

# **SH1: MacKays Crossing to Peka Peka, Kapiti Coast Expressway**

## **ROAD SAFETY AUDIT of the TOC DESIGN**

**A REPORT PREPARED FOR  
NZ TRANSPORT AGENCY**

**Reference: 10341  
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<sup>1</sup> Target Outturn Cost

## TABLE OF CONTENTS

<b>1.0</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	Road safety audit definition and purpose.....	1
1.2	The project.....	1
1.3	The road safety audit team .....	2
1.4	Previous safety audits.....	3
1.5	Report format.....	3
1.6	Disclaimer .....	3
<b>2.0</b>	<b>GENERAL.....</b>	<b>4</b>
2.1	Comment – Matters arising from previous safety audit.....	4
2.2	Significant Concern – Design of roundabouts at interchanges.....	5
2.3	Serious Concern – Cyclists using the expressway .....	7
2.4	Minor Concern – Cycle path tie in at local roads and signage .....	7
2.5	Significant Concern – Lighting of the off-road cyclist/pedestrian path .....	8
2.6	Significant Concern – Kerbs shown on local road bridge drawings .....	8
2.7	Minor Concern – Signage and pavement marking on off-ramps.....	9
2.8	Comment – Culvert headwalls not protected by barrier .....	9
2.9	Comment – Kāpiti to Raumati pedestrian bridge.....	9
2.10	Minor Concern – Landscaping issues.....	10
2.11	Comment – Cycleway realignments .....	11
<b>3.0</b>	<b>EXPRESSWAY MAINLINE .....</b>	<b>12</b>
3.1	Significant Concern – Raised median with wire rope barrier.....	12
3.2	Minor Concern – Median barrier offset from drain .....	12
3.3	Minor Concern – Planted medians.....	13
3.4	Minor Concern – Barrier design at CCTV sites .....	13
3.5	Minor Concern – Barrier test level on bridges .....	14
<b>4.0</b>	<b>INTERCHANGES.....</b>	<b>15</b>
4.1	Serious Concern – Northern termination at Peka Peka interchange.....	15
4.2	Significant Concern – No expressway termination threshold measures .....	16
4.3	Significant Concern – Lighting at Peka Peka interchange .....	16
4.4	Significant Concern – Signage at Peka Peka interchange.....	16
4.5	Minor Concern – Lighting at Poplar Avenue interchange.....	17
4.6	Comment – ADS signage at Poplar Avenue interchange .....	18

4.7	Minor Concern – Private accesses at Poplar Road interchange.....	18
4.8	Significant Concern – Kapiti Rd Interchange southbound on-ramp merge .....	19
4.9	Minor Concern – Lighting at Kapiti Road interchange .....	19
4.10	Minor Concern – Barriers at Kapiti Road Interchange .....	19
4.11	Minor Concern – Signage at Kapiti Road Interchange.....	20
4.12	Significant Concern – Alignment of southbound Te Moana Road off-ramp.....	21
4.13	Minor Concern – Barriers at Te Moana Road Interchange .....	21
4.14	Minor Concern – Signage at Te Moana Road Interchange.....	21
4.15	Significant Concern – Right turn into Hadfield Road.....	22
4.16	Significant Concern – Signage for level crossing in Hadfield Road.....	22
<b>5.0</b>	<b>LOCAL ROADS .....</b>	<b>24</b>
5.1	Minor Concern – Keep Left signs on traffic islands on local roads .....	24
5.2	Minor Concern – Abrupt end to shared use path at Poplar Avenue .....	24
5.3	Minor Concern – Lighting at Mazengarb Road bridge .....	24
5.4	Significant Concern – Alignment of Otaihanga Road .....	25
5.5	Minor Concern – Shared use path alignment at Te Moana Road Interchange .....	25
5.6	Comment – Speed limit on old SH1 south of Peka Peka.....	26
5.7	Minor Concern – Urupa access road vertical alignment.....	26
<b>6.0</b>	<b>AUDIT STATEMENT .....</b>	<b>27</b>

## 1.0 INTRODUCTION

### 1.1 Road safety audit definition and purpose

Road safety audit is a formalised process to:

- identify potential road or traffic safety concerns for all road users and others affected by a road project
- ensure that the measures to eliminate or reduce the concerns are considered fully

It can be carried out at the following project stages:

- Feasibility / Concept stage
- Scheme / Preliminary Design stage
- Detailed Design stage
- Post Construction stage

This road safety audit is of a level of design that has been prepared for costing – it is substantially more than a preliminary design, but not a fully detailed design. The aim of this safety audit is to identify potential road safety concerns and bring them to the notice of the project designers and the client. The recommendations are intended to be indicative only to focus the designer on the type of improvements that may be appropriate. They are not intended to be prescriptive and other ways of improving the road safety concerns identified should also be considered.

The procedure set down for road safety audits in the NZ Transport Agency Guideline “Road Safety Audit Procedures for Projects” (November 2004) is that this is a report to the client who then refers the report to the designer and/or contractor. The designer should consider the report and comment to the client on each of the concerns raised, including their cost implications where appropriate, and make a recommendation to either amend the design or reject the audit report recommendation. The client then makes the final decision on each issue raised and informs the designer. Copies of both the designer’s comments to the client and the client’s decisions should be given to the safety audit team leader (for information only).

### 1.2 The project

The project for which this is the road safety audit is the proposed SH1 Kapiti Coast Expressway between MacKays Crossing and Peka Peka, a distance of approximately 18 km.

Between its end terminals, the expressway is being designed to motorway standard with two lanes in each direction, fully grade separated, and both edge and median protected. Half interchanges are proposed at its southern end (Poplar Avenue - south

facing ramps only) and northern end (Peka Peka Road - north facing ramps only) with full interchanges at Kapiti Road (Paraparaumu) and Te Moana Road (Waikanae).

A separate off-road shared cycle/pedestrian facility is to be provided for much of the length, though being an expressway, cyclists will be able to use the new road if they so choose.

A three volume set of drawings was provided to the safety audit team including drawings for:

- Expressway and local road plans and long sections.
- Typical and detail cross sections.
- Signage and ITS.
- Barriers and lighting.
- Pavement marking
- Pavements and kerbs.
- Drainage and culverts.
- Bridge structures.
- Cycleway (shared use path).
- Landscaping.

