Contract No. NZTA PSW 202

Whirokino Trestle and Manawatu River Bridge

Scheme Assessment Report

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1. Executive Summary

1.1 Background

The Whirokino Trestle and Manawatu River Bridge are located on SH1, approximately 3km south of Foxton and 14km north of Levin. The Whirokino Trestle is a 1.1km long, 90 span reinforced concrete bridge over the Moutoa Floodway and adjacent floodplain. The Manawatu River Bridge is a 180m long, 7 span structural steel bridge over the Manawatu River.

The Whirokino Trestle is in extremely poor structural condition, with its remaining service life estimated at no more than 10 years under the current maintenance regime. Both the Whirokino Trestle and Manawatu River Bridge have a number of other issues, mainly relating to freight efficiency, safety and susceptibility to medium seismic events.

1.2 Project Objectives

The Transport Agency's primary project objectives are to improve safety, efficiency and resilience.

1.3 Key Factors

The key factors influencing the identification and assessment of options included:

a) The sand dunes to the south of the Manawatu River are the historic location of a pa and burial ground. This factor made options to the east of the existing SH1 unattractive;

b) A riparian strip on the southern bank of the Manawatu River is administered by the Department of Conservation and subject to a claim under the Treaty of Waitangi;

c) Realignment of the existing SH1 would have significant impacts on the utilisation of land within at least one property;

d) A gas transmission pipeline, being the sole supply to Wellington, is carried on the existing Manawatu River Bridge. Relocation of the pipeline will be required under all options involving replacement of the bridge and may also be required for options modifying the existing bridge;

e) Electricity transmission lines are located to the east of the study area, crossing SH1 south of the project limits. This factor made options to the east of the existing SH1 unattractive;

f) Geotechnical investigations have confirmed that the sandy soils are prone to liquefaction in a seismic event;

g) The residual fatigue life of the Manawatu River Bridge is uncertain and will be shortened by the passage of 50MAX vehicles, which were approved to cross the structure from 5 November 2014.

1.4 Options

The following options were shortlisted and analysed in full detail:

a) Do Minimum: Replacement of the Whirokino Trestle by 2022 and replacement of the Manawatu River Bridge by 2042, on an alignment immediately to the west of the existing SH1;

b) Option 1: Replacement of the Whirokino Trestle and Manawatu River Bridge on an off-line alignment to the west of the existing SH1;

c) Option 2: Replacement of the Whirokino Trestle and Manawatu River Bridge on an alignment immediately to the west of the existing SH1;

d) Option 2A: Replacement of the Whirokino Trestle on an alignment immediately to the west of the existing SH1, and widening and strengthening of the existing Manawatu River Bridge.

The Do Minimum was based on the minimum cross-sections permitted by current standards. Two cross-sections were assessed for each option, with and without a 1.5m wide median and wire rope median barrier.

1.5 Analysis of Options

Table 1.5.1 summarises the results of the cost estimation and economic analysis processes:

Table 1.5.1: Project Costs and Economic Efficiency

Parameter	Do Minimum	Option 1	Option 2	Option 2A
Minimum Cross-section				
Expected Estimate	$37.3M			
Cross-section including 1.5m wide median and wire rope median barrier				
Expected Estimate		$65.7M	$60.1M	$52.0M
BCR		1.0	1.1	1.1
Cross-section excluding 1.5m wide median and wire rope median barrier				
Expected Estimate		$60.3M	$55.5M	$48.6M
BCR		1.2	1.3	1.3

An assessment was undertaken to establish the extent to which the project objectives of improving safety, efficiency and resilience were achieved. The assessment identified that:

a) The Do Minimum does not meet the project objectives to the same extent as Options 1, 2 and 2A, and in many respects does not represent much change from the existing situation;

b) Option 2A does not meet the project objectives to the same extent as Options 1 and 2;

c) Options 1 and 2 both meet the project objectives of improving efficiency and resilience;

d) Options 1 and 2 both meet the project objective of improving safety, but not to the fullest extent possible.

A Multi-Criteria Analysis was undertaken incorporating a broad range of strategic, social, environmental, operational and economic factors.

The following conclusions can be drawn from the MCA:

i) There appears to be little to differentiate between Options 1, 2 and 2A;

ii) The Do Minimum is assessed as being least preferred, having significantly fewer and lesser positive effects than the options.

The investment profile is HML.

1.6 Comparison of Options

The assessment against project objectives and Multi-Criteria Analysis identified the Do Minimum as least preferred, having fewer and lesser positive effects than the options. The Do Minimum also presents a significant risk to route security under the current maintenance strategy. The Do Minimum is not preferred.

Option 2A is the lowest cost and one of the two most economically efficient options. The assessment against project objectives identified as being less preferred than Options 1 and 2. The Multi-Criteria Analysis did not distinguish between Options 1, 2 and 2A. However, the following factors are not obvious from the Multi-Criteria Analysis, which compares the options to the existing situation rather than to each other:

a) While widening and strengthening will significantly improve the function of the existing Manawatu River Bridge, it will not extend the residual service life of the structure. Retention of what will remain a 72 year old bridge carries ongoing risks of emergence of fatigue problems and exposure to liquefaction during a medium seismic event.

b) Extremely strong community support exists for replacement of both bridges;

c) The economic efficiency of all options is very similar;

d) The effects of all options are very similar. In particular, all options impact on the Manawatu River to more or less the same extent;

e) Option 2A will introduce a reverse curve between the new Moutoa Floodway Bridge and the existing Manawatu River Bridge for the medium term, which while compliant with current standards for rural state highways is less than desirable.

The assessment against project objectives and Multi-Criteria Analysis did not distinguish between Options 1 and 2. However, Option 2 incurs less cost and is more economically efficient than Option 1, and has less impact on utilisation of adjacent land. In this latter respect, Option 2 is expected to present the 'path of least resistance' through the statutory approval process. For these reasons, Option 2 is preferred over Option 1.

The full cross-section is consistent with the Safer Journeys approach to road design, and is preferred over the reduced cross-section, which is not.

1.7 Preferred Option

The benefits of Option 2 include:

a) Elimination of risks to route security presented by concrete deterioration and reinforcement corrosion, medium seismic events, steel fatigue and gas explosion;

b) Adequate capacity to allow passage of High Productivity Motor Vehicles, improving freight efficiency by reducing journey distance by 21km;

c) Increased cross-section width, both on and off the bridges, improving traffic safety and improving traffic efficiency by increasing the mean speed from 85km/h to 100km/h;

d) Wire rope edge barriers on the embankment and TL-5 concrete barriers on the bridges, improving traffic safety;

e) Retention of the existing at-grade cycleway across the Moutoa Floodway and adjacent floodplain, and conversion to a shared path, improving safety of cyclists and pedestrians;

f) Relocation of the existing rest area south of the Manawatu River to the redundant state highway embankment, improving safety of rest area users and improving amenity;

g) Acceptable archaeological, cultural, social and environmental effects;

h) Acceptable impacts on utilisation of adjacent land;

i) Elimination of any reputation risk to the Transport Agency in respect of assertions of inefficient investment in the Foxton South Curves project, completed in 2008;

j) Facilitation of a future eastern bypass of Foxton.

1.8 Recommendations

It is recommended that the Transport Agency confirm Option 2 with a 1.5m wide median and wire rope median barrier as the preferred option.

Option 2 has an Expected Estimate of $60.1M and a BCR of 1.1. The reduced cross-section would result in a cost saving of $4.6M.

2. Introduction

2.1 Background

2.1.1 Strategic Context

SH1 is New Zealand's principal arterial highway which runs the length of the North and South Islands, and links the cities of Auckland and Wellington. The purpose of SH1 is to connect places of national significance and facilitate long distance inter-regional movement of people, goods and services.

The Whirokino Trestle and Manawatu River Bridge are located on SH1 approximately 3km south of Foxton and 14km north of Levin. This section of SH1 is classified as a National Strategic state highway, being a state highway that makes a significant contribution to social and economic wellbeing by connecting major population centres, international ports or major airports.

The Whirokino Trestle is nearing the end of its service life. It is in extremely poor structural condition and has subsequent high ongoing reactive maintenance costs. Both the Whirokino Trestle and Manawatu River Bridge have a number of other issues, mainly relating to freight efficiency, safety and susceptibility to medium seismic events. These issues have the potential to compromise the Government's overall transport objective of an effective, efficient, safe, secure, accessible and resilient transport system that supports the growth of New Zealand's economy, in order to deliver greater prosperity, security and opportunities for all.

The Whirokino Trestle Bridge Replacement was one of the projects included in the Accelerated Regional Roads Package announced by the Government on 29 June 2014. It is one of six projects for which the Government has advanced funding to complete the investigation and consenting processes. In June 2015, the Cabinet will decide whether to commit construction funds for the project, which will be drawn from the Future Investment Fund rather than the National Land Transport Fund.

The Whirokino Trestle and Manawatu River Bridge are located on SH1, just north of the study area for the Ōtaki to North of Levin section of the Wellington Northern Corridor Road of National Significance (RoNS).

A number of upgrades are planned for the existing state highway between Ōtaki and North of Levin, which will realise important safety benefits in the short to medium term. The most northern of these upgrades is the Waitarere Beach Road Curves Realignment, which is located on SH1 3.3km south of the Whirokino Trestle and Manawatu River Bridge.

2.1.2 Remaining Service Life

The Whirokino Trestle Condition Report produced by Bloxam Burnett and Olliver Ltd in September 1997 concluded that the remaining service life of the structure was limited to 10 years unless significant maintenance was undertaken, which could extend the remaining service life to between 20 and 25 years and defer bridge replacement until between 2017 and 2023.

The Whirokino Trestle Bridge Management Plan produced by Bloxam Burnett and Olliver Ltd in November 2013 (supported by independent research undertaken by Opus International Consultants Ltd) concluded that:

a) The structure was in extremely poor condition due to reinforcement corrosion-induced concrete spalling and could reasonably be considered to have reached the end of its service life;

b) Unless significant maintenance was undertaken, the bridge should be replaced within 10 years (i.e. by 2023);

c) Ongoing monitoring and cyclical concrete patch repairs could extract up to 20 years service life from the structure (i.e. until 2033).

   A cyclical concrete patch repair maintenance strategy merely alleviates symptoms rather than restoring the structure to full health. The repair volume (and therefore cost) of each cycle of patching tends to increase, as does the level of compromise to the holistic integrity and durability of the structure, which places an upper limit on the number of times patch repairs can be carried out.

Cyclical concrete patch repairs were undertaken between 1998 and 2013, typically for a value of $100,000/year. Expenditure at this level is insufficient to keep ahead of deterioration, and the condition of the structure has continued to decline. There is evidence that some of the earlier repairs are beginning to fail. With the agreement of the Transport Agency's regional office, no structural maintenance will be undertaken on the Whirokino Trestle from June 2013.

The bridge was opened to 50MAX vehicles on 5 November 2014. The analysis undertaken as part of the approval process concluded that passage of 50MAX vehicles was acceptable on the basis that the bridge would be replaced within 10 years. While the deteriorating condition of the bridge is independent of live loading, the available load factor for 50MAX vehicle loadings is low (1.31).

Under these circumstances, the Whirokino Trestle should be replaced no later than 2022.

The Manawatu River Bridge has 27 years of its 100 year design life remaining. Bridge inspection has not identified any issues that would result in its remaining service life being any less than this.

2.1.3 Project Development

A Project Feasibility Report (PFR) produced by MWH New Zealand Ltd in February 2013 sought to establish the feasibility of improving freight efficiency by allowing the passage of High Productivity Motor Vehicles (HPMV) and providing a safe and secure route for SH1 over the Moutoa Floodway. The PFR identified two options to be taken forward into scheme assessment:

- Option 9-1: Replace the Whirokino Trestle on its existing alignment and strengthen the Manawatu River Bridge;
- Option 9-2: Replace both bridges on a new alignment to the west of the existing state highway.

In June 2014, the NZ Transport Agency engaged Bloxam Burnett and Olliver Ltd to undertake project investigations and develop a Scheme Assessment Report (SAR), building on the work completed in the PFR.

2.2 Abbreviations

The abbreviations used throughout this SAR are presented in Table 2.2.1.

Table 2.2.1: Abbreviations

Abbreviation	Description
AADT	Annual Average Daily Traffic
BCR	Benefit Cost Ratio
BOI	Board of Inquiry
CIA	Cultural Impact Assessment
DBC	Detailed Business Case
DOC	Department of Conservation
EEM	Economic Evaluation Manual
HCV	Heavy Commercial Vehicle
HDC	Horowhenua District Council
HPMV	High Productivity Motor Vehicle
HRC	Horizons Regional Council
MCA	Multi-Criteria Analysis
NZTA	NZ Transport Agency
PFR	Project Feasibility Report
PWA	Public Works Act 1981
RMA	Resource Management Act 1991
RoNS	Roads of National Significance
SAR	Scheme Assessment Report (this document)

3. Problem Description

3.1 Route Security

The section of SH1 on which the Whirokino Trestle and Manawatu River Bridge are located is classified as a National Strategic state highway, being a state highway that makes a significant contribution to social and economic wellbeing by connecting major population centres, international ports or major airports. As such, these bridges are considered to qualify as lifeline utilities under the Civil Defence Emergency Management Act 2002, which requires them to continue to function, albeit potentially at a reduced level, during and after an emergency event.

The condition of the Whirokino Trestle presents a significant risk to route security under the current maintenance strategy. It is in a state of advanced and widespread deterioration, with chloride ion infusion and lack of concrete cover being the principal cause of reinforcement corrosion and subsequent delamination of concrete.

Neither the Whirokino Trestle nor the Manawatu River Bridge meet current seismic requirements, and both structures remain at risk from medium seismic events.

3.2 Freight Efficiency

Neither the Whirokino Trestle nor the Manawatu River Bridge meets HPMV criteria. Until recently, 50MAX vehicles and HPMVs that would otherwise have travelled on SH1 between SH54 and SH57 have used the alternative SH3/SH56/SH57 route, adding 21km to the journey distance and resulting in significant time and cost implications.

On 5 November 2014, the Whirokino Trestle was the last bridge in the Horowhenua District to be rated to carry 50MAX vehicles, increasing freight efficiency in the region. However, the analysis undertaken as part of the approval process concluded that opening the bridge to 50MAX vehicles was acceptable on the basis that it would be replaced within 10 years, and stated that this conclusion would need to be reviewed if the bridge would not be replaced within 10 years.

It is estimated that approximately 40 HPMVs/day use the alternative SH3/SH56/SH57 route instead of SH1. However, feedback received at the public information day suggests that there may be suppressed demand.

3.3 Safety

The length of SH1 within the study area has a number of safety issues:

a) No median barrier, which is inconsistent with the Safe System approach to road design;

b) Both the Whirokino Trestle and Manawatu River Bridge have 0.16m wide shoulders, which does not meet current cross-section standards for state highway bridges;

c) Side protection on both the Whirokino Trestle and Manawatu River Bridge consists of the original concrete panelling, which offers a low level of protection to errant motor vehicles and carries no Test Level classification;

d) The Manawatu River Bridge lacks safe and convenient cyclist facilities, although no crashes involving cyclists have been recorded on this structure;

e) No right turn bays are provided for traffic turning from SH1 into Matakarapa Road or Whirokino Road;

f) At-grade crossings connect parts of two properties severed by SH1.

The length of SH1 within the study area is classified as high collective risk and medium personal risk under KiwiRAP, indicating that a Safer Corridor intervention or a Safe System Transformation intervention is warranted in accordance with the philosophy promoted by the High Risk Rural Roads Guide.

3.4 Traffic Efficiency

The relatively long length and narrow width of both the Whirokino Trestle and Manawatu River Bridge result in delays to traffic during the passage of overweight or over-dimension vehicles, during maintenance operations or following a crash.

Overweight vehicles that are restricted to crawl speed in their own lane potentially cause a backlog of following vehicles. However, the good sight distance available may provide overtaking opportunities. Overweight vehicles that are restricted to crawl speed central on the structure not only delay following traffic but also necessitate stopping opposing traffic off the structure. Overweight vehicles are not restricted in respect of the times that they may cross the bridges. The frequency of overweight vehicles cannot be established from existing data, as each vehicle is permitted for any number of trips on a particular route within a two year period.

Over-dimension vehicles are also likely to require passage central on the structure, although not at crawl speed unless they are also overweight. Over-dimension vehicles are restricted as to the times that they may cross the bridges, primarily during off-peak hours, Monday to Thursday. The frequency of over-dimension vehicles cannot be established from existing data. However, anecdotal evidence suggests that approximately one over-dimension vehicle can be expected to use the route each week.

