intersection to the rail corridor not providing sufficient space to achieve the necessary grades to integrate with the level of the existing corridor.

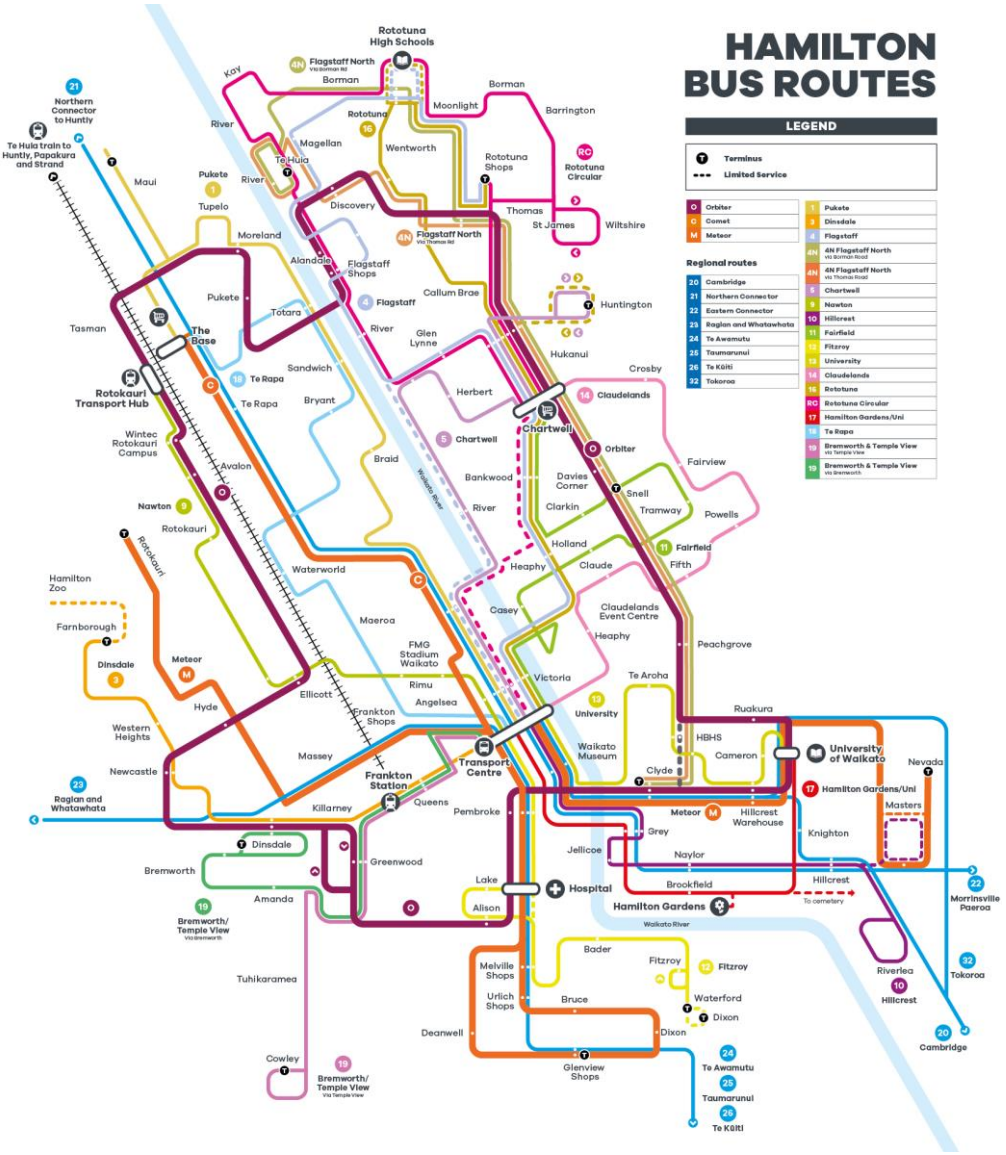


Figure 5-1: Hamilton Bus Network

5.7 Rapid Transit Network

The Regional Public Transport Plan (RPTP) outlines a 10-year frequent bus network that connects to the Rotokauri and The Base bus hubs with North-South and East-West. There is a key connection for the existing bus network across Te Kowhai East Road to connect to Tasman Road, providing access to the Rotokauri Transport Hub. A closure of the Te Kowhai East Road crossing would require the existing service that uses this crossing to use the crossing at Ruffell Road or Wairere Drive, increasing the distance and changing the potential catchments around the Te Kowhai East Road area and beyond for people travelling to that area.

