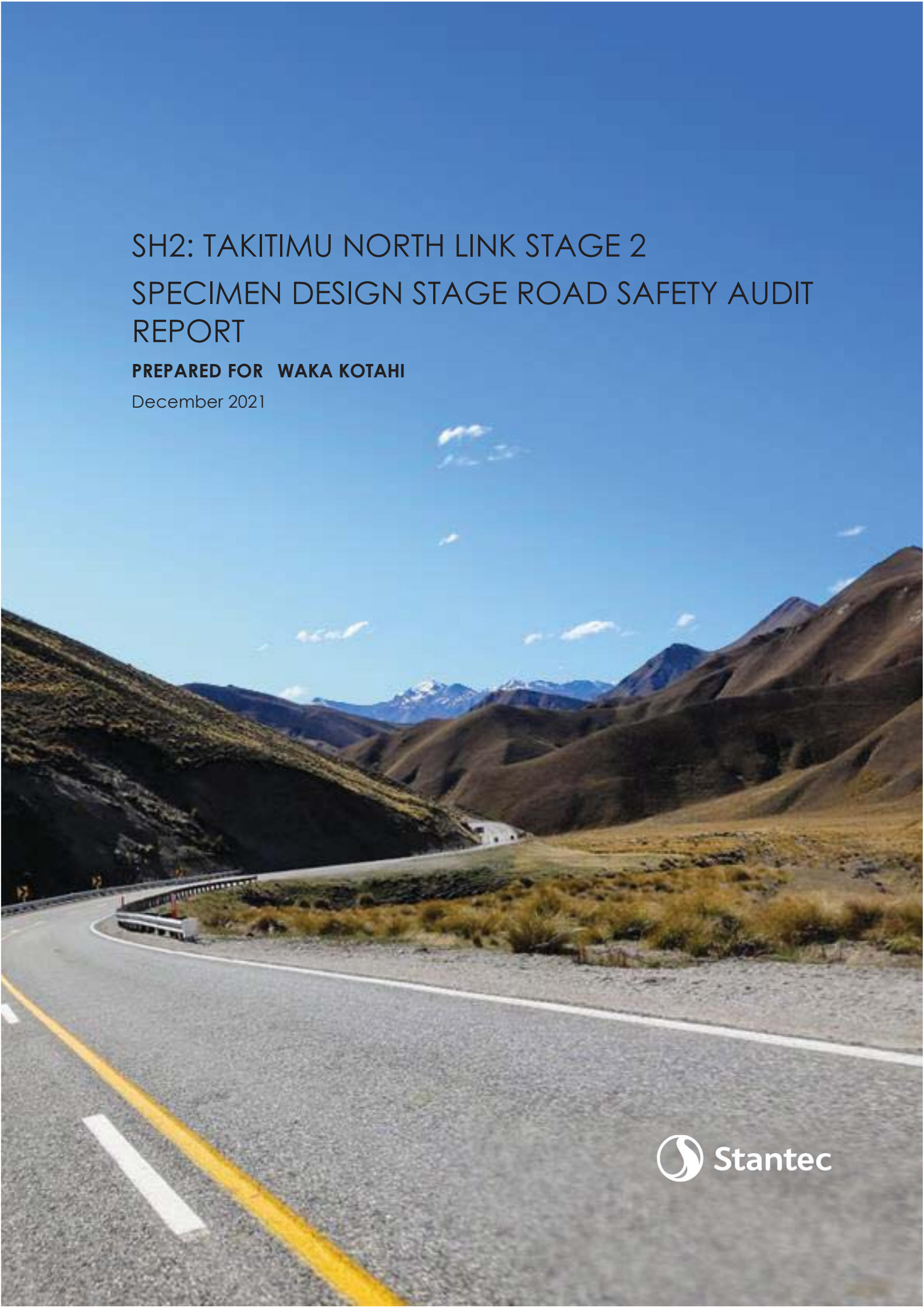
SH2: TAKITIMU NORTH LINK STAGE 2

SPECIMEN DESIGN STAGE ROAD SAFETY AUDIT REPORT

PREPARED FOR WAKA KOTAHI

December 2021



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1. Introduction

1.1 Safety Audit Definition and Purpose

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

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

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

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Safer Journeys and the Safe System approach, which is a safe road system increasingly free 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 so that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

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

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

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

- concept stage (part of business case);
- scheme or preliminary design stage (part of pre-implementation);
- detail design stage (pre-implementation or implementation); or
- pre-opening or post-construction stage (implementation or post-implementation).