At a crawl speed of 10km/h, it theoretically takes approximately 7 minutes to cross the Whirokino Trestle and 1 minute to cross the Manawatu River Bridge. During consultation for this SAR, the Heavy Haulage Association advised that in practice it can take up to 15 minutes to cross both bridges.

Above deck maintenance, including resurfacing, typically necessitates a lane closure with Stop/Go temporary traffic management.

Crashes necessitate either a lane closure with Stop/Go temporary traffic management or closure of SH1. The shortest temporary detour is along the Foxton-Shannon Road and SH57, adding 14km to the journey distance.

4. Site Description

4.1 Overview

4.1.1 Location

The study area consists of a 3.8km length of SH1 from 170m south of Newth Road to 1km south of the Manawatu River Bridge (RP954/10.30 to RP967/1.00). It is located approximately 3km south of Foxton and 14km north of Levin.

4.1.2 Topography

The topography is largely flat and featureless, modified significantly by stopbanks and the SH1 embankment. Small dunes are located on the plains to the north of the Moutoa Floodway and larger dunes are located to the south of the Manawatu River.

4.1.3 Land Use

The surrounding land use is predominantly rural, consisting of dry stock grazing, dairy farming and mixed cropping.

No significant changes to land use are expected within the study area in the medium term. The Horowhenua Development Plan, adopted by Horowhenua District Council (HDC) in 2008, plans how to manage district development and growth for 20 years and beyond. The Horowhenua Development Plan seeks to retain the open rural landscape and productive capacity of rural land in the district by enabling primary production activities to continue to function in rural areas. The Proposed Horowhenua District Plan (2013) also anticipates ongoing rural use.

4.1.4 Land Drainage

The Manawatu River floodplain has complex land drainage and flood control systems, including the Moutoa Floodway described in Section 4.2.1 below. Land drainage within the floodplain areas protected by stopbanks consists of a system of drains, pumps and culverts.

4.2 Key Features

The key features of the study area are shown on Drawing No. 142220/00/P/105, included in Appendix A.

4.2.1 Whirokino Trestle and Moutoa Floodway

The Whirokino Trestle was constructed in 1938, originally to cross the natural floodplain of the Manawatu River. It is a 1,097m long reinforced concrete structure, consisting of 90 simply supported spans of 12.19m supported on 9.14m long driven concrete piles. The bridge is straight and right, and has no longitudinal gradient. The top of the deck is approximately 4.6m above ground level. The cross-section consists of two 3.5m wide lanes with 0.16m wide shoulders.

The structure was screened as part of the 1999/2000 national seismic screening project and seismic upgrade completed in 2004, consisting of simple linkage bolts across the split pier crossheads. However, the structure remains at risk from medium seismic events, including

from liquefaction of the underlying sands. Liquefaction analysis included within Appendix D predicts that the 1:2500 year design event would result in liquefaction of even the very dense sands to a depth of 24m. The Whirokino Trestle Condition Report produced by Bloxam Burnett and Olliver Ltd in September 1997 assessed that damage to piers could be expected for an event between 40% and 60% of the 1:2500 year design event, depending on the orientation of seismic forces.

In 1962, the Lower Manawatu Scheme was constructed to protect newly reclaimed low-lying coastal plains from regular flooding. The scheme included the Moutoa Floodway, sluice gates located approximately 8km upstream from the Whirokino Trestle and 4m to 5m high stopbanks along the floodway and Manawatu River. The floodway is nominally 600m wide, with its northern stopbank located at the northern abutment of the Whirokino Trestle and its southern stopbank located at approximately mid-length of the Whirokino Trestle. The sluice gates have been opened 40 times in the 52 years they have been operational, most recently in July 2013. The floodway land within the study area is leased from Horizons Regional Council (HRC) by the adjacent landowners (Easton and Koputara Farm Ltd) for grazing.

4.2.2 Manawatu River Bridge and Manawatu River

The Manawatu River Bridge was constructed in 1942. It is a 180m long steel plate girder structure, consisting of 7 spans between 18.1m and 33.5m, supported on 15.24m long driven concrete piles. The bridge is straight with a 20^{o} skew, and falls at a 1% gradient from the mid-length to each end of the bridge. Mid-length of the bridge, the top of the deck is approximately 7.3m above low water level. The cross-section consists of two 3.5m wide lanes with 0.16m wide shoulders.

The structure was screened as part of the 1999/2000 national seismic screening project and seismic upgrade completed in 2004, consisting of simple linkage bolts across expansion joints. However, the structure remains at risk from medium seismic events, including from liquefaction of the underlying sands. Liquefaction analysis included within Appendix D predicts that the 1:2500 year design event would result in liquefaction of even the very dense sands to a depth of 24m. The draft Detailed Seismic Assessment prepared by Opus International Consultants Ltd in December 2014 concludes that the seismic resistance of the bridge is inadequate to satisfy current Transport Agency criteria for existing structures. The same report identifies a high risk of foundations being affected by liquefaction.

As with all steel structures, the Manawatu River Bridge is subject to the risk of fatigue. The detailing of the bridge does not suggest that fatigue was a significant consideration during design. The bridge's previous and poorly defined load exposure has locked in an uncertain fatigue history. The recent approval allowing 50MAX vehicles to cross the bridge will increase the stress range per vehicle, and reduce the number of cycles required to consume the structure's residual fatigue life. Bridge inspections to date have not identified any evidence of fatigue damage.

The Manawatu River is of ecological and cultural importance. It is also used for recreational purposes, including power boat racing, water skiing and whitebaiting.

4.2.3 Matakarapa Road/Whirokino Road Intersection

A crossroad intersection with SH1 exists at RP954/12.8, in the 160m length between the Whirokino Trestle and the Manawatu River Bridge. Matakarapa Road (no exit) runs from SH1 to the west and Whirokino Road from SH1 to the east. One of the southern spans of the Whirokino Trestle is currently used as an underpass to effectively provide left in/left out movements to and from SH1, and through movements between Matakarapa Road and Whirokino Road for vehicles less than 4.5m high. However, no physical barrier or signage prevents right turn movements into or out of either local road.

Matakarapa Road services two dwellings, a boat ramp and a local reserve. The boat ramp and reserve are well used, particularly during the summer months.

Whirokino Road services a large number of rural properties and connects to Foxton-Shannon Road via Kere Kere Road and Springs Road.

4.2.4 Existing Buildings

Two dwellings lie within the study area. These dwellings are located on Matakarapa Road on the property owned by Easton.

Two stockyards lie within the study area. The first is located at the northeastern corner of the property owned by Burling. The second is owned by HRC and located on the northern stopbank of the Moutoa Floodway, immediately to the east of the existing Whirokino Trestle.

4.2.5 Property Access

Prior to 2008, the North Whirokino Trestle Bridge (being a separate structure from the Whirokino Trestle) was located between the curves at the northern end of the study area (RP954/11.02). It was a 40m long, 3 span reinforced concrete structure, which provided adjacent landowners (Barnett and Koputara Farm Ltd) with connectivity between the two parts of their properties severed by SH1.

In 2008, the Foxton South Curves project was constructed to improve the safety of SH1 between Foxton and the north abutment of the Whirokino Trestle. The North Whirokino Trestle Bridge was removed as part of this project to provide increased shoulder width. The bridge was replaced by a 3.059m dia. steel multi-plate stock underpass. At-grade crossings of SH1 were also constructed on either side of the underpass to provide connectivity for equipment too large to use the stock underpass. During consultation for this SAR, the affected landowners have expressed dissatisfaction with this arrangement, particularly with the small size of the underpass.

One of the spans of the Whirokino Trestle is currently used to provide the adjacent landowner (Easton) with connectivity between the two parts of the property severed by SH1. Although the property either side of SH1 is held in separate titles, it is operated as a single productive unit.

Other vehicle entrances from SH1 are located within the study area as follows:

a) Access to property owned by Cull (RP954/10.37);

b) Paper road providing access to the properties owned by Burling, Himatangi Station Ltd and Koputara Farm Ltd (RP954/10.57);

c) Access to the northern stopbank of the Moutoa Floodway, both to the east and west;

d) Access to property owned by Langburn Holding Ltd (RP967/0.2);

e) Access to dwelling on property owned by Lewis Dairies Ltd (RP967/0.39).

4.2.6 Rest Area

A formal rest area exists on the southern bank of the Manawatu River (RP967/0.2). The rest area provides access to a riparian strip administered by the Department of Conservation (DOC), which adjoins a larger area of land further to the west also administered by DOC. This larger area of land is referred to locally as the Awahou Conservation Area. Both parcels of land are currently subject to claims under the Treaty of Waitangi.

4.2.7 Cycleway and Walkway

An at-grade cycleway, known as the Ken Everett Cycleway, was constructed across the Moutoa Floodway and adjacent plain following the death of a cyclist on the Whirokino Trestle in the 1990's. It consists of a 3.0m wide, 1.1km long sealed track, including a 23m long single span concrete bridge crossing the permanent standing water in the floodway. The cycleway is substantially located within the existing state highway reserve and is maintained by the Transport Agency.

The Piriharakeke Walkway starts in Foxton and follows the Foxton Loop and the northern stopbank of the Moutoa Floodway, ending at the Whirokino Trestle where it joins the Ken Everett Cycleway. A local community group has been formed (the Horowhenua Cycle and Shared Pathways Strategy Group) with plans to link the walkway to Foxton Beach, Shannon and the forestry area to the south of the Manawatu River as a shared path for pedestrians and cyclists.

4.2.8 Ecological Planting

The landowner to the south of the Manawatu River (Lewis Dairies Ltd) has planted along drains connecting to the Manawatu River, with the objective of encouraging inanga spawning. The landowner is keen to preserve this planting and plans to undertake further planting in the future.

4.2.9 Utility Services

Table 4.2.9 lists the known utility services in the vicinity of the study area.

Table 4.2.9: Utility Services		
Owner	**Service**	**Location**
Vector Ltd	Gas transmission pipeline	Carried on western side of Manawatu River Bridge
Transpower New Zealand Ltd	Electricity transmission line	East of SH1, crossing the state highway approximately 1km south of the Manawatu River
Electra Ltd	Overhead power line	Parallel to and west of SH1, crossing the state highway at the Matakarapa Road/Whirokino Road intersection
Chorus Ltd	Fibre optic telecom cable	Within the state highway reserve and carried in ducts on the western side of the Whirokino Trestle and Manawatu River Bridge
	Copper telecom cable	Within the state highway reserve and carried in ducts on the western side of the Whirokino Trestle and Manawatu River Bridge

The gas transmission pipeline is the only utility service with the potential to influence project options. It was constructed in 1968 and remains the sole supply to the Wellington region. A 'loop' under the Manawatu River was constructed in the late 1980's as a contingency measure. A gas main line valve exists on the western edge of the study area south of the southern Moutoa Floodway stopbank.

HDC currently has a wastewater disposal scheme on Matakarapa Island, located to the west of the study area. The resource consent for this facility expires in December 2014. During consultation for this SAR, HDC indicated that it will apply for an extension to its existing resource consent to allow it to continue to operate the scheme while an alternative is identified. One alternative involves a proposed wastewater pipeline carried on the Manawatu River Bridge to a disposal site to the south. If this proposal is preferred by HDC, the potential impact on the Manawatu River Bridge will need to be considered during detailed design.

4.3 Existing Highway Geometry

The study area, including the existing SH1, is shown on Drawing No. 142220/00/P/105, included in Appendix A.

Travelling from north to south, the existing SH1 deviates to the left through approximately 50^{o} on a 450m radius horizontal curve with approximately 8% superelevation, and continues to the southeast on a straight for approximately 350m before deviating to the right through approximately 50^{o} on a 380m radius horizontal curve with approximately 8% superelevation.

The state highway crosses the Whirokino Trestle, the Manawatu River Bridge and the 160m length of embankment between the two structures on a straight before deviating to the left through 26^{o} on a 950m radius horizontal curve with approximately 3% superelevation, and rising on a vertical grade of approximately 1%. A southbound passing lane begins at the start of the horizontal curve and continues for 750m (excluding tapers).

The existing alignment appears to achieve current standards for rural state highways with a design speed of 100km/h, within the limits of measurement accuracy. However, the observed operating speed is approximately 85km/h, due to the narrow bridge widths.

4.4 Traffic Volumes

4.4.1 SH1 Traffic Volumes

Table 4.4.1 presents the traffic volumes recorded at the Transport Agency's count stations on SH1 in the vicinity of the study area.

Table 4.4.1: SH1 Traffic Volumes

Location	Telemetry	2013 AADT	Growth[(1)]	% HCV
Foxton	N	7,583	-5.7%	11.9%
Whirokino	N	7,289	-0.1%	12.8%
North of Levin	N	9,349	-1.4%	10.5%

Note 1: Average annual growth rate based on previous 5 years

The negative growth rate for SH1 indicated by recent counts may be due to the economic recession rather than being an indicator of the long term trend.

HCV growth can only be reliably determined using telemetry data. The nearest telemetry site is Ohau, located approximately 25km south of the study area. Analysis of data collected at this telemetry site over the previous 5 years indicates an average HCV growth rate of -0.5%, although HCV numbers fluctuate from year to year with no pattern evident. This growth rate is consistent with the AADT growth rates in Table 4.4.1.

4.4.2 Local Road Traffic Volumes

Table 4.4.2 presents the traffic volumes recorded by HDC on local roads.

Table 4.4.2: Local Road Traffic Volumes

Location	Telemetry	2008 AADT	Growth[(1)]	% HCV
Matakarapa Road (150m west of SH1)	N	64	0%	N/A
Whirokino Road (100m east of SH1)	N	124	0%	N/A

Note 1: Estimated by Horowhenua District Council

4.5 Crash Data

Table 4.5.1 summarises the crash data from the NZTA Crash Analysis System for the 5 year period from 2009 to 2013 by severity.

Table 4.5.1: Crash History by Time and Severity (2009 – 2013)					
Year	**Fatal**	**Serious**	**Minor**	**Non-Injury**	**Total**
2009	0	1	0	2	3
2010	0	0	2	4	6
2011	0	0	1	1	2
2012	0	1	0	0	1
2013	0	1	1	2	4
Total	**0**	**3**	**4**	**9**	**16**

Table 4.5.2 summarises the crash data from the NZTA Crash Analysis System for the 5 year period from 2009 to 2013 by crash type and severity.

Table 4.5.2: Crash History by Type and Severity (2009 – 2013)						
Movement Category		**Fatal**	**Serious**	**Minor**	**Non-Injury**	**Total**
Overtaking	A	0	0	1	1	2
Head On	B	0	0	0	1	1
Lost Control	C, D	0	2	3	4	9
Obstruction	E	0	0	0	0	0
Rear End	F	0	0	0	2	2
Crossing/Turning	H, J, G, K, L, M	0	1	0	1	2
Pedestrian	N, P	0	0	0	0	0
Miscellaneous	Q	0	0	0	0	0
Total		**0**	**3**	**4**	**9**	**16**

The predominant crash type is Lost Control, accounting for over 50% of all crashes, and 70% of crashes resulting in injury.

Table 4.5.3 summarises the crash data from the NZTA Crash Analysis System for the 5 year period from 2009 to 2013 by crash location and severity.

Table 4.5.3: Crash History by Location and Severity (2009 – 2013)						
Location	**Length**	**Fatal**	**Serious**	**Minor**	**Non-Injury**	**Crash Rate**
Northern Approach	1.37km	0	1	1	4	0.88/km/yr
Whirokino Trestle	1.10km	0	1	1	3	0.84/km/yr
Embankment	0.16km	0	1	0	0	1.25/km/yr
Manawatu River Bridge	0.18km	0	0	0	0	0.0/km/yr
Southern Approach	1.03km	0	0	2	2	0.78/km/yr
Total	**3.84km**	**0**	**3**	**4**	**9**	**0.83/km/yr**

The analysed crashes are reasonably evenly distributed along the length of the study area. This is true both for all traffic movements and for Loss of Control movements. The apparent elevated crash rate on the embankment section and low crash rate on the Manawatu River Bridge are a function of the short length of these sections, and are not considered to be indicative of a high or low trend on these sections.

The following conclusions can be drawn from examination of the individual crash reports:

a) Three crashes are the result of drivers falling asleep. The circumstances of the remaining crashes are unique to each crash;

b) Road alignment appears to be a contributing factor in only one or two crashes;

c) No crashes appear to have resulted from turning movements at the Matakarapa Road/Whirokino Road intersection;

d) Six of the crashes might not have occurred, or would have had less severe outcomes, had there been greater bridge width;

e) Seven of the crashes might not have occurred, or would have had less severe outcomes, had there been roadside and median barriers on the highway.

5. Project Objectives

5.1 Specific Objectives

The Transport Agency's primary project objectives (as stated in the Request for Tender) are to improve safety, efficiency and resilience.