The RPTP outlines a 30-year plan that will see Bus Rapid Transit connecting to The Base from the CBD and Bus Rapid Transit light and frequent bus services connecting between the Rotokauri Transport Hub and Rotokauri and to the south. There will be bus lanes added on Te Rapa Drive to support the Bus Rapid Transit route through the area.

5.8 Surrounding Businesses

The businesses surrounding the Te Kowhai East Road level crossing have developed on the premise that the crossing remains open as potential closure has never been notified. Any potential closure of the level crossing will impact the viability of these businesses especially car sales yard that would see a significant decrease in passing traffic. Te Kowhai East Road provides a key northern connection to The Base shopping area so the closure of this connection would mean people would either travel further north (Ruffell Road), or to the south (Wairere Drive) to make the connection across the railway lines to connect to The Base. We envisage there would be significant opposition to any closure from local businesses.

6 Conclusion and Recommendations

The key findings of this memorandum are:

- Te Kowhai East Road provides a key east-west connection for Hamilton, and closing this road would result in additional vehicle volumes on Arthur Porter Drive and Te Rapa Road to connect to the Ruffell Road level crossing or Wairere Drive rail overpass
- The necessary upgrades of Ruffell Road and/or Wairere Drive would be significant and deemed not reasonably practicable due to implementation costs detailed below:
  - Four-lane Wairere Drive overpass = **$14,762,00 (plus intersection upgrades)**
  - Onion Road realignment and Ruffell Road level crossing upgrades = **$21,887,000**
  - Construction of proposed Koura Drive overpass = **$71,584,000**
- Journey lengths and corresponding travel times and emissions would increase if the Te Kowhai East Road level crossing is closed; and
- Te Kowhai East Road is the main public transport route for buses servicing the Rotokauri Transport Hub and it is proposed to remain this way as part of the RPTP. Should the closure of Te Kowhai East Road occur, buses will need to be rerouted which may incur additional journey time and potential travel time delays.

As the cost for four-laning Te Kowhai East Road and upgrading the level crossing is approximately **$25,360,000**, it is deemed grossly disproportionate to close this crossing as the cost of upgrading adjacent crossings sums to approximately **$108,233,000**. It is recommended that an LCSIA be conducted on the Ruffle Road level crossing to assess the implications and risks of reopening. There is the opportunity to stage any proposed upgrades; however, as the Future Score of Te Kowhai East Road is two-points away from meeting Criterion 1, the proposed recommendations do not make the crossing inherently unsafe. Analysis has also been conducted to prove that the proposed upgrades to Te Kowhai East Road are able to be accommodated by the network and adjacent intersections (refer to Rotokauri Arterials Designation ITA). This memorandum should be used as part of the LCSIA SFAIRP process as it highlights indicative costs relating to proposed upgrades as well as network implications.

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SAFETY, HEALTH AND ENVIRONMENT

ENTERPRISE-WIDE SHE TEMPLATE (Adapted for LCRAG SFAIRP Process)

04-TEM-006-SHE

SFAIRP STATEMENT REPORT

1. DOCUMENT DETAILS

Project Name:	Rotokauri Development Plan and four laning of Te Kowhai East Rd – affecting Te Kowhai East Rd Level Crossing, 548.10km, NIMT

Project Stage:	Design ☒	Implementations/Closeout (Construction) ☐	Operations ☐

Disciplines Covered:					
Track ☒	Civil ☐	Structures ☐	Signals & Comms ☒	Mechanical ☐	Traction/Elec ☐
Facilities ☐	Operations ☒	Rollingstock ☐	Network Service ☒	Ships ☐	
Others Please Specify:					

Document Control:		
DRAFT v1	For internal review by KiwiRail.	15/08/23
DRAFT v2	Updated with future increased train numbers as advised by KiwiRail, and with the consequential changes in FRP as advised by Aurecon. The SFAIRP conclusions are not affected by the changes. For review by stakeholders.	24/01/24
FINAL	No changes from stakeholder review meeting.	16/02/24

