

Before Hearing Commissioners

under: the Resource Management Act 1991

in the matter of: Notices of Requirement by the NZ Transport Agency to the Waipa District Council and the Waikato District Council to alter existing designations under section 181 of the RMA for the Cambridge Section of the Waikato Expressway

and:

in the matter of: resource consent applications by the NZ Transport Agency to the Waikato Regional Council under section 88 of the RMA for the Cambridge Section of the Waikato Expressway

Statement of evidence of Jeremy Gibbons (Project Overview and Construction) on behalf of the **NZ Transport Agency**

Dated: 27 June 2011

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STATEMENT OF EVIDENCE OF JEREMY GIBBONS ON BEHALF OF THE NZ TRANSPORT AGENCY

INTRODUCTION

- 1 My full name is Jeremy Nicholas Gibbons.
- 2 I am a Senior Transportation Project Engineer for Opus International Consultants Limited, in Hamilton. I have practised in the field of civil engineering for 13 years. My experience has been obtained in New Zealand, Australia and Malaysia. Over the past 11 years I have specialised in Traffic and Transportation engineering.
- 3 My relevant tertiary qualifications include a Bachelor of Engineering (Civil)(First Class Honours) and a New Zealand Certificate in Engineering (Civil). I am a Chartered Professional Engineer (CPEng), a Member of the Institute of Professional Engineers NZ (MIPENZ), and a Member of the IPENZ Transportation Technical Group.
- 4 I am responsible for project management, strategic transportation planning, traffic engineering and modelling, technical reports, and specialist inputs into major engineering projects throughout the country. Recent examples where I have been the Traffic and Transportation Engineer include the Waikato Expressway Te Rapa Section (I&R phase), SH2 Katikati Bypass, Christchurch Southern Motorway (CSM1) and SH1 Avalon Drive Bypass.
- 5 My evidence is given in support of notices of requirement for alterations to designations (*NORs*) and applications for resource consents lodged by the NZ Transport Agency (*NZTA*) on 22 December 2010 in relation to the Cambridge Section of the Waikato Expressway (*Project*).
- 6 I am familiar with the area that the Project covers, and the State highway and roading network in the vicinity of the Project.

SCOPE OF EVIDENCE

- 7 My evidence will deal with the following:
 - 7.1 Summary of evidence;
 - 7.2 My background and role in the Project;
 - 7.3 PART A: Project overview
 - (a) Overview of consultants' roles in the Project;
 - (b) The existing environment and site conditions;

- (c) The Project history and evolution;
- (d) The Project objectives;
- (e) Consideration of alternatives; and
- (f) Description of the Project and the proposed works.

7.4 PART B: Construction

- (a) The NZTA's proposed construction management framework;
- (b) Construction methodology; and
- (c) Key construction and design issues;

7.5 Comments on submissions;

7.6 Comments on Officers' Reports and recommended conditions; and

7.7 Conclusions.

SUMMARY OF EVIDENCE

8 For the reasons set out in this statement I consider that the Construction effects associated with the Project have been adequately identified and can be suitably mitigated. In particular:

- 8.1 The Project has a long history, with the original designation being confirmed in the District Plans in 1973.
- 8.2 The design of the alignment for the Cambridge Section has been developed through a rigorous consideration of alternatives to determine a preferred option that meets the Project objectives.
- 8.3 The preferred option requires alterations to the existing designations, primarily due to the requirements of the most recent design standards, the changes to local road connections and interchanges, a desire to minimise impacts on an adjacent Pa site, and additional land required for construction purposes.
- 8.4 Project construction effects will be managed through the development of a Construction Management Plan, with appropriate sub-management plans.

- 8.5 The NZTA proposes an appropriate review and certification process with the relevant Councils, which will ensure the Contractor implements appropriate methods and tools to avoid, remedy or mitigate the Project's potential adverse construction effects so as to comply with resource consent and designation conditions, relevant legislation, and the NZTA's own environmental objectives.
- 8.6 In addition, a suite of conditions has been proposed by the Project team to ensure the potential adverse effects of the Project can be appropriately avoided, remedied, or mitigated.

BACKGROUND AND ROLE

- 9 Since Opus' initial contract engagement in March 2007, my role has been to provide specialist technical inputs into the areas of traffic and transportation planning.
- 10 Since August 2009, my role has also included actively leading the multi-disciplinary Project team through the investigation phase up to this hearing. This role has included liaison with the NZTA and key stakeholders.
- 11 I compiled the Assessment of Environmental Effects (in liaison with other Opus staff members) and authored the Traffic Assessment report that accompanies the NORs (Appendix 3 to the AEE).

PART A – PROJECT OVERVIEW

Overview of consultants' roles in the Project

- 12 On 30 March 2007, Opus was engaged by the NZTA (then Transit NZ) to undertake professional services for the completion of the Investigation and Detailed Design phases of the Project. Since that time, Opus has provided engineering and planning analysis for the Project and engaged sub-consultants to assess other environmental factors for the Project. The areas assessed by sub-consultants include:
- 12.1 Air Quality – Sinclair Knight Merz;
- 12.2 Urban Design (preliminary) – Brewer Davidson;
- 12.3 Cultural – Nga iwi toopu o Waipa;
- 12.4 Transportation Modelling – Gabites Porter; and
- 12.5 Geophysical surveying (Archaeology) – Southern Geophysical Limited.

- 13 Since lodgement of the NORs, Opus has continued to provide engineering and planning advice to the NZTA, as well as considering submitters' concerns and participating in pre-hearing meetings with submitters.

The existing environment and site conditions

- 14 The location of the Project and the key landmarks referred to in my evidence are illustrated on **Annexure A** of my evidence.
- 15 Key features of the Project area include: the existing "Cambridge Bypass" designation, Cambridge Jockey Club, Cambridge to Hautapu Rail corridor, Proposed Hautapu Industrial Zone, Hautapu Dairy Factory, Cambridge North Deferred Residential Zone, St Kilda Waterways Residential Zone, and Karapiro Stream Gully.
- 16 The area surrounding the Project alignment is generally characterised by flat countryside, with an isolated deep incision comprising the Karapiro Stream Gully to the south-east of the Project area. (The Project traverses the Gully). The Gully is densely vegetated and a significant feature in the landscape. The Project bisects a number of local roads, intersects with one State highway corridor (SH1B), and has connections with SH1 at either end.
- 17 The principal land use around Cambridge Township is agricultural, with some lifestyle and residential development on the north and north-eastern side of the Township.
- 18 A key agricultural site of the Project area is the Hautapu Dairy Factory, which is located on the intersection of Hautapu, Hannon and Victoria Roads.
- 19 There are a number of well-established equestrian activities in the vicinity of the Project alignment, including horse breeders/training studs, and the Cambridge Jockey Club (developed adjacent to the existing "Cambridge Bypass" designation).
- 20 The Cambridge industrial Rail Line ends at the Hautapu Dairy Factory. The rail line originally continued into Cambridge (adjacent to the east side of SH1B), however this section of the track has not been used recently and the tracks were uplifted in 1999. The designation for the rail corridor remains in place in the Waipa District Plan.
- 21 On the eastern side of SH1B and on the southern side of the existing Cambridge Bypass designation, residential development is proposed as part of the Cambridge North Structure Plan. Residential development has already occurred between Swayne Road and Watkins Road, within the Saffron subdivision, and further

towards the south (near Thornton Road), including the Oakland subdivision.

- 22 St Kilda Waterways is a proposed subdivision located to the north of the existing Cambridge Section designation, between Watkins Road and St Kilda Road.
- 23 **Annexure B** to my evidence indicates the current daily traffic flows on the road network surrounding the Project corridor.¹ Apart from the State highway corridors, the existing daily traffic flows are very low and operate well within their existing capacity. The existing traffic flows on roads relevant to the Project include:
- 23.1 SH1 (north of Discombe Road): 18,000vpd;
- 23.2 Discombe, Forrest, Peake and Hannon Roads: all less than 1,000vpd;
- 23.3 Swayne, Watkins and Thornton Roads: 1,200 to 1,800vpd; and
- 23.4 SH1 (south of Cambridge Golf Course): 15,100vpd.
- 24 The proportion of Heavy Commercial Vehicles (HCVs) on these roads ranges from 7% to 11%.
- 25 The traffic volumes on these roads are expected to increase over the next 30 years as a result of inter-regional traffic growth and as the Cambridge area is developed. The future traffic flow projections are described in more detail within my traffic evidence.

Project history and evolution

- 26 The need for a State highway bypass of Cambridge has been recognised and investigated since the 1960s, with a designation for a bypass being included in the Waipa District Plan since 1973.
- 27 Since then, Transit NZ (and later the NZTA) conducted a number of investigations relating to the purpose of the Cambridge Bypass. The results of these investigations were summarised in the following documents.
- 28 In 1989, the *SH1 Cambridge Bypass Scheme Assessment* investigated alternative "internal" bypass alignments. However, subsequent consultation revealed the community's strong preference for an "external" bypass.

¹ The counts are based on available traffic count data from the NZTA, Waipa DC and Waikato DC

- 29 In 1990, the *Cambridge Bypass Scoping Report* reviewed 15 routes that had previously been investigated and recommended further investigation of four of these routes.
- 30 In 1991, the *Cambridge Bypass Project Investigation Report (PIR)* concluded that the 1973 alignment (known as the external route) was the preferred option.
- 31 In 1995 (based on the findings of the 1991 PIR), an alteration to designation was confirmed. The alteration reduced the existing designation width from a nominal 80m to a nominal 40m (based on design advice within the 1991 PIR that a four-lane corridor could be constructed within 40m) and provided for a number of possible intersection options at Victoria Road, Thornton Road, and at the St Kilda Road deviation.
- 32 In 2002, Transit NZ commissioned an investigation on the existing SH1 intersections within Cambridge, which highlighted the potential for the Bypass to relieve growing congestion problems at SH1 intersections within Cambridge.
- 33 In September 2004, the *Background Report: SH1 Waikato Expressway Cambridge Bypass* examined how well the Cambridge Bypass would comply with statutory requirements under the Land Transport Management Act 2003 (*LTMA*) and relevant high level planning documents.
- 34 In 2007, Transit NZ commissioned the "Cambridge Bypass Investigations" with the aim of confirming a designated corridor and appropriate resource consents, based on the alignment of the existing Cambridge Bypass designation. This hearing relates to those investigations.
- 35 The National Infrastructure Plan - March 2010 (*NIP*) outlines the Government's current infrastructure priorities. The Government Policy Statement on Land Transport Funding 2009/2010 – 2018/2019 (*GPS*) sets about implementing the NIP in relation to National Land Transport Funding priorities. The GPS identifies seven essential State highways that are linked to New Zealand's economic prosperity. In 2009, the NZTA was charged with delivering these roads of national significance (*RoNS*) within 10 years; one of which is the completion of the Waikato Expressway (including the Cambridge Section).
- 36 Since the 1991 investigation that recommended a reduction in corridor width, the design philosophy for the Cambridge Section has changed. These changes have included (amongst others):
- 36.1 A change in road hierarchy to recognise the Project as a RoNS;

- 36.2 Development by the NZTA of specific design standards for RoNS, which require additional corridor width;
 - 36.3 New requirements for the forms and function of the Expressway intersections (including design improvements and accessibility);
 - 36.4 Changes in stormwater management requirements [by Waikato Regional Council and the NZTA], including increased water quality requirements and the need to account for global climate change; and
 - 36.5 New knowledge of particular archaeological features.
- 37 The existing designation width (approximately 40m) was found to be insufficient to meet these requirements, so the NZTA determined alterations to designations were necessary.
- 38 In summary, the need to provide an alternative route around Cambridge has been investigated for at least 40 years, and subsequent investigations have confirmed the existing designated route is the preferred alignment. The existing designated width is insufficient for current design requirements and alterations to designations are needed for a widened corridor.

Project objectives

- 39 As described in Ms Clark's evidence, the objectives of the Waikato Expressway are:
- 39.1 To enhance inter-regional and national economic growth and productivity;
 - 39.2 To improve journey time reliability and relieve congestion through the main urban centres along SH1;
 - 39.3 To improve safety and reduce crashes on regional arterials, including SH1;
 - 39.4 To focus freight movement onto SH1 rather than upgrade alternative routes; and
 - 39.5 To provide improved local network operation and opportunities for improved urban design, travel choice and community connectivity within the major urban areas bypassed by the Expressway.
- 40 And the specific objectives for the Cambridge Section are:
- 40.1 To achieve the objectives of the Waikato Expressway RoNS project by constructing a four-lane Expressway bypassing

Cambridge and maximising the use of the NZTA's existing designated corridor north of the current SH1 route through Cambridge ("Cambridge Bypass"), while:

- (a) Reducing journey time between the Hamilton Section of the Waikato Expressway and SH1 south of Cambridge, by improving the level of service and reducing side friction for State highway traffic; and
- (b) Improving safety for road traffic and local pedestrians and cyclists.