During the entry meeting the Safety Audit Team were made aware of the following points:

- The Peka Peka Interchange and its layout was still to be discussed by the NZTA Board
- Wire Rope Barrier (WRB) will be provided in the central median and along the edges of the main carriageway
- Embankments steeper than 1 in 4 will be planted

### 1.3 The road safety audit team

The road safety audit was carried out, as far as practicable, in accordance with the NZ Transport Agency Guideline "Road Safety Audit Procedures for Projects" (November 2004) by:

- Jos Vroegop, Senior Consultant, Traffic Planning Consultants Ltd, Auckland.
- Steve Reddish, Senior Associate, Traffic Planning Consultants Ltd, Hawke's Bay.
- Jon England, Senior Road Safety Engineer, MWH New Zealand Ltd, Wellington.

The Safety Audit Team (SAT) attended an entry meeting at the offices of the M2PP Alliance, Wellington, on Tuesday 14 August 2012 and carried out a desk top review of

the drawings both that day and the following day. No site visit was undertaken as the members of the safety audit team were already familiar with the site.

#### 1.4 Previous safety audits

Two members of the SAT had previously undertaken a road safety review of the initial design options for the expressway and its findings were detailed in a report dated 9 February 2011. An Addendum to this report considered two options for the Kapiti Road interchange and the findings were set out in a report dated 8 April 2011.

A road safety audit of the scheme design was undertaken by the current safety audit team in July 2011 and its findings detailed in a report dated 5 August 2011.

#### 1.5 Report format

The potential safety concerns identified have been grouped as follows:

- **Serious Concern** – a major safety concern that should be addressed and requires changes to avoid serious safety problems.
- **Significant Concern** – a significant safety concern that requires consideration of changes to improve safety.
- **Minor Concern** – a safety concern of lesser significance, but which should be addressed as it may improve overall safety.
- **Comment** – a concern or an action that may be outside the scope of the road safety audit, but which may improve overall design or be of wider significance.

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

#### 1.6 Disclaimer

The findings, opinions, and recommendations in this report are based on an examination of the available relevant plans and knowledge of the environs, and might not address all issues existing at the time of the audit. The report also deals with technical matters. Readers are urged to seek specific advice on particular matters 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 members of the safety audit team or their organisations.

## 2.0 GENERAL

### 2.1 Comment – Matters arising from previous safety audit

In the safety audit process, once decisions are made not to address particular safety issues that are raised in a safety audit, these items are not normally repeated in subsequent safety audits unless the safety audit team still has serious concerns. However, some items are covered again in this report to clarify safety concerns, respond to designer comments and enhance recommendations.

Also, in the decision tracking form for the road safety audit of the scheme design (report dated 5 August 2011) it was noted that a number of issues would be dealt with at the time of detailed design. Some of these issues have been dealt with in this TOC design now being safety audited or are again covered in specific items of this report, but others will still need to be actioned at the detailed design stage. To ensure that these matters are carried forward to the next stage of design, they are listed in the table below with reference back to the scheme design road safety audit report which should be read in conjunction with actioning these items as part of the detailed design.

Reference <sup>2</sup>	Issue to be addressed at detail design	Comments
2.2	Design of roundabouts at interchanges per Austroads GTRD Part 4B	Ensure sufficient land is available See also item 2.2 in current report
2.3	Signage and Marking for cyclists at ramps on the ramp shoulders	Response to recommendation c. Refer also to item 2.3 in current report.
2.4	Design of links between the shared use path and local roads	See also item 2.4 in current report
2.6 & 3.2	Design of transition lighting at interchanges	See also items 4.3 and 4.5 in current report
3.1	Expressway alignment north of Poplar Avenue – adopt additional measures to improve curve definition	Response to recommendation a.
3.3	Consider increasing the horizontal curve radii each side of the 820mR curve at Otaihanga Road to enhance the alignment	Response to recommendation a.
4.1	Provision of a minimum of two (2) under bridge lights	Response to recommendation b.
4.4	Review sight distance along Kapiti Road interchange off-ramps	
4.5	Design of cycle facilities on Kapiti Road	Response to recommendation a.
	Safety of layout, controls and needs of vulnerable road users at the intersections either side of the Kapiti Road interchange	Response to recommendation c.

<sup>2</sup> Number in road safety audit report of scheme design dated 5 August 2011.

Reference	Issue to be addressed at detail design	Comments
4.6	Consider moving the roundabout serving the southbound ramps at Te Moana Road further east	Response to recommendation a. Ensure sufficient land is available
4.8	Design of the roundabout east of the expressway at Peka Peka re spacing between entry points and advance visibility	Response to recommendation b. Refer also 2.2 above.
4.9	Design of the Peka Peka Road roundabout and the approaches, including sight distance from the garden centre	Responses to both recommendations a. and b. Ensure sufficient land is available
4.10	Design of the merge and diverge of the Peka Peka interchange ramps	See also item 4.1 in current report
5.3	Barrier design to include risk assessment for length of need for particular barrier type (eg on approaches to bridges)	
5.7	Fencing on the shared cycle/pedestrian path for protection of hazards such as stormwater storage ponds, culverts and other similar hazards	
6.1	Safe connection for cyclists and pedestrians between the southern end of the shared use path at Leinster Avenue and Queen Elizabeth park	
6.2	Location and design of the connection of the shared use path to Raumati Road and associated crossing arrangement	Response to recommendation b. See also item 2.4 in current report
6.3	Location and design of the connections of the shared use path to Otaihanga Road either side of the expressway and the associated crossing arrangement	See also item 2.4 in current report
6.4	Location and design of the connections of the shared use path to Ngarara Road either side of the expressway and the associated crossing arrangement	See also item 2.4 in current report Ensure sufficient land is available
6.5	Design of the Otaihanga Road/Otaihanga access road intersection including widened shoulder	Ensure sufficient land is available
6.8	All footpaths to be re-assessed so that they are on pedestrian desire lines	

## 2.2 Significant Concern – Design of roundabouts at interchanges

As noted in the safety audit of the scheme design, the safety audit team (SAT) had a number of concerns with the designs for the various roundabouts at the Poplar Avenue, Te Moana Road and Peka Peka Road interchanges. In the response to the safety audit, the designers noted that the roundabout designs were only schematic and would be designed in accordance with current design requirements at the detail design stage (see item 2.1 above).