2. DOCUMENT APPROVAL

Project Assurance SFAIRP Due-diligence Declaration Confirming that:	Completed
1. SHE Risk Assessment has been implemented as intended and communicated to the key stakeholders and that the hazard/risks associated with project stage have been established, understood, and the relevant controls have been identified, implemented or planned.	☐
2. SFAIRP statement demonstrate a reasoned and supported arguments, that there are no other practical measures that could reasonably be taken to reduce risks further and that the controls implemented provide the highest level of protection that is reasonably practicable for these circumstances.	☐
3. Due diligence checks have been undertaken verifying that the identified controls are appropriate and documented evidence is available to confirm the risks have been mitigated to a degree consistent with KiwiRail systems and standards.	☐

Prepared by Author:	Phil McQueen Ltd	Signature		Date	16/02/24
Content Reviewed by:	Senior Level Crossings Engineer	Signature	E COOK	Date	16/2/24
Technical Authority Approval:	Professional Head Signals	Signature		Date	22/02/24
Operations Approval:	GM Operations, UNI	Signature		Date	19/2/2024
Zero Harm Approval:	Head of Safety Risk Assurance	Signature	Amanda Farmer	Date	21/02/2024

3. PURPOSE AND SCOPE OF THIS REPORT

As part of the Rotokauri Development Plan, Hamilton City Council (HCC) plans to upgrade Te Kowhai East Road to four lanes including at the level crossing of the North Island main Trunk (NIMT) railway, along with related changes to the road network in the vicinity. Construction of the upgrade of Te Kowhai East Rd is planned to be complete by 2032.

HCC has commissioned an LCSIA report from Aurecon to assess the impact of the changes on the level crossing. The LCSIA report describes the effects on the level crossing, the associated changes in risk, and makes safety improvement recommendations. Briefly:

- Te Kowhai East Road services Te Rapa, an industrial and retail centre north of Hamilton City and east of State Highway 1 and has a level crossing of two main lines of the NIMT railway.
- Growth in the area, along with implementation of the Rotokauri Development Plan, is forecast to drive increased road traffic volumes at the crossing.
- Train numbers and speeds at the crossing were assumed in the LCSIA analysis to remain at existing levels, as advised by KiwiRail, with no allowance for any increase in train numbers for the future case. Subsequently KiwiRail advised new information with an increase in future train numbers. The ALCAM analysis was updated accordingly and is presented in the Aurecon memo. The updated analysis is used in the SFAIRP review.
- The road crossing is currently controlled by HAB and FLB.
- There are pedestrian crossings on both sides of the road. The proposed safety improvements for both pedestrian crossings achieve criteria 1 and 2. Therefore they do not require an SFAIRP review and are not considered further.
- The LCSIA report has found that criterion 1 cannot be achieved for the road crossing other than by grade separation or crossing closure, and that criterion 2 can be achieved by a combination of other controls for the proposed design case but not for the future case.
- Grade separation or closure are considered “not reasonably practicable” by HCC, hence triggering the requirement for this SFAIRP review.

The purpose of this SFAIRP Report is to review whether grade separation or closure are “reasonably practicable” for the road crossing, by applying the process described in the LCRAG (v5), Appendix 9.

The figure below shows the existing Te Kowhai East Rd level crossing and is extracted from the LCSIA report Figure 5-1.

Figure 5-1. Te Kowhai Road Te Rapa Level Crossing (ALCAM 2474). Image source: map.grip.co.nz/map and annotated by LCSIA Team.

The figure below shows the proposed HCC concept design for Te Kowhai East Rd level crossing and is extracted from the LCSIA report Appendix B.

4. APPLICABLE REGULATIONS, ACTS AND STANDARDS

Type	Description
KiwiRail Engineering Standards	KiwiRail Infrastructure has a comprehensive suite of engineering standards and supporting documents, including those applying to level crossings. In particular, the Signals and Telecommunication Standard: Active Level Crossings (S-ST-LC-2103), which specifies minimum levels of protection at crossings.
NZTA Traffic control devices manual (TCD manual) – Part 09: Level crossings	The TCD manual provides standards for traffic control devices including at level crossings.
Level crossing risk assessment	The Level Crossing Safety Impact Assessment (LCSIA) and Australian Level Crossings Assessment Model (ALCAM) are methods used in NZ for assessing level crossing risk and identifying appropriate risk controls. The Level Crossing Risk Assessment Guide (LCRAG), prepared jointly by KiwiRail and NZTA Waka Kotahi, provides guidance on risk assessment and describes the SFAIRP review process to be used if there are risk controls identified that are considered to be "not reasonably practicable" to implement.
Act	Railways Act 2005
Act	Health & Safety at Work Act 2015
Regulations	Health & Safety at Work Regulations 2016

5. KEY CONSTRAINTS, ASSUMPTIONS, AND DEPENDENCIES

The risk has been assessed, and risk controls proposed, using the LCSIA process.