Consideration of alternatives

- 41 This section of my evidence provides an overview of the methodology and framework used in determining the design of the alignment for the Cambridge Section and an overview of the alternatives considered to determine a preferred option that meets the Project objectives.
- 42 As stated above, the Project objectives required consideration of options that related to the existing "Cambridge Bypass" designation and whether the extent of that designation was suitable for the Cambridge Section. Consideration of the NZTA's current design requirements for the Project determined that the width of the existing designation is insufficient. As such, the option to use the existing designation without alteration was not a viable solution.
- 43 In determining the preferred option, the Project team used a qualitative assessment framework in conjunction with applicable criteria covering a wide range of aspects. These included: geometric design, costs, efficiency, safety, structural issues, geotechnical conditions, noise, landscape, ecology, archaeology, cultural issues, water quality, drainage, social, and property impacts.
- 44 The options assessment can be described in a number of discrete evaluation outcomes, including:
- 44.1 Road geometry requirements (RoNS Standards);
 - 44.2 Location of the altered designation;
 - 44.3 Connection locations and form:
 - (a) Northern Interchange;
 - (b) Central (SH1B) Interchange;
 - (c) Southern Interchange;

44.4 Karapiro Stream Gully Crossing;

44.5 Vertical alignment design;

44.6 Pa site options; and

44.7 Localised design features.

45 Section 6 of the AEE provides a summary of the alternatives considered to determine the preferred option. Rather than reiterating the information contained in the AEE, I will provide additional information relating to specific option assessments that have been raised by submitters. These include the Central (SH1B) interchange, the vertical alignment design, and the alternative options to minimise the effect to the Pa site.

Central (SH1B) Interchange

46 The existing designation provides for a full-directional connection between SH1 and SH1B. The NZTA has also required that the designation width be sufficient for the SH1 corridor to be fully grade separated along its entire length, with no at-grade crossings. As such, the option assessment focussed on determining the optimal arrangement to provide full directional access at the Central Interchange with grade separation between SH1 and SH1B.

47 The Central interchange was considered on three fronts:

47.1 Interchange form;

47.2 Vertical alignment; and

47.3 Ramp termination intersections.

48 The vertical alignment of SH1 and SH1B at the Central Interchange has been challenged by a number of submitters. As such, my evidence provides additional information on the assessment of this component only.

49 In considering the issues relating to the Central Interchange, the following provides a summary of the key factors that were considered in the options assessment.

Cambridge Industrial Branch

50 A designated rail corridor (10m in width) runs parallel to the eastern boundary of SH1B. The rail designation is described as the Cambridge Industrial Branch. The railway corridor has been inactive for a considerable period and the railway infrastructure was removed more than 10 years ago. Currently, the Cambridge rail line now stops 3.5km from Cambridge (1.5km from the Project alignment) and operates as an industrial branch line to the Hautapu

Dairy Factory. The rail corridor can be seen on Annexure A to my evidence.

- 51 The NZTA has undertaken extensive consultation with KiwiRail since 2007 and KiwiRail has always maintained that it wishes to retain all of its rights over the rail corridor and has no plans to dispose of the corridor at this time. KiwiRail has advised that it would not agree to any interchange option that would potentially compromise the future of this rail link.
- 52 In March 2010, KiwiRail advised that it had agreed to allow the NZTA to construct an at-grade crossing of its designation. KiwiRail's approval was subject to the NZTA agreeing to meet all future costs for any subsequent infrastructure needed to enable rail traffic to travel unimpeded through the Interchange if the rail line was reinstated. KiwiRail has provided its section 176 RMA approval for the Project.

Adjacent land use development

- 53 The Central Interchange is located in an area identified for future land use development in the Cambridge North Structure Plan and the Hautapu Draft Structure Plan. When consulted about the design of the Interchange, the Waipa District Council (*Waipa DC*) indicated a strong preference for options that minimise the amount of potential development land that could be lost in providing the Interchange and associated ramps.
- 54 There is a growing emphasis by town planners on the urban design philosophy of "live, work, play" (including reference within the Ministry of Environment's NZ Urban Design Protocols), meaning there is a push to closely integrate living and employment zones to minimise reliance on motor vehicles and encourage the use of active transport modes. Waipa DC has developed land use development plans adjacent to the Central Interchange that look to promote the "live, work, play" philosophy. Waipa DC has identified proposals for large residential areas (Cambridge North) adjacent to large employment centres (Hautapu Industrial). SH1B (Victoria Road) will therefore always be an important transport connection within the Waipa DC roading network, by serving as the key link between Hautapu and the residential area of Cambridge.
- 55 Waipa DC also supports this connectivity through the establishment of "buffer zones" adjacent to the existing Cambridge Bypass designation. The Council intends to incorporate walking and cycling paths into these buffer zones, with such paths crossing the Project alignment (from north to south) at the Central Interchange. Refer to **Annexure C** of my evidence.

Geotechnical conditions

- 56 Geotechnical investigations have determined that the groundwater levels around the Central Interchange are variable and range between 7m below the surface to approximately 2m below the surface on the eastern approach to the Interchange. Where groundwater is encountered, excavation in these sandy soils would be challenging. Dewatering of any excavation would be needed during construction to prevent collapse of sand under seepage pressures. In addition, the proximity to the groundwater levels would necessitate permanent dewatering within open cuts. Due to the very flat topography and the substantial distance to any gully system (4km to Karapiro Stream Gully) dewatering would likely require permanent pumping stations. Accordingly, excavation in these sandy soils is best avoided, if possible.
- 57 Geotechnical investigations indicate that only minor settlement of embankment fills in this location are expected and this is predicted to occur relatively quickly and without specific treatment being required. Embankments do not have any constructability or stability issues (in comparison to open cuts) and are preferable from a geotechnical perspective. Excavation of cuts could impose significant geotechnical risks with regard to pavement performance, cut slope stability, environmental effects from lowering water tables and the longterm drainage needs of the cut.
- 58 The geotechnical considerations determined that corridors below ground level in this location are not practicable. As such, options were only considered whereby the grade separation is provided by construction of embankments.
- 59 The two options for vertical alignment of the Central Interchange included SH1 over SH1B (SH1B underbridge), and SH1B over SH1 (SH1B overbridge). **Annexure D** to my evidence provides diagrams of the two Central Interchange bridging options.
- 60 Key aspects from the option assessment determined:
- 60.1 If SH1B were to go over SH1, rail embankments would need to be approximately 1km in length on each approach to meet the necessary vertical requirements for rail design.
- 60.2 The embankment for the SH1B underbridge will be approximately 8m in height (above existing ground level) and each approach will be 700m in length.
- 60.3 The SH1B overbridge would need to be placed on an embankment approximately 9m in height (above existing ground level), with approach lengths of 350m (extending either direction from the ramp termination intersections). The increased height of SH1B would be needed to maintain

height restriction requirements of the Expressway. Similarly, the Expressway ramps would need to be elevated to a similar height and over a similar length to connect to an elevated SH1B corridor.

- 60.4 Special provision would be required to provide connectivity for pedestrians and cyclists to connect with an elevated SH1B corridor. The elevated SH1B corridor would essentially provide a 700m long severance to active road frontage, which would provide a lower amenity to active modes and could discourage walking and cycling. **Annexure E** to my evidence provides an illustration of the broken active edge.
- 60.5 Maintaining SH1B at ground level will provide a better linkage across the Expressway, which is particularly important for encouraging active modes of transportation. In addition, this arrangement allows intensification of land use adjacent to Victoria Road, which also supports active modes. **Annexure F** of my evidence illustrates how this arrangement allows adjacent land use to provide an active frontage to Victoria Road.
- 60.6 Waipa DC has indicated its expectation that the Central Interchange will become the preferred northern entrance or "Gateway" into Cambridge. The evidence presented by Mr Morton will describe how the SH1 embankment may be seen as a positive way to provide a defined separation between residential activities within Cambridge North from the industrial activities within Hautapu, thereby creating a defined town edge. In addition, Mr Morton will describe the benefits of keeping SH1B at ground level in that it is more amenable to creating a welcoming corridor (or entrance) into Cambridge Township.²
- 60.7 The SH1B underbridge arrangement does not preclude the reinstatement of the rail corridor.
- 61 In summary, the development of the current design layout with SH1B (Victoria Road) passing below the Expressway was judged to be the preferred alternative, due to improved connectivity (especially pedestrians and cyclists), safety, urban design (providing a defined entrance to Cambridge, improved accessibility and maintaining an active frontage), property impacts and the potential for rail provision. The SH1B underbridge option also provides for a marginally lower embankment height than the SH1B overbridge option.

² Refer Mr Morton's evidence, paragraph 78.

Vertical alignment

- 62 While it may be preferable for some that the Expressway be constructed in cutting (i.e. to minimise or eliminate visual and noise effects on adjacent properties), the geotechnical limitations described above prevented practicable options for constructing the Expressway below ground level, except in the vicinity of the Karapiro Stream Gully. As such, the following section of my evidence describes the constraints of the Project, which limited the ways in which the Project team could lower the vertical profile of the Expressway.
- 63 The Project team designed the vertical alignment of the Expressway by identifying the key constraints that prevent further lowering of the corridor. Many of these constraints relate to stormwater and water quality aspects, and Mr Burke will address these issues in more detail within his evidence. However, I will summarise the key constraints to setting the vertical alignment as follows:
- 63.1 The vertical alignment was constrained by the preferred Project options for the following elements:
- (a) Northern Interchange;
 - (b) Central Interchange;
 - (c) Karapiro Stream Gully crossing;
 - (d) Pa site;
 - (e) Southern Interchange; and
 - (f) Local road crossings.
- 63.2 The proximity of these elements to each other renders any effective changes to the vertical alignment of the Expressway impractical, thus requiring a steady elevation above ground level that is consistent with the design standards.
- 63.3 The flat terrain within the Project area makes it very difficult to grade stormwater channels to suitable outlets (outside the Expressway corridor), whilst maintaining minimum vertical grades needed to convey stormwater along the Expressway (0.3% vertical grade).
- 63.4 There is an overlying statutory requirement to ensure that stormwater from the Project is adequately treated before discharging to appropriate watercourses.

- 63.5 There are a limited number of suitable stormwater discharge points within the Project area, and the capacity of the existing outlets (other than the Karapiro Stream Gully) is very limited.
- 63.6 The relatively high groundwater level at some locations makes the possibility for deep cuttings impractical.
- 63.7 There are areas adjacent to the corridor that have the potential to flood and there is a need to maintain overland flows across the corridor, whilst providing adequate free-board during flood events and continuing general Expressway operation.
- 64 The requirement to cater for overland flows set a defined design constraint for the general Expressway cross-section and the underlying vertical alignment along the corridor length. **Annexure G** to my evidence provides an illustration of the typical Expressway cross-section showing a typical overland flow culvert across the Expressway.
- 65 This diagram shows the culvert (of 450-600mm diameter) linking the drainage swales on either side of the Expressway. A minimum cover of 1m is required above the culvert to ensure the culverts do not get crushed during construction of the remaining embankment. A general pavement thickness of 0.5m is placed on the embankment after the earthworks are complete. In addition, an additional height of 0.42m relates to the positive camber (drainage path across the sealed surface) across the Expressway, from the outside of the pavement to the centre of the road corridor. In total, this arrangement generally requires that the Expressway is located 2m above the existing ground level (measured at the centre line) to maintain overland flow paths.
- 66 This arrangement describes a practical construction solution to manage the overland flows. However, it is possible that further design refinement during the Project's subsequent detailed Design & Construction phase may develop innovative solutions that reduce the embankment height through alternative construction techniques or use of alternative materials.
- 67 Waipa DC has developed a stormwater management plan in relation to the Cambridge North Structure Plan. The stormwater management system provides for partial discharge of the collected stormwater to drains located on the northern side of the existing Cambridge Bypass designation. As such, to enable continuity of Waipa DC's stormwater management system, the staff of Waipa DC have provided design flows and associated flood levels, which Waipa DC considers the Expressway needs to be designed around. The supplied design flows and flood levels have been included as one of the constraints in fixing the vertical alignment of the Expressway.

68 In summary, the options for considering the vertical alignment of the corridor are limited by a number of constraints. As such, the vertical alignment has been optimised by the Project team with the aim of minimising the vertical height above ground level whilst maintaining a practicable solution. However, it is recognised that there is opportunity through the subsequent design phase of the Project that the vertical alignment of the Expressway could be lowered through innovative construction techniques or use of alternative construction materials.

Pa site options

69 The presence of the Pa site adjacent to the Karapiro Stream Gully was first identified as likely to be within the existing designation by Mr Chris Mallows following an archaeological walkover in 2007.³ The Pa site will be described in more detail by Mr Mallows.

70 **Annexure H** to my evidence provides an illustration of the extent of the Pa site (as defined by a Ground Penetrating Radar) and its encroachment into the existing designation.

71 The extent of the Pa site was found to intrude at least 15m into the existing (40m width) designation, with most of the apparent pa extents being located to the north of the Project alignment. This intrusion into the existing designation highlighted that the Project could not be constructed along the alignment enabled by the existing designation without affecting the Pa site.

72 Section 6.4.6 of the AEE (page 38) summarises the Expressway options that were considered to minimise the impacts on the Pa site. My following evidence provides some additional information relating to each of those options.

73 Four options were considered to minimise the impacts on the Pa site, including two horizontal realignments and two vertical realignments.

Horizontal Realignment towards the east

74 This option involved shifting the horizontal alignment to pass to the north east of the Pa site. This option would involve a significant alignment shift (as the majority of the Pa appears to extend towards the north east of the current designation).

Horizontal Realignment towards the west

75 This option required a very minor centreline shift towards the west, when combined with some refinement to the cross-section (localised narrowing of the median and inclusion of retaining walls).

³ Refer to Mallows, C. (2007a) Preliminary Archaeological Assessment of Proposed Alignment of the Cambridge Bypass, unpublished report for Opus International Consultants, Hamilton.

Vertical Realignment beneath the Pa site

- 76 The Project's preferred vertical alignment provides the corridor approximately 7m below ground level in the vicinity of the Pa site. A minor lowering of the vertical alignment would enable the corridor to be "tunnelled" underneath the Pa and still maintain appropriate vertical headroom.