The project is also required to align with the RoNS strategic objectives, including:

a) Build a new road network that demonstrates value for money;

b) Work constructively and collaboratively with other stakeholders;

c) Minimise environmental impact during construction and in operation;

d) Support economic growth and development initiatives at the local and regional levels;

e) Improve safety and reduce journey times.

6. Investigations

This section describes the investigations undertaken as part of this SAR.

None of the investigations eliminated or preferred any route. However, the findings of archaeological investigations make routes to the east of the existing SH1 less attractive than routes to the west.

6.1 Topographical Survey

The Survey Report for the survey undertaken as part of the investigations for this SAR is included as Appendix B.

An accurate Digital Terrain Model and survey of features has been prepared based on LiDAR data. Conventional surveying techniques were used to infill areas where LiDAR data is known to be inaccurate, such as drains, and to identify features such as roads, services and culverts.

6.2 Geotechnical

The Preliminary Geotechnical Appraisal Report and Geotechnical Report for ground investigations undertaken as part of this SAR are included as Appendices C and D respectively. These reports have been based on the following inputs:

a) Review of historic data and interpretation held by HRC and historic bridge drawings made available by the Transport Agency;

b) Geological mapping from site walkover by a senior geotechnical engineer;

c) Geotechnical site investigations and testing undertaken as part of the investigations for this SAR.

Site investigations were staged, with results from initial investigations being assessed to focus subsequent investigations on areas of greatest risk. Stage 1 site investigations consisted of CPTs in 20 locations. At 16 of these locations, a second or third test was performed to verify that the initial CPT refusal at relatively shallow depth was a true limit and not due to an isolated log or boulder. Shallow hand augers were also undertaken at 5 of the CPT locations. Stage 2 site investigations consisted of 9 machine boreholes, 6 of which were performed in close proximity to the CPT locations to allow correlation of data. Single standpipe piezometers were installed in selected boreholes.

Ground conditions broadly consist of multiple layers of silts and sands of varying density, overlain by a shallow layer of peat in the Moutoa Floodway and the adjacent floodplain. Groundwater is generally at or within 1m of the surface under wet winter conditions, and is tidally influenced in the vicinity of the Manawatu River.

A pile founding zone was identified at an approximate depth of 14m at the northern end, 30m in the centre and 16m at the southern end. A deep buried historic river channel accounts for the variation in the depth of the pile founding layer, and increases uncertainty in respect of predicted pile length.

The route is likely to be subject to liquefaction effects under seismic conditions, including lateral spread at river banks, stopbanks and any embankment constructed across the floodplain. The driven concrete piles supporting both existing bridges are potentially vulnerable to lateral spread. The driven concrete piles supporting the existing Manawatu River Bridge, which rely largely on friction rather than end bearing, are also considered to be vulnerable to liquefaction effects.

Investigations to date have not identified any geotechnically preferred alignment, with similar geotechnical challenges present across the full width of the study area.

6.3 Structural

6.3.1 Whirokino Trestle

Extensive investigation of the condition of the Whirokino Trestle has been undertaken as part of the Whirokino Trestle Condition Report produced by Bloxam Burnett and Olliver Ltd in September 1997 and the Whirokino Trestle Bridge Management Plan produced by Bloxam Burnett and Olliver Ltd in November 2013. The key findings of these reports are discussed in Sections 2.1.2 and 4.2.1 above.

No further investigation of the structural condition of the Whirokino Trestle has been undertaken for this SAR.

6.3.2 Manawatu River Bridge

A draft Detailed Seismic Assessment for the Manawatu River Bridge has been developed by Opus International Consultants Ltd. The key findings of this report are discussed in Section 4.2.2 above.

Preliminary analysis of the Manawatu River Bridge undertaken for this SAR has concluded that:

a) The maximum widening of the deck that could be achieved on the existing superstructure would result in 1.5m wide shoulders, 3.5m wide lanes and no median. Such widening would accelerate consumption of the structure's residual fatigue life, due to increased load eccentricity. Structural upgrade of at least the outer steel stringer beams is expected to be required.

b) The deck widening that could be achieved through provision of additional stringer beams and substructure is limited only by cost, and would be more cost-effective if performed on one side of the existing structure only. Such widening has potential to reduce the fatigue risk for existing stringer beams.

c) The existing deck has insufficient capacity to accommodate current generation TL4 or TL5 rigid edge barriers.

A fatigue analysis of the Manawatu River Bridge, in accordance with the requirements of the NZTA *Bridge Manual* and recently published NZTA research, would be a complex exercise beyond the scope of investigations required for this SAR. The decision as to whether to commission a fatigue analysis can be deferred until after the Transport Agency confirms the preferred option (i.e. a fatigue analysis will only be necessary if the preferred option does not include immediate replacement of the Manawatu River Bridge). Even then, a fatigue

analysis is considered to be of questionable value. It is expected that exhaustive analysis would be necessary to have any likelihood of achieving a positive result. The result of any such analysis is unlikely to be positive, and any positive result would need to be viewed with some caution.

Detailed structural inspections of the existing Whirokino Trestle and/or Manawatu River Bridge are beyond the scope of investigations required for this SAR. However, inspections of the Manawatu River Bridge undertaken as part of the regional bridge management contract have identified that repainting and some immediate maintenance (e.g. crack repair, expansion joint replacement, bearing maintenance, etc) would be warranted if the existing structure were retained as part of any option. It would be prudent to perform a detailed inspection of potentially fatigue-critical details on the Manawatu River Bridge prior to committing to any option that retained the existing structure.

6.4 Hydrology and Hydraulics

6.4.1 Drainage and Stormwater Management

The Drainage and Stormwater Management Report undertaken as part of the investigations for this SAR is included as Appendix E.

Limited options exist for stormwater management north of the Manawatu River due to the existing flood control facilities, the very flat terrain and high water table. The more favourable topography and absence of a stopbank south of the Manawatu River provide greater scope for conventional stormwater management methods. Runoff from the deck of the Manawatu River Bridge will be conveyed to one or both ends of the bridge for treatment.

6.4.2 Hydraulics

The Bridge Hydraulics Report undertaken as part of the investigations for this SAR is included as Appendix F.

The Moutoa Floodway and Manawatu River were modelled for the existing, proposed and during construction (with both existing and proposed bridges) situations, based on data provided by HRC. The model predicted that:

a) Under the proposed situation, the upstream water surface would be approximately 10mm lower than existing in the Moutoa Floodway and 200mm lower than existing in the Manawatu River;

b) Under the during construction situation, the upstream water surface would be unchanged from existing in the Moutoa Floodway and approximately 20mm higher than existing in the Manawatu River.

The modelling demonstrates that the difference in effects between the existing situation and the proposed and during construction situations is negligible.

6.5 Archaeological

The Archaeological Assessment undertaken as part of the investigations for this SAR is included as Appendix G.

The assessment identified sites in the immediate and wider vicinity containing artefact types of very significant style, age and rarity, with links to the first Polynesian settlers of New Zealand. In particular, the assessment identified that options to the east of the existing SH1 had potential to impact on the canoe mooring sites (tau waka) located immediately east of the existing Manawatu River Bridge, and the western edge of a pa located in the dunes south of the Manawatu River, including the remnants of its burial ground. Remnants of the previous bridge constructed in 1899 and the earlier ferry jetty are also located immediately to the west and east of the existing Manawatu River Bridge respectively.

The assessment concludes that all options will have the potential to impact on known and potential archaeological features. It identifies that Option 1 is preferable to Option 2 on archaeological grounds, on the basis that for the most part it does not impact on the ferry remnants and 1899 bridge piles. On the same basis, Option 2A will also have lesser archaeological effects than Option 2. However, the assessment identifies that the ferry remnants and the 1899 bridge piles have low heritage significance, and none of the options have impacts on archaeological values so high as to preclude their construction.

For Options 1 and 2, the assessment recommends that excavation of the dunes immediately to the west of the existing state highway and to the south of the river will require archaeological monitoring at the time of topsoil stripping. Archaeological monitoring of earthworks operations is also recommended on the northern and southern banks of the Manawatu River. It is also recommended that an archaeologist is on call in case of discoveries of suspected archaeological material elsewhere on the site during earthworks operations for all options.

An Archaeological Authority from Heritage New Zealand will be required under the Heritage New Zealand Act 2014 to modify or destroy sites affected by construction of the project.

6.6 Ecological

The Ecological Opportunities and Constraints Report undertaken as part of the investigations for this SAR is included as Appendix H.

Sensitive and significant ecological values within the study area are centred on the Manawatu River. This section of the river is used as a migration corridor for a number of fish species, some of which are nationally at risk. The tidally influenced riparian margins of the river have important habitat values for inanga, which are known to spawn in this reach of the river. The peak inanga spawning time is April to mid-June, over which time works that disturb the bed of the Manawatu River will need to be avoided.

The areas of permanent standing water within the Moutoa Floodway are artificial rather than natural water bodies and support prolific macrophyte growth of largely exotic species. The ecological significance of these water bodies is limited to habitat for the at-risk longfin eel. The Ecological Opportunities and Constraints Report recommends that piers for the new Moutoa Floodway bridge should not be placed within the permanent standing water.

The Moutoa Floodway is also likely to provide feeding habitat for a number of bird species, some of which may be at-risk or threatened.

A small modified swamp is located within the state highway reserve, immediately west of SH1 and south of the Manawatu River. Although the swamp supports very few native species and is not ecologically significant under the provisions of the Operative Horizons One Plan, it does have some ecological value due to wetlands being under-represented in the area.. The Ecological Opportunities and Constraints Report recommends that the loss of the swamp should be mitigated by an equivalent area of wetland (0.4 hectares).

The remainder of the study area consists of agricultural pasture grass and some exotic trees with no significant ecological value.

Most of the potential ecologically adverse effects of the project could be avoided through best practice design and construction procedures. Effective implementation of ecological mitigation and remediation measures would minimise the remaining adverse ecological effects of the project. This would include measures to avoid sediment runoff into, and concrete contamination of, the Manawatu River and permanent standing water within the Moutoa Floodway.

6.7 Noise and Vibration

The Route Option Assessment – Traffic Noise and Vibration undertaken as part of the investigations for this SAR is included as Appendix I.

A long duration on-site survey of ambient noise levels was undertaken at the dwellings on one property (Easton) and short duration on-site surveys were undertaken at two other properties (Dixon and Lewis Dairies Ltd).

6.7.1 Road Traffic Noise

Road traffic noise was assessed in accordance with the requirements of NZS 6806:2010 *Acoustics – Road – Traffic Noise – New and Altered Roads*, on the basis of the following noise parameters:

a) Design year of 2027, in compliance with the NZS 6806 requirement for the design year to be 10 years after completion of the project;

b) An average speed of 100km/hr on SH1;

c) 13% HCVs on SH1, 12% HCVs on Whirokino Road and 3% HCVs on Matakarapa Road;

d) Use of medium grade chip seal (e.g. Grade 3/5).

The predicted noise levels at the dwelling on the property owned by Dixon will meet the Category B noise criteria in NZS 6806:2010 for Option 1. Mitigation is not recommended for Option 1 as the traffic noise level is predicted to increase by 1 dBA, which is a negligible change. Options 2 and 2A will not affect the existing noise levels at the Dixon dwelling as the new alignments tie in to the existing state highway further south of the other options.

The predicted noise levels at the dwelling on the property owned by Lewis Dairies Ltd are comfortably less than the Category A noise criteria for all options. Therefore no mitigation is required.

The predicted noise level at the two dwellings on the property owned by Easton will comply with the Category A noise criteria for Options 1, 2 and 2A by a comfortable margin. The increase in noise levels at the dwellings is slightly to moderately adverse for all analysed options. However, as the noise levels will comply with the Category A standards, no mitigation will be required.

6.7.2 Construction Noise

The Route Option Assessment – Traffic Noise and Vibration includes a preliminary assessment of construction noise impacts. The main sources of construction noise are expected to be associated with bulk earthworks, bridge construction and paving/road finishing.

The Route Option Assessment – Traffic Noise and Vibration identifies that the application of NZS 6803:1999 *Acoustics – Construction Noise* will achieve equitable treatment of all affected parties and reasonable noise levels from project construction activities. NZS6803:1999 sets appropriate noise criteria that should be complied with if practicable. Where full compliance is not practicable, then alternative measures should be employed to deal with the potential exceedance to ensure that noise levels are managed and mitigated so as not to exceed a reasonable level.

The Route Option Assessment identifies that the option with the greatest construction noise risk profile is Option 1, particularly in relation to the dwellings on the property owned by Easton. Options 2 and 2A have a comparatively low construction noise risk profile, with the exception of the construction of the upgraded Matakarapa Road/Whirokino Road intersection, which is identified as being a medium construction noise risk in respect of the dwellings on the property owned by Easton.

The Route Option Assessment – Traffic Noise and Vibration recommends that a Construction Noise and Vibration Management Plan should be prepared prior to construction, to establish the measures to be adopted for the management and mitigation of construction noise. Examples given of potential on-site measures include training of personnel, maintenance of equipment, noise barriers and enclosures, and considerate behaviour and use of equipment. Examples of off-site measures include public liaison and communication, temporary barriers, offers of temporary resident relocation and noise level monitoring.

6.7.3 Road Traffic Vibration

The Route Option Assessment – Traffic Noise and Vibration identifies that the only potential source of road traffic vibration will be from HCVs. The assessment notes that there are no current New Zealand standards that address road traffic vibration. The international standard that is generally adopted is the Norwegian standard NS 8176.E:2005 *Measurement of vibration in buildings from land-based transport and guidance to evaluation of its effects on human beings*.

Assessment in accordance with NS 8176.E:2005 predicts that the road traffic vibration effects will be negligible for all receivers.

6.7.4 Construction Traffic Vibration

The Route Option Assessment – Traffic Noise and Vibration identifies that the applicable construction vibration standards are DIN 4150-3:1999 *Structural Vibration – Effects of Vibration on Structures*, the British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* and the Transport Agency's *State Highway construction and maintenance noise and vibration guide* (August 2013). The Transport Agency's guide has Category A criteria that aim to avoid annoyance for receivers and Category B criteria that aim to avoid damage to buildings.

The Route Option Assessment – Traffic Noise and Vibration identifies that the key sources of construction vibration for the project will be heavy construction activities, such as vibratory rollers, piling, and bulldozing. These activities generate vibration levels that can impact on buildings, building occupants and other structures.

Some of the construction activities have the potential to, at times, exceed Category A criteria at the dwellings on the Dixon and Easton properties, but not Category B criteria. For Option 2, significant construction vibration effects at the dwelling on the property owned by Dixon are not expected, due to the separation distance. For all options, construction vibration effects at the dwelling on the property owned by Lewis Dairies Ltd are not expected, due to the distance between the dwelling and the road.

The assessment recommends that a suitably qualified expert should be engaged to monitor vibration effects at potentially affected receivers during construction. It also recommends that a Construction Noise and Vibration Management Plan be prepared to establish the methodology for pro-actively avoiding, or responding to, any vibration issues that may arise during construction.

6.8 Landscape and Visual

The Preliminary Assessment of Landscape and Visual Amenity Effects undertaken as part of the investigations for this SAR is included as Appendix J.

Tall vegetation within the study area is limited to a few existing shelter rows outside the Moutoa Floodway, farm forestry, riparian vegetation, woody dune land vegetation and amenity planting associated with rural dwellings.

The view towards the Tararua Range from southbound SH1 on the northern approach to the Whirokino Trestle is identified as significant on the planning maps in the Operative Horowhenua District Plan. This view will be maintained for SH1 road users. There will be negligible effects in terms of loss of this view from surrounding properties, with the exception of the two dwellings on the property owned by Easton.

The landscape and visual amenity effects on the dwellings on the property owned by Easton are likely to be low for Option 2A, high for Option 2 and very high for Option 1. These ratings are largely due to the proximity of the new Matakarapa Road/Whirokino Road intersection and the associated loss of open space. Mitigation planting would reduce these effects to a small degree.

None of the options proposed in this SAR are expected to have a significant change in overall landscape character. Mitigation planting is recommended within the riparian areas adjacent to the Manawatu River Bridge and at the Matakarapa Road/Whirokino Road intersection. Easton should be consulted during detailed design stage with respect to the location and form of the mitigation planting.

6.9 Cultural

Two separate Cultural Impact Assessments (CIAs) have been prepared by Rangitaane O Manawatu and Ngāti Raukawa. The CIAs are included as Appendix K.

6.9.1 Rangitaane O Manawatu

The CIA prepared by Rangitaane O Manawatu is the initial part of a fuller report which will be completed to accompany the Notice of Requirement and resource consent application. The first stage report provides details of Rangitaane O Manawatu and their connection with the Manawatu River and it includes preliminary recommendations for the Transport Agency to consider. The second part of the report will provide a more detailed cultural analysis and more detailed recommendations.