This SFAIRP Report has been prepared using the process set out in LCRAG (v5) Appendix 9 and relies on the information contained in the reference documents listed in section 10, and where noted further information provided separately.

6. STAKEHOLDER ENGAGEMENT

The Key Stakeholders are:

Stakeholder	Reason for Engagement
KiwiRail	The KiwiRail Upper North Island Region is responsible for the maintenance of the infrastructure and the rail operations at the level crossing. KiwiRail Engineering and Zero Harm groups are KiwiRail's technical authorities re level crossing design and safety risk.
Hamilton City Council (HCC)	HCC is the Road Controlling Authority, and the sponsor of the project affecting the level crossing.

Engagement with stakeholders took place as part of the LCSIA of the crossing and included all relevant parties including worker representatives. Details are in the LCSIA report.

7. RISKS BEING CONSIDERED

Risk/Hazard ID	System/Rail Network – Key Risks/Hazards Description
	The risk of harm caused by a train vs road user collision at the road level crossing for the future use cases.

The key factors driving the risk at Te Kowhai East Rd are the existence of a level crossing of road and rail, and the increased traffic volumes for the future use case:

- Additional road traffic volumes generated by forecast growth and development growth in the area.
- Additional rail traffic volumes for the future use case as advised by KiwiRail.

This risk is not new, as it exists to a degree today at the existing crossing. Neither is it novel, as the same risk exists in varying degrees at numerous other level crossing locations on the rail network. However, the proposed change of use will result in increased traffic levels with an associated change in risk which must be considered, and appropriate controls identified.

8. SFAIRP JUSTIFICATION STATEMENT

KiwiRail currently manages this risk through a number of existing controls, selected and applied to each crossing site as appropriate, and which fall under KiwiRail's Safety Case and Licence to Operate. Therefore, this SFAIRP statement focuses on how existing controls will be applied at this crossing site.

The Risk has been assessed and the following Hierarchy of Controls considered:

Controls Considered		Results
Elimination	Grade Separation Closure	Not Practicable
Substitution	N/A	N/A
Engineering	Flashing Lights & Bells and Half Arm Barriers.	To be Implemented

Engineering	Road/rail intersection layout and design details physical works.	To be Implemented
Administrative	Signs and road markings.	To be Implemented

The controls proposed to be implemented:

- Will not achieve criterion 1 for any case.
- Will achieve criterion 2 for the proposed design case but not for the future case.

The criterion 1 controls (grade separation or closure) are considered not reasonably practicable by HCC, and the analysis in section 9 supports this position.

While the remaining controls do not achieve criterion 2 for the future case, they do provide a safety improvement compared to the change in use case, as indicated by the LCSS scores shown below.

Table 1-2. Summary of the change in LCSS at Te Kowhai Road level crossing.

	Updated Existing	Change in Use	Proposed Design	Future Score
LCSS SCORE	31 / 60	40 / 60	31 / 60	33 / 60
LCSS RISK BAND	MEDIUM	MEDIUM – HIGH	MEDIUM	MEDIUM
CRITERION MET			C1 FAIL, C2 MET	C1 and C2 FAIL

In addition, it is noted that all the available and suitable controls (short of grade separation or closure) have already been, or are proposed to be, implemented at the road crossing. Therefore the requirement "to manage safety risk 'so far as is reasonably practicable'" in the LCRAG section 2.1.1 has been met.

This statement is supported and evidenced by the ALCAM analysis (which underpins the LCSIA process) as ALCAM contains a full list of all the safety controls which are available at level crossings and are accepted as industry practice in NZ. As part of the ALCAM analysis, all the controls that are suitable for the subject level crossing have been selected from the list and recommended for implementation, and hence the LCSS score has been determined for each of the scenarios specified in LCRAG section 4.1.1.

Correspondence from Aurecon also supports this position: *"Aurecon did test multiple ALCAM scenarios, utilising all available control measures (short of grade separation / closure). The recommendations provided in the LCSIA also covered a range of aspects of the level crossing, all intending to introduce additional safety controls."*

It is considered that the safety risks associated with future use of the road level crossing at Te Kowhai East Rd Level Crossing, 548.10km NIMT, by projected additional road and rail traffic have been understood, the appropriate controls have been identified and are planned to be implemented, and that it has been demonstrated that they will be effective through a review of the documentation provided internally and by consultants.