The roundabout design issues raised in the previous safety audit covered:

- entry radii through the limit lines with respect to entry speeds.
- alignment of the approaches to the roundabouts in terms of visibility of the central island.
- road marking layout needing to be in compliance with Figure 3.17 of MOTSAM.
- footpath/cycle path crossing points.

The SAT also notes that the size of the central islands needs to be in accordance with the approach speeds (ref Table 4.1 in GTRD Part 4B) and not the speed limits. This may necessitate an increase in central island diameter at some of the proposed roundabouts.

The roundabout carriageway typical cross section on drawing CV-SC-023 shows a 2.8m apron around the central island. Aprons can blend in with the asphalt during wet and/or dark conditions and if a lip with significant upstand is hit at an acute angle by a motorcyclist this can lead to a crash. In addition, some motorists use aprons to negotiate roundabouts at higher speeds which in turn can lead to crashes. Aprons should only be installed if absolutely necessary for the tracking of larger vehicles.

In addition to the roundabout geometry, a key safety issue is the conspicuousness of the central island at all roundabouts. This can be achieved by way of mounding, planting and lighting, with appropriate levels of delineation provided. PW-69 chevron boards are proposed to be installed facing each approach at all roundabouts. However, these 2.6m wide signs (drawing CV-MF-160) are insufficient in width to cover the approach and the entry radius at most of the roundabout approaches. At least two PW-69 signs side to side should be installed.

**Recommendations:**

- a. *Ensure that the roundabout central island diameters are based on likely approach speeds.*
- b. *Avoid the use of aprons around the central island*
- c. *Ensure all designs are in accordance with Austroads GTRD Part 4B.*
- d. *Ensure that there is adequate land available in each instance to design a safe roundabout.*
- e. *Install at least two PW-69 chevron boards on the central island facing each approach to a roundabout.*

### 2.3 Serious Concern – Cyclists using the expressway

As noted in the safety audit of the scheme design, the SAT has a serious concern regarding the safety of cyclists if they are permitted to use the new expressway. The safety issues that could lead to serious or fatal crashes involving cyclists were noted as:

- Cyclists crossing on-ramps
- Cyclists crossing off-ramps
- Wind and/or buffeting by trucks causing cyclists to veer into traffic lanes.
- Narrow (1 m) shoulders on two lane off-ramps.

The drawings reviewed for the current safety audit did not show:

- 1) any signs prohibiting cyclists from the expressway
- 2) any facilities for safely crossing ramps

Given that there is to be a continuous off-street parallel cycle path, the SAT considers that cyclists should be prohibited from the expressway from the outset and the alternative off-street route clearly signed (see also item 2.4).

**Recommendation:**

- a. *Prohibit the use of the expressway by cyclists through local KCDC bylaw or by designating the expressway as motorway.*
- b. *Direct cyclists to use the adjacent off-road facility and the old SH1.*

### 2.4 Minor Concern – Cycle path tie in at local roads and signage

As noted in the safety audit of the scheme design, the SAT commends the proposed off-road shared pedestrian/cycle facility which will provide benefits (including safety benefits) to the local community in particular. It was noted that the shared use path has been designed in consultation with Kapiti Coast District Council (KCDC) and that the detail of the tie in to local roads will be addressed at detail design (see item 2.1 above). However, two concerns that the SAT notes are:

- 1) Whilst generic wayfinding signage is shown on drawing CV-MF-170 for the interface between the cycleway and local roads and at intersecting paths on the cycleway, no signage has been shown elsewhere on the local road network to direct cyclists to the cycleway. This can be a safety issue for cyclists who could find themselves unnecessarily in unsafe situations on busy arterial roads or on the expressway. This also applies to the discontinuity in the cycleway between El Rancho and Puriri Road, and where cyclists need to use Otaihanga Road and Ngarara Road to move between the paths either side of the expressway.
- 2) The general layout arrangement for the interface of the cycleway and local roads and at intersections along the cycleway as shown on drawing CV-MF-170 includes gabion basket walls which could obscure young children. A collision between a cyclist and a child pedestrian could result in serious injury.

**Recommendations:**

- a. *Provide guidance signage on the local road network to direct cyclists to the off-road facility, including signing the discontinuity between El Rancho and Puriri Road and using Otaihanga Road and Ngarara Road to move between the paths either side of the expressway.*
- b. *Review the use of gabion basket walls at the interface of the cycleway and local roads and at intersections along the cycleway having regard to the intervisibility between cyclists and young children.*

**2.5 Significant Concern – Lighting of the off-road cyclist/pedestrian path**

In the safety audit of the scheme design the SAT noted:

*“The off-road shared use pedestrian/cyclist path is proposed to be lit between Raumati Road and Mazengarb Road. However, the SAT is of the view that the shared use path should be lit between Poplar Avenue and Te Moana Road to cater for safe movements between the various Kapiti Coast communities. Lighting encourages use by pedestrians and cyclists as personal safety is enhanced as well as road safety. In the winter months in particular, early morning and evening use would be curtailed in the unlit sections.”*

The response noted that use of the shared use path outside the main urban area would be during daylight hours by commuters and school pupils. However, in the winter months it is dark by 5pm and commuters and school pupils staying for after school activities would be riding during the hours of darkness. (NB pupils cycle from Waikanae to Kāpiti College.) Solar studs or posts would not provide illumination of the path from a road safety or personal safety perspective.

**Recommendation:**

*Provide lighting of the shared use pedestrian/cycle path between Poplar Avenue and Te Moana Road having regard to safe use of the path by commuters and school pupils during the winter months in particular.*

**2.6 Significant Concern – Kerbs shown on local road bridge drawings**

On all drawings for local road bridges crossing the expressway or streams and which have footpaths; the footpath is noted as being a 200mm raised footpath with a vertical face kerb. Whilst not described as a bridge kerb, the form and height of the kerb would mean that any errant vehicle mounting the kerb is likely to be “launched” and not be appropriately protected by the barrier on the edge of the structure.

In addition, where cyclists need to cross the road (eg Ngarara Road) when using the bridge to access the cycleway on the other side of the expressway, the high kerb can be a hazard.

