TPC TRAFFIC PLANNING CONSULTANTS LTD

SH2: Baypark to Bayfair, Tauranga – Link Upgrade

ROAD SAFETY AUDIT Of the CONCEPTUAL DESIGN

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A REPORT PREPARED FOR
NZ TRANSPORT AGENCY

Reference 11180-1
September 2016

Hawke's Bay office:
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s 9(2)(a)

Project Information:

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Prepared By	s 9(2)(a) Ken Holst (NZTA)
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1.0 BACKGROUND

1.1 Road safety audit procedure

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

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

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

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

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

A road safety audit should desirably be undertaken at the following project milestones:

- Concept stage
- Scheme or Preliminary design stage
- Detailed design stage, and
- Pre-opening / Post-construction stage.

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

In accordance with the procedures set down in the revised NZTA Guideline "Road Safety Audit Procedures for Projects" (interim release May 2013), this is a report to the

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client who then refers the report to the designer. The designer should consider the report and comment to the client on each of the concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the safety audit report recommendation.

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

Decision tracking is an important part of the road safety audit process. A decision-tracking table is embedded into the report format at the end of each set of recommendations to be completed by the designer, safety engineer and client for each issue documenting the designer response, client decision and action taken.

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

1.2 The project

The project, for which this is the road safety audit, is the tender design prepared for the upgrade to SH2 between and including the SH2/29A intersection at Te Maunga, at the western end of the Tauranga Eastern Link (TEL), and the Maunganui Road/Girven Road intersection (MGI). The SH29A/Truman Lane intersection is also included in the extent of the project.

The SH2-TEL route forms one of the Roads of National Significance (RoNS). This is a key freight route for transporting goods from the Eastern Bay of Plenty agricultural and forestry areas to the Port of Tauranga and the wider markets.

The project objectives have previously been identified as:

1. Improve access for inter-regional road freight to the Port of Tauranga whilst maintaining rail services.
2. Improve safety for all road users.
3. Reduce congestion, improve vehicle journey time reliability and provide efficient traffic flows into Tauranga from the east.
4. Operation of an optimised 'One Network' plan that balances the needs of travel demands across the area.
5. Improved access for public transport users.
6. Improved access for tourism through and within Tauranga.

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The proposed works comprise: the grade separation of the MGI (one free flowing lane in each direction), the grade separation of the SH2/29A intersection and the grade separation of SH29A over the ECMT rail line. For traffic southbound on SH2, access to SH29A requires drivers to exit at the MGI and for traffic northbound on SH2; drivers will have to exit at SH29A to gain access to the MGI.

The design retains an at-grade intersection below the MGI flyover and replaces the current roundabout with a larger signalised roundabout, incorporating signalised crossings for pedestrians and cyclists that utilise the central island.

Truman Lane will be connected to SH29A with a 3-leg dual lane roundabout west of the proposed interchange. This roundabout will help to transition from the high-speed approach on SH29A to the proposed SH2/29A diamond interchange.

The T-intersection of Owens Place/Matapihi Road, west of the MGI, will be signalised and co-ordinated with the signalised roundabout at the MGI. Facilities for pedestrians and cyclists are also proposed at this intersection.

1.3 Documents provided

The drawings provided to the road safety audit team (SAT), and these are listed in the Appendix. The SAT was also provided with a briefing note.

1.4 The safety audit team

This road safety audit was carried out, as far as practicable, in accordance with the revised NZTA Guideline "Road Safety Audit Procedures for Projects" (interim release May 2013) by:

- s 9(2)(a), Senior Associate, Traffic Planning Consultants Ltd, Hawke's Bay
- s 9(2)(a), Robinson Transportation Consulting, Tauranga
- Ken Holst, Traffic and Safety Engineer, NZTA, Napier.

The SAT was briefed, and supplied with the drawings to be audited, by the design team in the Beca offices, Tauranga, on Monday 5th September 2016. The team subsequently carried out a desktop review of the drawings on Tuesday 6th September.

Whilst a comprehensive site visit had been carried out at the Specimen Design stage by two members of the safety audit team, a further site visit was undertaken on the

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afternoon of Monday 5th September to ensure that all members of the current safety audit team were familiar with the site.

An exit meeting was held with members of the design team on Thursday 8th September 2016 where the SAT verbally outlined its findings.

1.5 Previous safety audits

Safety audits of the scheme design and specimen design were undertaken in November 2013 and September 2015 respectively, with the findings detailed in reports dated 23 November 2013 and 7 October 2015. Two members of the current SAT were party to those safety audits.

1.6 Scope of safety audit

This safety audit has focused on the more significant aspects of the tender design drawings. Some items, such as regulatory/warning signage and pavement marking, have not been safety audited in detail as any issues can be addressed at the next stage of design.

1.7 Report format

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

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

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole; have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

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

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Table 1: Assessment Matrix

Likelihood of Fatality or Serious Injury	Probability of a Crash Occurring			
	Frequent	Common	Occasional	Infrequent
Very Likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very Unlikely	Moderate	Minor	Minor	Minor

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

Table 2: Categories of Concern

CONCERN	Suggested Action
Serious	Serious concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate concern that should be addressed to improve safety.
Minor	Minor concern that should be addressed where practical to improve safety.

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

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All potential concerns, comments and recommendations set out in this safety audit report should be noted and acted upon if appropriate.

1.8 Disclaimer

The findings and recommendations in this report are based on an examination of the relevant drawings, the specified road and environs, and the opinions of the safety audit team. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe. Furthermore, no warranty is implied that all safety issues have been identified in this report. Road safety audits do not constitute a design review or an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific advice on matters raised and not rely solely on the report. While every effort has been made to ensure the accuracy of the report, it is made available strictly on the basis that anyone relying on it does so at their own risk without any liability to the safety auditors or their organisations.

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2.0 AUDIT FINDINGS – General

Preamble:

The safety audit team (SAT) acknowledges that a number of elements put forward in this tender design address safety concerns raised in the safety audit of the specimen design. Of particular note are:

1. the signalised roundabout at the Maunganui Road/Girven Road intersection (MGI) provides a safe system solution to the significant concerns that the SAT had with the specimen design signalised intersection layout at that intersection. Crashes at the signalised roundabout would have a noticeably lower risk of fatality or serious injury compared to crashes at a conventional signals layout where side impact crashes and post-impact trajectory issues can generate fatalities or serious injuries.
2. the potential for unsafe weaving across the merge and diverge gore areas mid-block on SH2 between SH29A and the MGI has been eliminated in the northbound direction, including the lack of sight distance to the northbound MGI exit.

As noted in item 1.6, some items, such as regulatory/warning signage and pavement marking, have not been audited in detail as any issues can be addressed at the next stage of design. Nevertheless, matters pertaining to issues raised in previous safety audits, and which do not necessarily need addressing until detailed design is developed, are included in this audit report so that the report becomes a stand-alone document that can be taken forward to the next stage of design without the need for reference to previous safety audit reports.

It is also acknowledged that some matters raised in this safety audit will need input from the NZ Transport Agency before being able to be actioned by the designer.

The report is structured in a similar way to the safety audit report of the specimen design, covering general items, SH2 mainline plus SH29A, interchanges/intersections and additional specific issues arising from the review of the drawings.

2.1 Significant Concern – Speed environment

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Likely
Outcome – Significant

The issue of speed environment, speed limits and design speeds has been raised in previous safety audits. The SAT acknowledges that the B2B link is to be designed to an 80 km/h design speed (see also item 3.3) due to various constraints. It was considered

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that a 70 km/h speed limit would be required and this had been previously supported by the SAT.
However, the SAT is of the view that the transition northbound from motorway speeds (100 km/h+) on TEL to compliance with a speed limit of 70 km/h on a continuing grade separated route would not be achieved in reality. The SAT is also of the view that the 70 km/h speed limit on the Maunganui Road-Hewletts Road route is too high for safe operation given all the intersections, on-street parking and property accesses along the route.

Having regard to the above, the SAT considers that a more appropriate speed limit regime would be a northbound transition from 100 km/h to 80 km/h north of the Sandhurst Drive interchange (ie prior to the SH29A interchange) and then a transition from 80 km/h to 60 km/h north of the MGI flyover. These speed limits are also more in keeping with the Speed Management Guide.

The SH29A link between SH2 and Truman Lane should have a design speed of 50 km/h (see item 3.6) and consequently should have a speed limit commensurate with the design. The SH29A eastbound approach has a 100 km/h speed limit and it is considered that there should be a transition zone prior to the Truman Lane roundabout, as shown on drawing LS-2004, though the speed limit in that transition zone should be 80 km/h rather than 70 km/h, prior to entering the 50 km/h area at the roundabout.

As noted in the safety audit of the specimen design:

"The transition for northbound traffic from a high speed 100 km/h motorway/expressway environment on the TEL to an urban arterial environment on Maunganui Road is challenging from a design perspective and will require strong reinforcement with speed management treatments including thresholds and possibly active warning or variable speed limit signs, plus repeat signage to continuously reinforce the speed limit. It needs to be recognised that drivers' perception and expectations will be of a higher speed environment than is being delivered."