On this basis it is considered that the controls reduce the risk SFAIRP and are fit for the future use of the level crossing by the projected additional road and rail traffic.

The following section "Controls Implemented / Considered" provides further detail on the controls proposed to be implemented and those that were considered and found to be not reasonably practicable.

It should be noted that this report is focused on the safety risk reduction aspects of the proposed solution at the crossing and does not have scope to consider any wider amenity and development opportunities which might drive a different solution for other reasons as well as safety risk reduction.

9. CONTROLS IMPLEMENTED / CONSIDERED

Risk/Hazard ID	RISK DESCRIPTION	SFAIRP JUSTIFICATION	Hierarchy of Control IMPLEMENTED	Hierarchy of Control CONSIDERED
	The risk of harm caused by a train vs road user collision at the road level crossing for the future use cases.	Closure *[A "top down" evaluation of the potential for closure of Te Kowhai East Rd crossing was provided in the LCSIA report as required by the LCRAG. The "top down" is essentially a screening process done at the outset to determine whether an LCSIA assessment is necessary. In this case the "top down" found that that closure is not reasonably practicable, and accordingly the LCSIA proceeded. The justification provided for this conclusion, in summary:* - *Te Kowhai East Rd services a significant road corridor and there is not a suitable alternative crossing within a reasonable distance that services this industrial area.* - *Closing this crossing would impact network operations on Wairere Drive, road over rail bridge to the south.* - *At the time of writing, the Ruffell Road level crossing to the north has been temporarily closed.* *No evidence was provided in the LCSIA report to support these assertions.* *Considering suitability:* *Closure is a suitable control as it would eliminate the risk at Te Kowhai East Rd level crossing.* *Considering availability:* *Further commentary on the impacts of closure was provided in the Beca memo. This identified other roading network improvements that would be needed if Te Kowhai East Rd crossing was closed. In summary:* - *Widen the existing Wairere Drive rail overpass by four-laning the bridge.* - *Realign Onion Road to provide a north-south connection.*		Elimination

Risk/Hazard ID	RISK DESCRIPTION	SFAIRP JUSTIFICATION	Hierarchy of Control IMPLEMENTED	Hierarchy of Control CONSIDERED

		- *Implement the proposed Koura Drive overpass as a longer-term solution, providing a northern crossing facility and exploring the permanent closure of Ruffell Road level crossing.*
		
		Additionally, HCC advises that:
		
		- *Most of these projects do not exist inside the current funded HCC Long Term Plan.*
		- *There would be other significant impacts of closure including:*
		  ○ *Redistribution of trips to other parts of the network resulting in Journey distance increases that will result in increases in VKT (vehicle kilometres travelled) and emissions.*
		  ○ *Rotokauri transport HUB based on Tasman Road and changes to public transport provisions – increased operational costs.*
		  ○ *Business operations and impacts with loss of visual presence especially given the extensive car sales industry fronting this corridor and the industrial activities.*
		- *HCC does not support closure of Te Kowhai East Road level crossing.*
		
		The current road traffic volume at Te Kowhai East Rd crossing is 9,609 vehicles per day and forecast in 2032 is 11,826 vehicles per day and in 2042 (the future case date) is 12,181 vehicles per day.
		
		The effects of closing Te Kowhai East Rd are major in terms of other significant mitigation projects that would be required, and in terms of the impacts on road network efficiencies and on business and public transport in the area. It is at least uncertain whether it is a realistically "available" control in the present context. However, for the purpose of this SFAIRP review it is considered to be an available control.
		
		Considering cost proportionality:		