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

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

For each audit team recommendation that is accepted, the client will 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. It is to be completed by the designer, safety engineer, and client for each issue, and should record the designer's response, client's decision (and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken.

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

1.2 The Project

The Takitimu North Link (TNL) Stage 2 project involves the construction of approximately 5.2 km of four lane expressway between the Waipapa Stream north of Omokoroa Road and the northern extent of Takitimu North Link Stage 1X.

The proposed expressway will tie into the existing SH2 two-lane alignment approximately 500 m north of Omokoroa Road, and tie into the proposed TNL Stage 1X approximately at Gill Lane.

The Design statement provided is based on the following project scope:

- A full diamond grade separated interchange at Omokoroa Road.
- Upgrades of Youngson Road and Omokoroa Road to accommodate the new interchange.
- Realignment and upgrading of Francis Road.
- Realignment and revocation of the existing State Highway 2 between Omokoroa Road and Gill Lane to a local road controlled by WBoPDC.
- Grade separation of Plummers Point Road.
- Upgrading of Barrett Road and Plummers Point Road as required by the works.
- A four-lane bridge over the Te Puna Stream.
- Culverts or bridges to convey the new road alignments over a number of existing watercourses.
- An off-road active mode path (AMP) the full length of Takitimu North Link with connections to the local road network.
- Property adjustments and construction of alternative accesses to accommodate the above works
- Design speeds given in Table 4-1 of the Design Statement with 110 km/h TNL; 60 km/h Francis and Barrett Roads; 90 km/h ramps and Youngson Road; 70 km/h Omokoroa Road and Plummers Point Road; 80 km/h revoked SH2, Te Puna Quarry Road and Ainsworth Road.
- No design departures from accepted standards have been identified.

At the audit briefing the following additional related items were clarified:

- Any upgrade work on the proposed revoked section of SH2 is not within the scope of the project and will be considered separately.
- A northbound off-ramp from Takitimu North Link to Barrett Road is shown on the current drawing set but is no longer included in the scope of the project.
- Forward Sight lines have been checked on the main alignment and the median widened where necessary.
- Omokoroa overbridge to now have two lanes eastbound to Omokoroa but only a single lane westbound (differs from Design Philosophy Statement).

1.3 The Road Safety Audit Team

This road safety audit has been carried out in accordance with the NZTA Road Safety Audit Procedure for Projects Guidelines – Interim release May 2013, by:

- Ian Carlisle, Principal Transportation Engineer, Stantec NZ (Team Leader);
- Noel Tunnicliffe, Roading Engineer, RoadLab Limited; and
- Shashi Lakshminarasimhaiah, Senior Safety Engineer, Auckland, Waka Kotahi NZ Transport Agency.

The safety audit team (SAT) attended a briefing meeting by remote videoconferencing facility with the designer Caleb McCarthy of BBO on 11 November 2021. The SAT then undertook a desk top review of the

drawings and other information and held an audit meeting on 24 November 202. No site inspection was undertaken for this audit.

1.4 Previous Road Safety Audits

A previous road safety audit has been completed at the scheme design stage as follows:

- Concept Design Audit, SH2 Omokoroa to Te Puna Improvements TDG, April 2017 includes designer response but no safety engineer or client decision.

Additionally, audit reports undertaken for the adjacent sections of the TNL (Stage 1 and Stage 1X) have overlapping and relevant issues documented and relevant decisions from those audits should be considered alongside this audit report.

1.5 Scope of this Road Safety Audit

This is a Specimen Design (SD) stage road safety audit of the project as described in Section 1.2. The drawings have been developed to a minimum level of detail with the intention of securing the route pending future stages of design.

It should be noted that a road safety audit is not to be used as a substitute for design checking or peer review, nor is it a check on compliance with standards, drawings or specifications. In this respect, it is further highlighted that an audit is not intended to provide a check on the compliance of every element, for example barriers and their location (for which design and construction checks are anticipated) but provides an overview of the project and operation with respect to the safety of road users.