Vertical Realignment over the Pa site

- 77 This option included the construction of a bridge over the Pa site, leaving the ground underneath largely undisturbed. The Project would be aligned approximately 10m above the existing ground level.

Preferred option

- 78 Overall, the option with a minor horizontal realignment towards the west was determined to be the preferred option. This option had the least overall cost, had effects on the environment most similar to the existing designation, and required only a minor alteration of the existing designation towards the west.
- 79 Ngati Koroki Kahukura and Ngati Haua (as mana whenua for the Project area) have provided support to the Project team for the preferred option.

Description of the Project and the proposed works

- 80 The following section describes the Project's overall construction works (those contained in the existing and the proposed designation).
- 81 A detailed description of the Project is outlined in Section 4 of the AEE. I do not intend to reiterate that description, but instead provide a brief outline of the proposed works. To assist in understanding my following description, reference has been made to the relevant scheme drawings attached to the NOR documentation.

General

- 82 The Project generally consists of an alignment that bypasses Cambridge to the north of the existing township and is approximately 11km in length.
- 83 The alignment follows the existing designated route, with widening predominantly to the north.
- 84 The alignment consists of two almost straight sections, each approximately 4.5km in length. These two straight sections are joined by a right hand horizontal curve approximately mid-length of the overall Project alignment.

Northern Interchange

- 85 The Project route commences in the north at the Northern Interchange, with a grade separated connection to the existing SH1 corridor (just south of the Hautapu Road / SH1 intersection) as shown on Sheet 5 of the Scheme Drawings accompanying the NORs.
- 86 The Northern Interchange provides a grade separated southbound off-ramp that maintains access to Cambridge by an overbridge. The ramp re-joins the existing SH1 immediately south of the Interchange. An at-grade northbound on-ramp uses, in part, the existing State highway northbound lane.
- 87 The Northern Interchange and corridor alignment require the closure of the SH1/Discombe Road intersection. Discombe Road will be severed on the north side of the Project alignment.

Northern Interchange to SH1B Interchange

- 88 Continuing south from the Northern Interchange, the corridor is generally straight and constructed as close as practical to existing ground level (refer to Sheet 6 of the Scheme Drawings). As explained earlier in my evidence, the corridor is generally built on a 2m high embankment to allow for surface overland flow paths to cross the Expressway corridor.
- 89 The corridor crosses the first major stormwater culvert at approximate Chainage 2400. This requires a slight rise in the vertical alignment to accommodate the necessary culvert diameter. The vertical height at this location is also constrained by existing overhead power pylon cables at Chainage 2600. A minimum clearance of 8.3m has been provided between the Expressway road level and the cables. This is consistent with Transpower's requirements referred to within the NZ Electrical Code of Practice for Electrical Safe Distances (*NZECP*) to maintain safe clearances.
- 90 The existing local road (Forrest Road) is severed at this location, with cul-de-sac heads being provided within the existing local road reserve.
- 91 Sheet 7 of the Scheme Drawings shows the first local road (Peake Road) overbridge located at Chainage 3700. A minimum overhead clearance of 6.2 metres has been provided at the highest point on the alignment to the underside of the bridge deck.

Central (SH1B) Interchange

- 92 Immediately north of the mid-section curve a grade separated Central (SH1B - Victoria Road) Interchange is provided, as shown in Sheets 8 and 9 of the Scheme Drawings. The Expressway alignment passes over SH1B and full directional connectivity is provided by a traditional "diamond" ramp arrangement. Both ramp termination intersections with SH1B are controlled by signalised

intersections, which also accommodate at-grade pedestrian crossing phases.

- 93 As part of this interchange configuration, Hannon Road is severed on either side of the Expressway. Cul-de-sac heads are provided within the existing local road reserve
- 94 The grade separation of SH1B positions the Expressway at its highest point along the alignment, with a vertical height above ground level of approximately 8m. This provides a 6.0m clearance between the overbridge soffit and the SH1B road level (which remains at-grade). In addition, the Expressway overbridge has been lengthened to traverse the existing railway designation. This means the railway line (or similar transport corridor) can readily be re-established without significant construction requirements.

Central Interchange to Watkins Road

- 95 Further south along the Project corridor (Sheet 9 of the Scheme Drawings), the vertical alignment of the Expressway is graded downwards so that it is back to existing ground level by the time it reaches Swayne Road. In conjunction with this, the median width south of Chainage 6275 is tapered from 9m to 6m in width. The median taper is completed by Chainage 7785.
- 96 The RoNS geometric standards target the adoption of a 9m wide median in rural situations where the cross-section of the road is unconstrained. The use of a 6m wide median south of Victoria Road recognises the progression towards an urbanised environment and relative constraints either side of the corridor. The reduction in median width provides no reduction in driver safety.
- 97 At Chainage 6800, Swayne Road is vertically realigned over the Expressway on an overbridge approximately 8m above existing ground level. This maintains the minimum requirement for a 6.1m vertical height clearance beneath the overbridge structure.
- 98 As part of the embankment construction for the Swayne Road overbridge, the existing Swayne Road/Appleby Road intersection is relocated approximately 200m north of its existing location. This requires the realignment of Appleby Road to connect the existing corridor to the new intersection.
- 99 The realigned Appleby Road serves as an access corridor to two properties and provides no connectivity through to Watkins Road.
- 100 Between Swayne Road and Watkins Road a vertical crest curve is necessary to maintain positive drainage paths and ensure stormwater within this section is directed to a more appropriate location, as shown on Sheets 9 and 10. This means that the

embankment height in this section reaches a maximum height of 3m above existing ground level.

101 Sheet 10 shows the Expressway's crossing of Watkins Road with the embankment being approximately 1.4m high. The embankment height at Watkins Road is necessary to maintain appropriate clearance above modelled flood levels and to maintain connectivity of two significant drainage channels from the Cambridge North residential area (Chainage 7500 and 7650). These culvert flood levels have been determined by Waipa DC.

102 Watkins Road is severed by the Expressway and cul-de-sac treatments are provided within the local road corridor.

Watkins Road to Southern Interchange

103 Approximately 250m south of Watkins Road the Expressway continues below ground level. The Expressway is graded below ground level at a very flat slope (-0.35%), which is the minimum practical grade to maintain positive stormwater flow, whilst ensuring the Expressway alignment low-point (and the stormwater collection point) is located as close to the Karapiro Gully as possible. This arrangement is shown on Sheet 11 of the Scheme Drawings.

104 The alignment towards the Karapiro Stream Gully is relatively straight, although it includes a small horizontal shift towards the west to minimise the effects on the adjacent Pa site. The alignment low point (8m below ground level) is located at Chainage 9100 and includes an associated wetland (adjacent to the corridor) to store and treat stormwater from the cut-section. South of Thornton Road the cross-section includes part-height retaining walls to minimise the effects of the Expressway on the Pa site and the adjacent Athlone Drive properties.

105 Thornton Road is grade-separated over the Expressway and can be maintained almost at existing ground level due to the vertical depth of the Expressway at this location. Adjacent to the Thornton Road overbridge, the existing Thornton Road/St Kilda Road intersection is relocated approximately 100m further east. St Kilda Road is realigned for an approximate length of 400m to maintain connectivity between St Kilda Road and Thornton Road.

106 At approximately Chainage 9770 to 9980, the Project crosses the Karapiro Stream Gully by way of a 5-span viaduct. The viaduct is significant in size – approximately 220m long and 38m high. The viaduct also incorporates a large radii horizontal curve.

107 South of the Karapiro Gully viaduct, the Expressway is graded upwards to tie back into the existing SH1 corridor (approximately 1km south of the Karapiro Gully crossing) (refer to Sheet 12). To manage the stormwater on the Project alignment south of the

Karapiro Gully, a wetland has been included on the south side of the Gully to store and treat water, before being discharged into the Karapiro Stream.

Southern Interchange

- 108 At the southern end of the Project, the alignment travels through an easy left hand curve to rejoin the existing State highway alignment at the Southern Interchange. The Southern Interchange provides a southbound on-ramp (from Cambridge) and northbound off-ramp (to Cambridge). The southbound on-ramp is grade-separated and passes below the Expressway before joining SH1 at Chainage 11600. The northbound off-ramp commences at Chainage 11600. The Southern Interchange also includes separated local access roads to maintain access to adjacent properties. These local roads typically follow the alignment of the interchange ramps, but are maintained on separate corridors. The local access roads join the existing SH1 corridor on the Cambridge side of the Interchange and clear of the ramp merge/diverge areas. Wetland ponds have also been incorporated into the Interchange design to manage stormwater within the local roads and Interchange ramps.

Local Roads

- 109 As described above, several local roads are crossed by the Project route. Several of these are required to be closed, whilst others have been provided with overbridge connectivity. At these overbridge locations, the Expressway forms the demarcation of rural and urban environments and (where appropriate) a speed threshold into the greater Cambridge urban area has been incorporated into the design.

Cross-sections

- 110 The cross-section of the Expressway provides four traffic lanes, a wide central median (with wire rope barrier), 2.5m shoulders (with continuation across all Expressway bridges), and appropriate clear zone requirements.⁴ Where clear zones cannot be provided, such as on high embankments, the use of guardrails will be adopted to minimise earthworks and maintain personal safety.
- 111 All local road bridges provide 1.5m wide shoulders and 2m wide separated pedestrian pathways on one side of the bridge.

⁴ Clear zones provides a clear traversable width with only frangible obstructions, which allow drivers that run off the road to regain control with minimal personal and property damage.

PART B – CONSTRUCTION

The NZTA’s proposed construction management framework

- 112 The NZTA proposes the development of a Project-specific Construction Management Plan (*CMP*).
- 113 The CMP will detail the methods and tools to be implemented by the construction contractors to avoid, remedy and mitigate potential adverse environmental effects of the Project so as to comply with resource consent and designation conditions, relevant legislation, and the NZTA’s own environmental objectives.
- 114 The purpose of the CMP is to specify the structure and systems for environmental management and monitoring to be implemented during the Project’s construction phase.
- 115 The CMP defines details of what, where, when and by whom environmental management and mitigation measures are to be implemented. The CMP covers all anticipated construction elements, and presents a framework of principles, environmental policy, objectives and performance standards, as well as processes for implementing good environmental management. The CMP establishes the relationship with the related sub-management plans, which are included as part of the overall CMP.
- 116 Figure 9.1 of the AEE (page 80) provides an illustration of the proposed management plan framework for the Project, as well as an indication of which plans are to be reviewed, approved, or certified by the relevant Councils. However, since lodgement of the NORs and resource consent applications the framework has been refined and updated to reflect ongoing discussions with the Councils and submitters. **Annexure I** contains an updated version of the proposed management plan framework.
- 117 The CMP and the various sub-plans will be prepared by the Contractor to reflect the actual construction activities, techniques, risks, mitigation measures, responsibilities, and management processes that are consistent with their accepted construction proposal.
- 118 Recommended designation Condition 2 and recommended Condition 4 of Schedule One to the Waikato Regional Council resource consents sets out the measures that will be included in the CMP.
- 119 As set out in recommended designation condition 2.2(1), the CMP will include the following sub-management plans:
- 119.1 Construction Noise and Vibration Management Plan (required by designation condition 5 and which will be discussed by Mr Dravitzki);

- 119.2 Traffic Management Plan (required by designation condition 6 and which I will describe in my traffic evidence);
- 119.3 Earthworks Management Plan (required by designation condition 2.2(l)(iv));
- 119.4 Dust Management Plan (required by condition 16 of Schedule One of the resource consents);
- 119.5 Ecological Management and Restoration Plan (required condition 20 of Schedule One to the resource consents and which will be explained by Mr Turner);
- 119.6 Erosion and Sediment Control Plan (required by conditions 11 and 12 of Schedule One to the resource consents and which will be discussed by Mr Burke);
- 119.7 Hazardous Substances Management Plan (required by conditions 17 and 18 of Schedule One to the resource consents); and
- 119.8 Stakeholder Communications Plan (required by designation condition 8).
- 120 In summary, the CMP establishes the structure and systems to manage the adverse environmental effects that may arise from the Project. In conjunction with the proposed conditions of the resource consents and designations, the CMP (and its sub-management plans) will ensure that any adverse environmental effects of the Project will be appropriately avoided, remedied, or mitigated.

Construction Methodology

- 121 Section 5 of the AEE provides a generalised outline of the expected construction sequence for the Project, based on our preliminary design work. This part of my evidence provides some additional information relating to the proposed construction sequence.
- 122 It is important to establish that the Contractor awarded the Design and Construct contract by the NZTA will develop a final construction methodology based on any opportunities it determines to be of benefit to the Project, whilst still meeting the requirements of the NZTA, designation conditions, and resource consent requirements.
- 123 The proposed construction methodology suggests a programme of almost 4 years, but this timeframe may be shortened through innovative construction techniques.
- 124 The generalised elements of the construction sequence include:

- 124.1 *Pre-construction works* – Given the relatively short timeframes before the scheduled start date for construction, (i.e. the NZTA's accelerated programme has the construction of Cambridge Section commencing in September 2012) it is unlikely that the Project will involve any pre-construction works. The exception to this may be in the form of relocation of specific services (such as telephone, power, water, and stormwater).
- 124.2 *Set up traffic management* at SH1 and SH1B approaches and each of the local roads that are to remain open (Peake Road, Swayne Road and Thornton Road).
- 124.3 *Site establishment* including establishment of sediment ponds, drainage, contractors' yards, clearing and stripping of topsoil and further adjustment to existing services. The site will be progressively established along its corridor length based on optimisation of the individual work elements. This means that portions of the corridor will not be established until subsequent works are started in that area.
- 124.4 *Culvert construction* – permanent watercourse culverts will be constructed within the first 6 months of construction to enable haulage access along the Project length, as necessary. No permanent stream diversions are required but the construction of the permanent watercourse culverts will require works within existing watercourses.
- 124.5 *Structural embankment construction*. As I have previously described, a large portion of the corridor length is to be constructed upon a structural embankment (generally 2m in height), with additional elevation over SH1B and between Swayne Road and Watkins Road. Embankments are also required on the approaches to the Northern Interchange off-ramp and the local road crossings at Peake Road and Swayne Road. Section 5.9 of the AEE provides a description of the most likely cut and fill balancing method to be used on this Project. This method illustrates that it is likely that embankment construction will occur concurrently at multiple separate locations along the corridor. This construction will initially be centred around the fill requirements of the SH1B Interchange, which will be excavated from the cut area between Watkins Road and Karapiro Gully. In addition, to progress early completion of the Peake Road overbridge, structural fill for the Peake Road approaches will need to be imported from the north. Given the large volume of fill requirements, the earthworks construction is expected to take approximately 2.5 years.