Risk/Hazard ID	RISK DESCRIPTION	SFAIRP JUSTIFICATION	Hierarchy of Control IMPLEMENTED	Hierarchy of Control CONSIDERED
		- *The Beca memo provides a P50 cost estimate of $113M for the roading network improvements that would be needed if Te Kowhai East Rd crossing was closed. The memo notes that potential upgrades that may be triggered for other parts of the network are not included so the actual cost may be greater.* - *The fatal return period (FPR) calculated by the ALCAM analysis for the change in use scenario stage is 409 years. This equates to 0.24 fatalities over 100 years (an assumed time period for the purpose of this analysis).* - *The change in use scenario is used for this calculation as it represents the risk that would be present if the future case eventuated and no safety improvements had been made to the crossing, and therefore represents the benefit that would be gained by eliminating the risk by closing the crossing.* - *The Waka Kotahi VoSL (April 2023) is $12.5M, giving a value of risk reduction of $3.1M.* - *Closure of the crossing along with the identified roading network improvements would fully eliminate the level crossing collision risk, therefore the ICAF ratio is 36.* *The LCRAG App 9 guidance is that an ICAF ratio of:* - *2 or less will generally be considered proportionate.* - *10 or greater will generally be considered grossly disproportionate.* - *Between 2 and 10 will require specific consideration and justification.* *Based on the information available, closure is a suitable control, and is assumed to be an available control for the purpose of this analysis, but the cost would be grossly disproportionate to the risk benefit.* *Therefore, closure is not reasonably practicable.]*		
	The risk of harm caused by a train vs road user collision at the	<u>Grade separation</u>		Elimination

Risk/Hazard ID	RISK DESCRIPTION	SFAIRP JUSTIFICATION	Hierarchy of Control IMPLEMENTED	Hierarchy of Control CONSIDERED
	road level crossing for the future use cases.	*[A "top down" evaluation of the potential for grade separation of Te Kowhai East Rd crossing is provided in the LCSIA report as required by the LCRAG. The "top down" is essentially a screening process done at the outset to determine whether an LCSIA assessment is necessary. In this case the "top down" found that that grade separation is not reasonably practicable, and accordingly the LCSIA proceeded. The justification provided for this conclusion, in summary:* - *The cost of grade separation is grossly disproportionate to the risk.* - *There are geometric constraints that preclude grade separation.* - *Grade separation would impact Tasman Road intersection, private access ways, and potentially also the roundabout to the east.* *No evidence was provided in the LCSIA report to support these assertions.* *Considering suitability:* *Grade separation is a suitable control as it would eliminate the risk at Te Kowhai East Rd level crossing.* *Considering availability:* *While the "top down" identified some potential constraints and challenges to grade separation, for the purpose of this SFAIRP review it is considered to be an available control.* *Considering cost proportionality:* - *The cost estimate report from Beca (May 2023) reports a P95 estimate for a road over rail bridge of $106M, and notes material exclusions, among them land & property costs, and consenting costs.* - *The report recommends using the P95 estimate for comparison of options/solutions at this location.* - *The fatal return period (FPR) calculated by the ALCAM analysis for the change in use scenario stage is 409 years. This equates to 0.24*		

Risk/Hazard ID	RISK DESCRIPTION	SFAIRP JUSTIFICATION	Hierarchy of Control IMPLEMENTED	Hierarchy of Control CONSIDERED
		fatalities over 100 years (the assumed life of a grade separation structure). - *The change in use scenario is used for this calculation as it represents the risk that would be present if the future case eventuated and no safety improvements had been made to the crossing, and therefore represents the benefit that would be gained by eliminating the risk with a grade separation.* - *The Waka Kotahi VoSL (April 2023) is $12.5M, giving a value of risk reduction of $3.1M.* - *Grade separation would fully eliminate the level crossing collision risk, therefore the ICAF ratio is 34.* - *As a comparison, it is noted that the cost estimate report also reports a P50 estimate of $70M. If this less conservative estimate is used instead of P95 then the ICAF ratio is 23.* *The LCRAG App 9 guidance is that an ICAF ratio of:* - *2 or less will generally be considered proportionate.* - *10 or greater will generally be considered grossly disproportionate.* - *Between 2 and 10 will require specific consideration and justification.* *Based on the information available, grade separation is a suitable control, and is assumed to be an available control for the purpose of this analysis, but the cost would be grossly disproportionate to the risk benefit. Therefore, grade separation is not reasonably practicable.]*		
	The risk of harm caused by a train vs road user collision at the road level crossing for the future use cases.	<u>Flashing Lights & Bells and Half arm barriers.</u> *[FLB/HAB already exist at the crossing. Some improvements to the barriers and the associated crossing layout are proposed as detailed below.]*	Engineering	
	The risk of harm caused by a train vs road user collision at the	<u>Road/rail intersection layout and design details to maximise effectiveness of controls and reduce hazard likelihood at this site.</u> *[Includes:*	Engineering	