Apart from appropriate threshold treatment at the speed limit changes, consideration will need to be given to active management through such measures as CCTV, queue detection, variable speed limits, variable message signs, automated enforcement, etc. in order to maximise safety and minimise the risk of higher speed crashes.

Recommendations:

a. *Implement an 80 km/h speed limit on the SH2 link between the end of TEL in the south and north of the MGI flyover and then a 60 km/h speed limit for the balance of the Maunganui Road-Hewletts Road route.*
b. *Implement an 80 km/h transition zone on SH29A between the 100 km/h area and the Truman Lane roundabout.*
c. *Implement a 50 km/h speed limit on the SH29A link from SH2 through the Truman Road roundabout*

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d. *Incorporate a range of strong threshold treatments on SH2 and SH29A at the change points to lower speed environments.*
e. *Signage for the recommended 80 km/h and 60 km/h posted speed limits on SH2 should be regularly repeated along the corridor.*
f. *Implement a 50 km/h for the at-grade MGI intersection on all approaches and through the intersection.*
g. *Provide active route management infrastructure for measures such as CCTV, queue detection, variable speed limits, variable message signs, automated enforcement, etc.*

Designer Response:	a. The design speed allowed in the PRs is 80km/hr, which gives a posted speed of 70km/hr between the end of TEL in the south and north of the MGI flyover. This aligns with the Client's Decision for the same issue that arose in the Specimen Design RSA. The RSA recommendation for a 60 km/h speed limit for the balance of the Maunganui Road-Hewletts Road route is outside of the area of the B2B project and we have no comment. b. The designer supports a speed limit of 70km/hr for the area identified and is in line with the Client Decision for the same issue that arose in the Specimen Design RSA. The 80 km/h transition zone on SH29A between the 100 km/h area and the Truman Lane roundabout is largely outside of the area of the B2B project and we have no comment. c. The PRs required a design speed of 60km/hr to be adopted for this section of SH29A. We support the implementation of a 50km/hr speed limit as recommended by the RSA. d. We will seek to strengthen the threshold treatments already included on SH2 and SH29A during the detailed design. e. Lighting will be extended to the proposed threshold treatment on SH29A to reinforce the change in speed environment. f. We agree with providing regular repeating signs for the speed limits as required by the PRs and within the B2B project area. g. We agree on the implementation of a 50 km/h for the at-grade MGI intersection on all approaches and through the intersection. This will require NZTA and TCC approval and gazetting. As per the Client Decision on the same issue in the Specimen Design, the final speed limit proposed will be set in accordance with the Speed Management Guide once this has been finalised. h. The designer has provided ducting for future active route management as required by the PRs and in line with the Client Decision from the Specimen Design RSA.
Safety Engineer:	a. The safe and appropriate speed travel speeds and the corresponding speed limit associated with the SH2 link between the

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	end of TEL in the south and north of the MGI flyover, and the Maunganui Road-Hewletts Road route will be determined in accordance with the Speed Management Guide once this is finalised. The form of the road related to each section of safe and appropriate travel speed may need specific engineering and infrastructure measures to manage speed and crash severity outcomes. A posted speed limit of 70km/h is not available within the Speed Management Guide. b. The safe and appropriate speed travel speed and the corresponding speed limit associated with SH9A between the 100km/h area and the Truman Lane Roundabout will be determined in accordance with the Speed Management Guide once this is finalised. The form of the road related to each section of safe and appropriate travel speed may need specific engineering and infrastructure measures to manage speed and crash severity outcomes. A posted speed limit of 70km/h is not available within the Speed Management Guide. c. The safe and appropriate speed travel speed and the corresponding speed limit associated with the SH29A link from Sh2 through the Truman Lane roundabout will be determined in accordance with the Speed Management Guide once this is finalised. The form of the road related to each section of safe and appropriate travel speed may need specific engineering and infrastructure measures to manage speed and crash severity outcomes. d. Agree with the designer's response that strong threshold treatments on SH2 and SH29A at the change points to lower speed environments will be finalised during the detailed design. May need other specific engineering and infrastructure measures to manage speed and crash severity outcomes. e. Agree with the designer's response that lighting will be extended to the proposed threshold treatment on Sh29A to reinforce the change in safe and appropriate travel speed. f. Agree with the designer's response that regular speed repeater signs will be provided. A repeater sign shall be installed 200 metres downstream of all speed limit change points to assist with enforcement purposes. g. The safe and appropriate speed travel speed and the corresponding speed limit associated with the at-grade MGI intersection will be determined in accordance with the Speed Management Guide once this is finalised. The form of the road related to each section of safe and appropriate travel speed may need specific engineering and infrastructure measures to manage speed and crash severity outcomes. h. Agree with the designer's response that ducting be provided to

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	allow future active route management infrastructure.
Client Decision:	a. Agree with Safety Engineer – speed transition and threshold to be provided between Mangatawa Interchange and SH2/SH29A interchange. A second transition may be required in the vicinity of the MGI flyover. The speed transitions should be consistent with the proposed Speed Management Guide. This can be addressed in the detailed design phase. b. Agree with Safety Engineer – a speed transition and threshold treatment shall be provided on SH29A in advance of the Truman Lane roundabout. This should be included in the tendered sum. The speed transition will need to be consistent with the proposed Speed Management Guide. This can be addressed in the detailed design phase. c. Agree with Safety Engineer – proceed as per Safety Engineer response above. d. Agree with Safety Engineer – proceed as per Safety Engineer response above. e. Due to drafting error, note that Designer and Safety Engineer responses out of alignment with SAT recommendations and appear to refer to SAT recommendation d. Agree with Safety Engineer – proceed as per Safety Engineer response above to extend lighting as part of threshold treatment. f. As per response above – Designer and Safety Engineer responses appear to refer to SAT recommendation e. Agree with Safety Engineer – proceed as per Safety Engineer response above to install repeater signs. g. As per response above – Designer and Safety Engineer responses appear to refer to SAT recommendation f. Agree with Safety Engineer – proceed as per Safety Engineer response above. h. As per response above – Designer and Safety Engineer responses appear to refer to SAT recommendation g. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

2.2 Significant Concern – Signage for counter intuitive layout

Probability of Crash Occurring – Frequent
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Significant

Previous safety audits have raised safety concerns regarding the mixing of regional State Highway traffic movements with slower local links and intersections. The design achieves uninterrupted flow for SH2 through traffic only, but not for traffic movements

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between SH29A and SH2 (both directions) which cannot use the Girven Road overpass. It is acknowledged that many options for the project have been considered leading to the arrangement put forward through the Specimen Design and Principal's Requirements. This arrangement essentially requires drivers to exit at one interchange in order to access the next one, which is counter intuitive.
Signage becomes critical to the safe operation of the overall layout to try to minimise the impacts of it not being self-explaining and the risks of GPS devices directing drivers to undertake unsafe manoeuvres.

To this end, the overhead repeat advance destination signage for southbound motorists on SH2 prior to the MGI as shown on drawing LS-2001 will need to be essentially mirrored for the northbound direction prior to the SH29A interchange.

In addition, the destination wording on all signs will be critical to assist those drivers who are not familiar with the area. For example, the use of "Tauriko" is not helpful (the non-local members of the safety audit team had no idea where this destination is located) compared to the strategic destination "Hamilton", similar to the use of Rotorua and Whakatane. Similarly, the use of street names such as "Girven Road" on destination signs is less helpful than discrete and better-known destinations such as the "Bayfair" shopping centre.

Recommendations:

a. *Install repeat overhead destination signage on SH2 northbound prior to the exit at SH29A.*
b. *Ensure that all destinations used will be clear and likely to be known to motorists who are not familiar with the area.*

Designer Response:	a. Our response to the RSA Comment 3.1 has resulted in removal of the trapped lane. The exit arrangement has been updated to a standard single lane exit that does not require overhead signs. b. We agree with the RSA comments. As per the response provided for the same concern raised in the Specimen Design, the destination names has been advised by the NZTA and agreed with TCC.
Safety Engineer:	a. Agree with the designer's response in terms of the removal of the trapped lane; however, the first and second advance exit signage is to be overhead signage. Given that the *"Girven Road, Sh29A Tauriko"* is a major state highway to state highway interchange, there will be a high volume of traffic using the exit. There will also be a large volume of heavy vehicles in the left lane using this exit potentially blocking visibility to any ground-mounted signage. The use of overhead signage will provide better visual cues for the distance to the exit to allow drivers adequate time to make the necessary lane changes particularly with the close proximity of the

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	Sandhurst Drive interchange further upstream. This will also be consistent with the overhead signage needed at the commencement of the lane drop as detailed in the Safety Engineer Response for Item 3.1 *"SH2 Northbound Land Drop"* below. b. Agree with the designer's response. The destination convention for interchanges must be in accordance with the Traffic Control Devices Part 10 in terms of approved destinations.
Client Decision:	a. Agree with Safety Engineer – overhead sign gantries shall be provided. b. Agree with SAT recommendation – project team to explore opportunities to adopt signage names more readily recognised by visitors not familiar with the area, acknowledging this may not align with approved destination convention as stipulated in TCD part 10.
Action Taken:	

2.3 Comment – Drainage, landscaping, structural details

The SAT notes that for this tender safety audit, drainage, landscaping and structures details were unavailable. It is understood that these will be provided at the time of detailed design and any potential safety issues associated with the following will need to have been addressed:

1. Drainage: the main potential safety concerns related to drainage are surface water flow issues that could generate aquaplaning and sump grate designs that could adversely affect cyclist safety.
2. Landscaping: the principal concern with landscaping is likely to be where planting may restrict sight lines at intersections or driveways for drivers and/or cyclists.
3. Structures: potential safety concerns are around visibility and extent of protection.