**Recommendation:**

*Use fully mountable kerbs on bridges.*

**2.7 Minor Concern – Signage and pavement marking on off-ramps**

- 1) One of the high risk situations leading to serious or fatal crashes is when drivers turn the wrong way onto motorway/expressway off-ramps from the local road at interchanges. The signage drawings show appropriate No Entry and No Right Turn/No Left Turn signage at the intersection of the off-ramp and local road. However, if a driver still turns onto any of the off-ramps from the local road he/she will be confronted by only a single RG-18 Wrong Way sign (ref drawings CV-MF-105, 110, 120 and 130). Whilst this arrangement is still shown in Section 2: Interchanges of TCD Manual Part 10: Motorways and Expressways (former MOTSAM Part 3), the signage now adopted to reduce the incidents of drivers continuing to drive down an off-ramp the wrong way is to have gated MI-38 Wrong Way – Go Back signs as detailed in Section 6 of TCD Manual Part 10.
- 2) In addition to signage, the edge line on the right hand side of the off-ramp at its intersection with the edge line of the local road is best configured at 90° rather than a radius to provide additional guidance to drivers on the local road not to turn left onto the off-ramp.

**Recommendations:**

- a. *Install gated MI-38 “Wrong Way – Go Back” signs on all off-ramps.*
- b. *Intersect the edge line on the right hand side of the off-ramp and the edge line of the local road at 90° and not with a radius.*

**2.8 Comment – Culvert headwalls not protected by barrier**

Some new culverts on local roads will have headwalls not protected by barrier. As a standard, these headwalls should have traversable safety intakes.

**2.9 Comment – Kāpiti to Raumati pedestrian bridge**

On drawings ST-BW-100 and CV-SP-113 the proposed footbridge across the expressway at CH 7050 takes pedestrians to and from a swale on the east side and has piers in the middle of the shared footpath/cycleway on the west side. Obviously, further thought and work on the function and design of this bridge is required.

## 2.10 Minor Concern – Landscaping issues

The landscaping drawings show areas that will be subject to various planting regimes. Whilst landscaping details have yet to be developed, the SAT has a number of concerns relating to the potential of some planting to have adverse road safety implications. Examples of these concerns are:

- 1) Drawing UD-LV-205: “mass planting” at the Poplar Avenue interchange has the potential to adversely affect sight distance requirements
- 2) Drawings UD-LV-210 and 220: “specimen trees” or “tree groups” may result in trees not being protected by barriers
- 3) Drawings UD-LV-210 and 220: at the interchanges the trees need to be located so that they do not restrict the intervisibility between pedestrians/cyclists and drivers
- 4) Drawings UD-LV-210 and 220: trees near property accesses can adversely affect visibility for exiting drivers
- 5) Drawing UD-LV-220: no tall plants or trees should be planted on the inside of the curve of Te Moana Road east of the expressway so that visibility of the roundabout for westbound drivers is not restricted
- 6) Drawing UD-LV-214: any trees in the “mass planting with tree enrichment” that are planted alongside Mazengarb Road may be a hazard and if on the inside of the curve could restrict forward sight distance
- 7) Drawings UD-LV-230 and 231: “mass planting” or trees planted near the roundabouts can be a hazard for any errant vehicles as well as restricting sight line requirements

Even small trees can be a significant hazard for errant vehicles:



**Recommendation:** Ensure that the detailed landscaping proposals take account of road safety requirements, especially any potential effects on visibility and the locations of unprotected trees that could be hazards.

## 2.11 Comment – Cycleway realignments

On the stormwater drawings showing the various culverts (series 800), there are a number of locations where the cycleway is shown realigned around a proposed culvert headwall. These realignments are not necessarily safe for cyclists and it would appear that the realignments are being dictated by drainage rather than the other way around. It is important to ensure that the cycleway is designed appropriately for cyclists.

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### 3.0 EXPRESSWAY MAINLINE

#### 3.1 Significant Concern – Raised median with wire rope barrier on bridges

A number of the bridges are shown with the median wire rope barrier on a raised median (refer structural drawings BA-103, BF-110, BG-110, BH-110, BN-102 and BR-110). The kerbing of the raised medians is shown as semi-mountable (75mm high with 45° profile face) which in many instances if struck by an errant vehicle would result in that vehicle striking the barrier in a way that would not necessarily contain the vehicle.

**Recommendations:**

- a. Eliminate raised medians where wire rope barrier is to be installed.
- b. If a raised median is necessary on the bridges to support the wire rope barrier, use only fully mountable low profile kerbs for the raised medians.

#### 3.2 Minor Concern – Median barrier offset from drain

In the safety audit of the scheme design, the SAT noted:

*“The mainline median typical cross sections on dwg CV-SC-010 show the median wire rope barrier being offset by up to 850 mm from the median drain on super elevated curves. The concern is that with 1 in 10 slopes into the drain from both sides, this might affect the suspension of an errant vehicle prior to it striking the barrier. Assessment is that an offset of no more than 350 mm would probably be acceptable as the body of an errant vehicle would strike the wire rope before the wheel goes too far into the ‘V’ drain. So that barrier function is not compromised, it should be installed closer to the drain (ie 350 mm). It is noted that this may reduce forward sight distance on some curves and this will need to be checked and the drain rather than barrier position amended if necessary.”*

The designer’s response confirmed that the barrier location will change on curves to achieve forward sight distance, but that the median drain cannot be relocated.

The SAT is still concerned that the barrier offset from the V drain as shown on cross sections B and D (drawing CV-SC-010) will result in the barrier not being effective due to the 20% change in ground profile affecting an errant vehicle’s suspension and trajectory prior to hitting the barrier. Ideally the barrier should always be within 350mm of the drain or greater than 2m from the drain.

**Recommendation:**

*Where the median barrier needs to be offset from the centre of the median for forward sight distance, locate the median ‘V’ drain within 350mm of the wire rope median barrier or with an offset that is greater than 2m.*

### 3.3 Minor Concern – Planted medians

The landscaping drawings show “mass planting” of the expressway median from CH 4100 to CH 8400. It is not clear what “mass planting” entails, but it is important that such planting will not compromise the performance of the wire rope barrier.