124.6 *Construct bridge structures* (could occur during the embankment consolidation period, but not before embankment construction). As the Karapiro Stream Viaducts will take the longest period of time to be constructed (of all the structures), this bridge structure will commence construction at the earliest part of the construction sequencing. Its construction is expected to take 2 years to complete. In parallel, the Peake Road overbridge and the SH1B underbridge will be constructed early in the programme and in isolation from the approach embankments.

Waipa DC has indicated a preference for the Peake Road and Swayne Road overbridges to be constructed without maintaining connectivity on these local roads during the bridges' construction. As such, Peake Road and Swayne Road will be temporarily closed during construction of each overbridge, with alternative access being provided through Forrest Road, Victoria Road or St Kilda and Thornton Roads.

124.7 *Construction of pavement and surfacing* including kerb and channel.

124.8 *Completion of remaining traffic services* (signage, lighting, traffic signals, pavement marking). Includes installation of any outstanding noise mitigation measures (e.g. those noise walls/bunds that are not required as part of the construction requirements).

124.9 *Landscaping* (topsoil on batters, grassing and planting).

124.10 *Construction of tie-in* onto SH1 at either end.

Key construction and design issues

125 In this section of my evidence I will focus on the key construction issues in relation to the Project that will need to be carefully managed through the detailed design phase and adequately addressed within the CMP and associated sub-plans. Where appropriate, I indicate how these issues have been addressed by the Project team, or how they will be addressed through the subsequent detailed design and construction phases.

125.1 *Construction of the Expressway across the Karapiro Gully* – includes comprehensive management of potential erosion and sediment, establishment of anchors to improve support of the Gully slopes, and construction of a large viaduct structure within the base of a deep and wide gully. Section 5.11 of the AEE provides a summarised methodology for completing the construction of the Karapiro Stream Viaducts. This was supplemented with additional information in a s92 response

to Waikato Regional Council (WRC),⁵ providing further description of the construction methodology and associated possible erosion and sediment control measures. The construction methodology for the viaducts will be further enhanced and refined by the Contractor during the detailed design phase to reflect the actual bridge design. WRC will be closely consulted through the approval of the Erosion and Sediment Control plans.

125.2 *Construction impacts from noise, dust, and vibration* – the appropriate mitigation in relation to these aspects will be discussed in the evidence of the relevant technical experts, and explicitly managed in the appropriate Construction Noise, Vibration⁶ and Dust Management Plans.

125.3 *Construction on the State highway tie-ins* – careful construction programming, sequencing, and detailing will be provided within the Traffic Management Plan, in consultation with the relevant local Councils.

125.4 *Construction of the embankments* – requires the transport of large volumes of cut and fill material and accessibility to the Expressway corridor through the existing road network. My evidence on construction traffic identifies the most likely transport routes and describes how these construction traffic effects can be managed through the preparation of a detailed Traffic Management Plan. The Traffic Management Plan will be prepared in close consultation with Waipa DC and Waikato DC, with an emphasis on how any effects on local traffic will be managed. In addition, the development of an approved Earthwork Management Plan will describe the timing and methodology for construction of the earthfill embankments, including what measures are required to ensure compliance with all relevant consent and designation conditions.

125.5 *Retaining road network connectivity during construction* – particularly the local roads of Peake, Swayne and Thornton Roads. At this stage, Waipa DC has expressed a desire for the early completion of the Peake Road overbridge. To facilitate early construction, Waipa DC has suggested that a staged closure of local roads would be preferable to establishing temporary roads and associated traffic management around the local road embankment and bridge construction areas. In such a situation, Forrest Road would

⁵ The NZTA's section 92 response to WRC dated 2 March 2011.

⁶ Paragraph 171 below provides further clarification of the construction vibration effects and a proposed minor alteration to Condition 5.3(h) of the recommended designation conditions.

remain open whilst Peake Road is closed during construction of its overbridge and embankments. On completion of the Peake Road overbridge, Forrest Road would be formally closed. The philosophy of staged local road closures will be enhanced through the preparation of the approved Traffic Management Plan.

COMMENTS ON SUBMISSIONS

- 126 I have read the submissions lodged on the Project that raise issues relating to Project construction. In this section of my evidence, I will address issues raised in submissions that are relevant to my expertise to the extent such issues are not already covered in my earlier Report or the preceding evidence.

Peake Road overbridge

- 127 Paul and Deirdre Robinson have asked why the Expressway cannot drop below ground level at Peake Road to allow Peake Road to cross at ground level.

- 128 As described earlier in my evidence, with the exception of the approaches to the Karapiro Stream Gully, there are a number of constraints within the corridor length that prevent the Expressway being developed below ground level. These primarily relate to the geotechnical difficulties associated with the existing high ground water levels and the very few opportunities along the corridor to treat and dispose of collected stormwater. Accordingly, lowering the Expressway in this location is not a practicable solution.

Fencing during and after construction

- 129 The submissions of Susan Jackson, and Malcolm and Steven Wallace request that a stock proof fence be maintained during and after construction. I can confirm that this will be provided through the use of temporary and permanent fencing, prior to and during the construction phase of the Project and this will be detailed within the CMP.

Realignment of St Kilda Road

- 130 Mr Owen Haskell has opposed the realignment of St Kilda Road around his property. However, the existing designation provides for the realignment around Mr Haskell's property, and therefore is not an effect of the alterations to designations or NORs that are the subject of this hearing.

Transpower

- 131 Transpower has identified concerns relating to the proximity of works to their pylons. The Project works are adequately offset from the pylons to ensure no structural effect on the pylons, and sufficient clearance has been provided to Transpower's transmission lines for operation. The NZTA has reviewed Transpower's

submission and, as a result, proposes to include condition 14 in the designation requiring an Electrical Infrastructure Site Development and Construction Management Plan.

Height of the Expressway above ground

- 132 A number of submitters⁷ have queried the height of the Expressway above existing ground level.
- 133 The evidence of Mr Burke will explain the requirement to maintain overland flow paths across the Project corridor. My evidence has described the necessary design requirements to cater for the overland flow culverts within the Expressway cross-section. Design requirements have necessitated the centreline of the Expressway to be approximately 2m above existing ground level, which is a design constraint that prevents lowering of the general Expressway vertical alignment.
- 134 The evidence to be presented by other technical specialists (particularly Mr Morton – landscape/visual and Mr Dravitzki – noise) will demonstrate that the potential adverse effects associated with the embankment height requirement can be appropriately mitigated.
- 135 As explained previously in my evidence, it is recognised that the Design and Construct contractor may develop innovative construction methodologies or techniques to further lower the Expressway height. In this way, I am comfortable that the height of the constructed Expressway will be no higher than that proposed in the NORs and application documents, and there is an expectation that actual design levels could be lower.

Grade separation of SH1 over SH1B at the Central Interchange

- 136 Several submissions⁸ have suggested that SH1B should be grade-separated over the Expressway at the Central Interchange.
- 137 There appears to be a misconstrued assumption that the choice in grade separation has been because of a fixed requirement to preserve the ability to reinstate the railway corridor between Hautapu and Cambridge.
- 138 The AEE and my evidence clearly describe the option assessment process that was undertaken in relation to the grade separation of SH1 and SH1B.

⁷ Including the submission of Matthew and Nicole Smith and Kevin Burgess (as Trustees of Emanen Trust), Grantchester Farms Limited, Eleanor Duncan-Sittlington, ABC Land & Properties Ltd, EB & JC Horner, and Transland Group/Terry Came.

⁸ Including the submission of Matthew and Nicole Smith and Kevin Burgess (as Trustees of Emanen Trust), Grantchester Farms Limited, and Murlyn Trust.

- 139 Whilst the rail corridor was one consideration in that assessment, the NZTA's preference for having SH1 over SH1B was based on a qualitative comparison of the effects relating to the alternative arrangement.
- 140 To reiterate my earlier evidence, the grade separation of SH1 over SH1B was preferred due to improved connectivity (especially pedestrians and cyclists), safety, urban design (providing a defined entrance to Cambridge, improved accessibility and maintaining an active frontage), property impacts, and providing a marginally lower embankment height than the alternative. The potential for having rail provision was considered to be an additional benefit.
- 141 Mr Morton and Mr Dravitzki will describe how the effects of the preferred Central Interchange design can be appropriately mitigated.
- 142 Grantchester Farms Limited suggests the NZTA's preferred design for the Central Interchange is contrary to the Waipa Integrated Transport Strategy (*WITS*), based on a diagrammatic plan contained on page 33 of the referred document. Whilst I agree that the referred plan could potentially cause some confusion based on the order in which the lines show on the plan, it is important to establish that the bridge annotation showing each side of the bridge has been correctly orientated. I have also contacted the authors of *WITS*, who confirmed that the intention of the plan in this context was purely to be regarded as diagrammatic only and not intended to show any preference for grade separation arrangement.
- 143 Grantchester Farms Limited also refers to the *WITS* in its reference to page 9, whereby it states "It is unlikely that rail will be a viable option over the lifetime of this strategy...". The reference within the Grantchester Farms submission fails to refer to the next sentence in the *WITS*, which states "This Strategy recommends that existing rail corridors....are protected for consideration for future opportunities in the district."
- 144 Importantly, the *WITS* goes further to:
- 144.1 Identify strategic intervention by "Protection of transport routes (including rail) for future" (Table 1 on page 9);
- 144.2 Identify visions for urban and rural living in Waipa having "Capacity for passenger rail retained" (Table 4 on page 16); and
- 144.3 Confirm reference to the Hautapu to Cambridge Line "Kiwirail have specified that the designation must remain in place" (page 24).

- 145 In summary, the NZTA's options assessment for the vertical arrangement of the Central Interchange considered the effects of comparative arrangements. I can confirm that the determination of the preferred configuration was not based on an assumed constraint requiring the preservation of the existing rail corridor.

Inadequate Assessment of Alternatives

- 146 The submissions of Murlyn Trust, Lyndon Sim & Marama Lynch, Emanen Trust, and Grantchester Farms question the NZTA's adequacy of the assessment of alternatives for the Project.
- 147 Murlyn Trust states that there has been no consideration of alternative routes, and the submission of Lyndon Sim and Marama Lynch seek to have the Expressway moved 500m – 1000m further from their property.
- 148 The NORs relate to alterations of existing designations. Those existing designations have been extensively investigated to confirm they embody the preferred route. Consequently, the Project objectives refer to "...maximising the use of the NZTA's existing designated corridor north of the current SH1 route through Cambridge...". As such, investigation of alternative routes for the Cambridge Section was not a relevant consideration for the Project.
- 149 Murlyn Trust submits that there has been no consideration of alternative configurations of the Victoria Road Interchange, whereby Victoria Road goes over the Expressway. This is not correct. Section 6.4.3(b) of the submitted AEE, and my preceding evidence describe the consideration of alternatives related to the Central (SH1B) Interchange.
- 150 Emanen Trust states that there has not been adequate consideration given to alternative methods of undertaking work in a way that would have significantly less adverse effects on the environment. I do not agree with this statement. In determining the preferred option for the Project, I consider a balanced approach has been undertaken in assessing effects and suitability of each option.
- 151 Emanen Trust also refers to the assessment of alternatives relating to the vertical alignment design being inadequate. As I have explained, the vertical alignment of the Project has been optimised between the discrete elements of the Project as determined by option evaluations. My evidence describes that there are limited opportunities to further reduce the vertical height of the Expressway due to a number of physical and assessed constraints. However, during the Design & Construction phase of this Project, there may be opportunities to progress innovative solutions that reduce the embankment height through use of alternative construction methodologies or use of unconventional materials. Regardless, the evidence of the Project team will demonstrate that the potential

adverse effects from the Project can be suitably mitigated to a reasonable level, even if the vertical heights of embankments are not further reduced.