Designer Response:	Points 1, 2 and 3 have been considered during the development of the tender design and will be fully detailed for the detailed design RSA.
Safety Engineer:	Agree with the designer's response that: 1. Potential safety concerns relating to surface water flows issues and sump grate designs, 2. Potential restriction of sightlines at intersections by landscaping, 3. Potential safety concerns regarding visibility obstructions by structures and extent of protection will be addressed during detailed design.
Client Decision:	Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

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2.4 Comment – Forward sight distance

The SAT was verbally advised that the design provides appropriate forward sight distance where required. Whilst the median and shoulder widening on curves and the barrier offsets were not detailed, the SAT accepts that forward sight distance on horizontal curves has been assessed to arrive at the design presented for safety audit, but will need to be rechecked when design is developed in detail.

Designer Response:	The tender design has been developed with the required forward sight distance.
Safety Engineer:	Agree with the designer's response that forward sight distance on all horizontal curves within the design presented for safety audit has the required forward sight distance, and this will be preserved during the detailed design.
Client Decision:	Agree with Safety Engineer – this will be presented and checked during the detailed design phase.
Action Taken:	

2.5 Moderate Concern – Cycle network continuity and safety

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

1. Whilst it has been agreed that cyclists should be prohibited from using the flyover, the SAT questions how this can be legally achieved, as the flyover is not part of a motorway. It is obviously essential that, southbound, cyclists be banned from the flyover so that they do not end up on the TEL route.

   Signage is shown on drawing LS-2001 prohibiting cyclists on the flyover (southbound) and advising them to use the off-ramp to the MGI. However, there is no road marking or ramps to access the shared path associated with this. In addition, there is no signage shown on drawing LS-2002 prohibiting cyclists from accessing TEL via the southbound on-ramp at SH29A.

2. Shared pedestrian/cyclist paths are proposed at the MGI to facilitate east-west/west-east movements between Matapihi and Girven Roads, but these are shown tying into footpaths as opposed to shared paths (drawing AL-1101). It is not clear what facilities the shared paths will tie into and how this will be done safely. As part of the cycle network, all links from the shared paths onto local roads or other paths should not introduce any unsafe tie-ins.

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3. Whilst the SAT commends the provision of shared paths in terms of safety for vulnerable road users, it needs to be recognised that there will be cyclists who prefer to remain on-road for some or all of their journey through the area. Safety for these cyclists needs to be catered for by way of cycle boxes at traffic signals and separate ramps to access the crossing facilities.

4. Whilst proposed wayfinding signage for pedestrians and cyclists is shown on drawings AL-1100-1102, further work is need on this signage regime, as the signs shown on drawing AL-1100 do not correlate with the signage locations shown on drawings AL-1101 and 1102. It is important from a safety point of view that the wayfinding signage clearly directs pedestrians/cyclists to the appropriate crossing for the safest route to the key destinations.

Recommendations:

a. Provide signs and markings to stop cyclists from using the SH2 flyover and the southbound on-ramp at SH29A.
b. Ensure that the pedestrian/cyclist shared paths have no discontinuity in terms of fitting into the overall pedestrian/cyclist network.
c. Ensure that the links from the shared paths to the local road network do not introduce any unsafe tie-ins and that all crossing points are located to maximise safety.
d. Ensure that the shared paths are appropriately designed for the safe crossing of any driveways, with particular regard to indivisibility requirements.
e. Provide infrastructure for the safety of on-road cyclists by way of cycle boxes at traffic signals and separate ramps to access the crossing facilities.
f. Develop a wayfinding signage regime that clearly directs pedestrians and cyclists to key destinations via the appropriate crossings at the MGI in particular.

Designer Response:	At the detailed design stage the designer will: a. Consider providing the additional signs and markings to discourage the usage by cyclists of the SH2 flyover and the southbound on-ramp at SH29A. b. Within the constraints of the site and designation pedestrian/cyclist shared paths will be best located to fit the wider network. c. Within the constraints of the site and designation, the shared paths to the local road network will be located to maximise safety. d. Design the shared paths where crossing driveways to take into account of the inter-visibility between the two. e. Consider the provision of infrastructure to support the safety of road cyclists. f. Develop a wayfinding signage strategy that meets the needs of pedestrians and cyclist generally and particularly at the MGI.
Safety Engineer:	a. Agree with the safety audit team's recommendation and the designer's response that the signage and delineation design will

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	discourage cyclists from using the SH2 flyover and the southbound on-ramp at SH29A. b. Agree with the designer's response that the pedestrian/cyclist shared paths will integrate with the wider pedestrian/cyclist network. c. Agree with the designer's response that the shared paths to the local road network will not have any unsafe tie-ins and all crossing points will be located to maximise safety. d. Agree with the designer's response that the design of shared paths will include for the safe crossing of any driveways and will take into account the inter-visibility between the two. e. Agree with the designer's response that the design will provide infrastructure for on-road cyclists at traffic signals and to access crossing facilities. f. Agree with the designer's response that way finding signage will be provided that clearly directs pedestrians and cyclists to key destinations via the appropriate crossings, and at the MGI in particular. This will require engagement and consultation with Tauranga City Council to allow consistency and continuity of the overall way finding signage strategy.
Client Decision:	a. Designer to provide signage and markings to discourage cyclists from using the SH2 flyover and the southbound on-ramp at SH29A. b. Agree with Safety Engineer – proceed as per Safety Engineer response above. c. Designer to ensure that the links from the shared paths to the local road network do not introduce any unsafe tie-ins and that all crossing points are located to maximise safety. d. Agree with Safety Engineer – proceed as per Safety Engineer response above. e. Designer to provide advance stopping boxes for the safety of on-road cyclists at traffic signals and access to off-road crossing facilities. f. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

2.6 Minor Concern – Kerb types

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

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Some of the kerb types within the project are specified on the typical cross sections. However, the kerb types for median and intersection islands are not specified. From a safety perspective, these should be mountable kerbs so that if an errant vehicle hits any traffic island, the driver is able to recover by partially mounting the island and does not react by oversteering back across the carriageway or losing control.

On drawing AL-1403, the typical cross section at Ch. 1240 shows a vertical face kerb on the southbound on-ramp adjacent to the shared path. Not only can a vertical barrier kerb have an adverse impact on vehicle trajectory resulting in a vehicle not engaging the safety barrier correctly, there is also a safety issue for cyclists on the shared path. Where shared paths are adjacent to a carriageway, mountable kerbs should be utilised so that cyclists have a safe "escape" route onto the adjacent carriageway shoulder if a pedestrian, child, dog, etc. suddenly moves into the cyclist's path. If vertical kerbs are used, there is a much higher likelihood of a cyclist who is evading a collision by moving onto the road will come off his/her bicycle with consequential injuries.

Recommendations:

a. Install mountable kerbs on all traffic and median islands.
b. Install mountable kerbs on the southbound on-ramp from SH29A.
c. Use mountable kerbs where shared paths are adjacent to the carriageway.

Designer Response:	a. The designer agrees with the SAT's comment and will provide mountable kerbs on all traffic and median islands b. The designer agrees with the SAT's comment and will provide mountable kerbs on the southbound ramp from SH29A c. The PR's require non-mountable kerbs on local roads.
Safety Engineer:	a. Agree with the designer's response that mountable kerbs will be provided on all traffic and median islands b. Agree with the designer's response that mountable kerbs will be provided on the southbound ramp from SH29A c. Agree with the designer's response that non-mountable kerbs will be provided on local roads where the posted speed limit will be less than 70km/h.
Client Decision:	a. Agree with Safety Engineer – proceed as per Safety Engineer response above. b. Agree with Safety Engineer – proceed as per Safety Engineer response above. c. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

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2.7 Comment – Street lighting poles

Whilst proposed street lighting provision is shown on drawings LT-2900 to 2904, information is not provided on the types of poles to be used or their location relative to safety barriers.

1. Generally, ground mounted, collapsible poles should be used rather than shear base poles as streetlights are located either behind safety barriers or within lower speed areas.
2. When located behind barriers, poles should be positioned at least 1.5m behind the barrier to allow for deflection of the barrier when it is struck, and 1.0m absolute minimum. (NB wire rope barrier deflection is 1.5-2.7m.)

The SAT also considers that interchanges/intersections should be lit to a higher standard than the specified V2 for the benefit of vulnerable road users in particular.