The typical median cross section ‘A’ on drawing CV-SC-010 shows a crowned grassed/planted median, but the safety concern is that this could result in silt washing onto the road in heavy rain which can make the carriageway slippery. Where the median is to be crowned, it would be preferable to have a sealed median per cross section ‘C’. Maintenance of grassed/planted medians is also a safety concern as it exposes crews to unnecessary danger, even when working under temporary traffic management conditions.

**Recommendations:**

- a. *Ensure that median “mass planting” proposals will not adversely affect the performance of the wire rope barrier.*
- b. *Consider the safety of maintenance crews when deciding on the planting of medians.*
- c. *Consider having a sealed median where a crowned median is proposed or measures to ensure that silt is not washed onto the carriageway.*

### 3.4 Minor Concern – Barrier design at CCTV sites

A number of CCTV installations are proposed along the length of the new expressway. These are noted as having an access pad for maintenance vehicles. However, edge protection wire rope barrier is shown as being continuous past the CCTV sites negating the ability for a maintenance vehicle to access the pads. It is assumed that it is not intended to service the CCTVs from the expressway shoulder which would be unsafe.

Overlapping barriers should be designed to provide for safe entry and exit via the shoulder to the maintenance pads. The design must allow for access and the manoeuvring of any vehicle accessing the CCTV sites in a way that has no impact on the traffic flow in the adjacent live traffic lanes; this includes deceleration, turning and acceleration movements.

**Recommendation:**

*Design overlapping barriers in front of the CCTV infrastructure to allow safe entry/egress for service vehicles via the expressway shoulder.*

### 3.5 Minor Concern – Barrier test level on bridges

The SAT notes that some of the expressway bridges are shown with TL-4 barriers over local roads and some with TL-5 barriers. In particular, the bridges over Otaihanga Road and over Te Moana Road are shown with TL-5 barriers and all others, including Kapiti Road, with TL-4 barriers. (NB there is also disparity between the barrier drawings and structural drawings as to the barrier test level for the bridge over Te Moana Road.)

From a safety perspective, the SAT is concerned to ensure that the appropriate test level barrier is provided on each bridge to minimise the risk of a serious crash if a larger vehicle is not contained and falls onto the road below. The SAT would have expected to see TL-5 barriers specified for edge protection on bridges over busier roads, such as Kapiti Road. A similar concern applies to the barrier on the Peka Peka Link Road bridge (TL-4 – drawing CV-MF-229) with the more heavily trafficked expressway under.

**Recommendation:**

*Undertake the appropriate risk assessment to determine the barrier test level required on all the expressway bridges, including local road bridges going over the expressway.*

## 4.0 INTERCHANGES

### 4.1 Serious Concern – Northern termination at Peka Peka interchange

The SAT has serious safety concerns regarding the northern termination of the expressway with its tie in to the existing SH1. Even if the tie in is for a relatively short period, the crash risk is considered to be high. Essentially northbound drivers will have been travelling on a high speed grade separated expressway for 18 km<sup>3</sup> only to suddenly find themselves on a two-way two lane road. For some drivers who do not pay due attention to the change in roading environment, there is a high risk of head-on crashes if the median barrier is not continued along the existing SH1.

Also of concern is the lack of a northbound off-ramp to Peka Peka Road. It will be difficult to sign the need for northbound motorists to exit for Peka Peka Road and the associated area back at the Te Moana Road interchange and have drivers find their way through the local road system. GPS units that have not been updated will also be misleading. This can lead to unsafe manoeuvres. In the interim situation before construction of the Peka Peka to Otaki expressway there would be a significant risk of some drivers attempting to U-turn at the end of the expressway to use the southbound off-ramp to access Peka Peka Road. Extending the median wire rope barrier to a location where U-turns could be made safely would prevent unsafe U-turns close to the interchange/expressway environment.

Notwithstanding the recommendation to extend the wire rope barrier, the SAT considers that overall safety would be enhanced by having at least a northbound off-ramp exit at Peka Peka Road to the roundabout on the western side of the expressway. Note that the northbound off-ramp exit should not be from an exit-only lane as this can lead to late unsafe lane changes – the two lanes to one lane merge at the end of the expressway should occur after the recommended exit.

In the longer term, the proposed lack of south facing ramps at Peka Peka interchange results in Te Horo bound motorists having to either continue further north to Otaki before doubling back on local roads to access Te Horo or to continue using the existing SH1. When interchanges cater for only one direction, motorists must use local roads to drive to an interchange that caters for the direction they wish to travel. Some local roads are less safe than the proposed expressway, so it is beneficial not to preclude access in one direction at the interchange.

#### **Recommendations:**

- a. *Provide a full interchange with south facing ramps at the Peka Peka Road interchange from the outset, or*

<sup>3</sup> If Transmission Gully is in place, drivers could have travelled from Wellington on high speed grade separated highway (~65 km)

- b. *As an interim measure provide a northbound off-ramp exit at Peka Peka Road to the roundabout on the western side of the expressway.*
- c. *In designing the recommended northbound off-ramp, ensure that the two lanes to one lane merge at the end of the expressway occurs after the exit.*
- d. *Extend the wire rope barrier northwards along a median on the existing SH1 to prevent unsafe U-turns at the end of the expressway.*

#### **4.2 Significant Concern – No expressway termination threshold measures**

Further to the expressway terminating at Peka Peka, there are no threshold features or signage shown on any of the drawings to alert drivers to the change in environment when going from a grade separated median divided expressway to a rural two-way highway. With such a significant change in environment, not only are measures required to alert drivers to the change, but a change in speed limit should also be considered to reduce the risk of serious crashes.

**Recommendations:**

*Install threshold measures and signage to highlight the change in environment when going from a grade separated median divided expressway to a rural two-way highway north of Peka Peka.*

#### **4.3 Significant Concern – Lighting at Peka Peka interchange**

On drawing CV-MF-230 street lighting is shown for the intersections and ramps, but no lighting is shown on the mainline in the critical area where two lanes are reduced to one prior to the northbound on-ramp merge.