Hence omission of a comment or concern on an issue in this report does not imply approval of any particular detail. Further safety audits will be carried out of the detailed design of other elements which may have some interdependency on geometry, and therefore may raise issues not already noted at this stage.

The design is understood to comply with the Waka Kotahi standard requirements for the project except where specifically identified otherwise by the designers and noted herein.

1.6 Report Format

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

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

Reference to 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 concern assessment rating matrix in Table 1-2. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

In ranking specific concerns, the auditors have considered the objectives of the Safe System approach, i.e. to minimise fatal or serious injury crashes.

In undertaking this assessment, the Safety Audit Team have utilised the following descriptor tables to enable a fair and reasonable rating of the risks.

Table 1-1: Crash Frequency Descriptor

Crash Frequency	Indicative Description
Frequent	Multiple crashes (more than 1 per year)
Common	1 every 1-5 years
Occasional	1 every 5-10 years
Infrequent	Less than 1 every 10 years

Crash Severity is determined on the likelihood of a crash resulting in death or serious injury. The reader is advised that the severity of an injury is determined in part by the ability of a person to tolerate the crash

forces. An able-bodied adult will have a greater ability to recover from higher trauma injuries, whereas a elderly person may have poor ability to recover from high trauma injuries. The auditors consider the likely user composition, and hence the likely severity of injury to that user.

Table 1-2: Concern Assessment Rating Matrix

Severity (likelihood of death or serious injury)	**Frequency** (probability of a crash)			
	Frequent	Common	Occasional	Infrequent
Very likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very unlikely	Moderate	Minor	Minor	Minor

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide a suggested action for each concern category is given in Table 1-3.

Table 1-3: Concern Categories

Concern	Suggested action
Serious	Major safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant safety concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate safety concern that should be addressed to improve safety.
Minor	Minor safety 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 lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, in some instances suggestions may be given by the auditors.

For example, comments may be either:

- of a general nature; or
- cannot be related to any specific safety concern; or
- relate to previous safety concerns that may have been misinterpreted; or
- relate to subsequent design developments that could become safety concerns in a future safety audit; or
- relate to safety concerns that the designers are already aware of; or
- relate to design elements where the safety implications are not yet clear due to insufficient detail for the stage of the project.

Comments are included for the consideration of the designers and the client. Decision tracking tables are included to record responses, as attention paid to the comments may contribute to improving overall road safety.

1.7 Documents Provided

The SAT was provided with the following documents for this audit.

- Copy of the designer's response (only) to the Concept Design Road Safety Audit SH2 Omokoroa to Te Puna Improvements TDG, April 2017
- Specimen Design drawing set prepared by BBO labelled Takitimu North Link Munro Road to Waipapa Stream Section (Stage 2), November 2021. No drawing list was provided, and therefore drawings provided are summarised as numbered 144702-00- (all rev A unless noted otherwise)
    - 1200 (B), 1201 (D), 1202- 1205 (C), 1206 (D),1207 (D);
    - 1211 (C), 1212 (C);
    - 1221 (C), 1222 -1223 (B),1224 -1225(D);1226 (C), 1227 -1228(D);
    - 1231-1232 (D); 1233 (C); 1235 (B);
    - 1241 -1242(C),1245 (B)
    - 1260-1263; 1265-1269;
    - 1274, 1280- 1286;
    - 1290-1292;
    - 1301, 1302, 1311,1312;
    - 2800-2802, 2804-2808;
    - 2900-2906.

The following additional information was provided for background information only

- Takitimu North Link – Stages 1X and 2 Contract number/s: NZTA 2/16-007/501 Draft Design Philosophy Statement for Specimen Design January 2021.

It is highlighted that no cross-sections other than typical sections were provided and no traffic data nor forecast traffic flows were available at the time of audit.