Designer Response:	1. Ground Mounted collapsible poles will be used behind safety barriers or for the lower speed areas. 2. Lighting poles will be positioned outside of the deflection area required by all safety barrier types. Lighting levels has been provided to the required V2 level of the PRs.
Safety Engineer:	1. Agree with the designer's response that ground Mounted collapsible poles will be provided behind all road side safety barriers or within safe and appropriate travel speeds less than 70km/h. 2. Agree with designer's response that all lighting poles will be positioned outside of the deflection area required by the road side safety barrier type located in front of the lighting pole. 3. Agree with the designer's response that the lighting design has been provided to the specified V2 level of the Principal Requirements.
Client Decision:	1. Agree with Safety Engineer – proceed as per Safety Engineer response above. 2. Agree with Safety Engineer – proceed as per Safety Engineer response above. 3. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

2.8 Significant Concern – Throw screens on SH29A bridges

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Very likely

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Outcome – Significant

Consideration should be given to the installation of throw screens on the bridges on SH29A over SH2 and the ECMT railway having regard to the number of pedestrians (including some possibly intoxicated plus horseplay) likely to be walking to and from the Baypark facilities when there are events. Objects thrown from the bridge onto SH2 can result in a crash with serious consequences.

Designer Response:	It is not a current PR requirement to provide throw screen and not included in our design but it is noted that they were identified in the Specimen Design's SiD register. Our detailed bridge design philosophy will facilitate easy future fitting of throw screens. Should the PR's be updated during the tender period for the fitting of throw screens then they will be incorporated into the tender concept design.
Safety Engineer:	Agree with the designer's response that the design of the SH29 bridge over SH2 and the ECMT railway will facilitate any future fitting of throw screens with ease.
Client Decision:	PR's have since been updated to include provision of throw screen.
Action Taken:	

2.9 Comment – Vehicle tracking

The SAT was provided with full vehicle tracking drawings showing 18m semi-trailers being able to track side by side at multi-lane intersections. The SAT queries whether full side-by-side tracking allowance is necessary in all situations as this can lead to excessive carriageway widths and hence higher speeds by other vehicles. Professional truck drivers will tend to mutually stagger their mutual movements through intersections where room is limited.

Designer Response:	The designer agrees with the SAT comments of excessive width for two tracking 18m semi-trailers. During development of the tender design, we applied for a departure from standard to relax the PR that was not approved. The tender design complies with the PRs.
Safety Engineer:	Agree with the designer's response that the design vehicle envelope arrangement to be used at intersections should be appropriate to the form and function of the intersection, as well as the volume and type of non-motorist road users crossing the intersection. There should be opportunity to review the appropriate design vehicle envelope arrangement at intersections during the detailed design.

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Client Decision:	Agree with Safety Engineer – proceed as per Safety Engineer response above. Design vehicle envelope can be reviewed during detailed design.
Action Taken:	

3.0 AUDIT FINDINGS – SH2 Mainline and SH29A

3.1 Significant Concern – SH2 Northbound lane drop

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Likely
Outcome – Significant

The design presented to the SAT has dual northbound lanes on the SH2 TEL expressway that bifurcate at the proposed off-ramp at SH29A. Exit only lanes such as this have a high risk of crashes at the gore area due to late braking and lane changing by drivers who suddenly realise that they are in an exit-only lane, despite advance signage. Rollover crashes can occur in this scenario due to sharp changes in direction by drivers.

To reduce the risk of late unsafe decisions due to drivers being in the "wrong" lane, a safer arrangement is to continue two lanes past the exit and develop two lanes to one lane merge downstream per MOTSAM. This should occur on the straight prior to the 385m radius horizontal curve under SH29A.

With a standard exit to SH29A as proposed above, it will be important to ensure that queuing on the off-ramp does not generate early braking and slow traffic on the mainline, which can lead to nose to tail crashes and unsafe lane changing. Assuming that exiting traffic is still travelling at 80 km/h past the exit nose, there needs to be sufficient deceleration distance from there to the back of any queue.

To achieve the two lanes to one lane merge on the straight and to accommodate sufficient queue storage on the off-ramp for safe operation of the mainline, it may be necessary to move the exit slightly southwards.

Recommendations:

a. *Continue two lanes northbound on SH2 past the exit at SH29A and develop two lanes to one lane merge per MOTSAM prior to the 385m radius horizontal curve under SH29A.*

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b. Move the northbound exit further south, if necessary, to (1) achieve the above two lanes to one lane merge on the straight and (2) ensure that there is sufficient storage on the off-ramp to prevent any early braking or queuing on the mainline.

Designer Response:	a. The design will be amended as per the SAT recommendation and submitted with the Certificate A submission. b. (1) The design has been amended to allow for a 180m length of parallel lane beyond the diverge point with a 135m taper that extends 35m beyond the straight and it is completed prior to the fully circular 385m horizontal radius curve. b. (2) There is adequate deceleration and queuing space on the off ramp for the 95%ile queue as is required.
Safety Engineer:	a) Agree with the designer's response with the revised lane arrangement as provided with the Certificate A submission. The lane drop will require advance warning overhead signage and this is to be placed on a sign gantry nine metres downstream of the gore nose. The overhead gantry will also include the MI-3 Exit Sign for "*Girven Road, SH29A Tauriko*" and a MI-22 "Pull Through" sign. b) Agree with the designer's response that the design be modified to achieve the two lane merge to one lane on the straight, and that there will be sufficient storage on the off-ramp to prevent any early braking or queuing on the mainline.
Client Decision:	a) Agree with Safety Engineer – proceed as per Safety Engineer response above. b) Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

3.2 Significant Concern – On-ramp southbound between MGI and SH29A

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Likely
Outcome – Significant

The SAT acknowledges that the serious safety concern regarding the potential for northbound weaving across the gore areas between the northbound on-ramp from SH29A and the SH2 mainline has been eliminated. However, the equivalent arrangement at the southbound on-ramp has not been eliminated and risk of unsafe weaving across the gore areas is proposed to be mitigated by the installation of wire rope barriers within the gore areas as sketched on drawing RD-2111.

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The SAT considers that this form of mitigation only introduces a different hazard and untested barrier transitions that are not approved. In certain light and weather conditions, the barriers in the gore areas are likely to be hit.

The situation is compounded by the presence of property accesses and the Exeter Street intersection. The site visits by the safety auditors have highlighted concerns about the observed tendency for southbound vehicles on SH2 to decelerate sharply from 70 km/h to turn into Exeter Street or into properties.

The SAT considers that the southbound layout should mirror the northbound arrangement (ie an "up and over" arrangement at SH29A interchange for southbound access to TEL).

Recommendations:

a. Remove the southbound on-ramp between the MGI and SH29A interchanges.
b. Improve the layout at the Exeter Street intersection in terms of shoulder width to facilitate safe turns.

Designer Response:	a. The designer does not agree with recommendation. A concern was raised in the RSA of the Specimen Design (item 4.2) with regard to weaving between Girven Road and Te Maunga interchanges. The relevant SAT recommendation was to provide physical barriers or relocated gore and barrier termini to prevent SH2 overpass traffic being able to cut across the southbound on-ramp to the Maunganui frontage road. This recommendation was also supported in the Client Decision. During the tender design, we considered two options to resolve this concern, including the option shown in our RSA design that prevents the illegal manoeuvre through relocation of the gore areas with the use of a wire rope barrier in the gore. This generally aligns with the RSA of the Specimen Design decision. We also considered the option now recommended by the SAT. The decision to adopt this solution was made because it met the safety concerns without affecting the operational performance of the SH29A intersection, and offers a better whole of life cost outcome. With regard to the concerns raised by the SAT in relation to wire rope barrier, we comment as follows: I. The wire rope barrier has been tested for vehicle impact irrespective of whether it is located in the gore. It should also be noted that the wire rope barrier's primary purpose is to

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	act as a deterrent and prevent illegal manoeuvres across the gore. II. With regard to the wire rope barrier to concrete barrier transition that included a crash, cushion. This will be amended to reflect the requirements of NZTA TM2503 Detail RSB7C. The lane arrangements, safety concerns and sight distance issues in the southbound direction do not reflect those in the northbound direction; therefore, we do not believe that it follows that the layout provided in the northbound direction be adopted in the southbound direction. To mitigate the speed differential between the southbound on-ramp entry traffic from the lower speed environment and the mainline through traffic in the higher speed environment at the commencement of the on-ramp lane gain. The tender design includes: III. An acceleration length of 100m (Ch. 820m to 920m) between the southbound on-ramp entry traffic and mainline through traffic as per AUSTROADS Part 4a. The conflicting movement between adjacent lanes will be minimal due to lane gain arrangement and not a merge. IV. A gated '70' speed sign will be been provided at Ch. 820m to reinforce the change in speed environment from 50kmph to 70kmph for the southbound onramp and the solid line between the traffic lanes extended up to Ch. 920m for the full length of acceleration. b. Current southbound shoulder width along Maunganui local road is 1.5m as per Principal's Requirements. For the final tender submission the shoulder width will be increased between 0.5m and 1.0m from Ch. 540m and Ch. 890m to help turning movements for access into Exeter Street and ingress into and egress from property access ways within the lower speed environment. The widened shoulder will enable a vehicle to slow down without impeding the through traffic. The shoulder will contain chevron markings to discourage it being used for parking. We understand that the Transport Agency is discussion with Tauranga City Council to close completely or the closure of the left turn out from Exeter Street that would provide significant opportunity to provide additional safety benefits.
Safety Engineer:	a) Agree with the designer's response with the proposed on-ramp arrangement being provided. Designer to note for their comment IV that the posted speed limit is to be one that provide safe and appropriate travel speeds along this section of state highway in accordance with the Speed Management Guide.