**Recommendation:**

*Extend lighting on the expressway south from the Peka Peka on-ramp merge area to also cover the two lanes to one lane merge area on the mainline and the northbound off-ramp recommended in item 4.1.*

#### **4.4 Significant Concern – Signage at Peka Peka interchange**

- 1) There is no warning signage provided for the two lanes to one lane merge northbound on the expressway. Adequate warning of the merge needs to be provided to drivers so that unsafe late lane changing or overtaking manoeuvres are not undertaken.
- 2) On drawing CV-MF-130 and 131 there are various ADS and IDS signs that refer to “EWY NORTH”. However, there will be a period of time after completion of

the M2PP expressway when there is no expressway to the north. Drivers' expectations need to be managed so that they drive appropriately to the type of road; therefore there should be no reference to "expressway" to the north until the expressway is extended to Otaki.

- 3) Sign 174/160 on the northbound on-ramp states "EXPRESSWAY". As on ADS and IDS signs directing drivers north there should be no reference to "expressway."

**Recommendations:**

- a. Install gated PW-43.3 signs on the northbound carriageway both in advance of the two lanes to one lane merge and at the merge.
- b. Delete all reference to "expressway" on ADS and IDS signs directing drivers to the north at Peka Peka.
- c. Remove EXPRESSWAY sign 174/160 from the northbound on-ramp at Peka Peka.

#### 4.5 Minor Concern – Lighting at Poplar Avenue interchange

In the safety audit of the scheme design the SAT noted:

*"The drawings show the on and off-ramps at Poplar Avenue as being lit, but not the expressway carriageway over Poplar Avenue. This lighting arrangement can lead to increased glare for expressway drivers from the ramp lights and a reduced ability to clearly see the carriageway and the way ahead. Lighting the expressway carriageway would reduce the contrast between the unlit carriageway and surrounding lighting."*

The designers concurred with the above and recommended lighting the expressway carriageway to CH 3000. However, the client decision did state "Consider lighting only the conflict area from chainage 1800 to 2400. Continuing lighting to the end of the crest curve may affect drivers' ability to read the following horizontal curve." The SAT acknowledges the NZTA decision, but considers that lighting of the expressway through the interchange has greater safety benefits in terms of reducing the effects of glare from the adjacent street lights, shadows cast by the barriers and contrast between the unlit carriageway and the surrounding lighting<sup>4</sup>.

In the previous safety audit the SAT also raised the issue of there being only one under-bridge light for the Poplar Road Bridge and that an additional light should be provided to ensure that the contrast between daylight and shadow is minimised. The decision was that "a minimum of two under-bridge lights shall be provided", but only one light is still shown on the drawings now audited (ref drawing CV-MF-205).

<sup>4</sup> These effects are noticeable at two interchanges on the Hastings Expressway where the main carriageway over the local roads has no lighting whilst the ramps and local roads are lit.

**Recommendations:**

- a. *Provide lighting for the expressway carriageway at the Poplar Avenue Interchange through to approximately CH 2850.*
- b. *Provide at least two under-bridge lights on the Poplar Avenue bridge to minimise the contrast between daylight and shadow under the bridge.*

**4.6 Comment – ADS signage at Poplar Avenue interchange**

The IDS finger board signs correctly show “Raumati South” but ADS signs 10/151 and 6/150 only show “Raumati.”

**4.7 Minor Concern – Private accesses at Poplar Road interchange**

- 1) The western roundabout at the Poplar Avenue interchange has a leg opposite the off-ramp that serves private property. The SAT accepts that this can be a safe way to facilitate access to private property. However, it will be important that the access is designed to look like a driveway and not a road, but with sufficient width to allow a safe left turn in at the same time as a vehicle may be waiting to exit to avoid unexpected braking/stopping on the roundabout itself.

The SAT also notes that advance destination sign (ADS) 6/150 shown on drawing CV-MF-105 directs traffic to Palmerston North and Taupo via SH1 along the private property access!

- 2) The private property access on the northern side of Poplar Avenue some 80m west of the roundabout will cross the off-road cycleway and then up a 1 in 4 slope to the new carriageway which is on fill (ref typical cross section on drawing CV-SC-021). To provide for safe entry and exit, the access should have a “platform” area before connecting to the carriageway. This platform should not have a slope greater than 1:20 and be 5-6m in length (ie long enough to accommodate a vehicle waiting to turn onto Poplar Avenue).

**Recommendations:**

- a. *Design the property access leg of the western roundabout at the Poplar Avenue interchange so it is clearly a driveway but with sufficient width to allow a safe left turn in at the same time as a vehicle may be waiting to exit.*
- b. *Amend ADS 6/150 to remove the SH1 direction to Palmerston North and Taupo and show the leg opposite the off-ramp as a private access.*
- c. *Design the access on the northern side of Poplar Avenue some 80m west of the roundabout with a 5-6m long platform area at the Poplar Avenue carriageway that has a grade no greater than 1:20.*

#### 4.8 Significant Concern – Kapiti Rd Interchange southbound on-ramp merge

In the safety audit of the scheme design the SAT noted:

*“The southbound on-ramp merge with the mainline is located on the inside of a curve which can increase the risk of crashes. For merging traffic it is awkward for a driver to look back to check traffic on the mainline and only a limited distance back is viewable in the mirrors due to the curve. Of particular concern, is that vehicles on the mainline can be in the blind spot of entering trucks. In addition, the road marking for the full merge is often not visible and drivers often attempt to merge early when not necessarily up to mainline speed.”*

The decision with regard to the above concern was that consideration should be given to extending the merge. The SAT considers that a safer option would be to introduce a length of parallel lane prior to the merge to give drivers more time to assess traffic on the mainline especially as the ramp is below the mainline. This would allow merging at various points along its length. Austroads Guide to Road Design Part 4C: Interchanges recommends this layout (Figure 11.7(a) and considers the simple merge (Figure 11.6) only “suitable for some low-speed situations” and that it “can be used in very constrained situations (i.e. where space is not available for a parallel lane).”

**Recommendations:**

- a. *Lengthen the Kapiti Road southbound on-ramp prior to the merge to provide a longer length of parallel lane to give entering drivers more time to assess gaps in the mainline traffic before merging.*
- b. *Ensure that drivers on the southbound on-ramp from Kapiti Road have forward sight distance of the full length of the merge taper.*

#### 4.9 Minor Concern – Lighting at Kapiti Road interchange

On drawing CV-MF-210 the two lane southbound off-ramp is shown as being lit from 8m poles with GL600 100W luminaires, whilst the other ramps are lit predominantly from 10m poles with GL600 150W luminaires. In the absence of any other information, the SAT questions whether the level of lighting on the two lane southbound off-ramp will be at the appropriate standard.