1.8 Disclaimer

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

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

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

Designer response	The eastern tie-in to the Stage 1X requires a portion of the initial stage to be reworked. The projects have been coordinated to ensure the horizontal and vertical geometry align.
Safety Engineer comment	Accept Designer response.
Client decision	Designer is correct. Unfortunately substantial rework of the expressway of Stg1 will be required for the 1X tie in, ideally this would be agreed and Stg 1X funded prior to construction of the area around Loop Rd under the Stg1 Contract in order to avoid this sunk cost.
Action taken	No further action at this stage

2.6 Western Tie-in / Transition

Significant

At its northern end the project ties in with the existing two-lane rural highway. It is anticipated that as part of Waihi to Tauranga SH2 safety improvements currently under construction, the section of SH2 north of the project will be upgraded and it is likely that this will include a wide centreline treatment with localised roadside barriers and potentially in the future a median barrier. However, it is understood at this stage that the existing bridges will be retained, and it is not clear if the upgrade project to the north does in fact extend to the Waipapa River Bridge.

Irrespective of the existing or proposed treatment at this northern interface, there will be a significant change in the highway environment from a four-lane median divided highway to a two-lane undivided (physically) highway immediately south of the Waipapa River bridge. The SAT is concerned about the ability of a northbound driver to adjust their behaviour and understand the changed road environment in response to the reduced standard of highway and increased risk of both crashes and severity of crashes.

The concern is exacerbated by a number of factors:

- Northbound drivers will have experienced many kilometres of high standard median divided road with grade separated interchanges and no side accesses from Tauranga to Omokoroa Road.
- The change in road standard and in particular the median barrier which terminates on the north side of a vertical curve, limiting the advance warning to a driver of the changing environment.
- The narrow bridge has concrete balustrades with w-section approach rails, but the concrete ends remain a hazard to vehicles if directly impacted.
- There are a number of property accesses and a narrow bridge immediately beyond the project end at the bottom of a steep grade. The steep gradient is currently observed to encourage higher traffic speeds in the existing environment which is likely to be exacerbated by the four laning.
- The first horizontal curve beyond the project (about 1.5 km north) will be a significantly lower radius curve than for the four–lane section (estimated at 300 m or less) and is coupled with a crest curve which restricts visibility.
- The project ends immediately beyond the Omokoroa Interchange northbound on-ramp and the two to one lane merge which is an area which is already requiring driver concentration and decision making.
- The existing highway to the north with single lane and a steep grade immediately beyond the Waipapa Stream Bridge will likely encourage drivers to pass slow vehicles prior to the end of the expressway and result in last minute / late passing movements on the approach to the narrow bridge.
- A northbound cyclist will enter the SH2 from the northbound on-ramp and forced to “claim the lane” on the bridge in the presence to the high-speed traffic with the multiple drivers demands as described above.

The SAT notes that several recommendations of the Concept Stage audit appear to have been adopted including the extension of the median barrier, to just south of the bridge (but not over the bridge) and the extension of the wide shoulder widths and barriers through the transition zone again as far as the bridge (at least appears about right at the scale of drawing provided).

However, the SAT remains concerned that the northern end of the project features a narrow bridge with concrete barriers located about 250 m north of the end of the 2 lanes to 1 lane taper. It would be

desirable to continue the four lanes further to the north to a location where a safe transition can be formed. In this respect it is noted that it is proposed to construct a roundabout at the intersection of SH2 and Pahoia Road / Esdaile Road to the north which would form a better location for signalling a change in environment providing a threshold to lower speeds.

If the project is not extended as described above then, as a minimum, additional safety measures are recommended to provide a safe transition from the expressway to existing highway. Such measures could include but not limited to:

- The use of prominent and repeated signage will be necessary to warn drivers that the expressway standard of road is ending e.g., using gated signs including posted speed signs (the existing highway has a lower posted speed than the expressway – at least currently).
- A high standard of marking and delineation particularly of the first geometric elements following the project end.
- Widen the Waipapa Stream bridge to provide safe shoulders for both vehicles and pedestrians with appropriate barriers.
- Provide a good standard of lighting through all merge areas and the transition to existing road (see item of lighting).

Recommendation(s)

1. Extend the project four-laning further to the north such as through to the proposed roundabout at the intersection of SH2 and Pahoia / Esdaile Roads.
2. If the project is not extended to Pahoia Road then as a minimum, provide additional safety measures to provide a safe transition from expressway to existing SH2 including appropriate shoulder widths, safe roadside barriers, median barriers and signs and markings to address the above-described concerns over the first one to two kilometres of the existing road (including the bridge).