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	Refer to Safety Engineer's response to Item 2.1 *Significant Concern – Speed Environment* above. b) Agree with the designer's response that design of the shoulder width facilitate safe turns
Client Decision:	a) Agree with Safety Engineer – proceed as per Safety Engineer response above. b) Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

3.3 Moderate Concern – Geometry of SH2 flyover at MGI

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Moderate

The long section on drawing AL-1001 shows the vertical alignment of the flyover at the MGI as having a K value of 23.9. which equates to a design speed of approx. 75 km/h? Given the likely speed environment (see item 2.1), this would be substandard and potentially unsafe given that, northbound, there is a horizontal curve of 360m radius starting on the crest of the vertical curve. There would not be any forward view of this curve. Recent research has shown that it is important that at least 30% of the pavement and markings of the arc of a horizontal curve needs to be seen for safe operation. Furthermore, the radius of the horizontal curve is within the 300m to 450m radius band, which is the hardest for drivers to read. The above can lead to loss of control and higher speed nose to tail crashes.

Recommendations:

a. Flatten the vertical alignment of the flyover to achieve at least an 80 km/h design speed in terms of view to the pavement. (NB this should be considered in conjunction with recommendation 3.2a.)
b. Consider a variable speed limit for congestion or incidents (refer also to recommendation 2.1g).

Designer Response:	a. The vertical crest curve has been increased to K of 35 to allow for 80km/h grade corrected SSD over the flyover. Item 3.2a was not allowed for in this update, as the designer does not accept it. b. The designer has provided ducting for future active route management as required by the PRs and in line with the Client Decision from the Specimen Design RSA

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Safety Engineer:	a. Agree with the designer's response that the vertical alignment is to provide for an 80km/h grade corrected SSD over the flyover. Designer to also note the Safety Engineer response to Item 2.1 *Significant Concern – Speed Environment* above. b. Agree with the designer's response and as per the Safety Engineer's response to Item 2.1 *Significant Concern – Speed Environment* above.
Client Decision:	a. Agree with Safety Engineer – proceed as per Safety Engineer response above. b. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

3.4 Moderate Concern – Split level on SH2

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

Drawing AL-1403 shows the SH2 northbound and southbound carriageways at different levels through the horizontal curve under SH29A. This split necessitates the provision of a rigid barrier in the median with transitions to the wire rope barrier that is used in the median through the balance of the route. Flexible (wire rope) barrier can result in 30% less serious injury/fatal crashes compared to rigid barrier. Consequently, the SAT considers that there should be no split-level and that flexible median wire rope barrier should be continuous through the route.

In addition, there should be flexible wire rope barrier on the outside of the 385m radius horizontal curve as shown on drawing RD-2102.

Recommendations:

a. Do not introduce split carriageway levels on SH2 and provide continuous flexible wire rope barrier in the median.
b. Provide flexible wire rope barrier on the outside of the 385m radius horizontal curve, as shown on drawing RD-2102.

Designer Response:	a. The SAT recommendations is accepted, the split carriageway is no longer part of the concept design. b. Due to the presence of a retaining wall, a concrete barrier is required.
Safety Engineer:	a. Agree with the designer's response that the split carriageway will be removed from the concept design. b. Acknowledge the designer's response regarding the presence of the

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	retaining wall, though there should be opportunity to review the design of the precast fascia panel that can allow a flexible wire rope barrier to be installed.
Client Decision:	a. Split carriage design required a departure request that has been declined. Agree with Safety Engineer – proceed as per Safety Engineer response above. b. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

3.5 Moderate Concern – Shoulder width

Probability of Crash Occurring – Infrequent
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

On drawing AL-1403, at Ch. 1980, the SH2 shoulder is shown as being 2.5m wide and the detail on drawing AL-1410 (detail C) shows only 0.2 or 0.3m further clearance to the barrier, making a total width of 2.7 or 2.8m. Shoulders adjacent to barriers should be at least 3.0m wide to allow passenger and driver doors to be opened without the risk of being hit by vehicles in the adjacent traffic lane.

It is also not clear exactly where the barrier is in relation to the adjacent kerb, which should be immediately behind the back of the kerb so that there is little or no scope for the kerb to affect an errant vehicle's suspension before it engages the barrier.

Recommendations:

a. Provide 3.0m shoulders adjacent to edge barriers.
b. Ensure that edge barriers are installed hard up against any kerbs.

Designer Response:	a. The designer notes the SAT recommendation. The typical section at CH1980 is approximately at the tie in with TEL that has a shoulder width of 2.5m. Shoulder width has been provided in accordance with the PR's. b. We will ensure that edge barriers are installed as close as practicable against any kerbs.
Safety Engineer:	a. Acknowledge the designer's response. The designer is to note the Safety Engineer's response to Item 2.1 *Significant Concern – Speed Environment* above. The safe and appropriate travel speed that is to be determined for this section of state highway may have a form adjustment to reinforce the posted speed limit as determined by the Speed Management Guide.

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	b. Agree with the designer's response that road side safety barriers will be installed as close as practicable against any kerbs.
Client Decision:	a. Agree with Safety Engineer – proceed as per Safety Engineer response above. b. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

3.6 Minor Concern – Geometry of SH29A link

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

On drawing AL-1004, the 100m radius horizontal curves on the SH29A link between Truman Lane and SH2 are shown as having 3% superelevation. This equates to a design speed of 40 km/h on a length of road that is to be posted at 50 km/h. The safety risk is drivers losing control if travelling too quickly through the curves.

Curve delineation signage (e.g. PW-67 chevrons) may also be needed to highlight the 100mR reverse curves.

Furthermore, as the reverse curve alignment of the SH29A link from SH2 does not put the driver in direct view of the roundabout at Truman lane, pre-warning signage of the roundabout would be beneficial.

Recommendations:

a. Design the SH29A link between Truman Lane and SH2 with a 50 km/h design speed.
b. Consider the installation of PW-67 chevron signs to highlight the reverse curves. (NB this may be best assessed post construction.)
c. Provide gated advance warning signage on SH29A (both directions) of the Truman Lane roundabout.

Designer Response:	a. The designer agrees and has increased the super-elevation on the Eastern most curves to 5%. The approach/entry curve to the Truman roundabout has remained at 3%, as the speeds will be lower as they are entering the roundabout and on the exit. b. PW-20 signs will be provided in the design. The provision of PW-67 signage may result in a complicated signage along the relatively short link. We will consider use of PW-67 signs further at the detailed design stage. c. Consideration for the use of PW-8 signs or similar to form gated

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	advance warning signs will be considered during the detailed design stage.
Safety Engineer:	a. Agree with the designer's response that a 50km/h design speed will be provided for the SH29A link between Truman Lane and SH2. b. Agree with the designer's response that the curve delineation signage is to be determined during the detailed design based on the hierarchy within MOTSAM Part I. c. Providing the advance direction roundabout map signage is well designed there should not be the need for any PW-8 signs.
Client Decision:	a. Agree with Safety Engineer – proceed as per Safety Engineer response above. b. Agree with Safety Engineer – proceed as per Safety Engineer response above. c. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

3.7 Minor Concern – Lighting on SH29A

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

Drawing LT-2904 shows lighting on SH29A west of the Truman Lane roundabout extending for 130m to ch 270. The proposed speed change threshold is shown at Ch. 50 on drawing LS-2004 and the SAT considers that lighting is an important element in highlighting the change in speed environment on SH29A (refer also to item 2.1) for safe operation on the approach to the roundabout at Truman Lane.

Recommendation:

Install street lighting at the speed change threshold on SH29A and continue the lighting up to the roundabout at Truman Lane.

Designer Response:	The SAT's comments have been incorporated into the concept design.
Safety Engineer:	Agree with the designer's response that street lighting will be installed at the speed change threshold on SH29A and continued up to the roundabout at Truman Lane.
Client Decision:	Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action	

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Taken:	

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4.0 AUDIT FINDINGS – Interchanges/intersections

4.1 Moderate Concern – MGI signalised roundabout: signs and signals

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Moderate

As noted in the Preamble to this report, the SAT endorses the proposed signalised roundabout at the MGI, being a more safe system compliant form of intersection than a conventional signalised intersection incorporating cross movements and an inherently large number of conflict points which can lead to an increase in crash risk and crash severity, including additional risks to vulnerable road users.

1. The concept design shown on drawing AL-1101 is appropriate for the location and for managing pedestrians and cyclists. However, the signals design as shown on drawing TR-2401 needs some revision as not all approaches have secondary and tertiary lanterns which are necessary to both improve awareness of the signals on each approach and cover the eventuality of one of the red aspects not working. This also applies to the signals installation at Matapihi Road/Owens Place.