The CIA identifies that the Manawatu River is the feature of paramount importance to Rangitaane O Manawatu. Rangitaane O Manawatu's focus of occupation was around the Manawatu River, forming settlements and cultivations along the entire course of the river, with the river acting as the main highway for travel and communication purposes for Rangitaane O Manawatu and other iwi. Rangitaane O Manawatu's cultural, spiritual and historical links with the area still exist today.

Rangitaane O Manawatu holds a geographic information system database, which contains sites that are culturally, spiritually and socially important to them. Sites of significance which are identified in the immediate vicinity of the project area are largely to the south east of the existing river bridge, including tau waka (canoe mooring sites) and Koutu Roa Pa. Based on the map provided by Rangitaane O Manawatu, the identified sites are not likely to be directly affected by Options 1, 2 or 2A, which are all located to the west of the existing state highway. However, the CIA notes that sites may be affected or removed as a result of the works.

Environmental and cultural values also need to be preserved, particularly in relation to the Manawatu River. The CIA notes that the river is identified as a site of cultural significance in the Operative Horizons One Plan.

The preliminary recommendations in the first stage CIA include:

a) Development of a formal relationship between the Transport Agency and Rangitaane O Manawatu;

b) Ongoing consultation;

c) Development of an Accidental Discovery Protocol;

d) The opportunity for Rangitaane O Manawatu to name all new roads and bridges;

e) The opportunity for Rangitaane O Manawatu to perform any opening of the new road and bridges in accordance with cultural protocols.

6.9.2 Ngāti Raukawa

A draft CIA has been received from Ngāti Raukawa that identifies the cultural values associated with the area and makes recommendations to the Transport Agency. The CIA remains a draft as its findings and recommendations require discussion with iwi and hapu members prior to the report being finalised. This will occur prior to lodgement of the Notice of Requirement and resource consent application.

The CIA sets out Ngāti Raukawa's strong identification with the Manawatu River and its spiritual mauri or essence. Since Ngāti Raukawa settled in the Manawatu in the early 19th Century, the river has been a very important means of identification, as well as transport and connection between the various pa, kainga and cultivations along its banks. The river was also a rich source of kai, and continued to be long after colonisation. Ngāti Raukawa has significant concerns about the degraded state and poor water quality of the river. Waters within the floodway, known as Te Awa a Ihakara, are also of significance to Ngāti Raukawa.

The CIA identifies sites of significance in the area. In addition to the Manawatu River, these include tau waka (canoe mooring sites) to the south-east of the Manawatu River Bridge and Oturoa Pa which is also south-east of the bridge (also referred to as Koutu Roa Pa). The pa has an associated urupa, located to the west of the pa. The CIA states that further disturbance to the urupa is not expected to result. The Ngāti Raukawa CIA also identifies that there have been archaeological finds in the dune ridges in the local area, including a blackstone adze, a whalebone patu and burials.

The CIA confirms support for the replacement of both bridges as well as the approach upgrades. Ngāti Raukawa would also like cycle/pedestrian access to be provided (including retention of the Ken Everett Cycleway within the floodway), a rest area retained on the southern river bank to provide access to the river and the Awahou Conservation Area, and retention and enhancement of the swamp within the rest area.

Suitable construction methods need to be adopted to maintain water quality in the Manawatu River and to avoid impacts on whitebait spawning. Ngāti Raukawa would like water quality to be improved where opportunities may exist.

Ngāti Raukawa's recommendations include:

a) Ongoing consultation;

b) Development of an Accidental Discovery Protocol (including monitoring by iwi/hapu);

c) Preservation and commemoration of the piles from the pre-1900 ferry;

d) Establishment of pou at either end of the bridges to represent either the two taniwha in the area or the two birds which the area is known for;

e) Discussion about a possible protocol for the removal of the existing bridges, such as a poroporoaki.

Other recommendations made by Ngāti Raukawa which are not considered to be practical or achievable, or which are outside of the scope of this project, include:

i) Provision of cycleways and walkways on the new floodway and river bridges;

ii) Provision of road access to Matakarapa Marae via upgrades to Matakarapa Road;

iii) Improved road access to the Awahou Conservation Area;

iv) Provision of a rest area to the north of the new floodway bridge.

These matters will need to be discussed as part of the further consultation which will be undertaken with Ngāti Raukawa.

7. Design Standards and Parameters

7.1 Geotechnical

Table 7.1.1 presents the estimated geotechnical design parameters, which will require confirmation at detailed design stage.

Table 7.1.1: Estimated Geotechnical Design Parameters					
Material	**Bulk Density**	**Effective Cohesion**	**Effective Friction**	**Undrained Shear Strength**	**Young's Modulus**
Peat	11kN/m^3			20 - 60kPa	N/A
Upper silts	17kN/m^3	3kPa	25^o	20 - 100kPa	2 - 8MPa
Loose to medium dense sands	17kN/m^3	0kPa	30^o		12 - 20MPa
Dense to very dense sands	19kN/m^3	0kPa	36^o		60 - 80MPa
Lower silts	17kN/m^3	3kPa	25^o	20 - 100kPa	2 - 8MPa
Refusal layer	20kN/m^3	0kPa	38^o		80 - 100MPa
Dune sands	17kN/m^3	0kPa	33^o		N/A
Stopbank fills	17kN/m^3	3kPa	25^o	20 - 100kPa	2 - 8MPa

An ultimate end bearing capacity of 12MPa is recommended at the pile founding depth. Skin friction capacity to the CPT refusal depth should be ignored, due to potential liquefaction effects.

7.2 Geometrics

The geometric standards in the following references have been applied:

a) State Highway: AustRoads *Guide to Road Design*;

b) Local Roads: HDC *Development Manual*;

c) Vehicle Entrances: NZTA *Planning Policy Manual*.

Full sight line offsets have been provided (i.e. manoeuvre sight distance provisions not required).

At the instruction of the Transport Agency, two cross-sections for SH1 have been considered for each option, as defined in Table 7.2.1, to inform decisions about the preferred cross-section taking into account project objectives, environmental factors and cost.

Table 7.2.1: Highway Cross-Sections			
Element	**Existing Cross-section**	**Cross-section H1**	**Cross-section H2**
Grassed Berms	0.0m	0.5m	0.5m
Sealed Berms	0.0m	1.0m	1.0m
Shoulders (barrier face to edgeline)	1.5m to 2.0m	3.0m with wire rope barrier[(1)]	3.0m with wire rope barrier[(1)]
Traffic Lanes	3.5m	3.5m	3.5m
Median	0.0m with no median barrier	1.5m with wire rope barrier[(1)]	0.0m with no median barrier
Total Carriageway Width		**16.7m**	**15.2m**

Note 1: At the instruction of the Transport Agency, left side and median side shoulder widening to provide sight distance past barriers on curves to low height objects has not been applied.

7.3 Structures

The NZTA *Bridge Manual*, including all amendments and provisional amendments issued by the Transport Agency to date, has been the primary reference for the conceptual design of all structures.

The minimum soffit level of each bridge under each option has been established from hydraulic modelling results, and includes allowance for climate change and debris clearance.

At the instruction of the Transport Agency, two bridge cross-sections have been considered for each option, as defined in Table 7.3.1, to inform decisions about the preferred cross-section taking into account project objectives and cost.

Table 7.3.1: Bridge Cross-Sections

Element	Existing Cross-section	Cross-section B1	Cross-section B2
Edge Barrier(1)	0.48m/0.71m(2)	0.5m(3)	0.5m(3)
Shoulders (barrier face to edgeline)	0.16m	2.0m	2.0m
Traffic Lanes	3.5m	3.5m	3.5m
Median	0.0m with no median barrier	1.5m with wire rope barrier	0.0m with no median barrier
Total Bridge Deck Width	**8.28m/8.74m(2)**	**13.5m**	**12.0m**

Note 1: A TL5 barrier is provided on all new bridges for Options 1 and 2. A TL4 thrie-beam edge barrier is provided on both sides of the existing Manawatu River Bridge under Option 2A, providing the performance standard required by the NZTA *Bridge Manual* and remaining within the capability of the existing bridge deck, but falling short of the TL5 preference identified by NZTA.

Note 2: The Whirokino Trestle has 0.48m wide barriers resulting in a total bridge deck width of 8.28m. The Manawatu River Bridge has 0.71m wide barriers resulting in a total bridge deck width of 8.74m.

Note 3: 0.65m width for left edge barrier (new) and 1.0m width for right edge barrier (existing) provided on the Manawatu River Bridge under Option 2A.

To provide a consistent experience for road users, cross-sections B1 and B2 have only been considered in combination with cross-sections H1 and H2 (as defined in Section 7.2) respectively (e.g. B1/H2 and B2/H1 cross-section combinations have not been considered).

7.4 Hydrology and Hydraulics

7.4.1 Drainage and Stormwater Management

Stormwater management will be designed in accordance with the requirements of the NZTA *Stormwater Treatment Standard for State Highway Infrastructure*.

Culverts will be constructed beneath the proposed state highway embankment on the existing drains to maintain continuity and preserve the integrity of the existing land drainage systems. These culverts will be designed with sufficient capacity to convey design flows, without heading up to a level higher than the top of the existing drains. The design flow will be based on the full flow capacity of the existing drain.

7.4.2 Hydraulics

The Moutoa Floodway Bridge and Manawatu River Bridge have been developed to accommodate the existing flood protection scheme. The hydraulic performance of the new bridges will meet the criteria specified in the NZTA *Bridge Manual*, as refined during consultation with HRC.

The design event is the 100-year flood event, as defined by HRC. The flows were increased by 20% to take account of climate change, as requested by HRC. Tidal influences are negligible.

7.5 Traffic Services

Technical Memorandum TM-2013 has been applied in respect of transition details from wire rope barrier to W-section barrier.

7.6 Maintenance

Fill batter slopes of 2:1 are considered suitable for grazing. This standard is consistent with that adopted for the Huntly Section of the Waikato Expressway.

Berms are to be surfaced for a distance of 1.0m behind the wire rope edge barriers to facilitate vegetation control.

8. Options

Alignment options are shown on Drawing No. 142220/00/P/106, included in Appendix A.

8.1 Option Identification Process

8.1.1 Do Minimum

The Do Minimum was developed to meet the definition in the NZTA *Economic Evaluation Manual*, Section 2.7, being the minimum level of expenditure required to maintain a minimum level of service.

Replacement of the Whirokino Trestle is considered an essential element of the Do Minimum. There can be little doubt that the structure will require replacement within the analysis period, the only question is in respect of the timing of the replacement. The Do Minimum is based on replacement by 2023, taking into account:

a) The current maintenance strategy;

b) The nationally strategic nature of this section of SH1;

c) The unacceptable consequences of unplanned closure of this section of SH1 for an extended period due to structural failure.

Replacement of the Manawatu River Bridge at the end of its 100 year design life is considered to be a reasonable assumption. The Do Minimum is based on replacement by 2042, taking into account:

i) The risk of fatigue in the structural steel superstructure limiting the likelihood that the service life will significantly exceed the design life;

ii) The nationally strategic nature of this section of SH1;

iii) The unacceptable consequences of unplanned closure of this section of SH1 for an extended period due to structural failure.

8.1.2 Options

Options to the east of the existing SH1 alignment were discarded for the reasons described in Section 8.6.3 below.

Option 1A was identified as the most obviously logical option, being the shortest distance between two points. Options to the west of Option 1A, including Option 9-2 identified in the PFR, were discarded as being higher cost than options to the east of Option 1A with no additional benefits.

The requirement for SH1 to remain operational throughout construction precludes online replacement. Option 2 was identified as the next best alternative, being replacement immediately adjacent to the existing SH1.

Option 1 was identified as one of many possible alignments to the west of Option 2 and east of Option 1A, and was selected to reduce bridge length from Option 1A and reduce the effects of Option 1A on the two existing dwellings on the property owned by Easton.

Option 2A was identified as a low cost option addressing some of the less desirable or sensible aspects of the Do Minimum (e.g. widening of the existing Manawatu River Bridge to provide a consistent cross-section along the project length).

8.2 Do Minimum

The Do Minimum involves the continued use of the existing state highway, until such time as replacement of the Whirokino Trestle and Manawatu River Bridge becomes essential.

The existing Whirokino Trestle will be maintained until the end of its service life in 2023, at which point a replacement bridge will be opened to traffic. The replacement bridge will extend between the stopbanks of the Moutoa Floodway and be on the same alignment as Option 2A. It will have the absolute minimum cross-section permitted by the NZTA *Bridge Manual* for traffic volumes exceeding 4,000 AADT, being 1.2m wide shoulders, 3.5m wide traffic lanes and no median.

The existing Manawatu River Bridge will be maintained throughout the remainder of its design life, including repainting every 15 years. It will not be widened, nor will it be strengthened to accommodate HPMV loads. A replacement bridge will be opened to traffic in 2042. It will be on the same alignment as Option 2 and have the have the absolute minimum cross-section permitted by the NZTA *Bridge Manual* for traffic volumes exceeding 4,000 AADT, being 1.2m wide shoulders, 3.5m wide traffic lanes and no median.

The Do Minimum would have limited effects on state highway traffic, with only short term impacts during construction of the tie-ins at either end of the project.

8.3 Option 1

Option 1 involves replacement of both the Whirokino Trestle and the Manawatu River Bridge on an alignment to the west of Option 2 and east of Option 1A.

The realigned SH1 would:

a) Tie into the existing SH1 to the north on a horizontal curve of radius 800m;

b) Cross the property owned by Koputara Farm Ltd. A new, larger agricultural underpass would be provided to connect the two parts of the property severed by the realigned state highway and the existing at-grade crossing removed;

c) Encroach on the property owned by Barnett;

d) Cross the Moutoa Floodway on a new 630m long bridge with a skew of approximately 15^{o};

e) Cross the property owned by Easton. A new agricultural underpass on the existing farm race alignment would provide connectivity between the two parts of the property severed by the realigned state highway;

f) Cross Whirokino Road and the Manawatu River on a new 230m long bridge with a skew of approximately 26^{o};

g) Cross the existing state highway reserve, destroying the existing swamp;

h) Encroach on the property owned by Lewis Dairies Ltd;

i) Tie into the existing SH1 to the south on a horizontal curve of radius 1,100m.

Left in/left out access from SH1 would be provided to Matakarapa Road and Whirokino Road in both directions.

The Ken Everett Cycleway would not be retained and a new shared path would not be constructed.

The existing rest area south of the Manawatu River would be relocated to the redundant state highway embankment.

This option would have limited effects on state highway traffic, with only short term impacts during construction of the tie-ins at either end of the project.

8.4 Option 2

Option 2 involves replacement of the Whirokino Trestle Bridge and Manawatu River Bridge on an alignment immediately to the west of the existing SH1.

The realigned SH1 would:

a) Tie into SH1 immediately north of the Moutoa Floodway on a horizontal curve of radius 450m;

b) Cross the Moutoa Floodway on a new 615m long bridge with a skew of approximately 5^{o};

c) Cross the property owned by Easton. A new agricultural underpass on the existing farm race alignment would provide connectivity between the two parts of the property severed by the realigned state highway;

d) Cross Whirokino Road and the Manawatu River on a new 225m long bridge with a skew of approximately 16^{o};

e) Cross the existing state highway reserve, destroying the existing swamp;

f) Encroach on the property owned by Lewis Dairies Ltd;

g) Encroach on the property owned by NZ Guardian Trust;

h) Tie into the existing SH1 to the south on a horizontal curve of radius 1,300m.

Left in/left out access from SH1 would be provided to Matakarapa Road and Whirokino Road in both directions.

The Ken Everett Cycleway would be retained and converted to a shared path.

The existing rest area south of the Manawatu River would be relocated to the redundant state highway embankment.

The existing horizontal curves on SH1 north of the Moutoa Floodway have largely been retained, for the following reasons:

i) The recorded crash record on the curves does not differ significantly from other parts of the study area;

ii) Reworking the curves so soon after the Foxton South Curves project carries a reputational risk for the Transport Agency;

iii) Economic efficiency is maximised by limiting the works to those necessary to address the problems identified in Section 3 above (i.e. the primary objective of the project is to replace the Whirokino Trestle, not to improve the state highway alignment).

This option would have limited effects on state highway traffic, with only short term impacts during construction of the Matakarapa Road/Whirokino Road intersection and the tie-ins at either end of the project.

8.5 Option 2A

Option 2A involves replacement of the Whirokino Trestle Bridge on an alignment immediately to the west of the existing SH1, widening and underpinning of the existing Manawatu River Bridge, strengthening of the existing Manawatu River Bridge to accommodate HPMV loads and replacement of the Manawatu River Bridge at the end of its design life in 2042.