Details on earthwork treatment

- 152 The submission of Grantchester Farms Limited questions how the cut material within the Project will be treated to become structural fill, the cost of treatment, and the cost/benefit implications of the method of treating the fill compared to importing the fill.
- 153 Specific geotechnical testing and assessment has been undertaken to determine the suitability of cut material for the purposes of structural fill. The suitability of cut material for fill purposes depends on a range of factors, with fine grained soils being the most problematic. The relevant soils in cut areas of the Project include both coarse soils (sands and gravels), which are interbedded with fine grained soils (silts and clays). The key factors that determine suitability include:
- 153.1 The water content;
 - 153.2 The effort (or cost) to change water content if it is not near optimum; and
 - 153.3 The strength of the soil when it is compacted.
- 154 There are a number of methods for increasing the use of otherwise unsuitable soils, including:
- 154.1 Reducing the water content of in-situ soils, such as: pre-draining cut areas, well pointing, or consolidation;
 - 154.2 Reducing the water content of excavated soils, such as: evaporation by spreading cut soil, mechanical drying, use of quick lime or cement;
 - 154.3 Use of sand layers incorporated within the fill to dissipate porewater pressures;
 - 154.4 Use of geotextiles for drainage and/or strength;
 - 154.5 Use of tracked machines or high energy rollers (such as impact rollers) to spread and compact soils; and
 - 154.6 Surcharging the fill embankments to squeeze out excess water.
- 155 In summary, there are numerous potential methods available to the contractor to make best use of the available materials. There are also many possible scenarios as to how the contractor will value

each option of treatment. As such, to be risk averse, the determination of proposed treatment requirements within our assessment is a conservative estimate on actual possible usage of cut material.

- 156 Whichever method the Design & Construct contractor employs to complete the necessary earthworks, the contractor will always need to operate within the designation and consent conditions.

Inadequate designation width

- 157 Grantchester Farms Limited and Emanen Trust submit that the designation width is insufficient to include the mitigation measures they consider necessary.
- 158 I can confirm that all mitigation proposed by the NZTA can be contained within the altered designation boundaries.

Excessive designation width

- 159 The submissions of Eleanor Duncan-Sittlington and Kiwi Lane Limited question the necessity of the extent of the altered designation affecting their properties.
- 160 The extent of the designation width has been determined by both the construction and the operational needs of the Project. Often the construction land requirements are significantly greater than the final operational requirements for the Project and upon completion of the construction works, the Crown may choose to dispose of excess land.
- 161 In the case of the Duncan-Sittlington property, some land is needed for temporary erosion and sediment control measures during construction of the Project. In addition, an alternative stormwater management system may be adopted for the Project on this property.
- 162 The whole of the Kiwi Lane Limited property is included within the boundaries of the alteration to designation. To maximise the use of otherwise unsuitable cut material for the Project, large areas of land may be required for drying of cut material. The location of the Kiwi Lane property makes it ideally situated for this purpose in that it is reasonably close to the source of the cut material and adjacent to the major destination of treated fill.
- 163 In addition, during consultation Kiwi Lane identified their desire to sell the entire property to the NZTA.
- 164 In my view, the extent of the alterations to designations is reasonably necessary to undertake the necessary construction works, and is sufficient for the operational requirements of the Project.

Designation requirements on Hannon Road

- 165 Richard Hannon seeks that the designation extents on Hannon Road, and on the north side of the Project, be aligned with the northern boundary of Lot 2 DPS 54561.
- 166 I can confirm that the NZTA has no long-term desire to own or designate the area of Hannon Road that Mr Hannon refers to. However, the NZTA is seeking to designate this area of Hannon Road to allow the construction of the associated cul-de-sac heads at the severance points.

COMMENTS ON OFFICERS' REPORTS AND RECOMMENDED CONDITIONS

- 167 I have read the Waipa and Waikato District Councils' Officer's Report (*District Report*) and the Waikato Regional Council's Officer's Report.
- 168 The District Report makes a number of recommended designation conditions relating to Construction. I agree with these recommended conditions, however I suggest several minor changes to provide better clarity and certainty as follows.
- 169 Condition 2.2(l) of the recommended designation conditions lists the sub-management plans to be contained within the CMP. However, this list should ideally reflect the descriptions and content recommended within the WRC's proposed resource consent conditions. In particular, the content required as part of Condition 2.2(l)(ix) (*Soil Contamination Contingency Plan*) appears to be covered within the requirements listed under Condition 17 of Schedule One of the WRC Resource Consents (*Hazardous Substances Management Plan*). As such, I consider reference to the Soil Contamination Contingency Plan should be removed.
- 170 I recommend the following amendments to recommended designation Condition 2.2(l):

(l) *The following sub-management plans:*

- (i) *Construction Noise and Vibration Management Plan (in accordance with condition 5);*
- (ii) *Traffic Management Plan (in accordance with condition 6);*
- (iii) *Archaeological Site Management Plan;*
- (iv) *Earthworks Management Plan;*
- (v) *~~Construction~~ Dust Management Plan;*
- (vi) *~~Riparian~~ Ecological and Restorative Management Plan;*
- (vii) *Erosion and Sediment Control Plan;*
- (viii) *Hazardous Substances Management Plan;*

~~(ix) Soil Contamination Contingency Plan; and~~

(ix) Stakeholder Communications Plan (in accordance with condition 8).

- 171 Condition 5.3(h) of the recommended designation conditions refers to the preparation of dilapidation reports on susceptible houses in relation to potential construction vibration effects. In particular the condition refers to:

"..preconstruction inspections of all buildings within 50 metres of the edge of earthworks."

- 172 I asked Mr Peter Cenek (author of the Vibration Assessment Report within Appendix 7 of the AEE) to review the requirements of this condition.

- 173 The reference to inspections of buildings within 50m of the edge of earthworks appears to have been taken from Mr Cenek's theoretical vibration analysis completed within his assessment report. Mr Cenek has since prepared a brief memorandum (contained in **Annexure J** of my evidence) that provides further rationalisation of his original recommendations and explains why he now believes this blanket reference to a 50m offset (as described) is particularly onerous.

- 174 Mr Cenek states that "...my recommendation for a critical distance of 50 metres is quite arbitrary as it has been derived from vibration characteristics of three specific plant items (two rollers and a dozer), which may or may not be used on earthworks associated with the project."

- 175 Mr Cenek also states "it seems prudent to first determine the vibration levels generated by the rollers that will be used on the project (based on actual construction methodology) and their rate of decay with distance."

- 176 Based on Mr Cenek's advice, I recommend that Condition 5.3(h) of the designation conditions be amended, as follow (deletions shown as ~~strikethrough~~ and additions shown as underline):

(h) *Preparation of dilapidation reports on ~~susceptible~~ dwellings identified as being susceptible to damage from groundborne vibrations arising from construction activity based on inspections of the dwellings prior to, ~~during~~ and after construction of works. ~~and preconstruction inspections of all buildings within 50 metres of the edge of earthworks.~~*

- 177 Mr Cenek concludes that "this revised condition will result in better outcomes for all parties as it will allow more cost effective and robust identification of buildings that will be most susceptible to

vibration induced damage in relation to the actual construction methodology adopted.”

- 178 I believe that my evidence and that of the other NZTA witnesses, in conjunction with the proposed NZTA conditions will suitably address the issues that have been raised in those reports.
- 179 In particular, I concur with the conclusions and recommendations of both reports, subject to the recommended changes to conditions proposed by the NZTA.

CONCLUSIONS

- 180 The Project has a long history, with the original designation being confirmed in the District Plans in 1973
- 181 The phase of the Project investigations that lead to the lodgement of the NORs and the resource consent applications has been undertaken by a team of technical specialists, providing engineering and planning analysis and detailed assessment to the NZTA since March 2007.
- 182 The design of the alignment for the Cambridge Section has been developed through a rigorous consideration of alternatives to determine a preferred option that meets the Project objectives. The Waipa and Waikato Officer's Report states that ".....the territorial authorities can be satisfied that the NZTA has given adequate consideration to alternatives for upgrading the designation alignment and the other design considerations/methods thereafter...".
- 183 The preferred option requires alteration to the existing designations. Primarily due to the requirements of the most recent design standards, changes to local road connections and interchanges, a desire to minimise impacts on an adjacent Pa site, and additional land required for construction purposes.
- 184 The construction effects will be managed through the development of a Construction Management Plan, with appropriate sub-management plans.
- 185 The NZTA proposes an appropriate review and certification process with the relevant Councils, which will ensure the Contractor implements appropriate methods and tools to avoid, remedy or mitigate the Project's potential adverse construction effects so as to comply with resource consent and designation conditions, relevant legislation, and the NZTA's own environmental objectives.

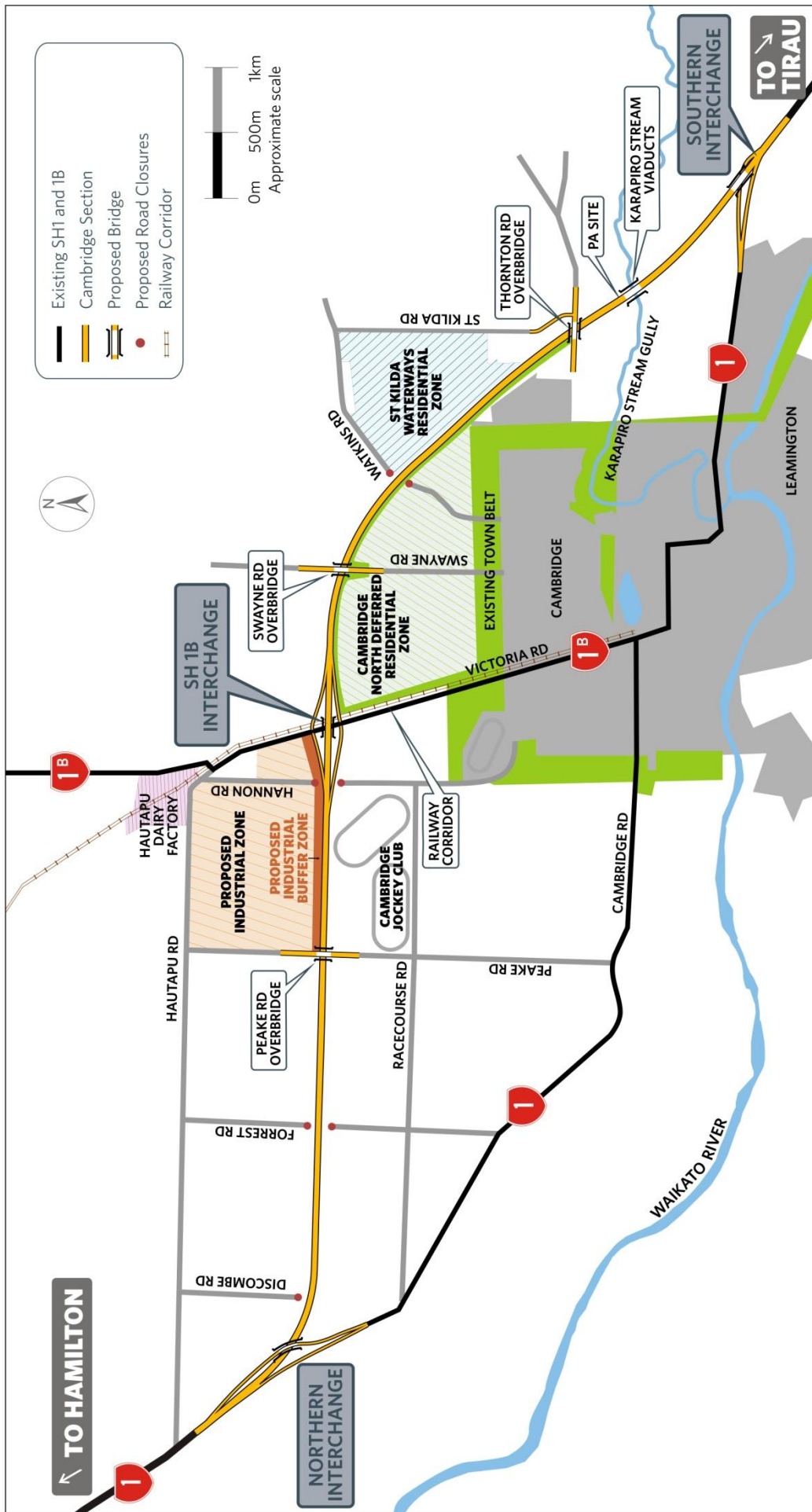
- 186 In addition, a suite of conditions has been proposed by the Project team to ensure the potential adverse effects of the Project can be appropriately avoided, remedied or mitigated.
- 187 For all of the above reasons, I support the NORs and consider that the designations should be confirmed and the consents granted, on the conditions as proposed by the NZTA.