**Recommendation:**

*Ensure that the lighting of the Kapiti Road southbound off-ramp is at the same level as the other ramps.*

#### 4.10 Minor Concern – Barriers at Kapiti Road Interchange

- 1) On drawing CV-MF-210 there are sections of mainline semi rigid barrier where the back of the barriers are exposed to traffic on the southbound and

northbound on-ramps. The SAT does not have enough information on the inter-relationship of the on-ramps relative to the mainline to fully assess the risk, but as the on-ramps curve toward the mainline it would appear that there is a significant risk of an errant vehicle from either on-ramp easily traversing the grassed area and hitting the back of the mainline barrier.

- 2) At both off-ramps, the back of the noise wall barrier on the mainline is exposed to collision from an errant vehicle on the off-ramp.
- 3) On drawing ST-BD-101 semi rigid barriers are shown positioned hard up against the bridge central piers on Kapiti Road. For the barrier to perform correctly when struck there needs to be a suitable gap between the barrier and the pier to allow for deflection of the barrier. If there is insufficient space for deflection then a rigid F shape barrier should be substituted for the semi rigid barrier.

**Recommendations:**

- a. *Shorten and/or extend the semi rigid barriers on the mainline and on-ramps at the Kapiti Road interchange as necessary to ensure that the back of any barrier is appropriately protected.*
- b. *Extend the semi-rigid barriers on the Kapiti Road off-ramps to provide protection for the back of the noise wall barriers.*
- c. *Ensure that there is sufficient space between the semi rigid barrier and the bridge piers on Kapiti Road to allow for deflection of the barrier when struck or substitute a rigid F shape barrier for the semi rigid barrier.*

#### 4.11 Minor Concern – Signage at Kapiti Road Interchange

- 1) “No Left Turn” signs 211/160 and 212/160 are both shown on the central island of Kapiti Road (drawing CV-MF-110). These signs need to be directed at drivers in the left hand lanes of Kapiti Road to stop them turning left onto the off-ramps. Both signs should be attached to the respective left hand side primary traffic signal poles.
- 2) IDS sign 26/151 as shown on drawing CV-MF-110 when facing eastbound traffic on Kapiti Road will actually be pointing toward the southbound off-ramp and not the southbound on-ramp which may confuse approaching drivers.

**Recommendations:**

- a. *Install “No Left Turn” signs 211/160 and 212/160 on the respective left hand side primary traffic signal poles on Kapiti Road.*
- b. *Correct IDS sign 26/151 as shown on drawing CV-MF-110 so that it points toward the southbound on-ramp.*

#### 4.12 Significant Concern – Alignment of southbound Te Moana Road off-ramp

The southbound off-ramp at Te Moana Road has a 2,000m radius curve tightening into a 220m radius curve prior to the roundabout. The roundabout is not initially in the view of approaching motorists (unlike the northbound off-ramp) and the visibility of the 220mR curve and the roundabout itself will be affected by both the ADS sign 42/155 (drawing CV-MF-120) and the bridge over the Waimeha Stream.

The alignment also compounds safety at the roundabout itself in terms of the entry radius not providing sufficient deflection to slow traffic prior to entering the circulating carriageway (see also item 2.2).

**Recommendations:**

- a. *Realign the Te Moana Road southbound off-ramp so that the roundabout is in the view of approaching drivers at approximately CH 12100.*
- b. *Ensure that the bridge on the Te Moana Road southbound off-ramp over the Waimeha Stream does not exacerbate the forward visibility to the roundabout.*

#### 4.13 Minor Concern – Barriers at Te Moana Road Interchange

Based on the typical mainline cross section 9 on drawing CV-SC-003, there could be some 1 in 4 slopes adjacent to the on and off ramps that are not barrier protected (refer drawing CV-MF-220). It is assumed that where the slopes are 1:3 per the typical cross section for single lane ramps shown on drawing CV-SC-020 barrier protection has been provided.

**Recommendation:**

*Undertake a risk assessment to determine exactly where barriers are required on the on-ramps and off-ramps at Te Moana Road Interchange.*

#### 4.14 Minor Concern – Signage at Te Moana Road Interchange

The IDS signs 47/155 and 48/155 shown on drawing CV-MF-120 are to be located underneath the expressway bridge and may not be clearly seen given the contrast in light from outside to underneath the bridge.

**Recommendation:**

*Ensure that the IDS signs 47/155 and 48/155 on Te Moana Road are located where they can be clearly seen by approaching drivers and are not affected by the shadow of the overbridge.*

#### 4.15 Significant Concern – Right turn into Hadfield Road

The SAT remains concerned about the safety of the proposed layout at Hadfield Road where the southbound off-ramp traffic will pass at speed through this T-intersection and then onto a two-way two lane road which could result in head-on crashes if drivers are not fully concentrating on signage and markings (drawings CV-MF-130 and CV-MF-230. As noted in the safety audit of the scheme design *“at-grade intersections with high speed through movements can have serious consequences if a crash occurs. The decision process for drivers turning right tends to be more difficult when judging both distances to travel and higher speeds.”*

The designer’s response was that the intersection *“will be refined during the next stage to provide a safe arrangement that eliminates the potential for high severity crashes.”* The layout as shown on the drawings now safety audited is essentially unchanged and the SAT considers that alternative options for this intersection should be developed prior to the detail design.

One such option is to provide an at-grade roundabout at the intersection which would have the benefits of

- 1) Slowing traffic through the intersection
- 2) Providing a safer right turn manoeuvre
- 3) Providing a clear demarcation between the one-way off-ramp and the two-way two lane local road

Even a slightly sub-standard roundabout would be preferable to the proposed T-intersection layout.

Any intersection design will need to take into account the presence of the at-grade railway crossing some 20 m to the east of the intersection on Hadfield Road.