Frequency Crashes are likely to be occasional	Severity Death or serious injury is very likely	Rating The safety concern is significant
Designer response	The designer acknowledges the SAT concerns and responds to the recommendations as follows: 1. Unfortunately, modifications to, and beyond the Waipapa Stream bridge are outside the scope of this project. 2. The designer agrees with the SAT and proposes the following: a. The movement of the 2-1 merge to prior to the onramp will provide a more gradual transition between a four-lane median divided carriageway and the existing SH2. b. The median barrier is to extend as far north as practical within the wide centreline/median (but not over the Waipap Stream Bridge). The side barriers are to also extend as far north as practical including closing the existing private access at the immediate extent of the project. c. Detailed design to ensure appropriate signage and lighting at the project extent. Works beyond the Waipapa Stream are outside the scope of works for this project. The following geometric element (right hand curve) already has gated warning signs with backing boards and ATP. Furthermore, as discussed there are safety improvements proposed for the SH2 and Pahaia / Esdalle Roads intersection which will further improve the transition between the standards of roads. As such, no works are proposed beyond the Waipapa Stream as part of this project.	
Safety Engineer comment	1. Client to advise. 2. The merge point will need to be agreed with the Client. Support Designer response to extend the median and side barriers, closing the private access, and appropriate signage and lighting. Other options to consider during detailed design are yellow no-overtaking lines, diagonal shoulder stripe markings, and cycle warning signs for the narrow bridge.	

Recommendation(s)

Client decision	Most of the items are existing concerns regardless of new projects, however the expressway will exacerbate the issues. This has been an ongoing debate for several years. Bridges were specifically excluded from the W2O project in 2017 Board Decision, this has been re-pitched several times but declined, therefore the W2O widening work will terminate approx. 150m north of the bridge. This will be revisited once again during implementation of the W2O median barrier over the next 3yrs or as funding provisions become available. Extra road width and barriers will be included under the W2O project between the bridge and Pahoia/Esdaile. All other items to be included at Takitimu Detailed Design stage, including a request for scope extension to replace/widen the bridge.
Action taken	TBC during detailed design. Noted for W2O project as it approaches design stage for this portion of SH2

2.7 Wide Shoulders

Moderate

Wide shoulders (of over 5 m on the outside shoulder and 6 m or more on the median shoulder) are proposed on the inside of horizontal curves and it is understood that the width of shoulder has been determined by the designers based on the forward visibility requirements for the design speed. Wide shoulders of 3m or greater may appear as additional lanes and may result in drivers using them as a lane.

The SAT considers that additional treatment is required to ensure that the wide shoulders do not encourage use by drivers. Ideally this would comprise a different surfacing and/or berm slope that makes it apparent that the shoulder is not part of the usable carriageway, either by way of a different material or at the very least a different appearance e.g. use of contrasting coloured surfacing.

Recommendation(s)

1. Provide additional treatment of wide shoulders to ensure that the shoulders are clearly differentiated from the trafficable carriageway.

Frequency **Crashes are likely to be infrequent**	**Severity** **Death or serious injury is likely**	**Rating** **The safety concern is moderate**
Designer response	The designer agrees with the SAT and proposes that this is addressed in detailed design.	
Safety Engineer comment	Accept Designer response.	
Client decision	Agreed to be undertaken at Detailed Design	
Action taken	NA	

2.8 Lighting - Comment

Lighting details are yet to be developed but it is acknowledged that the Design Statement specifies lighting through the most critical areas of the project included the northern tie- in to existing SH2, the interchange and ramps, and the local roads.

The SAT notes that lighting of the northern tie-in is expected to include a sag curve around 5200- 5350 m which does not meet headlight criteria and should be lit. Similarly, the sag curve at 6500-6850 has a K of 42 which appears to be based on the 100 km/h criteria rather than 110 km/h and therefore require more rapid deceleration than for the stated design speed. However, as this curve is also within the interchange area it is anticipated that there will also be adequate lighting for this sag curve (to be confirmed in design).