Jeremy Gibbons

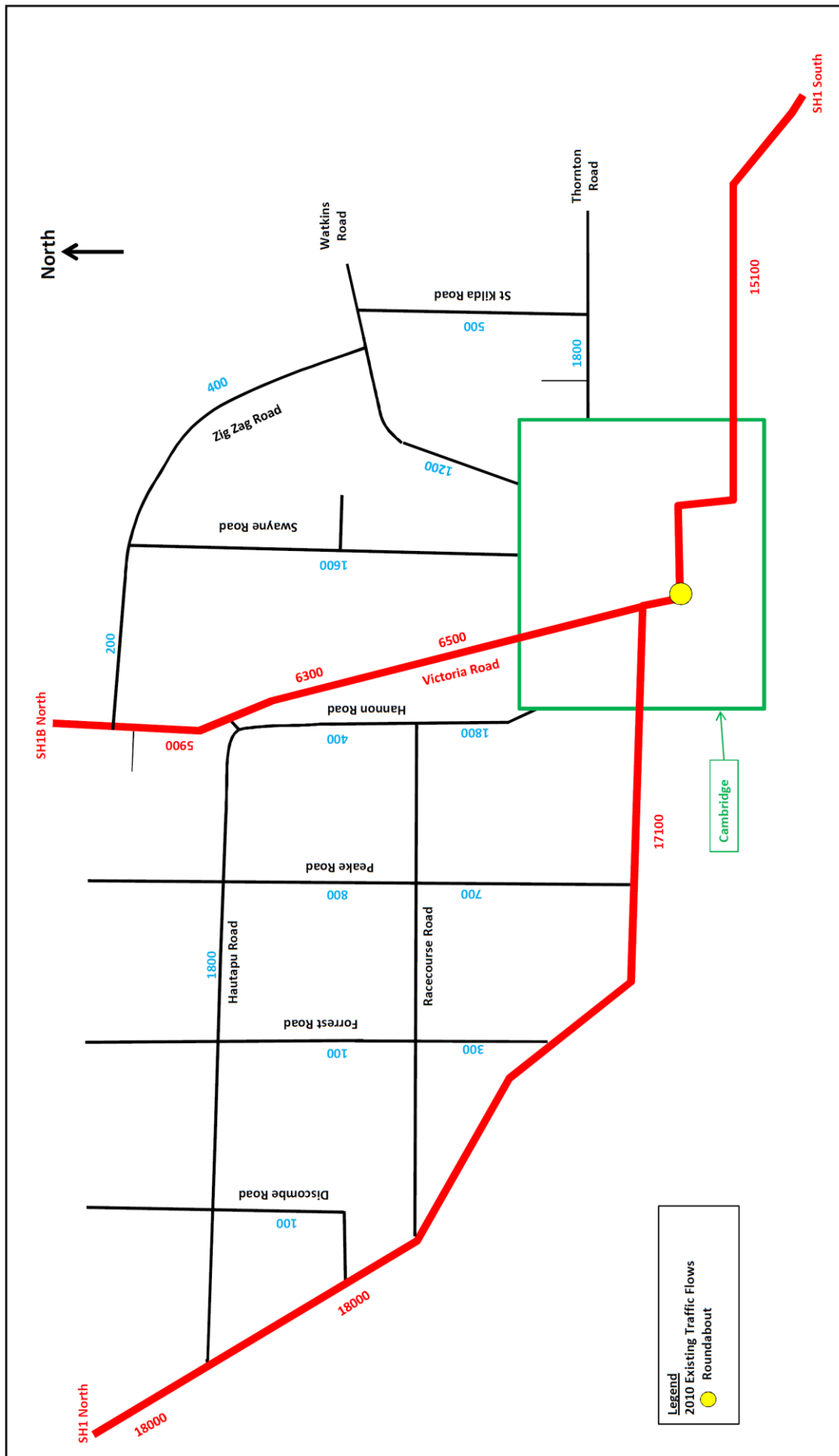
27 June 2011

Annexures

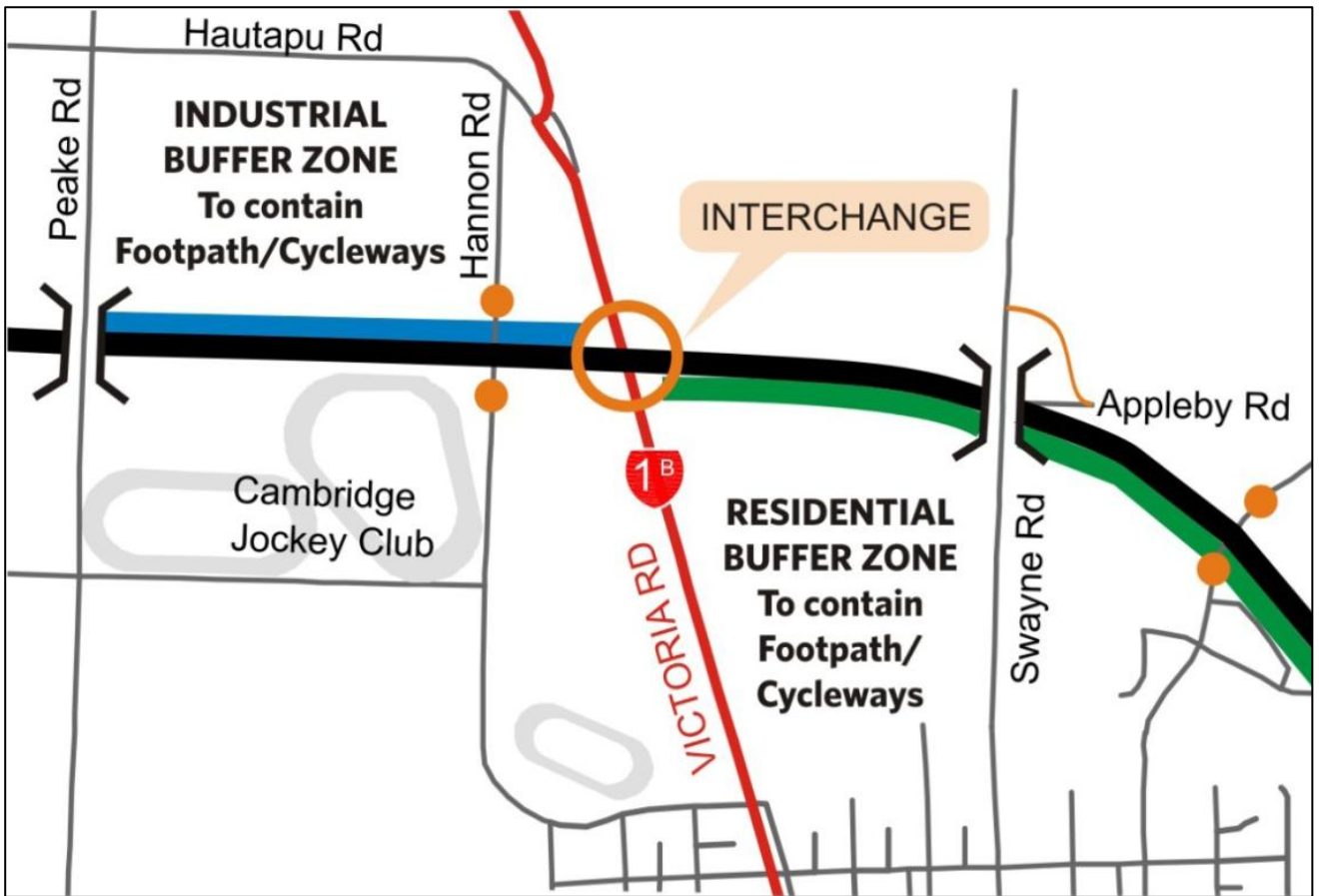
- A Overview map of Project Area
- B Approximate 2010 Daily Traffic Volumes
- C Waipa DC Buffer Zones
- D Alternative Central Interchange Bridging Options
- E Potential Broken Active Edge of Victoria Road (SH1B)
- F Potential for Intensification of Land Use Adjacent to Victoria Road (SH1B) and Other Local Roads
- G Typical Expressway Cross-section Showing Overland Flow Culvert
- H Extent of Pa Site within the Existing Designation
- I Management Plan Framework
- J Memorandum from Peter Cenek to support Vibration Assessment (dated 22 June 2011)



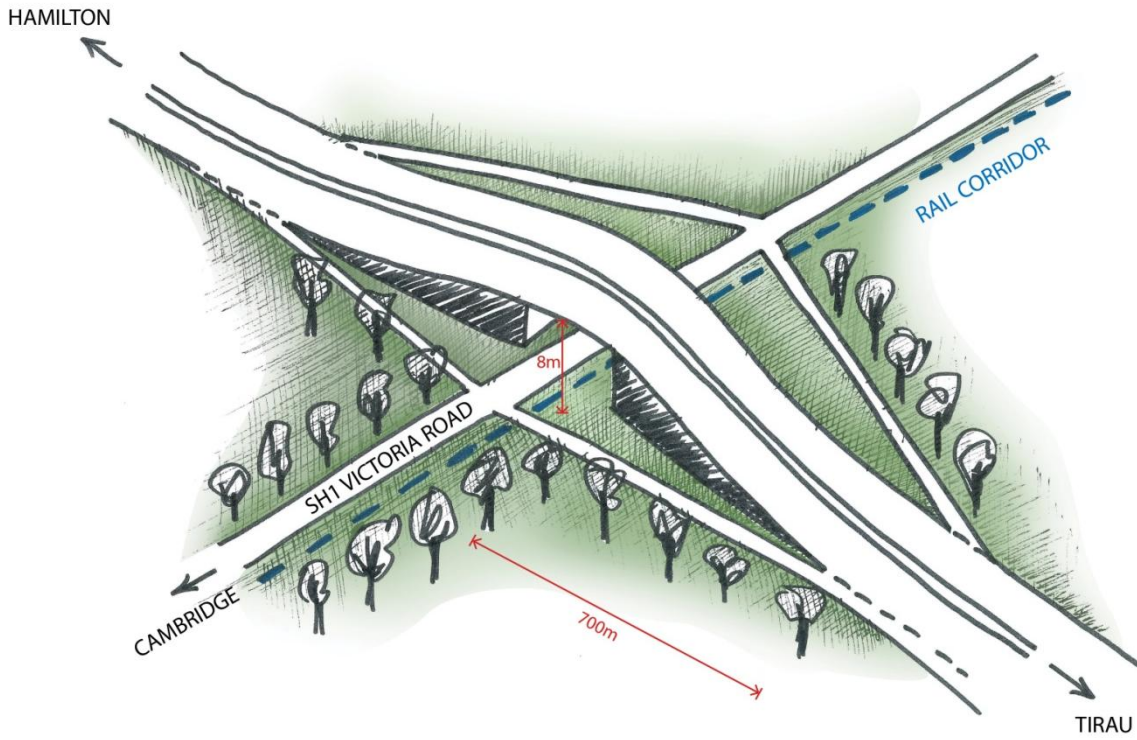
Annexure A: Overview Map of Project Area



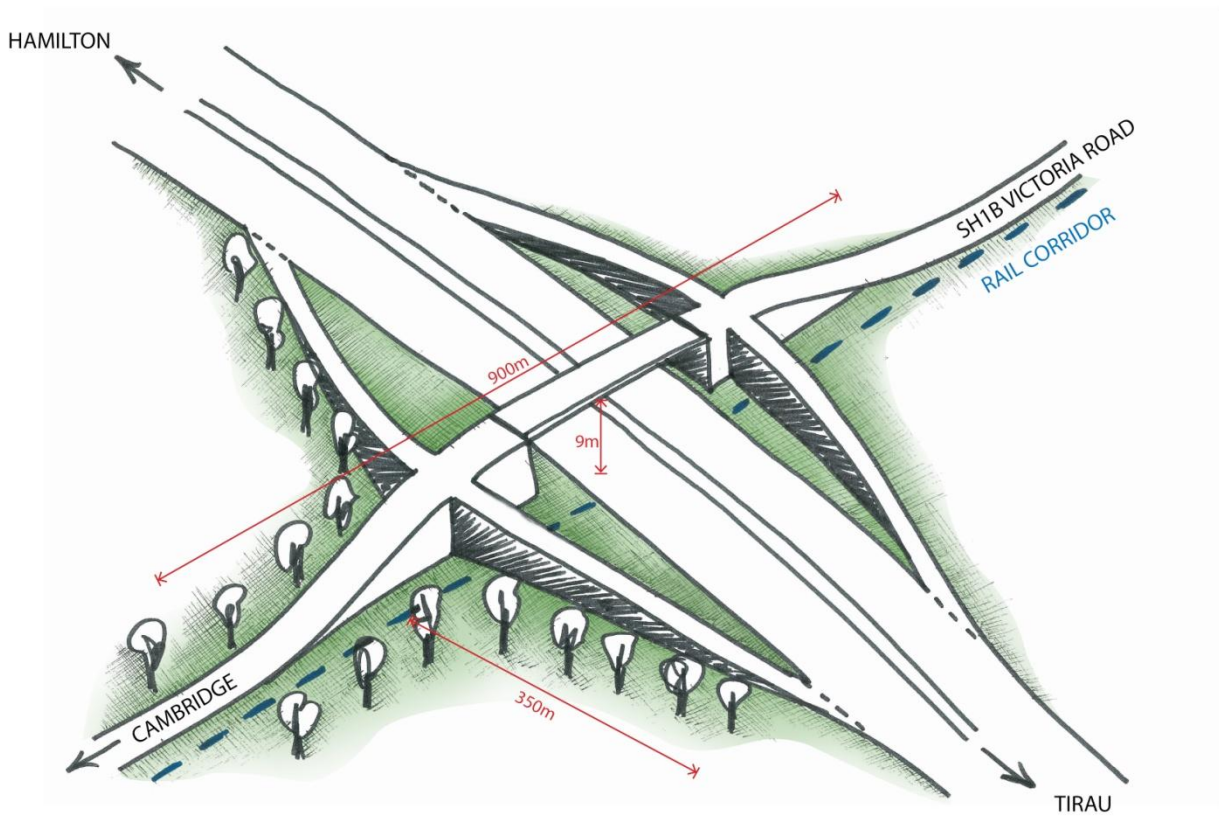
Annexure B: Approximate 2010 Daily Traffic Volumes