The realigned SH1 would:

a) Tie into SH1 immediately north of the Moutoa Floodway on a horizontal curve of radius 450m;

b) Cross the Moutoa Floodway on a new 615m long bridge with a skew of approximately 5^{o};

c) Cross the property owned by Easton. A new agricultural underpass on the existing farm race alignment would provide connectivity between the two parts of the property severed by the realigned state highway;

d) Cross the realigned Whirokino Road on a new 24m long bridge;

e) Tie into the existing SH1 north of the Manawatu River Bridge on reverse horizontal curves of radius 2,400m;

f) Cross the Manawatu River on the existing structure, with widened deck and strengthened to accommodate HPMV loads.

Left in/left out access from SH1 would be provided to Matakarapa Road and Whirokino Road in both directions.

The Ken Everett Cycleway would be retained and converted to a shared path.

The existing horizontal curves on SH1 north of the Moutoa Floodway have largely been retained, for the reasons listed in Section 8.4 above.

As the existing Manawatu River Bridge deck has insufficient capacity to accommodate a TL5 rigid edge barrier, a TL4 thrie-beam edge barrier would be provided.

The works to the existing Manawatu River Bridge required by this option would necessitate speed restrictions on SH1 during construction, expected to result in only minor traffic delays.

8.6 Other Macro-Options

The following macro-options were considered and discarded during the investigation process.

8.6.1 Option 1A

Option 1A comprises a straight tangential to the curves at either end of the study area.

This option has a superior geometric alignment to the analysed options described above, which avoids any impact on the property owned by Barnett and minimises the impact on the swamp to the south of the Manawatu River. However, it was discarded for the following reasons (in assessed order of importance):

a) It has significant adverse effects on the land utilisation and drainage of property owned by Koputara Farm Ltd;

b) It has longer bridges and embankments than the analysed options, and requires the relocation of the two existing dwellings on the property owned by Easton. The expected construction cost is estimated to be at least $1.1M more than Option 1 and at least $6.7M more than Option 2;

c) It does not offer any quantifiable benefits over Option 1;

d) It crosses the riparian strip administered by DOC and subject to a claim under the Treaty of Waitangi, which would introduce the risk of significant delays to the land acquisition process;

e) It does not preclude a future eastern bypass of Foxton, but it would result in a sub-optimal horizontal alignment if the bypass was constructed.

8.6.2 Option 9-2

Option 9-2 was one of two options identified in the PFR. The alignment consists of an extension of the straights at either end of the study area, joined immediately south of the Moutoa Floodway by a single large radius horizontal curve. It is the western-most option considered.

This option has a superior geometric alignment to other options, which makes use of a paper road to minimise impacts on the properties owned by Barnett and Koputara Farm Ltd. However, it was discarded for the following reasons (in assessed order of importance):

a) It has longer bridges and embankment than the analysed options, and a horizontal curve on the new bridge crossing the Moutoa Floodway. The expected construction cost is estimated to be at least $5M more than Option 1 and at least $9M more than Option 2;

b) It was strongly opposed by Vector Ltd, due to its close proximity to the gas main line valve and the proximity of the gas transmission pipeline to the southern abutment piles for the proposed bridge across the Moutoa Floodway. The cost of relocating the gas transmission pipeline and main line valve away from the alignment would be prohibitive;

c) It was strongly opposed by Lewis Dairies Ltd, due to the significant land severance, increased road noise at the dwelling, and removal of established ecological planting;

d) It crosses the riparian strip administered by DOC and subject to a claim under the Treaty of Waitangi, which would introduce the risk of significant delays to the land acquisition process;

e) It does not avoid the need to acquire land from Barnett and Koputara Farm Ltd, as the width of the paper road is insufficient to accommodate the state highway embankment.

8.6.3 Eastern Options

Options to the east of the existing SH1 were discarded for the following reasons (in assessed order of importance):

a) They would potentially impact on archaeological sites, including the tau waka (canoe mooring sites) and jetty remnants on the banks of the Manawatu River, and the pa and burial ground in the dunes to the south of the Manawatu River, which are of significant cultural importance;

b) They do not offer any benefits over options to the west of the existing SH1. Relocation of the gas transmission pipeline would still be required, unless the existing Manawatu River Bridge was to be retained;

c) They would potentially have a greater impact than the analysed options on the permanent standing water within the Moutoa Floodway, which is of cultural and ecological interest;

d) They would potentially impact on the electricity transmission lines owned by Transpower;

e) They would impact on one additional property (Davis Dry Holdings Ltd) located to the north of the Moutoa Floodway, and two additional properties (Langburn Holdings Ltd and Turner/Wehipeihana) located to the south of the Manawatu River.

8.6.4 Total Bridging Option

The existing Whirokino Trestle spans the Moutoa Floodway and almost the full width of the adjacent floodplain, with only a 160m length of embankment between it and the Manawatu River Bridge. Several consulted parties expressed concern over the potential route security and drainage impacts of an embankment over the floodplain.

This option consists of a replacing the Whirokino Trestle with a new bridge of the same length. It was discarded for the following reasons (in assessed order of importance):

a) The bridge is significantly longer than the analysed options, estimated to increase the expected construction cost by approximately $20M.

b) In the event of stopbank failure north of the new bridge, the hydraulic difference between a bridge and embankment over the floodplain is very small. The proposed agricultural underpass on the Easton property and the culverts installed to maintain the function of the existing drainage scheme will further reduce the hydraulic difference.

c) In a seismic event, in the absence of ground improvements, an embankment would be susceptible to liquefaction. However, it is expected that temporary access could be restored relatively quickly.

8.7 Other Micro-Options

The following micro-options were considered and discarded during the investigation process.

8.7.1 Separate Cycle and Pedestrian Facilities across the Manawatu River

Options 2 and 2A retain the Ken Everett Cycleway, and convert it to a shared path.

This option consists of extending this facility to provide separated cyclist and pedestrian passage across the Manawatu River. However, it was discarded for the following reasons (in assessed order of importance):

a) The proposed 2m wide sealed shoulders are considered to provide safe and convenient passage across the Manawatu River, given the demand for cycling in this location. The 'Safer Journeys For People Who Cycle' report developed by the Cycling Safety Panel demonstrates that shoulder widths of between 0m and 1m present the greatest risk to cyclists.

b) There are no cycle or pedestrian facilities south of the Manawatu River, either within the state highway corridor or on adjacent land (i.e. the facility risks becoming a 'bridge to nowhere'). In particular, it is noted that the riparian strip administered by DOC, which the Horowhenua Cycle and Shared Pathways Strategy Group aspires to incorporate into the local pathway network, is the subject of a claim under the Treaty of Waitangi.

c) It is estimated to increase the expected construction cost by at least $1.5M for a separate cycle bridge or $1.2M for widening of the Manawatu River Bridge.

8.7.2 Closure of Matakarapa Road/Whirokino Road Intersection

This option would involve removing the existing connections between SH1 and Matakarapa Road/Whirokino Road. Grade separation would be provided to allow through movements between Matakarapa Road and Whirokino Road. This option was discarded for the following reasons (in assessed order of importance):

a) The length of the alternative route is likely to attract opposition from residents and Manawatu River users, with the journey to Foxton being increased from approximately 4km to 17km;

b) It would likely require the upgrade of local roads to provide safe and convenient access to Foxton-Shannon Road.

9. Consultation

9.1 Overview

Consultation with key stakeholders, directly affected landowners, other potentially affected people and organisations and the local community has been undertaken to inform and develop the identified options, to consider the advantages and disadvantages of the options and to assess the potential effects. Consultation has also assisted in gaining a better understanding of the key issues and the likely processes for the statutory approvals that will be required.

9.2 Consultation Approach

The preferred method of consultation with potentially affected landowners and key stakeholders was individual meetings at their residence or business. The following items outline the consultation process followed for individual meetings with these parties:

a) Initial phone contact was made with potentially affected landowners and key stakeholders. The project was briefly explained and their interest in the project confirmed. Meeting arrangements were made to provide full details of the project;

b) At the meetings, the consulted party was provided with an outline of the project status, contact details and details of the project. Consultation was often issue-specific or targeted to the consulted party's area of interest;

c) Notes were recorded at all meetings and key issues reported to the project team. The project team actioned all undertakings recorded in the meeting notes;

d) Telephone/written contact and further meetings with each consulted party were undertaken as appropriate. All communications were recorded in writing.

For some stakeholders, individual meetings were not deemed to be necessary and consultation was undertaken through telephone, letters and emails.

Consultation with tangata whenua focussed on identifying:

a) Any areas of cultural importance and significance to tangata whenua that exist in the study area, including waahi tapu sites;

b) Any issues or adverse effects of the project on tangata whenua values, interests and associations which tangata whenua indicate are a concern to them;

c) Measures to avoid, remedy, or mitigate any adverse effects of the project on identified cultural values, interests and associations during consultation.

Guidance has been provided by the Transport Agency's cultural liaison consultant, Mahara Okeroa, as to which tangata whenua groups should be consulted in relation to this project. Hui have been held and have been attended by all of the groups who have expressed an interest in the project including Ngāti Takihiku, Ngāti Rakau, Turanga, Te Au, Muaupoko, Ngāti Ngarongo, Ngāti Whakatere, Ngāti Kauwhata, Ngāti Kikopiri, Cook whanau, Ngāti Huia and Rangitaane O Manawatu. Consultation with tangata whenua will need to be ongoing throughout the duration of the project.

Consultation with the local community was undertaken in the form of a project newsletter and a public information day held in Foxton.

9.3 Feedback and Responses

The specific issues raised during consultation with stakeholders, landowners/lessees, tangata whenua and the local community are summarised in Sections 9.4, 9.5 and 9.6 below.

Records of all meetings and other forms of consultation undertaken as well as detailed feedback and responses from all consulted parties are contained within the Consultation Report included as Appendix L.

The records of consultation with tangata whenua are contained within the Consultation Report included as Appendix L, and the Statement of Identified Maori Interest included as Appendix M.

9.4 Consulted Parties – Stakeholders

Consulted stakeholders and their issues of specific concern are presented in Table 9.4.1.

Table 9.4.1: Consulted Parties - Stakeholders

Party/Stakeholder	Specific Issues
Horowhenua District Council - Dorstan Hayman (Planning Services Manager) - Kevin Peel (Roading Services Manager) - Gallo Saidy (Asset Manager)	• Local road access. No concerns raised with the preliminary design for the local road access proposed for the various options. • Don't see any need to retain the existing cycleway if alternative facilities are provided on the new road/bridges. • Would like the bridge to be designed for services to be attached to it if required in the future. • Alteration to designation requirements.
Horizons Regional Council - Peter Blackwood (Manager Investigations & Design) - Paul Joseph (Area Engineer) - Leana Shirley (Consent Planner)	• Moutoa Floodway capacity, operation and design requirements. • Manawatu River design requirements. • Flood contingency measures during construction. • Access to stopbanks. • Effects on the Manawatu River. • Resource consent requirements.
Tangata Whenua - Ngāti Takihiku - Ngāti Rakau - Turanga - Te Au - Muaupoko - Ngāti Ngarongo - Ngāti Whakatere - Ngāti Kauwhata - Ngāti Kikopiri - Cook whanau - Ngāti Huia - Rangitaane O Manawatu	• Areas of archaeological and cultural significance (areas of settlement (pa), burial, canoe mooring sites (tau waka), food gathering sites, flora and fauna). • Effects on the Manawatu River and watercourses within the Moutoa Floodway, including aquatic ecology and water quality. • Desire to be consulted throughout the duration of the project. • Commemorations on the new bridges (e.g. pou). • Treaty claims related to Crown land south of the Manawatu River administered by DOC. • Maintain access to the Manawatu River and nearby Crown land administered by DOC.

Table 9.4.1: Consulted Parties - Stakeholders	
Party/Stakeholder	**Specific Issues**
Vector Ltd - Darryl McMillan (Land Management Coordinator) - John Fang (Pipeline Integrity Engineer)	• Impact on existing gas transmission pipelines. • Relocation of gas transmission pipeline if Manawatu River Bridge is replaced. • Resource consent issues.
Department of Conservation - Chris Lester (Conservation Partnerships Manager)	• Process associated with acquisition of Crown land administered by DOC expected to be difficult due to claim under Treaty of Waitangi. If part of the land is to be taken under the Public Works Act for a bridge/road, DOC would need to receive and consider an application for the Minister of Conservation's consent. • Ecological effects, particularly related to the Manawatu River.
Fish and Game New Zealand - Stacey Tahere (RMA Officer)	• Ecological effects, including impacts on trout in the Manawatu River. • Impacts on recreational fishing in the Manawatu River. • Maintain access to the river. • Impacts on hunting of game birds in the Moutoa Floodway between April and June.
Manawatu Power Boat Club - Christine Hanning (Committee Member)	• Impacts on the recreational use of the river and the boat ramp. • Safe access to Matakarapa Road is important for cars and trailers. • Access and limitations during construction.
Heritage New Zealand - Kathryn Hurren (Regional Archaeologist)	• Impacts on potential archaeological sites including dunes and levees and known archaeological sites including remnants of the previous bridge constructed in 1900. • The dunes to the south of the Manawatu River have high archaeological potential. The dunes may contain substantial archaeological material relating to Pre European Maori settlement noted in the historic records. • For options which will affect the dunes, further archaeological work is suggested to identify the possible archaeological makeup of the study area so that appropriate mitigation or archaeological work can be developed.
Emergency Services - NZ Police - NZ Fire Service - St John Ambulance	• St John requires details about temporary travel restrictions during construction to manage deployment. • NZ Fire Service would like route security to be enhanced by replacing the Manawatu River Bridge, and by bridging the Moutoa Floodway and adjacent floodplain to the south. • NZ Police have advised that they have no comments.

Table 9.4.1: Consulted Parties - Stakeholders	
Party/Stakeholder	**Specific Issues**
Road User Associations - Heavy Haulage Association - Road Transport Association - Road Transport Forum - Automobile Association	• The Automobile Association initially advised that they would like an eastern alignment considered to future-proof the route for a long term bypass of Foxton. They have more recently advised that they support the realignment options to the west of the existing state highway due to the factors weighing against an eastern option. • The Heavy Haulage Association is supportive of the replacement of both bridges. They have reviewed the proposed cross sections and would like additional highway width to accommodate over-dimension loads. They also have concerns that a wire rope median barrier will compromise the transportation of over-dimension and overweight loads. • No consultation feedback has been received from the Road Transport Association or the Road Transport Forum.
Fonterra - Nigel Nichols (Business Analyst)	
School Bus Operators - Madge Coachlines - Manawatu College	
Horowhenua Cycle and Shared Pathways Strategy Group - Janine Smart (Interim Chair)	• Needs to consider the planned creation of a 'shared pathways' (walkers and cyclists) network throughout the district. • Want physically separated cycle lanes included on both bridges, similar to Atiamuri Bridge on SH1. • Consider connections to/from the walkway on the northern stopbank which eventually may form part of a link from Foxton Beach to Shannon, safe travel across the floodway with connections to Whirokino Road and Matakarapa Road, safe travel across the Manawatu River and a future shared path from the southern side of the river westward toward the forest and beach.

Full contact details for the consulted stakeholders are appended to the Consultation Report included as Appendix L.

9.5 Consulted Parties – Landowners/Lessees

Consulted landowners/lessees and their issues of specific concern are presented in Table 9.5.1. The location of the properties which are owned/leased by the parties in Table 9.5.1 is shown on Drawing No. 142220/00/P/105 in Appendix A.

Table 9.5.1: Consulted Parties – Landowners/Lessees	
Party/Stakeholder	**Specific Issues**
S & C Cull	• Property access, including impacts on the existing property access to SH1. • Drainage, including impacts on the existing pumped drainage schemes in the area with suitable provision so as not to worsen drainage from the upstream properties.

Table 9.5.1: Consulted Parties – Landowners/Lessees	
Party/Stakeholder	**Specific Issues**
Koputara Farm Ltd	• Land requirement. • Property access, including: - Access between the parts of the title which are severed by SH1 and which currently rely on access via a cattle underpass and farm gates either side of SH1. If the farm gate access is removed then the landowner requires a larger underpass to accommodate large machinery. - Access from the existing paper road. • Preference for Option 2. Option 1A is least preferred by the landowner due to the property impacts of severing the land and leaving a small area to the west of the new highway that would be unsuitable for cropping. • Drainage, including impacts on the existing pumped drainage arrangement.
Himatangi Station Ltd	• Property access, including access from the existing paper road. • Drainage, including impacts on the existing pumped drainage arrangement.
E Barnett (landowner) M Huzziff (lessee)	• Land requirement. • Property access, including access between the parts of the title which are severed by SH1 and which currently rely on access via a cattle underpass and farm gates either side of SH1. If the farm gate access is removed then the landowner requires a larger underpass to accommodate large machinery. • Drainage, including impacts on the existing pumped drainage arrangement. • Preference for Option 1A. Option 2 is least preferred by the landowner due to the property impacts of severing the land and leaving a small area to the west of the new highway that would be unsuitable for cropping.
Easton Dairy Ltd	• Land requirement. • Impact on two existing houses. If the houses are directly affected (i.e. Option 1A) then the landowner would like them to be replaced/relocated in a suitable location above the flood level of the surrounding land. The houses are functional and hold no sentimental value. • Property access, including access between the titles either side of SH1. The landowner wants an underpass built in the location of the existing farm race suitable for a tractor (with cab) and other farm machinery. • Drainage, including: - Impacts on the existing pumped drainage arrangement. - Impacts on tile (subsoil) drains. - Suitable provision for drainage beneath the new fill embankment. • Preference for the cycleway to be moved onto the new road with the existing cycleway closed.