Risk/Hazard ID	RISK DESCRIPTION	SFAIRP JUSTIFICATION	Hierarchy of Control IMPLEMENTED	Hierarchy of Control CONSIDERED
	road level crossing for the future use cases.	- *Upgrade to signalised intersection (Te Kowhai East Road/Tasman Road, will also be linked to the rail level crossing) with an escape lane.* - *The roundabouts to the east (The Boulevard/Te Kowhai East Road and Te Rapa Road/Church Road) to be converted to traffic signals. The controllers will be set to give a green signal for traffic from the west when triggered by an approaching train to help clear any potential queues at the rail crossing.* ○ *In discussions between KiwiRail and HCC it was advised that the timing of the conversion of the eastern roundabouts to traffic signals was uncertain and was unlikely to align with the 4 laning of Te Kowhai East Rd. Therefore the potential for queueing across the level crossing may remain. Potential queueing issues will be resolved when the intersections are signalised, but HCC and KiwiRail have agreed to investigate and monitor the extent to which queueing actually occurs and to put place interim mitigations if required.* - *Median islands on the approaches to address the risk of impatient drivers driving around the controls.* - *Investigate the provision of streetlighting at the crossing to ensure approaching train drivers can see vehicles queueing or stacking across the crossing at night.]*		
	The risk of harm caused by a train vs road user collision at the road level crossing for the future use cases.	<u>Road/rail intersection layout and design details to maximise effectiveness of controls and reduce hazard likelihood at this site.</u> *[Includes:* - *Mark crosshatching with long life road marking at the level crossing.* - *Mark 'RAIL X' on eastbound approach with long life road marking.* - *Adjust WX1 on left-hand side on eastbound approach so that it faces eastbound drivers (rather than the commercial accessway as current).* - *Setup remote operation of FLB for HiRail vehicles and KiwiRail workers – to avoid having to give way to vehicles on Te Kowhai East Road.]*	Administrative	

Extract from LCSIA report summarising ALCAM outputs for the various scenarios:

Table 1-4. Summary of ALCAM changes at Te Kowhai Road level crossing.

	Updated Existing	Change in Use	Proposed Design	Future Score
ALCAM Risk Band	High	High	High	High
ALCAM risk score change (%)	-	+ 14%	+ 8%	+ 11%
Fatal Return Period	510 years	446 years	472 years	464 years

Extract from the Aurecon memo showing the updated ALCAM outputs calculated using the increased future train numbers:

Table 2 ALCAM Scores from the May 2023 LCSIA report vs. December 2023 analysis with updated train volumes

	May 2023 LCSIA				Updated Train Volumes Dec 2023			
Proposal Stage	**Volume Data**	**ALCAM Risk Score**	**Years between Fatalities**	**LCSS**	**Volume Data**	**ALCAM Risk Score**	**Years between Fatalities**	**LCSS**
Updated Existing	AADT 9690 veh/day 32 trains	0.00196 (19.6) 24/30	520	31/60	AADT 9690 veh/day 31 trains, (2024)	0.00193 (19.3) 24/30	517	31/60
Change in Use	AADT 12,181 32 trains	0.00224 (22.4) 25/30	446	40/60	AADT 12,181 38 trains (2042)	0.00245 (24.5) 25/30	409	40/60
Proposed Design	AADT 11,826 32 trains	0.00212 (21.2) 25/30	472	31/60	AADT 11,826 36 trains (2032)	0.00225 (22.5) 25/30	444	31/60
Future Score	AADT 12,181 veh/day 32 trains	0.00215 (21.5) 25/30	464	33/60	AADT 12,181 veh/day 38 trains (2042)	0.00235 (23.5) 25/30	425	33/60

10. REFERENCE DOCUMENTS

1. Aurecon report: LCSIA Risk Assessment Te Kowhai East Road, Hamilton City Council, Reference: P522481, Revision: 1, 2023-05-16.
2. Aurecon report: LCSIA Risk Assessment Te Kowhai Road Pedestrian Level Crossings, Hamilton City Council, Reference: P522481, Revision: 0, 2022-09-23.
3. Aurecon memo: Te Kowhai LCSIA Addendum, Reference P522481, 2024-01-16.
4. Beca report: Rotokauri Arterials Designation Grade Separated Crossing Option - Te Kowhai E Road Cost Estimate Report, Revision A, 03-05-2023.
5. Beca Memo: Te Kowhai East Road SFAIRP Memorandum, Ref:4288564-727269281-399922, September 2023.
6. Joint KiwiRail and Waka Kotahi publication: Level Crossing Risk Assessment Guide (LCRAG), v5 draft for consultation.