Annexure C: Waipa DC Buffer Zones

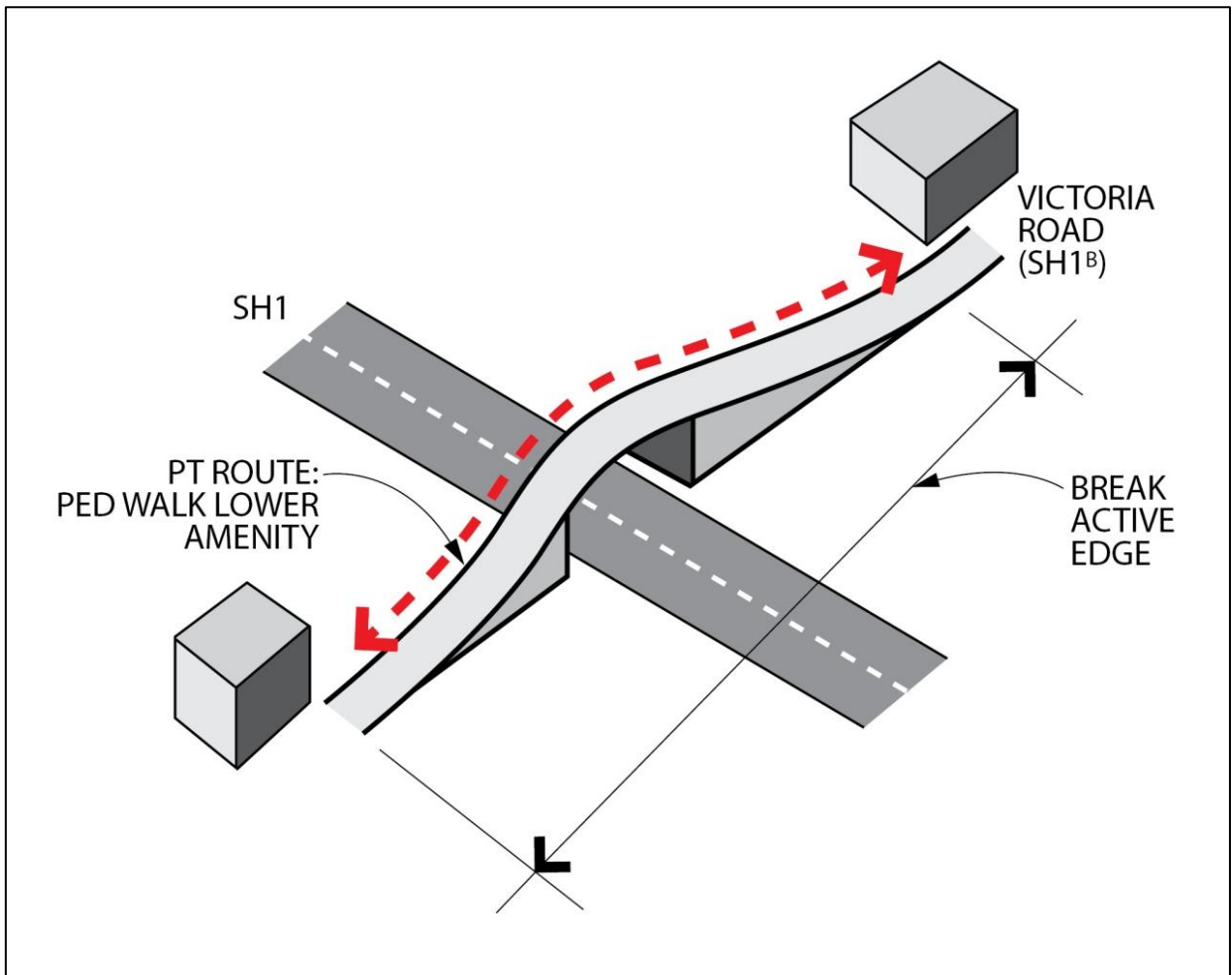


SH1 over SH1B (Victoria Road)

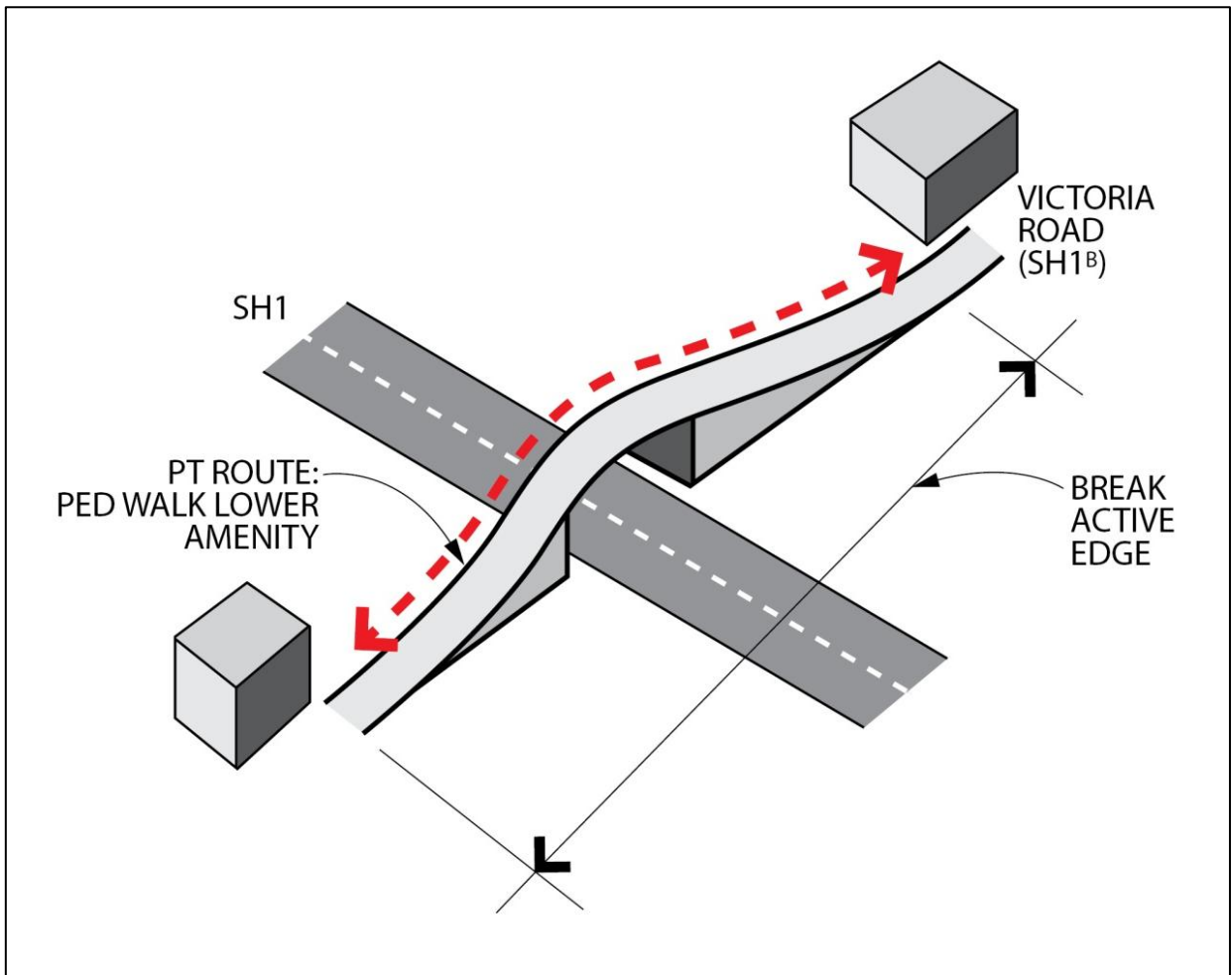


SH1B (Victoria Road) over SH1

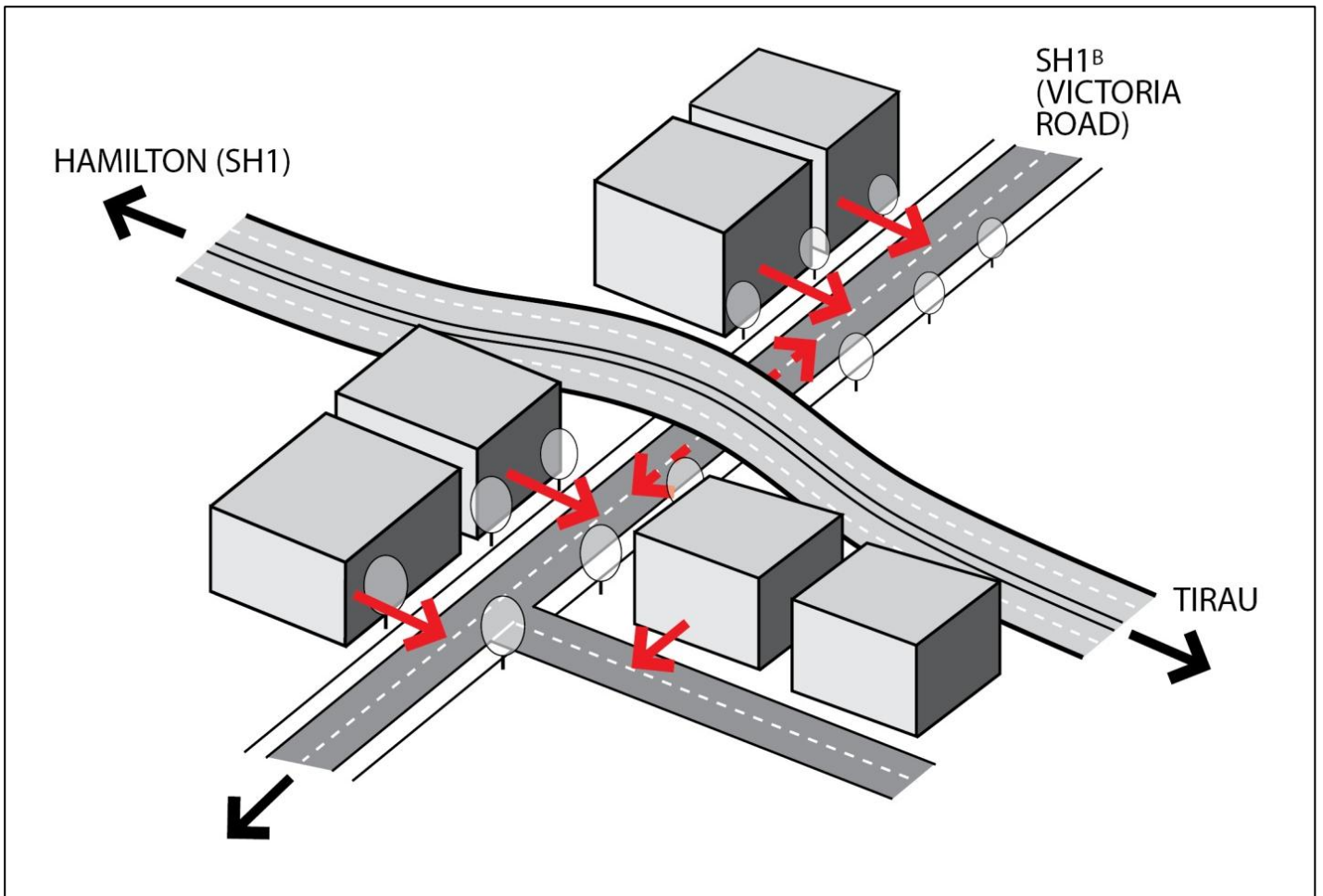
Annexure D: Alternative Central Interchange Bridging Options



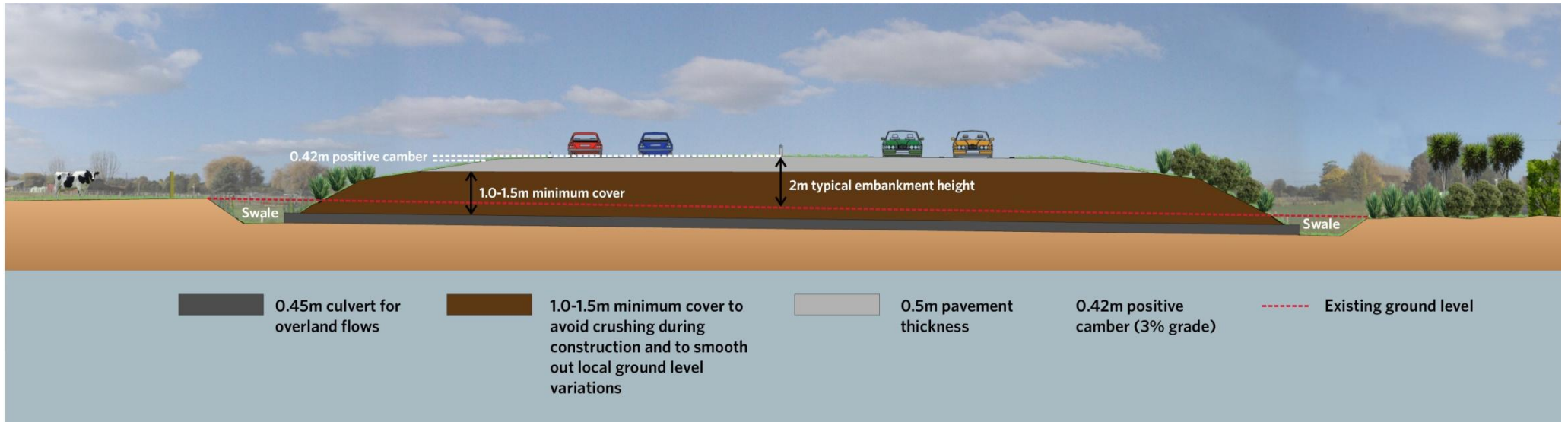
Annexure E: Potential Broken Active Edge of Victoria Road (SH1B)