Table 9.5.1: Consulted Parties – Landowners/Lessees	
Party/Stakeholder	**Specific Issues**
Lewis Dairies Ltd	• Comfortable with Options 1, 1A and 2 which will all have minimal land requirements. Opposed to any alternative alignments closer to the existing house. • Property access, including strong opposition to a central wire rope barrier extending beyond the existing entranceway. • Potential impacts on drains which have been planted as part of an ecological enhancement project for inanga spawning.
NZ Guardian Trust	• Telephone contact has been made with NZ Guardian Trust but no feedback has been provided.
Langburn Holdings Ltd	• Property access, including potential turning restrictions from a wire rope median barrier. The landowner is opposed to a left in/left out arrangement to their existing farm access, particularly as they intend on building a house that will utilise the access.
B Burling, G Burling, S Burling, S Fordyce, G Baker	• Property access, including the need to accommodate truck access to the existing stock yards which are located adjacent to a paper road. The landowner is opposed to restricted left turn in/out turning from the paper road due to inconvenience, especially for trucks. • Drainage.
M & M Dixon	• Property access, including concern with the idea of forming the existing paper road opposite Newth Road to provide access to the northern properties within the study area. If an alternative access is required from opposite Newth Road the landowner would consider relocating the existing dwelling further away from the road to enable a new local road to be constructed parallel to SH1. Preference is to form the paper road that currently provides access to some of the properties and retain their existing entrance. • Drainage, including impacts on the existing pumped drainage arrangement.

Full contact details for the consulted landowners and lessees are appended to the Consultation Report included as Appendix L.

9.6 Consultation – Local Community

A public information day was held at the Foxton War Memorial Hall on 13 November 2014 to capture stakeholder issues by sharing project information, and to seek public feedback on proposed solutions.

Displays at the information day included facts about the project, details of the investigations that had been, or were being, undertaken and preliminary design drawings of the options and cross sections. The display posters are appended to the Consultation Report included as Appendix L.

The attendance register records that 118 people attended the information day. However, actual attendance numbers were considered to be closer to 140 people.

A list of the information day participants and a record of feedback received from the information day are contained within the Consultation Report. The feedback received demonstrates that there is a very strong level of support for the project. The majority of

feedback received supported replacing both the Whirokino Trestle and the Manawatu River Bridge. Of the 64 responses received, only one respondent considered strengthening and upgrading the Manawatu River Bridge to be a better option than full replacement of the bridge. The reasons for these views were not substantiated.

Based on the feedback, Option 1A was preferred by many people over the other options due to it being the most direct route. However, some of the comments received identified the importance of considering other factors such as cost and property impacts. It is noted that full details about the relative merits and economics of each option were not presented at the information day as the investigations were ongoing.

A range of other views were also expressed, including requests for a higher standard of provision for cyclists such as a physically separated cycleway alongside the road, and suggestions from some attendees that a more comprehensive four laning solution should be progressed.

10. Property Requirements

10.1 Land Requirement

The land requirement for Option 1 is shown on Drawings 142220/00/P/401 and 142220/00/P/402. Option 1 affects 8 land parcels and 5 individual landowners.

The land requirement for Option 2 is shown on Drawings 142220/00/P/421 to 142220/00/P/423. Option 2 affects 8 land parcels and 6 individual landowners.

The land requirement for Option 2A is shown on Drawings 142220/00/P/431 and 142220/00/P/432. Option 2A affects 6 land parcels and 4 individual landowners.

All land requirement plans have been developed on the basis of the Scheme Design and are subject to change as the design develops.

Table 10.1.1 summarises the land required by each option.

Table 10.1.1: Land Requirement

Owner	Legal Description	Option 1	Option 2	Option 2A
Crown	Pt Sect. 425 Town of Foxton	0.07ha	Nil	Nil
	Pt Sect. 428 Town of Foxton	0.49ha	0.84ha	0.84ha
	Sect. 645 Town of Foxton	0.15ha	0.11ha	0.11ha
	Pt Lot 1 DP3002	3.88ha	2.48ha	2.48ha
EH Barnett	Pt Sect. 428 Town of Foxton	0.61ha	1.50ha	1.50ha
JD & GP Easton	Pt Lot 1 DP3002	5.83ha	5.11ha	2.95ha
Easton Dairy Ltd	Pt Sect. 429 Town of Foxton	Nil	0.32ha	0.78ha
Koputara Farm Ltd	Pt Sect. 425 Town of Foxton	4.25ha	Nil	Nil
Lewis Dairies Ltd	Pt Sect. 5, Blk IX Mt Robinson SD	0.15ha	0.64ha	Nil
NZ Guardian Trust	Pt Oturoa 2	Nil	0.27ha	Nil
Total		**15.43ha**	**11.27ha**	**8.66ha**

HRC administers the land on which the Moutoa Floodway is located. The land is gazetted for Soil Conservation and River Control Purposes.

10.2 Property Acquisition Strategy

10.2.1 Objective

The objective of this Property Acquisition Strategy is to identify properties and owners affected by the Scheme Design options and to assess the land, compensation and property costs associated therewith.

The Property Acquisition Strategy is aimed at providing a framework that enables the Transport Agency to:

a) Have surety of financial forecasting, thereby enabling the Transport Agency to manage funding of the acquisition and all related costs;

b) Identify strategically significant properties and risks, and allocate resources to their acquisition;

c) Ensure that all property agreements will be in place using the most appropriate methodology, in accordance with budget and the project programme.

10.2.2 Public Works Act 1981 (PWA)

Property values have been assessed on the basis of compensation being paid in accordance with the principles of the PWA. The PWA provides the Transport Agency with the statutory authority to acquire land for a public work.

The acquisition process generally takes place after all required resource consents for use of the land and designations are approved. As a consequence, land purchase is usually one of the last actions to be completed before construction commences, and in some cases can be the reason why some projects are delayed. This is especially so in cases where the land is required to be compulsorily taken, or there are objections to the acquisition of the land. It is noted that land acquisition under the PWA can take up to 3 years if acquisition cannot be agreed by negotiation.

It is proposed to commence property negotiations on a willing seller/willing buyer basis. Due to the possibility of the project proceeding to construction quickly, property negotiations should commence with landowners as soon as possible after the alteration to designation and resource consents have been approved and confirmed. Alternatively, to reduce the risk of delays even further, the Transport Agency could commence property negotiations prior to the alteration to designation and resource consents being approved. The main risks of this approach are project funding not being forthcoming, and the potential for the designation boundaries to change as a result of matters raised during the processing of the statutory applications. The latter risk is considered to be relatively low for this project.

If the land that is required for the project cannot be purchased with the agreement of the affected landowners, compulsory acquisition will be necessary. To mitigate this risk, it is recommended that section 18 notices should be issued under the PWA at the commencement of the negotiation process for each property to be acquired, to ensure access is available for construction. If negotiations do not result in agreement to purchase the land and compulsory purchase is required, the Transport Agency will need to demonstrate that the taking of the land is reasonably necessary. Prior to the section 23 notice being issued to landowners notifying the Transport Agency's intention to take the land, the PWA requires the Transport Agency to identify and consider alternatives to the taking of the land.

Some of the land which is currently required for state highway will no longer be required following the completion of construction. This land should be identified prior to negotiations commencing with landowners to allow the potential for land exchange to occur. This may assist with securing agreements with landowners and is likely to reduce land acquisition costs. In addition, it will potentially avoid severance titles being created that are likely to be unsuitable for sale to third parties as a separate land parcel, due to their expected shape, access requirements and proximity to the state highway.

10.2.3 Property and Compensation Assumptions

This Property Acquisition Strategy is based on the following assumptions:

a) Land purchases will be partial and not total (i.e. only the identified land required will be purchased but not the entire property affected);

b) Cost estimate assumptions listed in Section 14.3 below.

10.3 Other Property Related Matters

10.3.1 Agricultural Underpasses

Agricultural underpasses will be required, as all of the options will bisect one or more of the existing titles. The existing state highway bisects some of these titles.

An existing shared underpass beneath SH1 provides access for the properties owned by Koputara Farm Ltd and Barnett. These landowners also use at-grade crossings either side of SH1 to move large machinery that cannot be transported through the underpass. Option 1 involves closure of these at-grade crossings and construction of a new, larger agricultural underpass to accommodate the landowner's requirements. Options 2 and 2A involve relocation of these at-grade crossings.

Easton and Easton Dairy Ltd also own separate titles either side of SH1 that are farmed as a single productive unit. Access between the titles is currently provided beneath a span of the Whirokino Trestle. The landowner has advised that retaining connectivity between the titles is important to their farming operations. All options involve construction of a new agricultural underpass on the existing farm race alignment to accommodate the landowner's requirements.

10.3.2 Access to Moutoa Floodway and Stopbanks

HRC has advised its requirements in respect of access to the Moutoa Floodway and its stopbanks.

Access from SH1 to the northern (true right) stopbank of the Moutoa Floodway is required to be maintained and available at all times, including for heavy machinery. HRC would also like access to be maintained from SH1 to the stockyard located on the northern stopbank to the east of the existing Whirokino Trestle. There is also public demand for access between the Ken Everett Cycleway and the Piriharakeke Walkway which is located on top of the northern stopbank, to the west of the Whirokino Trestle.

Under Options 2 and 2A, the proposed maintenance access to the northern stopbank will also provide access to the existing stockyard. In addition, pedestrian and cycle access will be provided between the Piriharakeke Walkway and the Ken Everett Cycleway.

Option 1 will be remote from the stockyard, making it more difficult to provide access. Relocation of the stockyard is likely to prove more practical under this option. This matter will require further consideration at detailed design stage if Option 1 is preferred. Option 1 does not include the retention of the Ken Everett Cycleway and no public access would be provided to the Piriharakeke Walkway from SH1.

Access to the southern (true left) stopbank of the Moutoa Floodway is currently obtained from Matakarapa Road and Whirokino Road. No access is required directly from SH1 to the southern stopbank of the Moutoa Floodway, although HRC has advised that such access would be beneficial if it could be provided. All options rely on access to the southern stopbank from Matakarapa Road.

10.3.3 Temporary Contractor's Working Area

A contractor's working area will be required as a base for a site office as well as machinery and materials storage over the duration of the construction period. The most suitable location will depend on the option that is selected. The location and size of the contractor's working area should be considered prior to the Notice of Requirement being lodged for the alteration to designation, so that a temporary designation can be sought specifically for this purpose. This matter will also need to be addressed through the property agreement with the affected landowner.

11. Statutory Approvals

11.1 Alteration to Designation

Options 1, 2 and 2A would all require an alteration to the existing state highway designation which is included in both the Operative and Proposed Horowhenua District Plans as designation reference D2. The purpose of the designation in the Operative Horowhenua District Plan is *"State Highway 1"* and the purpose in the Proposed Horowhenua District Plan is *"State Highway 1 – to undertake maintenance, operation and use of, and improvement of a State Highway"*. The proposed alteration will be in accordance with those purposes.

At this stage it is expected that the Notice of Requirement to alter the designation will be processed by HDC with either limited or public notification.

A preliminary analysis of the alteration to designation in terms of the key provisions in the Resource Management Act 1991 (RMA) follows.

Section 181 – Alteration of designation

As the requiring authority for the designation for state highway purposes contained in the Operative and Proposed Horowhenua District Plans, the Transport Agency can give notice of its requirement to alter the designation.

Section 181(3) specifies the circumstances in which alterations to designation can be made without reference to sections 168 to 179 of the RMA. With respect to section 181(3)(a)(i) the effects on the environment related to the alteration to the designation may be more than minor in some respects, including visual and landscape effects and property effects. However, section 181(3)(a)(ii) will be satisfied as the changes to the designation boundaries are minor in the context of the existing designation for State Highway 1. Given the number of affected landowners and occupiers and the accelerated programme for this project, section 181(3)(b) may not be satisfied as it would require all affected landowners and occupiers to provide their written approval to the alteration to designation prior to lodgement of the Notice of Requirement.

Therefore the alteration that will be required to the designation may not satisfy the tests of section 181(3) of the RMA, and reference to sections 168 to 179, with all necessary modifications, is expected to be required. The key provisions of those sections are addressed below.

Section 171 – Recommendation by territorial authority

The Transport Agency does not own or have a sufficient interest in the land required for the designation of any of the identified options. Therefore an assessment of whether adequate consideration has been given to alternative sites, routes and methods of undertaking the work is required pursuant to section 171(1)(b) of the RMA.

As established through case law, the decision maker must simply satisfy itself that the requiring authority has undertaken a business-like identification and comparison of alternative sites. The key consideration is whether adequate process has been followed as opposed to whether the most appropriate alternative has been adopted.

A Notice of Requirement for an alteration to designation for this project will need to include a comprehensive assessment of environmental effects as well as a suitable assessment of the alternatives which have been considered. The assessment of alternatives provided with the Notice of Requirement can draw on all of the investigations undertaken to date and the findings of this SAR, including (but not limited to) the Multi-Criteria Analysis included as Appendix T.

Section 171(1)(c) requires that an assessment must be made of whether the work and designation are reasonably necessary for achieving the objectives of the requiring authority. The Land Transport Management Act 2003 provides the overall objective for the Transport Agency which is set out in section 94 as being *"…to undertake its functions in a way that contributes to an effective, efficient, and safe land transport system in the public interest"*. The primary objectives of the project are to improve the safety, efficiency and resilience of the transport network. All of the identified options would achieve these objectives. Therefore the work and alteration to designation will meet the tests for reasonable necessity under section 171(1)(c). The works would also be consistent with the purpose of the existing designation, as stated in the Operative and Proposed Horowhenua District Plans.

The existing designation will need to be retained to enable construction of the new bridge(s) and highway to be completed offline, while the existing state highway remains in use. Following completion of construction, the part of the existing designation which is no longer required for state highway purposes will need to be removed.

Section 176 – Effect of designation

The alteration to designation will also impact on existing flood control designations. The Moutoa Floodway and its stopbanks form part of the Lower Manawatu Flood Control Scheme which is designated under both the Operative and Proposed Horowhenua District Plans. HRC is the requiring authority for the designations.

Section 176(1)(b) requires that where a designation is included in a District Plan then no person may, without the prior written consent of that requiring authority, do anything in relation to the land that is subject to the designation that would prevent or hinder a public work or project or work to which the designation relates. This includes undertaking any use of the land. The Transport Agency's alteration to designation will therefore require approval to be obtained from HRC pursuant to section 176(1)(b).

Section 184 – Lapsing of designations which have not been given effect to

Section 184 specifies that designations typically have a 5 year lapse period unless a longer period is specified. The main purpose of limiting the designation lapse period is to avoid uncertainty for directly affected landowners and the community. However, for major roading projects such as this a longer lapse period is often sought. As the Whirokino Trestle is expected to require replacement within 10 years, consideration should be given to seeking a 10 year lapse period for the designation.

11.2 Resource Consents

11.2.1 State Highway

The HRC One Plan was made operative on 19 December 2014. Table 11.2.1 presents the resource consents that are expected to be required under the Operative HRC One Plan to construct any option.

Table 11.2.1: Expected Resource Consent Requirements	
Consent Type (Relevant One Plan Rules)	**Scope**
Earthworks (Rules 14-21 and 14-30)	To undertake construction earthworks and vegetation clearance, including works affecting the existing floodway and stopbanks, and temporary discharge of sediment laden stormwater run-off during construction.
Bridges (Rules 17-3, 17-6 and 17-22)	To erect bridges in, on, under and over the Moutoa Floodway and Manawatu River and to remove the existing Manawatu River Bridge (except for Option 2A).
Stormwater Discharge (Rules 14-18 and 14-19)	Long term discharge of stormwater from the completed state highway to land and water.
Water Take and Use (Rule 16-5)	Temporary water take for dust suppression and construction purposes.

At this stage, it is expected that HRC will require all regional consents to be processed on the basis of either limited or public notification. This is because it is unlikely that written approvals will be obtained from all affected parties prior to lodgement.