##### **Recommendations:**

- a. *Separate the southbound off-ramp and Hadfield Road traffic, or*
- b. *Design options for a safer intersection at Hadfield Road that eliminates the potential for high severity crashes, takes account of the proximity of the rail crossing and provides a definitive threshold between the one way/one lane operation and the two way/two lane operation (eg roundabout).*

#### 4.16 Significant Concern – Signage for level crossing in Hadfield Road

- 1) Drivers turning left or right into Hadfield Road will encounter the NIMT railway crossing as soon as they enter Hadfield Road. To reduce the potential for crashes associated with the railway crossing there should be appropriate warning and regulatory signage installed. The only warning signage shown on drawing CV-MF-

130 is a WX1R sign on the southbound off-ramp which is inappropriate. WXL2 and WXR2 warning signs should be erected on the off-ramp and the northbound approaches to Hadfield Road. Gated WX1R and WX1L warning signs should be erected on Hadfield Road together with other signage and pavement markings specified in TCD Manual: Part 9 Level Crossings.

- 2) Further to 1) above, there would be safety benefits if the ADS sign 69/158 on the southbound off-ramp had reference to the railway crossing that drivers will encounter as soon as they turn left into Hadfield Road.

**Recommendations:**

- a. *Install signage and pavement markings as specified in TCD Manual: Part 9 Level Crossings on the approaches to and within Hadfield Road.*
- b. *Include reference to the railway crossing on ADS sign 69/158 on the southbound off-ramp.*

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## 5.0 LOCAL ROADS

### 5.1 Minor Concern – Keep Left signs on traffic islands on local roads

At the Poplar Avenue, Kapiti Road and Peka Peka Interchanges, the ends of traffic islands on local roads are shown highlighted with RG-17.1 signs. At the Te Moana Road interchange the islands are shown with the larger RG-17 keep left signs. The RG-17 signs have better target value and more clearly highlight the noses of traffic islands for approaching traffic under dark and/or wet conditions in particular. This can reduce the incidents of traffic island noses being hit.

**Recommendation:**

*Use RG-17 rather RG-17.1 keep left signs on the noses of all traffic islands.*

### 5.2 Minor Concern – Abrupt end to shared use path at Poplar Avenue

Drawing ST-BA-100 shows the new shared footpath/cycleway coming to an abrupt end on Poplar Avenue at the expressway bridge over Poplar Avenue. The drawing also shows a short length of cycle lane on Poplar Avenue between the two interchange roundabouts. As noted in item 2.2 the road marking layout at roundabouts should be in compliance with Figure 3.17 of MOTSAM in terms of safety for cyclists and should include an off-road option for cyclists to safely negotiate roundabouts.

**Recommendation:**

*Ensure that at the detailed design stage there is safe two-way connectivity provided for cyclists between the shared footpath/cycleway and old SH1 and not an abrupt end to the shared use path.*

### 5.3 Minor Concern – Lighting at Mazengarb Road bridge

On drawing CV-MF-214 two underbridge lights are shown on the northern side under the expressway bridge over Mazengarb Road. As there are footpaths on both sides of Mazengarb Road, for the safety of pedestrians and cyclists it would be beneficial if there were underbridge lights on both the northern and southern sides.

**Recommendation:**

*Provide underbridge lights on both the northern and southern sides of the Mazengarb Road overbridge.*

#### 5.4 Significant Concern – Alignment of Otaihanga Road

When the SAT raised concerns about the existing curvilinear alignment of Otaihanga Road (6.3 in August 2011 audit) the designers response was that it is to remain unchanged “as KDCDC has stipulated that” Otaihanga Road is to retain its “existing rural road alignment”. This continues to be of concern to the SAT which has previously observed vehicles cutting corners and not driving at an appropriate speed for the environment.

As Otaihanga Road is a location where cyclists on the cycleway (shared use path) need to shift from one side of the expressway to the other, the project will thus be putting cyclists onto a rural road that has inherent safety issues. Whilst sight lines beneath the bridge are adequate for forward sight distance, the combination of the alignment of Otaihanga Road and the darkness/shadows beneath the bridge are likely to put both cyclists and pedestrians at risk in terms of seeing and being seen by drivers.

##### **Recommendations:**

- a. *Realign the section of Otaihanga Road to the approaches to and under the expressway to provide improved visibility along the road for the safety of cyclists and pedestrians in particular.*
- b. *Ensure that the cycleway (shared use path) intersections with Otaihanga Road on both sides of the expressway provide good intervisibility between cyclists and drivers having regard to safe stopping distance for the prevailing speed on Otaihanga Road.*

#### 5.5 Minor Concern – Shared use path alignment at Te Moana Road Interchange

On drawing CV-SP-120, users of the shared use path will need to cross Te Moana Road immediately east of the eastern roundabout. The shared use path alignment as shown on the southern side of Te Moana Road directs pedestrians and cyclists to cross the road at the roundabout limit line. This would be unsafe as drivers will be looking to their right when stopped at the limit line and may not see a pedestrian or cyclist crossing from their left. The path should be aligned so that pedestrians and cyclists will be crossing behind the lead vehicle at the limit line.

##### **Recommendation:**

*Ensure that the shared use path alignment and the detail roundabout design have pedestrians and cyclists crossing the Te Moana Road approach lane at least 6m from the limit line.*

## 5.6 Comment – Speed limit on old SH1 south of Peka Peka

Drawing CV-MF-130 shows old SH1 changing to a 50 km/h speed limit at Hadfield Road. However, on drawing CV-MF-131 there is no signage indicating what the speed limit will be on old SH1 to Waikanae after the roundabout – it is assumed it would not be 50 km/h.

## 5.7 Minor Concern – Urupa access road vertical alignment

On sheet 20 of the local road long sections, the vertical alignment for the Urupa access road (MC75) shows a crest curve with a K value of 3.4. Whilst this should just be adequate for a driver to see an object at an operating speed of 40 km/h, the SAT has no information on the likely volumes or actual speeds of vehicles using this access road.

### **Recommendations:**

- a. *Having regard to the proposed vertical alignment of the Urupa access road, confirm that speeds will not exceed 40 km/h.*
- b. *If speeds are likely to exceed 40 km/h, improve the vertical alignment accordingly.*

**6.0 AUDIT STATEMENT**

We certify that we have used the documents noted in section 1.2 to identify features of the project 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: 23 August 2012

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