2. It is also noted that louvres and not just visors may be needed in some instances to ensure that there is no "read-through" of signals leading to a driver potentially proceeding through a red signal when a green signal is seen at the next control point on the roundabout.

3. The left turn lane southbound on SH2 for turning into Girven Road appears to be rather short having regard to the likely volume of traffic turning into Girven Road. This could affect the queue lengths and encourage drivers to attempt to bypass queues in the left hand lane, make unsafe lane changes on the approach to the roundabout, and also turn left from the central (ahead only) lane. It is also important that the layout and signal settings deter the current practice of rat running through local streets to avoid queuing.

4. There is the risk that the lane assignment signage on the SH2 approaches (drawing LS-2001) may encourage some drivers to turn right the wrong way onto the roundabout. This problem has been observed by members of the SAT at other roundabout locations in NZ.

5. PW-3 traffic signals warning signs are shown on the SH2 approaches (drawing LS-2001), but not on the Matapihi Road and Girven Road approaches where the proposed AD signs on the approaches may give the impression to drivers that it is a standard roundabout ahead and not a signalised roundabout. Consideration

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should also be given to installing PW-64 "prepare to stop" supplementary signs on all the PW-3 signs.

Recommendations:

a. *Revise the signals infrastructure design to ensure that there are both secondary and tertiary signals on all approaches per standard traffic signals design in NZ.*
b. *As well as the judicial placement of signals to minimise the potential for "read-through", also consider the use of louvres.*
c. *Assess queue lengths having regard to the short left turn lane southbound on SH2 and lengthen the left turn lane or consider marking a double left turn into Girven Road, if necessary.*
d. *Redesign the lane assignment AD signs so that it is clear to motorists about the need to circulate around the roundabout to complete right turns. (Also, include PW-69 chevron signs on the central island.)*
e. *To reinforce the fact that the roundabout approaches are signal control, install PW-3 signs on all approaches and consider installing PW-64 "prepare to stop" supplementary signs below the PW-3 signs.*

Designer Response:	a. SAT comments have been accepted. b. SAT comments have not been accepted. The use of louvres and blinds on signal heads was considered but not adopted because with modern LED aspects the more disperse light source makes louvres less effective with correct placement and angle of aspect the dominant design feature to provide clear visibility. c. SAT comments have been accepted. d. SAT comments have been accepted in part PW69 signs have not been provided. e. SAT comments have been accepted in part PW64 signs have not been provided.
Safety Engineer:	a. Agree with the designer's response that the signals infrastructure design will be revised to provide secondary and tertiary signals on all approaches. b. Acknowledge the designer's response, however the designer is to note that the use of specific cowls and/or lourves may be required for certain displays if identified at the signal commissioning phase. c. Agree with the designer's response that the length of the SH2 southbound left turn lane will accommodate the necessary queue length in terms of acceptable operational performance of the signals. d. Agree with the Safety Audit Team's recommendation that the PW69 signs should be provided. The Advance Direction signage will require specific design in conjunction with the Transport Agency National Office to develop a standard of signage that is to

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	be used for signalised roundabouts. e. As per the response above the standard of signage for approaches to signalised roundabouts needs to be developed in conjunction with the Transport Agency National Office.
Client Decision:	a. – e. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

4.2 Moderate Concern – Traffic signal coordination with railway crossing

Probability of Crash Occurring – Infrequent
Likelihood of Serious/Fatal Injury – Likely
Outcome – Moderate

The SAT was advised that queue detection on Matapihi Road would be utilised to facilitate the clearance of any vehicles from the railway crossing. However, the SAT is not convinced that this would ensure that at all times vehicles would and could be cleared from the crossing when a train is imminent.

The SAT understands that at Spring Creek, Blenheim, a demand signal can be sent to a VMS sign that a train is approaching to advise any potential queue over the rail line to clear beforehand. Such an approach would be beneficial for the Matapihi Road rail crossing in terms of a signal being sent to the traffic signal controller to facilitate the clearance of any queue.

Recommendation:

Ensure that the traffic signals set up at Matapihi Road / Owens Place / MGI provides a mechanism to ensure that any queue of vehicles across the rail line can be safely cleared prior to a train arriving.

Designer Response:	The concept design is in accordance with the PR's that does not require a mechanism as recommended by the SAT. The proposed road layout does not preclude signals with a direct connection to the rail in the future.
Safety Engineer:	Agree with the Safety Audit Team's recommendation in that there be an active process that allows any queues to be safely cleared prior to a train.
Client Decision:	Agree with Safety Engineer – signals to ensure rail line can be safely cleared prior to a train arriving.
Action	

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Taken:	

4.3 Comment – Lighting at railway crossing

Further to item 4.2 above, the SAT is not aware whether additional street lighting is proposed to be installed at the railway crossing. It would certainly be beneficial from a road safety perspective if good lighting were installed at the crossing for the benefit of all road users, whether installed under the rail relocation contract or the B2B project.

Designer Response:	Additional street lighting has not been provided at the railway crossing, it is not a PR requirement.
Safety Engineer:	Agree with the Safety Audit Team's recommendation that the lighting design at the rail crossing should be adequate for non-motorised road-users.
Client Decision:	Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

4.4 Moderate Concern – SH2/SH29A interchange

Probability of Crash Occurring – Common
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Moderate

1. The signals design as shown on drawing TR-2402 needs some revision as not all approaches have secondary and tertiary lanterns which are necessary to both improve awareness of the signals on each approach and cover the eventuality of one of the red aspects not working.

2. If the queue analysis for the northbound off-ramp indicates a risk of an adverse impact on the SH2 mainline (refer to item 3.1), consideration could be given to making the left turn onto SH29A a give way control, with zebra crossing for pedestrians, if that would improve the efficiency. Note also that many pedestrians on signal controlled left turn slip lanes press the pedestrian call button, but do not wait for the green man, generating unnecessary delays to vehicles. Conversely, when there are events at Baypark a zebra crossing could be dominated by pedestrians and lead to queues down the off-ramp, adversely affecting safety on the SH2 mainline.

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3. There is a significant risk of drivers turning the wrong way onto the off-ramps. This is actually a quite common occurrence at signalised diamond interchanges. Additional No Entry (RG-9) and Wrong Way (RG-18) signage will be required to that shown on drawing LS-2002. Extending the median island on the eastbound SH29A approach would also be a deterrent to turning right onto the off-ramp.

4. It is likely that drivers on the SH29A eastbound approach to the T-intersection at the southbound on-ramp will not adhere to the significant setback of the limit line and would mostly stop adjacent to the second primary signal shown on drawing TR-2402. This could adversely affect the safety of the double right turn from the southbound off-ramp. Having a single primary signal and a staggered limit line would probably overcome this issue.

Recommendations:

a. Revise the signals infrastructure design to ensure that there are both secondary and tertiary signals on all approaches per standard traffic signals design in NZ.
b. Consider making the left turn onto SH29A a give way control, with a zebra crossing for pedestrians, but having regard to potential adverse effects when there are events at Baypark.
c. Provide additional signage to reduce the risk of drivers turning the wrong way onto the off-ramps.
d. Extend the median island on the eastbound SH29A approach at the northbound off-ramp.
e. Provide a staggered limit line on the SH29A eastbound approach to the T-intersection at the southbound on-ramp with a single primary signal.

Designer Response:	a. We will incorporate the SAT's recommendations into the design. b. Consideration will be given to providing a give way left turn onto SH29A at the detailed design stage c. We will incorporate the SAT's recommendations into the design d. We will incorporate the SAT's recommendations into the design as far as practicably possible without affecting the northbound through movement. e. Consideration will be given to providing a staggered limit line on the SH29A at the detailed design stage.
Safety Engineer:	a. Agree with the designer's response that secondary and tertiary displays will be provided on all approaches. b. Agree with the designer's response that a give way priority left turn should be considered providing there are no adverse effects when there are events at Baypark. If a give way priority left turn is to be provided there is not be a zebra crossing. c. Agree with the designer's response though others measures such as delineation and physical deterrents should also be considered to minimise the incidences of wrong way drivers.

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	d. Agree with the designer's response that the median island be extended as practicably possible without affecting the northbound through movement e. Agree with the designer's response that a staggered limit line on the SH29A will be considered during the detailed design stage.
Client Decision:	a. – e. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

4.5 Minor Concern – Truman Road roundabout

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

1. The Truman Lane approach to the roundabout does not appear to have the necessary entry path curvature to ensure that the entry speed is commensurate with the circulating speed. This can lead to crashes on the roundabout.

2. To improve safety, the splitter island on Truman Lane should be extended to both highlight the approach to the roundabout through the approach curve and to restrict right turn movements into and out of the additional Baypark entry/exit that is proposed to the east of the roundabout.

3. The SAT considers that the left turn entry to Baypark from SH29A as shown on drawing AL-1104 should be eliminated, as it is so close to the exit from the roundabout. Even under traffic management control, this could still be a safety issue with regard to nose to tail crashes.

4. For safe and consistent operation on all sections of the roundabout, the circulating carriageway should be marked as two lanes with Alberta style markings given that there are two lane entries and two lane exits on all approaches.