11.2.2 Gas Transmission Pipeline

The existing gas transmission pipelines owned by Vector Ltd are not designated under either the Operative or Proposed Horowhenua District Plans. Therefore, Vector Ltd will need to obtain any resource consents necessary to relocate the pipeline.

The rules for Utilities and Energy in Chapter 22 of the Proposed Horowhenua District Plan are not subject to any appeals and therefore must be treated as operative. As the gas transmission pipelines are not designated, any works involved with their replacement must be assessed in terms of the rules in Chapter 22 of the Proposed Horowhenua District Plan. Rule 22.1.10 permits the maintenance and replacement of gas pipelines. Confirmation has been received from the Planning Services Manager at HDC that the replacement of the gas transmission pipeline is likely to be a permitted activity under Rule 22.1.10. As such, resource consent from HDC may not be required.

If the gas transmission pipeline requires replacement under the bed of the Manawatu River as expected, resource consent to establish a new structure will be required under the Operative HRC One Plan. If the gas transmission line is attached to the bridge then it would be dealt with through the resource consent for the bridge structure.

11.3 Building Consent

Consenting authorities have recently been choosing to exercise the discretion provided to them under Schedule 1, Part 1, Item 2 of the Building Act 2004 to waive the requirement to obtain building consent for structures that they believe will be designed, constructed and (where relevant) demolished in compliance with code requirements.

Confirmation has been received from the Senior Building Officer at HDC that they will waive the requirement for building consent to be obtained in this instance.

11.4 Archaeological Authority

As outlined in Section 6.5 above, and as recommended in the Archaeological Assessment included as Appendix G, an archaeological authority from Heritage New Zealand will be required to modify or destroy archaeological sites.

The authority is likely to be subject to conditions, which are expected to reflect the recommendations contained in the Archaeological Assessment. The recommendations include requirements for an archaeologist to monitor the earthworks on the north and south bank of the Manawatu River and for an archaeologist to be on call for all other works and contacted in the event that any suspected heritage material is revealed. In addition, protocols are recommended regarding discovery and recording of any archaeological sites that may be uncovered.

The existing Whirokino Trestle and Manawatu River Bridge were not built over 100 years ago, nor are they listed as historic sites. Accordingly, no archaeological authority is required to remove either of the existing bridges.

11.5 Consents Strategy

11.5.1 General

The resource consent application will be processed by HRC and the Notice of Requirement will be processed by HDC. The applications should be made jointly to enable them to be processed at the same time. If both applications are notified as expected, the concurrent lodgement of the applications will potentially allow them to be determined at a joint hearing which will be more efficient in terms of both time and cost. The approach of applying for the necessary resource consents and the alteration to designation at the same time also reflects best practice in terms of statutory approvals under the RMA.

The Transport Agency wishes to maximise the certainty in respect of statutory approvals prior to the Cabinet decision in June 2015. This results in a relatively short period for the preparation of the resource consent application and Notice of Requirement. While the programmed period will be adequate to enable preparation of the applications, including some consultation, the timeframe is unlikely to be sufficient to secure written approvals from all affected parties prior to lodgement. Written approvals should be sought from all directly affected landowners and lessees, tangata whenua, DOC, Fish & Game New Zealand and Vector Ltd. Even if written approvals cannot be obtained from all affected parties, the provision of some written approvals will still assist with the processing of the resource consent application and Notice of Requirement as the Councils will need to disregard effects of the proposed activities on those parties who have provided written approval.

Where written approvals are not able to be obtained prior to lodgement, consultation should be ongoing with those parties so that any approvals obtained after lodgement can be forwarded to the Councils for consideration.

Consultation will follow the approach outlined in Section 9.2 above, including individual meetings, hui and telephone and written contact as appropriate.

HDC and HRC staff have confirmed that they would like to review draft applications prior to lodgement. This approach is recommended if time allows, as it will enable any information gaps to be identified and issues addressed prior to lodgement.

11.5.2 Risks

Risks associated with the proposed consents strategy include:

a) Greater likelihood of opposition from affected parties;

b) Greater likelihood of a hearing being required;

c) Potential appeals if any parties are not satisfied with the decisions on the resource consent applications or the alteration to designation.

Opposition from landowners to the resource consent application or Notice of Requirement may also complicate and delay the land acquisition process.

11.5.3 Outline Plan

As the Notice of Requirement will be based on a preliminary level of design, the proposed works will be subject to a requirement to submit an Outline Plan of Works to the territorial authority for approval prior to works commencing.

The Outline Plan of Works will need to include information such as the detailed design for the bridges, fill embankments, local road intersection, provision for private access, landscaping, stormwater drainage and ecological mitigation and any other matters to avoid, remedy or mitigate any adverse effects.

11.5.4 Archaeological Authority

Prior to applying for an archaeological authority from Heritage New Zealand, the Transport Agency must either own the land that will be subject to the authority or have written approval from the current landowners. As such, it is unlikely that an application for an authority will be able to be lodged with Heritage New Zealand at the same time as the lodgement of the Notice of Requirement and resource consent application.

It is recommended that written approvals to an application for an archaeological authority should be sought from all affected landowners at the same time as consultation is undertaken for the Notice of Requirement and resource consent application. The application for an archaeological authority should be lodged as soon as the Transport Agency owns the land or all written approvals have been obtained, whichever occurs first.

12. Environmental and Social Responsibility Screen

The Environmental and Social Responsibility Screens for Options 1, 2 and 2A, completed in accordance with draft NZTA Minimum Standard Z/19 – *Environmental and Social Responsibility*, are included as Appendix N.

The assessment identifies a number of risks, opportunities and actions for Options 1, 2 and 2A, which have been captured in the Risk Register included as Appendix Q.

13. Other Client Requirements

13.1 Existing Whirokino Trestle

All options include the construction of a new bridge across the Moutoa Floodway, raising the question of the future of the existing Whirokino Trestle.

The Building Act 2004 obliges the bridge owner to maintain the structure to a safe standard, even if public access is not encouraged. The extremely poor structural condition of the existing Whirokino Trestle would continue to attract significant ongoing maintenance costs.

No opportunities to transfer ownership to other parties have been identified. It is considered highly unlikely that HDC would be willing to assume ownership of the structure, given that it was unwilling to assume ownership of the existing Manawatu River Bridge, which is shorter, located in a more strategic position and in better condition that the existing Whirokino Trestle.

Removal of the existing structure would improve the operation of the Moutoa Floodway, as debris clearance would be increased by removal of the relatively short 12.1m spans.

As such, the cost estimates for all options include the cost of demolishing the existing Whirokino Trestle.

13.2 Existing Manawatu River Bridge

Options 1 and 2 include the construction of a new bridge across the Manawatu River, raising the question of the future of the existing Manawatu River Bridge.

The Building Act 2004 obliges the bridge owner to maintain the structure to a safe standard, even if public access is not encouraged. Ownership options for the bridge include:

a) **NZ Transport Agency:** The Transport Agency does not wish to incur the ongoing maintenance costs of this structure once it no longer forms part of the state highway network.

b) **Horowhenua District Council:** Potential exists to incorporate the bridge into the local road network. During consultation for this SAR, HDC stated that it would be unwilling to assume ownership, and therefore maintenance liability, of the existing structure.

c) **Vector Ltd:** The existing structure currently carries the gas transmission pipeline, creating the potential for Vector Ltd to assume ownership of the structure. This opportunity has not been discussed with Vector Ltd to date, but the commercial drivers make it extremely unlikely that it would agree to such a proposal. Under current legislation, the cost of relocating the gas transmission pipeline (other than material costs) falls to the Transport Agency. Vector Ltd is financially incentivised to relocate the gas transmission pipeline off the bridge, thereby acquiring a new and lower risk asset at minimal cost and avoiding the ongoing maintenance costs of the existing bridge.

As such, the cost estimates for Options 1 and 2 include the cost of demolishing the existing Manawatu River Bridge.

13.3 Cycleway

With appropriate contractual provisions, the Ken Everett Cycleway could remain operational during construction of all options.

Under Option 1, the Ken Everett Cycleway would be closed and removed on completion of construction, as it is considered unsafe and poor land utilisation to have a path located so remote from the state highway. A new shared path would not be constructed adjacent to the realigned state highway for the following reasons:

a) It would no longer be necessary with the shoulder width provided on SH1 under all options making provision for safe and convenient use by cyclists;

b) Its reconstruction would incur significant cost.

Under Options 2 and 2A, the Ken Everett Cycleway would be retained and converted to a shared path on completion of construction.

As such, the cost estimate for Option 1 excludes the cost of replacing the Ken Everett Cycleway.

13.4 Rest Area

The Transport Agency's Network Operations team has stated its intention to close the existing rest area located on the south bank of the Manawatu River (RP967/0.2).

However, during consultation for this SAR it has emerged that tangata whenua and DOC use the rest area to access the adjacent riparian strip.

The Scheme Drawings for Options 1 and 2 are based on closure of the existing rest area and utilisation of the redundant state highway embankment to the south of the Manawatu River to create a new rest area. The relocated rest area will:

a) Make use of the existing vehicle entrance to the Langburn property, eliminating one vehicle entrance on SH1;

b) Provide enhanced visibility from SH1, which will have positive effects on its amenity and function;

c) Provide a physical connection to the riparian strip administered by DOC, which in turn provides access to the Awahou Conservation Area.

13.5 Utility Services

Table 13.5.1 lists the utility service relocations required for each option:

Table 13.5.1: Utility Service Relocations[(1)]

Service	Option 1	Option 2	Option 2A
Gas transmission pipeline	0.35km (beneath the Manawatu River)	0.35km (beneath the Manawatu River)	0.35km[(2)] (beneath the Manawatu River)
Electricity transmission line	0km	0km	0km

Table 13.5.1: Utility Service Relocations[1]			
Service	**Option 1**	**Option 2**	**Option 2A**
Overhead power line	2.4km (from the northern extent of the study area to south of the Manawatu River)	1.1km (from south of the Moutoa Floodway to the southern extent of the study area)	0.5km (from south of the Moutoa Floodway to north of the Manawatu River)
Fibre optic telecom cable	2.4km (from the northern extent of the study area to south of the Manawatu River)	0.5km (from south of the Moutoa Floodway to south of the Manawatu River)	0.6km (from south of the Moutoa Floodway to north of the Manawatu River)
Copper telecom cable			

Note 1: Relocation lengths are approximate estimates.

Note 2: Relocation only required in 2042.

The estimates for all options include the cost of relocating these utility services.

Power and telecommunication utility services could be readily accommodated on one or both new bridges. Further consultation with service authorities will be necessary to establish duct requirements.

13.6 Future Proofing

To the extent possible, options should not preclude the future four laning of this section of SH1 or a future eastern bypass of Foxton.

14. Cost Estimates

14.1 Project Delivery Costs

The cost estimates included in Appendix O have been prepared as Scheme Estimates in accordance with the NZTA *Cost Estimation Manual* and NZTA Minimum Standard Z/44 – *Risk Management*.

Table 14.1.1 presents the estimated undiscounted project delivery cost (in 2014 dollars) of each option.

Table 14.1.1: Project Delivery Cost				
Parameter	**Do Minimum**	**Option 1**	**Option 2**	**Option 2A**
Minimum Cross-section				
Expected Estimate	$37.3M			
95%ile Estimate	$41.3M			
Cross-Section H1/B1				
Expected Estimate		$65.7M	$60.1M	$52.0M
95%ile Estimate		$70.7M	$64.6M	$56.0M
Cross-Section H2/B2				
Expected Estimate		$60.3M	$55.5M	$48.6M
95%ile Estimate		$65.3M	$60.0M	$52.6M

The costs presented in Table 14.1.1 are not whole-of-life costs (i.e. exclude maintenance costs). Maintenance costs are discussed in Section 16.3 below.

14.2 Basis of Estimation

Cost estimates have generally been based on rates drawn from historical tenders and adjusted for cost fluctuation. These rates have been verified against rates published in the 2013/14 Rawlinson's New Zealand Construction Handbook and knowledge of the market.

Property purchase costs have been based on a desktop exercise undertaken by The Property Group Ltd.

Contingencies and funding risk have been assessed on the basis of the residual risk exposure in the Risk Register using professional engineering judgement and experience, in accordance with the General Approach under NZTA Minimum Standard Z/44 – *Risk Management.*

14.3 Assumptions

The cost estimates are based on the following assumptions:

a) General

- Two year construction period;
- Procurement under the Staged model (i.e. separate detailed design and construction contracts);

b) Property

- $38,000/ha for land purchase;
- $20,000/ha for land disposal;
- The existing stockyard on the northern stopbank of the Moutoa Floodway will be relocated under Option 1;

c) Design

- $100,000 for geotechnical investigations;
- Design costs approximately 4% of the physical works cost;

d) Construction

- MSQA costs approximately 2.5% of the physical works cost, based on construction monitoring to level CM3;
- The existing SH1 embankment will be recontoured within the existing designation, except under Option 1, for which it will be removed from site.
- Ground improvements required at the abutments of the Manawatu River Bridge under Options 1 and 2;
- Bridge costs based on global unit rates, with no allowance for reduced pile lengths in some locations;
- The existing Whirokino Trestle will be demolished, once replaced;
- The existing Manawatu River Bridge will be demolished, once replaced;
- SMA surfacing on bridges, with chipseal surfacing elsewhere;
- Second coat chipseal surfacing and long life pavement marking are included within the project scope;
- $1,600,000 to relocate gas transmission pipeline under Option 1;
- $1,525,000 to relocate gas transmission pipeline under the Do Minimum (in 2042) and Option 2;
- Offset mitigation includes a new wetland south of the Manawatu River and riparian planting on the banks of the Manawatu River;
- All-weather maintenance access provided to the Moutoa Floodway stopbanks;
- The Ken Everett Cycleway will be retained, except under Option 1;
- Preliminary and General are 25% of the physical works cost of all elements except structures, for which Preliminary and General are included in the rates.

14.4 Exclusions

The following items are not included in the cost estimates:

a) Investigation and reporting fees (sunk costs);

b) Injurious affection (included in Risk Register);

c) Building Consent fees;

d) Ground improvement at the abutments of the Moutoa Floodway Bridge (included in Risk Register);

e) Ground improvements beneath fill embankments, beneath agricultural underpasses or at the abutments of the Whirokino Road Underpass (included in Risk Register);

f) Escalation beyond September 2014.

14.5 Peer Review

The Transport Agency commissioned an independent peer review of the cost estimates. The peer review report is included in Appendix S.

The Expected Estimates were reconciled to within a maximum of 3%.

15. Risk

15.1 Risk Management Process

Risk management has been undertaken in accordance with the General Approach under NZTA Minimum Standard Z/44 – *Risk Management.*

The Summary Risk Analysis Report and Risk Register are included as Appendices P and Q respectively.

15.2 Residual Risk Profile

The project risk profile consists of a small number of Extreme residual risks (i.e. post-mitigation), with a larger number of High to Medium residual risks. Table 15.1.1 presents the Extreme residual risks.

Table 15.1.1: Very High and Extreme Risks

Risk	Rating	Option	Description
PT06: Estimate Accuracy	25	1, 2, 2A	Tendered rates differ from estimated rates.
LT02: DOC Land	23	1, 2	The process to allow for relocation of the gas transmission pipeline beneath DOC land is prolonged and complicated.
PT04: Project Development	23	1, 2, 2A	Additional costs are identified during design development.
UT04: Delays by Utility Services	23	1, 2, 2A	Utility services relocations delay construction.

None of the residual risks are considered to challenge the viability of any of the analysed options.

Only one residual opportunity remains.

15.3 Risk Status

14 of the 21 live risks above the Risk Tolerance Threshold (15) have been parked, primarily because no further treatment is possible at this stage of project development.

16. Economics

16.1 Basis of Analysis

The Economic Evaluation Report undertaken as part of the investigations for this SAR is included in Appendix R. The economic analysis was completed in accordance with the Full Procedures specified in the NZTA *Economic Evaluation Manual* (1st Edition Amendment 0), (EEM) using a 6% discount rate and 40 year period of analysis.

Time zero is 1 July 2015.

The Do Minimum and options are defined in Section 8.

16.2 Road User Benefits

16.2.1 Traffic Growth Rate

A time zero growth rate of 0% has been used, which is the default traffic growth rate assumed by the EEM. This is consistent with the average annual growth rate recorded at count stations in the vicinity of the study area over the previous 10 years.

As discussed in Section 4.4.1 above, the HCV growth rate appears to be consistent with the growth rate for all traffic.

It is possible that the traffic demand growth rate for HPMVs will exceed the growth rate for other vehicle types. However, due to the high degree of uncertainty, it has been (conservatively) assumed that the traffic demand for HPMVs will grow at the same rate as the growth rate for other vehicle types.