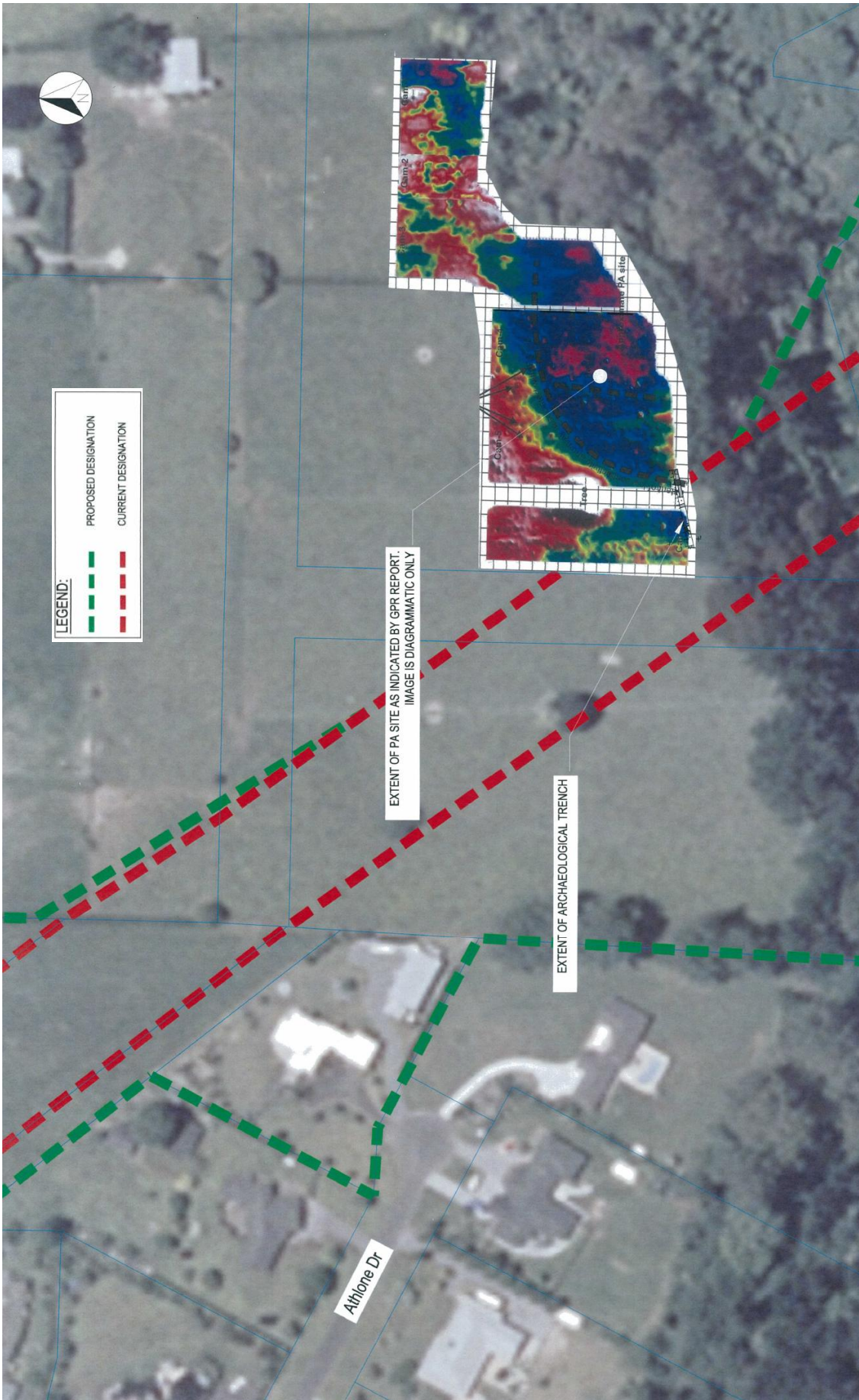
Annexure E: Potential Broken Active Edge of Victoria Road (SH1B)



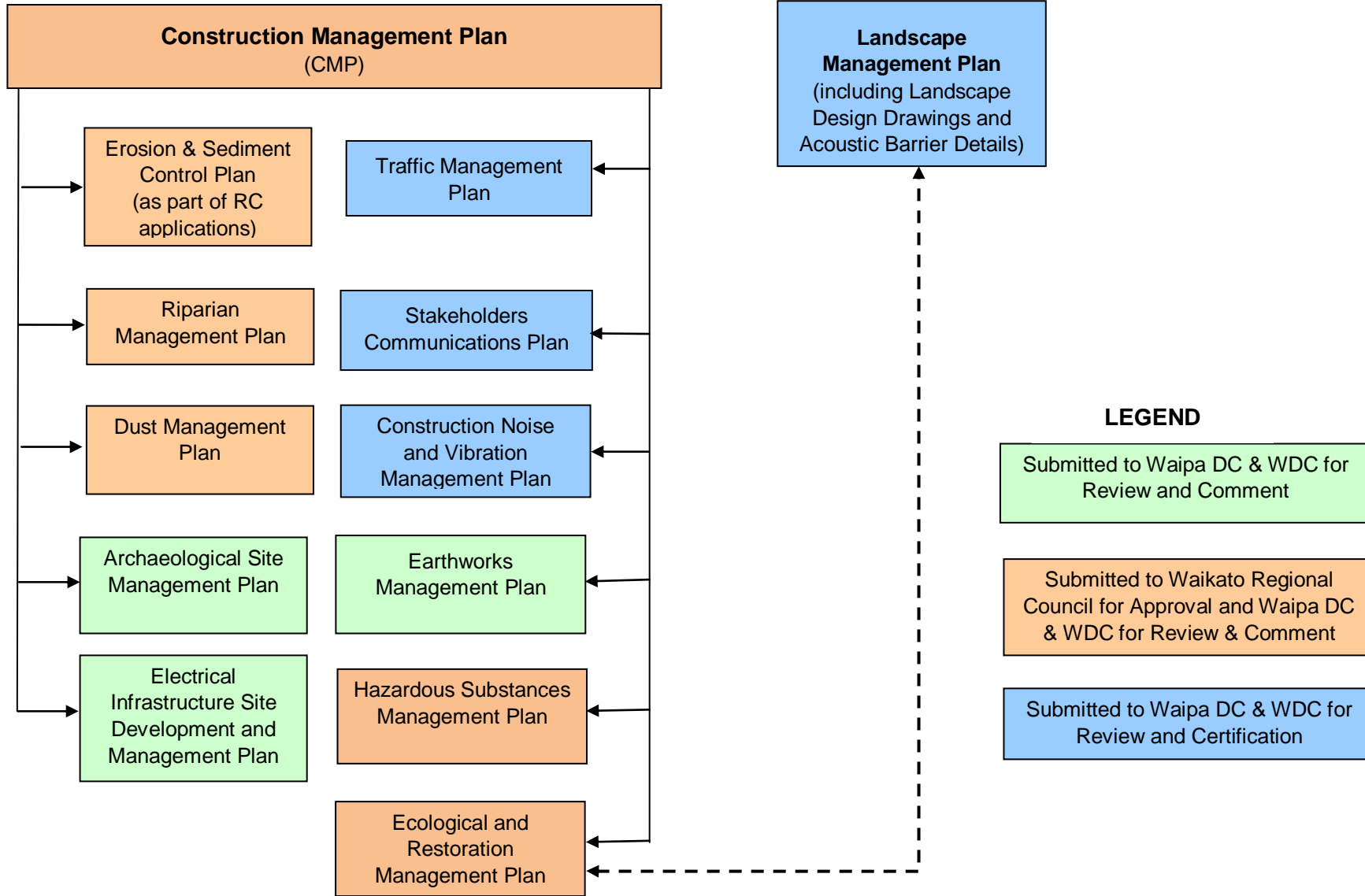
Annexure F: Potential for intensification of land use adjacent to Victoria Road (SH1B) and other local roads



Annexure G: Typical Expressway Cross-Section showing overland flow culvert



Annexure H: Extent of Pa site within the existing designation



Annexure I: Management Plan Framework

**Annexure J: Memorandum from Peter Cenek to support
Vibration Assessment**

TO Jeremy Gibbons

FROM Peter D Cenek

DATE 22 June 2011

FILE 2-61647.00 Task 900CL

SUBJECT Waikato Expressway - Cambridge Section:
Draft Designation Conditions Pertaining to Potential
Construction Related Vibrations



As requested, I have reviewed the draft construction vibration related designation conditions contained in the Officer's Report for Waikato and Waipa Districts, and comment as follows.

Condition 5.3(h) of the Waikato District and Waipa District Recommended Conditions

This condition requires preparation of dilapidation reports on susceptible dwellings prior to, during and after construction of works and preconstruction inspections of all buildings within 50 metres of the edge of earthworks.

It appears the reference to the distance of 50 metres has been taken from the theoretical analysis presented in Opus Central Laboratories Report 10-261647.00, which indicated that at this distance the largest ground vibrations are likely to be about 1 mm/s peak particle velocity (ppv), corresponding to the British Standard BS5528-2009 threshold for complaint in residential environments.

Since preparation of this assessment report I have become aware that the requirement of preconstruction inspections of all buildings within 50 metres of the edge of earthworks would apply to at least 75 residential dwellings based on the proximity table prepared as part of the noise assessment for the Waikato Expressway Cambridge Section. In my view this number of dilapidation reports would be particularly excessive given the actual risk associated with structural damage to buildings from construction vibration.

It is important to establish that my recommendation for a distance of 50 metres was quite arbitrary as it was derived from vibration characteristics of three specific plant items (two rollers and a dozer), which may or may not be used on earthworks associated with the project.

With reference to British Standard BS 52282-2:2009, the largest magnitude groundborne vibrations arising from mechanized construction works are likely to be due to piling and specific roller compaction activities. Furthermore, the magnitude of ground vibrations generated by rollers is a function of the maximum amplitude and frequency of the drum

vibration, the width of the vibrating drum and the number of vibrating drums. New Zealand experience suggests that for two rollers capable of performing the same compaction task, the magnitude of the roller-induced ground vibrations can be up to a factor of 4 or 5 different. Given such a variation in the magnitude of roller induced vibrations, it seems prudent to first determine the vibration levels generated by the rollers that will be used on the project (based on actual construction methodology) and their rate of decay with distance.

This will require vibrations produced by construction equipment to be monitored on soil structures similar to that of the project by suitably qualified personnel prior to the construction proper commencing. The vibrations will have to be monitored at two distances from source to establish how quickly the vibration levels attenuate with distance

The resulting vibration data can then be applied to identify dwellings that are likely to be susceptible to vibration-induced damage, and preconstruction inspections can then be focussed around the relevant properties. This will result in a much more effective use of resources and a better outcome for neighbouring residents, than the blanket application of the 50 metre distance over the entire length of the Expressway.

It is universally accepted that the construction activity that generates the highest magnitude ground vibrations is pile driving. Two main types of pile driving hammer are used in New Zealand, these being the vibratory hammer and the impact hammer.

Vibratory hammers work by imparting a vertical vibration onto the pile. These hammers are particularly effective at driving piles in soils such as sand that are vibratorily mobile. The other form of pile driving, impact hammer, works by dropping a large weight of several tonnes onto the pile and normally utilises a combustion process to help raise the weight before each impact.

Unlike vibratory piling operations, groundborne vibrations from drop weight piling operations can be reasonably well estimated from the drop mass and the drop height. For example, a maximum product of drop mass and drop height of 9 tonnes-metre should be sufficient to ensure vibrations at 50 metres from the piling operation do not exceed the threshold value of 3 mm/s ppv for onset of structural damage in sensitive/historic structures given in German Standard DIN 4150-3:1999.

Because groundborne vibrations from vibratory pile driving cannot be predicted with as much certainty as drop weight piling, measured vibration levels pertaining to two vibratory piling operations were utilised in carrying out the vibration assessment of the Waikato Expressway Cambridge Section. The two vibratory piling operations were sheet piling with the pile at refusal and a pile casing being driven and extracted. The required separation distance from both these vibratory piling activities for ground vibrations to not exceed the DIN 4150-3 guideline value of 3 mm/s ppv was again estimated to be about 50 metres.

An inspection of 50 metre offsets from the potential pile-driving sites for the Waikato Expressway Cambridge Section identified only four residences that are within this distance. The effected residences are in the proximity of the Thornton Road overbridge, the Pa site retaining walls and the Karapiro Stream Gully viaducts and are identified as H135, H137, H141 and H145 in the project noise assessment report. Whilst it could be argued that these specific houses be identified for requiring dilapidation reports, it again

seems prudent to make reference to identification of susceptible buildings based on the actual construction methodology adopted for the Project. In this way, the Councils are provided with the assurance (as certifiers of the Construction Noise and Vibration Management Plan, CNVMP) that susceptible houses are appropriately identified based on the actual construction methodology. This targeted approach will result in a much more effective use of specialist resources.

Recommended Changes to the Vibration Related Designation Conditions

On the basis of the above discussion, I recommend that the wording of Condition 5.3(h) of the Waikato District and Waipa District designation conditions be amended, as follows:

Preparation of dilapidation reports on ~~susceptible~~ dwellings identified as being susceptible to damage from groundborne vibrations arising from construction activity based on inspections of the dwellings prior to, ~~during and after~~ construction of works. ~~and preconstruction inspections of all buildings within 50 metres of the edge of earthworks.~~

I believe this revised condition will result in better outcomes for all parties as it will allow more cost effective and robust identification of buildings that will be most susceptible to vibration-induced damage in relation to the actual construction methodology adopted.

I understand that you will refer to this memorandum as part of your evidence for the Waikato Expressway Cambridge Section hearing. I can confirm that I can make myself available during a specified period of the upcoming hearing to answer any specific questions the Hearing Commissioners may have in regards to my assessment of the recommended condition.



Peter Cenek
Work Group Manager, Physical & Engineering Sciences
MIPENZ