5. As noted in the safety audit of the specimen design, the central island should be clearly visible from all approaches, mounded landscaped and signed to provide an effective visual target. (NB the SAT acknowledges that the proposed central mast lighting will enhance this.)

Recommendations:

a. Ensure that the roundabout design achieves the necessary entry path curvature on all approaches.

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b. *Extend the splitter island in Truman Lane from the roundabout to past the proposed additional Baypark entry/exit.*
c. *Eliminate the entry to Baypark from SH29A and permit the exit to be used only under approved traffic management control.*
d. *Mark all sections of the circulating carriageway as two lanes with Alberta style markings for the exits.*

Designer Response:	a. The necessary entry path curvature has been provided on all the approaches except for the Truman Lane approach and this will be addressed during the detailed design phase. b. We will incorporate the SAT's recommendations and extend the splitter island in Truman Lane from the roundabout to past the proposed additional Baypark exit. c. Banning of the entry into Baypark is not a decision the designer can make and we are providing what is required by the PRs. d. Consideration will be given to the Alberta style markings at exits at the detailed design stage.
Safety Engineer:	a. Agree with the designer's response that all approaches will have the necessary entry path curvature. b. Agree with the designer's response that the splitter island in Truman Lane will be extended from the roundabout to past the proposed additional Baypark exit. c. Agree with the Safety Audit Team's recommendation about the removal of both the ingress and egress from Baypark, though there may be a consent condition allowing this to be here. This should be confirmed if this is the case. If the ingress and egress is allowable at this location then any use definitely needs to be controlled under a specific traffic management plan. Transport Agency to follow up on this. d. Agree with the designer's response that Alberta markings will be provided for exits at the detailed design stage.
Client Decision:	a. – d. Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

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5.0 AUDIT FINDINGS – Other matters

5.1 Minor Concern – Narrow shoulder on local roads adjacent to SH2

Probability of Crash Occurring – Occasional
Likelihood of Serious/Fatal Injury – Unlikely
Outcome – Minor

Drawing AL-1401 shows 0.3m shoulders adjacent to vertical face kerbs on the local roads between the MGI and SH29A interchanges. As noted in item 2.6, vertical kerbs can generate safety issues if hit, in terms of drivers oversteering back across the carriageway or losing control of the vehicle. To minimise the risk, the kerbs should either be mountable or the shoulders increased in width to provide some recovery space prior to the kerb being hit.

Recommendation:

Provide mountable kerbs or widen the 0.3m shoulders to approx. 1.0m along the local roads between the MGI and SH29A interchanges.

Designer Response:	Drg 1401 refers to a section showing a state highway and we have widened the shoulder to 1.0m On all local roads, TCC non-mountable kerbs have been used.
Safety Engineer:	Agree with the designer's response that the shoulder be widened to approximately one metre, and that TCC non-mountable kerbs be used on local roads with posted speed limits less than 70km/h
Client Decision:	Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

5.2 Comment – Safety barriers on SH29A

On drawing RD-2102 guardrail is shown along the northern side of the SH29A link behind the edge line in a location where the shoulder has been widened to provide forward sight distance on the inside of the 100m radius horizontal curve. The barrier should be at the back of the shoulder and the SAT assumes that this is a draughting error.

Also on drawing RD-2102 guardrail is shown along both sides of the footpath that runs from the SH29A link down to Truman Lane. Again, the SAT assumes that this is a draughting error – a fence may be required along part of the path if there is a steep drop and an appropriate treatment will need to be introduced for the gap in the guardrail along the southern side of SH29A to provide pedestrian access to the footpath.

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Designer Response	We will incorporate the SAT's recommendations
Safety Engineer:	Agree with the designer's response that on drawing RD-2102: • The barrier should be at the back of the shoulder along the northern side of the SH29A link. • The footpath that runs from the SH29A link down to Truman Lane may should have a fence along parts where there is a steep drop and also introduce an appropriate treatment for the gap in the guardrail along the southern side of SH29A to provide pedestrian access to the footpath.
Client Decision:	Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

5.3 Comment – Bayfair vehicular access on Girven Road

The SAT understands that the Bayfair shopping centre access on Girven Road east of the MGI is to remain, but is to become left in and left out only. This will require changes to the median island on Girven Road and to signage at the intersection. None of this has been shown on the drawings.

Designer Response:	This is outside of the scope of the project.
Safety Engineer:	Acknowledge the designer's response and if this work is to be carried out by others there needs to be coordination between the designs to provide a seamless transition between the project extents. Transport Agency to clarify the intent of the median island work and the coordination process.
Client Decision:	Closing the right-turn out onto Girven Road is to be included as part of the scope of the B2B project. Tender documents to be clarified if necessary.
Action Taken:	

5.4 Comment – Pedestrian route from Bayfair shopping centre to signals

The SAT noted in the safety audit of the specimen design that there are no paths from the Bayfair shopping centre that would guide pedestrians (or cyclists) to the proposed signalised crossing facilities at the MGI. Currently pedestrians and cyclists are guided to the subway under SH2. Appropriate signage and paths will need to be developed within the shopping centre as well as on the road reserve.

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Designer Response:	Appropriate signage will be provided within the road reserve.
Safety Engineer:	Agree with the designer's response that appropriate signage to be provided within the road reserve.
Client Decision:	Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action Taken:	

5.5 Comment – Signage and markings near Hewletts Road SH2 flyover

Following the NZTA decision that the wire rope median barrier on the B2B project would be extended north along Maunganui Road to the Hewletts Road flyover to eliminate the likelihood of unsafe U-turns, the SAT made the following recommendations in the specimen design safety audit:

a. *Continue the double yellow centreline south from the flyover to the wire rope leading end terminal and develop into a wide centreline treatment, including yellow RRPMs.*
b. *Mark arrows in the northbound lanes to mirror the southbound lane arrows.*
c. *Add a supplementary "Exit Only" panel on the northbound Mount Maunganui AD signs.*
d. *Install solid lane line from upstream of the northbound overhead ADS sign to the diverge gore.*

These recommendations were made to address various potential safety concerns and were generally accepted. The action noted in the decision tracking is that the works are to be undertaken by the network maintenance contractor as an enabling works package. The SAT notes that no work has been undertaken to date.

This matter is raised again in this safety audit report so that it is carried forward and not forgotten. Of particular concern is the overhead signage given that there will be increased lane changing/weaving between the MGI and Hewletts Road given that MGI flyover traffic will access the right hand lane and traffic from the MGI will access the left hand lane. It is important that drivers are aware that the left hand lane northbound is an exit only lane – members of the SAT have witnessed unsafe late lane changing across the diverge gore area at the Hewletts Road flyover.

Designer Response:	As per the Client Design for the same concern raised in the Specimen Design, the Transport Agency is to engage the network Maintenance Contractor to undertake these works as an enabling works package.
Safety Engineer:	Agree with the designer's response that the works can be carried out separately as an enabling works package.
Client Decision:	Agree with Safety Engineer – proceed as per Safety Engineer response above.
Action	

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Taken:	

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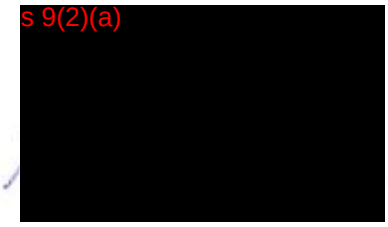
6.0 AUDIT STATEMENT

We certify that we have used the documents noted in section 1.3 and the Appendix to identify features of the project we have been asked to look at that could be changed, removed or modified in order to improve safety. The problems identified have been noted in this report, together with recommendations, which should be studied for implementation.



Signed:.....Date: 19 September 2016

s 9(2)(a) BSc(Eng), MIPENZ, MCIHT, FITE, Dip TE
Senior Associate
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Signed:.....Date: 19 September 2016

s 9(2)(a), PrEng (RSA), MEng, MITE
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Signed:.....Date: 18 September 2016

Ken Holst, Dip TP (NSW), NZCE
Traffic and Safety Engineer
NZ Transport Agency, Napier

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Designer:	*Name* s 9(2)(a)	*Position Design Team Lead*
	Signatur s 9(2)(a)	*Date 4 October 2016*
Safety Engineer:	*Name:* s 9(2)(a)	*Position: Senior Safety Engineer*
	Signature: s 9(2)(a)	*Date: 16 October 2016*
Project Manager:	*Name*.....	*Position*.....
	Signature.....	*Date*.....
Action Completed:	*Name*.....	*Position*.....
	Signature.....	*Date*.....

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

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APPENDIX

Drawing list

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DRAWING NUMBER	TITLE
B2B-DRG-GE-0002	DRAWING INDEX
B2B-DRG-GE-0003	GENERAL ARRANGEMENT - PLAN
B2B-DRG-AL-1001	ROAD ALIGNMENT - PLAN AND LONG SECTION - SHEET 1
B2B-DRG-AL-1002	ROAD ALIGNMENT - PLAN AND LONG SECTION - SHEET 2
B2B-DRG-AL-1003	ROAD ALIGNMENT - PLAN AND LONG SECTION - SHEET 3
B2B-DRG-AL-1004	ROAD ALIGNMENT - PLAN AND LONG SECTION - SHEET 4
B2B-DRG-AL-1100	WAYFINDING SIGN DETAILS
B2B-DRG-AL-1101	ROAD ALIGNMENT - SH2, MATAPIHI RD, GIRVEN RD, OWENS PL - INTERSECTION PLAN
B2B-DRG-AL-1102	ROAD ALIGNMENT - SH2, SH29 - INTERSECTION PLAN
B2B-DRG-AL-1111	ROAD ALIGNMENT - SH2, MATAPIHI RD, GIRVEN RD INTERSECTION - VEHICLE TRACKING PLANS - SHEET 1
B2B-DRG-AL-1112	ROAD ALIGNMENT - SH2, MATAPIHI RD, GIRVEN RD INTERSECTION - VEHICLE TRACKING PLANS - SHEET 2
B2B-DRG-AL-1113	ROAD ALIGNMENT - SH2, SH29 INTERSECTION - VEHICLE TRACKING PLANS - SHEET 1
B2B-DRG-AL-1115	ROAD ALIGNMENT - SH29, TRUMAN LANE - VEHICLE TRACKING PLANS - SHEET 1
B2B-DRG-AL-1116	ROAD ALIGNMENT - SH29, TRUMAN LANE - VEHICLE TRACKING PLANS - SHEET 2
B2B-DRG-AL-1301	ROAD ALIGNMENT - LONG SECTIONS - SHEET 1
B2B-DRG-AL-1302	ROAD ALIGNMENT - LONG SECTIONS - SHEET 2
B2B-DRG-AL-1303	ROAD ALIGNMENT - LONG SECTIONS - SHEET 3
B2B-DRG-AL-1304	ROAD ALIGNMENT - LONG SECTIONS - SHEET 4
B2B-DRG-AL-1305	ROAD ALIGNMENT - LONG SECTIONS - SHEET 5
B2B-DRG-AL-1401	ROAD ALIGNMENT - TYPICAL CROSS SECTIONS - SH2 - SHEET 1
B2B-DRG-AL-1402	ROAD ALIGNMENT - TYPICAL CROSS SECTIONS - SH2 - SHEET 2
B2B-DRG-AL-1403	ROAD ALIGNMENT - TYPICAL CROSS SECTIONS - SH2 - SHEET 3
B2B-DRG-AL-1404	ROAD ALIGNMENT - TYPICAL CROSS SECTIONS - SH29A - SHEET 4
B2B-DRG-AL-1405	ROAD ALIGNMENT - TYPICAL CROSS SECTIONS - GIRVEN RD & MATAPIHI RD - SHEET 5
B2B-DRG-AL-1410	ROAD ALIGNMENT - TYPICAL EDGE DETAILS
B2B-DRG-AL-1501	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 1
B2B-DRG-AL-1502	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 2
B2B-DRG-AL-1503	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 3
B2B-DRG-AL-1504	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 4
B2B-DRG-AL-1505	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 5
B2B-DRG-AL-1506	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 6
B2B-DRG-AL-1507	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 7
B2B-DRG-AL-1508	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 8
B2B-DRG-AL-1509	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 9
B2B-DRG-AL-1510	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 10
B2B-DRG-AL-1511	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 11
B2B-DRG-AL-1512	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 12
B2B-DRG-AL-1513	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 13
B2B-DRG-AL-1514	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 14
B2B-DRG-AL-1515	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 15
B2B-DRG-AL-1516	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 16
B2B-DRG-AL-1517	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 17
B2B-DRG-AL-1518	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 18
B2B-DRG-AL-1519	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 19
B2B-DRG-AL-1520	ROAD ALIGNMENT - CROSS SECTIONS - MC10 - MAINLINE SHEET 20

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B2B-DRG-AL-1521	ROAD ALIGNMENT – CROSS SECTIONS – MC10 – MAINLINE SHEET 21
B2B-DRG-AL-1522	ROAD ALIGNMENT – CROSS SECTIONS – MC10 – MAINLINE SHEET 22
B2B-DRG-AL-1523	ROAD ALIGNMENT – CROSS SECTIONS – MC10 – MAINLINE SHEET 23
B2B-DRG-AL-1531	ROAD ALIGNMENT – CROSS SECTIONS – MC20 – GIRVEN ROAD SHEET 1
B2B-DRG-AL-1532	ROAD ALIGNMENT – CROSS SECTIONS – MC20 – GIRVEN ROAD SHEET 2
B2B-DRG-AL-1533	ROAD ALIGNMENT – CROSS SECTIONS – MC20 – GIRVEN ROAD SHEET 3
B2B-DRG-AL-1534	ROAD ALIGNMENT – CROSS SECTIONS – MC20 – GIRVEN ROAD SHEET 4
B2B-DRG-AL-1541	ROAD ALIGNMENT – CROSS SECTIONS – MC30 – SH29 SHEET 1
B2B-DRG-AL-1542	ROAD ALIGNMENT – CROSS SECTIONS – MC30 – SH29 SHEET 2
B2B-DRG-AL-1543	ROAD ALIGNMENT – CROSS SECTIONS – MC30 – SH29 SHEET 3
B2B-DRG-AL-1544	ROAD ALIGNMENT – CROSS SECTIONS – MC30 – SH29 SHEET 4
B2B-DRG-AL-1545	ROAD ALIGNMENT – CROSS SECTIONS – MC30 – SH29 SHEET 5
B2B-DRG-AL-1546	ROAD ALIGNMENT – CROSS SECTIONS – MC30 – SH29 SHEET 6
B2B-DRG-AL-1547	ROAD ALIGNMENT – CROSS SECTIONS – MC30 – SH29 SHEET 7
B2B-DRG-AL-1548	ROAD ALIGNMENT – CROSS SECTIONS – MC30 – SH29 SHEET 8
B2B-DRG-AL-1551	ROAD ALIGNMENT – CROSS SECTIONS – MC40 – OWENS SHEET 1
B2B-DRG-AL-1561	ROAD ALIGNMENT – CROSS SECTIONS – MCE0 – TRUMAN LANE SHEET 1
B2B-DRG-AL-1562	ROAD ALIGNMENT – CROSS SECTIONS – MCE0 – TRUMAN LANE SHEET 2
B2B-DRG-AL-1563	ROAD ALIGNMENT – CROSS SECTIONS – MCE0 – TRUMAN LANE SHEET 3
B2B-DRG-AL-1564	ROAD ALIGNMENT – CROSS SECTIONS – MCE0 – TRUMAN LANE SHEET 4
B2B-DRG-LS-2001	LINE MARKING AND SIGNAGE – LAYOUT PLAN – SHEET 1
B2B-DRG-LS-2002	LINE MARKING AND SIGNAGE – LAYOUT PLAN – SHEET 2
B2B-DRG-LS-2003	LINE MARKING AND SIGNAGE – LAYOUT PLAN – SHEET 3
B2B-DRG-LS-2004	LINE MARKING AND SIGNAGE – LAYOUT PLAN – SHEET 4
B2B-DRG-LS-2005	LINE MARKING AND SIGNAGE – LAYOUT PLAN – SHEET 5
B2B-DRG-LS-2011	LINE MARKING AND SIGNAGE – SIGNAGE DETAILS – SHEET 1
B2B-DRG-LS-2012	LINE MARKING AND SIGNAGE – SIGNAGE DETAILS – SHEET 2
B2B-DRG-LS-2021	LINE MARKING AND SIGNAGE – PAVEMENT MARKING DETAILS – SHEET 1
B2B-DRG-LS-2022	LINE MARKING AND SIGNAGE – PAVEMENT MARKING DETAILS – SHEET 2
B2B-DRG-LS-2023	LINE MARKING AND SIGNAGE – PAVEMENT MARKING DETAILS – SHEET 3
B2B-DRG-LS-2024	LINE MARKING AND SIGNAGE – PAVEMENT MARKING DETAILS – SHEET 4
B2B-DRG-LT-2900	LEGEND AND NOTES
B2B-DRG-LT-2901	LIGHTING – LAYOUT PLAN – SHEET 1
B2B-DRG-LT-2902	LIGHTING – LAYOUT PLAN – SHEET 2
B2B-DRG-LT-2903	LIGHTING – LAYOUT PLAN – SHEET 3
B2B-DRG-LT-2904	LIGHTING – LAYOUT PLAN – SHEET 4
B2B-DRG-RD-2101	SAFETY BARRIERS – PLAN – SHEET 1
B2B-DRG-RD-2102	SAFETY BARRIERS – PLAN – SHEET 2
B2B-DRG-RD-2103	SAFETY BARRIERS – PLAN – SHEET 3
B2B-DRG-RD-2104	SAFETY BARRIERS – PLAN – SHEET 4
B2B-DRG-RD-2111	SAFETY BARRIERS – TRANSITION DETAILS
B2B-DRG-TR-2401	TRAFFIC SIGNALS – SH2, MATAPIHI RD, GIRVEN RD – INTERSECTION PLAN
B2B-DRG-TR-2402	TRAFFIC SIGNALS – SH2, SH29 – INTERSECTION PLAN

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