16.2.2 Travel Time Costs, Vehicle Operating Costs and Vehicle Emission Costs

Travel time and vehicle operating cost savings arise from two sources:

a) Reduction in route length (due to realignment) and increase in mean speed (due to widened cross section) for all vehicles traversing the project length; and

b) Benefits from HPMVs being able to use the SH1 route instead of the 21km longer SH3/SH56/SH57 alternative route, as described in Section 3.2.

Travel time and vehicle operating costs for vehicles traversing the project length have been calculated using an estimated mean speed of 85km/h for the Do Minimum and 100km/h for the Options. Option 1 is 170m shorter than the Do Minimum and Option 2 is 20m shorter than the Do Minimum.

Benefits due to reduction in roughness have not been calculated as these are assumed to be relatively minor.

No data exists as to the number of HPMVs currently using the alternative SH3/SH56/SH57 route, as each HPMV is permitted for any number of trips on a particular route within a two year period. The number of HPMVs currently using the SH3/SH56/SH57 alternative route was assessed using the following process:

i) Dr Richard Paling, who is a recognised expert engaged by NZTA at a national level to perform an economic analysis for HPMVs, was engaged to provide a forecast;

ii) Dr Paling's forecast was independently validated by phone survey of national HPMV operators and HPMV operators within the Manawatu region.

Travel time and vehicle operating costs for HPMVs have been calculated using:

- EEM vehicle and freight travel time cost for HCV II's;
- Vehicle operating cost of 230 cents/km as supplied by Dr Richard Paling;
- Mean speed of 60km/h, which assumes HPMV's travel at the speed limit throughout all speed zones on the 21km detour.

Benefits from reductions in vehicle emissions have been set at 5% of base Vehicle Operating Costs.

16.2.3 Crash Costs

The site crash record has sufficient injury crashes for a crash by crash analysis to be used for the Do Minimum.

Accident rate analysis has been used to determine the crash costs for the options, as the safe system design approach is considered to introduce a fundamental change to the road environment.

The EEM does not have a crash prediction model for a two lane state highway with safe system cross section (i.e. continuous median and edge barriers). The EEM model for rural two lane roads has been used (model 11), which is likely to have significantly underestimated the benefits of the project options, particularly for the H1/B1 cross section.

16.2.4 Total Road User Costs

Table 16.2.4 provides a summary of the total road user costs.

Table 16.2.4: Total Road User Costs (NPV)

Parameter	Do Minimum	Option 1	Option 2	Option 2A
Travel Time Costs	$68.3M	$54.5M	$56.2M	$56.2M
Vehicle Operating Costs	$75.7M	$69.6M	$71.7M	$71.7M
Vehicle Emission Costs	$3.8M	$3.5M	$3.6M	$3.6M
Crash Costs	$14.8M	$8.3M	$8.3M	$8.3M
Total Road User Costs (NPV)	**$162.6M**	**$135.9M**	**$139.8M**	**$139.8M**

16.3 Costs

Table 16.3.1 provides a summary of the total costs.

Table 16.3.1: Total Cost (NPV)				
Parameter	**Do Minimum**	**Option 1**	**Option 2**	**Option 2A**
Minimum Cross-Section				
Capital Cost (NPV)	$29.3M			
Maintenance Cost (NPV)	$1.7M			
Total Cost (NPV)	**$31.0M**			
Cross-Section H1/B1				
Capital Cost (NPV)		$57.1M	$52.2M	$49.9M
Maintenance Cost (NPV)		$0.1M	$0.1M	$1.7M
Total Cost (NPV)		**$57.2M**	**$52.3M**	**$51.6M**
Cross-Section H2/B2				
Capital Cost (NPV)		$52.4M	$48.3M	$46.7M
Maintenance Cost (NPV)		$0.1M	$0.1M	$1.6M
Total Cost (NPV)		**$52.5M**	**$48.4M**	**$48.3M**

Costs under the Do Minimum include:

a) $5,000/year for inspection and $0/year for maintenance of the Whirokino Trestle until its replacement, in accordance with the maintenance strategy agreed with the Transport Agency's regional office;

b) Replacement of the Whirokino Trestle by year 9 of the analysis period;

c) Immediate expenditure of $300,000 to address deferred maintenance on the Manawatu River Bridge;

d) Immediate expenditure of $500,000 for seismic strengthening of the Manawatu River Bridge;

e) Immediate expenditure of $1,000,000, and every 15 years thereafter, to paint the Manawatu River Bridge, prior to its replacement;

f) $30,000/year for maintenance of the Manawatu River Bridge, prior to its replacement;

g) Replacement of the Manawatu River Bridge by year 29 of the analysis period.

Maintenance costs for new structures under all options including the Do Minimum are minimal throughout the analysis period, as would be expected with new reinforced concrete structures. A nominal allowance of $1,000 per year for each structure has been included.

Costs under Option 2A include all of the maintenance, deferred maintenance, seismic upgrading and painting costs for the Manawatu River Bridge under the Do Minimum, and replacement of the Manawatu River Bridge by year 29 of the analysis period.

16.4 BCR Summary

Table 16.4.1 provides a summary of the Benefit Cost Ratios (BCR) of the options.

Table 16.4.1: Benefit Cost Ratios				
Parameter	**Do Minimum**	**Option 1**	**Option 2**	**Option 2A**
Cross-Section H1/B1				
Net Total Benefits (NPV)		$26.7M	$22.8M	$22.8M
Net Cost (NPV)		$26.2M	$21.4M	$20.6M
Benefit Cost Ratio		**1.0**	**1.1**	**1.1**
Cross-Section H2/B2				
Net Total Benefits (NPV)		$26.7M	$22.8M	$22.8M
Net Cost (NPV)		$21.6M	$17.4M	$17.3M
Benefit Cost Ratio		**1.2**	**1.3**	**1.3**

16.5 BCR Sensitivity Analysis

Table 16.5.1 demonstrates the potential impact on BCRs for cross section H1/B1 due to changes in assumptions:

Table 16.5.1: Benefit Cost Ratios				
Parameter	**Change**	**Option 1**	**Option 2**	**Option 2A**
Cross-Section H1/B1				
Benefit Cost Ratio (Table 16.4.1)		1.0	1.1	1.1
Discount Rate	4%	1.6	1.8	1.6
	8%	0.7	0.7	0.8
Traffic Growth Rate	+1.0%	1.2	1.2	1.2
	-1.0%	0.9	0.9	0.9
Capital Costs	+20%	0.8	0.9	0.9
	-20%	1.3	1.4	1.4
Maintenance Cost Savings	+50%	1.1	1.1	1.1
	-50%	1.0	1.0	1.1
Time Zero	1 July 2017	1.1	1.2	1.2
	1 July 2019	1.3	1.5	1.6
	1 July 2021	1.7	2.1	2.2
Crash Reduction (analysis method predicts 44% reduction)	90% reduction	1.2	1.3	1.3
Mean Speed of Do Minimum (analysis uses 85km/h)	90km/h	0.9	0.9	1.0
Roughness (benefits not included in analysis)	120 NAASRA on Whirokino bridge	1.0	1.1	1.1
HPMV Numbers (analysis uses 40/day)	60	1.3	1.4	1.4
	20	0.8	0.8	0.8
HPMV mean speed on detour (analysis uses 60km/h)	70km/h	1.0	1.0	1.1

Table 16.5.1: Benefit Cost Ratios				
Parameter	**Change**	**Option 1**	**Option 2**	**Option 2A**
HPMV Growth (analysis assumes zero growth)	+1.0%	1.1	1.1	1.2
Do Minimum cross-section standard (analysis assumes no median barrier in Do Minimum)	Include barrier in Do Minimum	1.1	1.2	1.3

Table 16.5.1 indicates that the BCRs are:

a) Sensitive to changes in the discount rate;

b) Sensitive to changes in capital cost of the options, although this is dampened to some extent as an increase in the cost of any option implies an increase in the cost of the Do Minimum;

c) Sensitive to assumptions regarding numbers of HPMVs;

d) Sensitive to crash benefits. The methodology described in Section 16.2.3 above for calculating crash benefits results in a 44% reduction in crash costs. This may be an underestimate given that the project includes significantly wider shoulders and safe system barriers;

e) Highly sensitive to changes in time zero (i.e. to changes in the timing of bridge replacement). The underlying reason for this sensitivity is the fixed date of 2023 for replacement of the Whirokino Trestle under the Do Minimum. As the interval between time zero and 2023 shortens, the NPV of capital works under the Do Minimum increases, and the dis-benefits accrued over the 40 year analysis period increase.

Road user benefits associated with HPMV's account for 33% of Travel Time Costs and 102% of Vehicle Operating Costs respectively for Option 1 and 37% of Travel Time Costs and 133% of Vehicle Operating Costs respectively for Options 2 and 2A. Total benefits are therefore sensitive to the HPMV forecasts described in Section 16.2.2. However the sensitivity analysis in Table 16.5.1 indicates that HPMV numbers would have to be significantly different to forecast to have a meaningful effect on the BCR.

Mean speed estimates for the Do Minimum and for the options are important to the calculation of Travel Time Costs and Vehicle Operating Costs for road users on the project length. Speed surveys have not been undertaken to date however the 85km/h value assumed for the Do Minimum is considered realistic based on drive times recorded during site visits undertaken for this SAR. Mean speed values for the options are assumed to be 100km/h based on traffic volumes and the high standards applied to the alignment and cross-section. Table 16.5.1 indicates the reduction in BCR if the difference in mean speed is 10km/h as opposed to 15km/h assumed in the analysis.

16.6 Peer Review

The Transport Agency commissioned an independent peer review of the economic analysis. The peer review report is included in Appendix S.

17. Investment Assessment

17.1 Strategic Fit

Strategic Fit is classified as High for all options because SH1 is a key strategic route for all classes of journey (employment, tourism, freight, economic and social opportunities), and there would be a significant gap to the appropriate customer levels of service for safety, journey time reliability and resilience if the Whirokino Trestle was not replaced.

17.2 Effectiveness

Table 17.2.1 provides the assessment of the project options against each component of the effectiveness criteria:

Table 17.2.1: Effectiveness Assessment

Component	Rating	Evidence
Outcomes Focussed	H	The project options all replace the existing Whirokino Trestle with a new bridge compliant with current geometric and durability standards. They will therefore meet the project objectives of safety, efficiency and resilience.
Integrated	H	The project will provide cross section and safety standards consistent with the Safer Journeys strategy and upgraded sections of SH1 to the south. It is consistent with the current network and future transport plans and accommodates the appropriate transport modes, including cycles.
Correctly Scoped	M (Options 1 & 2) H (Option 2A)	The scope of the project necessarily includes approach realignment in order to be able to construct the new bridge. For Option 2A the realignment length is no more than is necessary to achieve the project objectives using minimum geometric standards to tie the replacement bridge back into the adjoining alignment. Options 1 and 2 have increased scope in order to achieve other objectives (improved alignment in the case of Option 1; Manawatu River Bridge replacement in the case of Options 1 and 2).
Affordable	H	Project is to be funded from the Future Investment Fund as part of the Accelerated Regional Roads Package.
Timely	H	The project would deliver immediate benefits for both HPMV operators and all other vehicle classes. The project is also being developed to meet the programme for the Accelerated Regional Roads Package. The remaining life of the Whirokino Trestle is assessed at 10 years. With a project development timeframe of 3 years from investigation to completion of construction, this project is appropriately timed to reduce the risk of closure of SH1 due to bridge failure.
Confidence	H (Options 1 and 2) M (Option 2A)	By replacing the Whirokino Trestle and the Manawatu River Bridge, Options 1 and 2 address all current and future risks in respect of structural life and seismic and flood events. The existing Manawatu River Bridge would remain at risk under Option 2A, until its replacement in 2042.
Overall	**M for all project options.**	

17.3 Benefit and Cost Appraisal

The BCR is between 1.0 and 1.1 for Cross-section H1/B1, and between 1.2 and 1.3 for Cross-section H2/B2, resulting in a rating of Low.

17.4 Investment Profile

The investment profile is HML.

18. Comparison of Options

18.1 Process for Comparison

The following long list of options was developed, based on preliminary design undertaken by the project team, options identified in the PFR, and stakeholder suggestions:

a) Do Minimum, as described in Section 8.2 above;

b) Option 1, as described in Section 8.3 above;

c) Option 1A, as described in Section 8.6.1 above;

d) Option 2, as described in Section 8.4 above;

e) Option 2A, as described in Section 8.5 above;

f) Option 9-2, as described in Section 8.6.2 above;

g) Eastern Options, as described in Section 8.6.3 above;

h) Total Bridging Option, as described in Section 8.6.4 above.

Option 1A, Option 9-2, Eastern Options and the Total Bridging Option were discarded at an early stage after preliminary assessment identified one or more unacceptable characteristics in each, which are detailed in Section 8.6 above.

The Do Minimum and Options 1, 2 and 2A were shortlisted for detailed analysis.

The preferred option was identified on a holistic basis, taking into account:

i) The results from an assessment against project objectives, described in Section 18.2 below;

ii) The results of a Multi-Criteria Analysis, described in Section 18.3 below;

iii) Additional criteria identified in Section 18.4 below;

iv) Cost and economic efficiency.

18.2 Achievement of Project Objectives

Table 18.2.1 presents an assessment of the extent to which each of the analysed options achieves the project objectives.

Table 18.2.1: Achievement of Project Objectives

Objective	Do Min	Options 1, 2 and 2A
Safety		
Shoulder Width (Highway)	No change from existing.	Increased from 1.5m-2.0m to 3.0m.
Shoulder Width (Whirokino Trestle)	No change from existing 0.16m shoulders for first 10 years. Increased to Absolute Minimum standard of 1.2m thereafter.	Increased from 0.16m to 2.0m, which is above Absolute Minimum standard of 1.2m, but less than Desirable standard of 2.5m.

Table 18.2.1: Achievement of Project Objectives		
Objective	**Do Min**	**Options 1, 2 and 2A**
Shoulder Width (Manawatu River Bridge)	No change from existing 0.16m shoulders.	Increased from 0.16m to 2.0m, which is above Absolute Minimum standard of 1.2m, but less than Desirable standard of 2.5m.
Median Barrier	No median barrier. No change from existing.	Cross-section H1/B1: 1.5m median with wire rope barrier. Cross-section H2/B2: No median barrier. No change from existing.
Edge Barrier (Highway)	No edge barrier. No change from existing.	Wire rope barrier.
Edge Barrier (Whirokino Trestle)	No change from existing for first 10 years, which does not meet preferred standard for given exposure. TL5 concrete barrier thereafter, which meets preferred standard for given exposure.	TL5 concrete barrier, which meets preferred standard for given exposure.
Edge Barrier (Manawatu River Bridge)	No change from existing for first 27 years, which does not meet preferred standard for given exposure. TL5 concrete barrier thereafter, which meets preferred standard for given exposure.	Options 1 and 2: TL5 concrete barrier, which meets preferred standard for given exposure. Option 2A: TL4 thrie beam barrier for first 27 years, which does not meet preferred standard for given exposure. TL5 concrete barrier thereafter, which meets preferred standard for given exposure.
Matakarapa Road/Whirokino Road Intersection	No change from existing for first 27 years. Left in/left out access thereafter.	Left in/left out access.
Paper Road Intersection	No change from existing.	Option 1: Improved intersection. Options 2 and 2A: No change from existing.
At-Grade Crossings (Barnett and Koputara Farm Ltd)	At-grade crossings retained. No change from existing.	Option 1: At-grade crossings removed and replaced with agricultural underpass. Options 2 and 2A: At-grade crossings retained. No change from existing.
Separate Cycleway	Existing cycleway retained. No change from existing.	Option 1: Existing cycleway removed and not replaced. Options 2 and 2A: Ken Everett Cycleway retained. No change from existing.

Table 18.2.1: Achievement of Project Objectives		
Objective	**Do Min**	**Options 1, 2 and 2A**
Efficiency		
HPMVs	HPMVs use SH3/SH56/SH57 route for first 27 years. No change from existing. HPMVs use SH1 route thereafter, reducing journey distance by 21km. 50MAX use of SH1 route could be compromised within first 10 years.	HPMVs use SH1 route, reducing journey distance by 21km.
Mean Speed	Mean Speed of 85km/h. No change from existing.	Mean Speed increased from 85km/h to 100km/h.
Resilience		
Concrete Deterioration and Reinforcement Corrosion	Risk to route security for first 10 years.	Risk to route security minimised.
Seismic Exposure (Whirokino Trestle)	Damage to piers expected under 1:1000 year event if event occurs in first 10 years. No change from existing. Liquefaction resulting from design event would undermine pile integrity if event occurs in first 10 years. No change from existing. Meets current seismic design standards thereafter.	Meets current seismic design standards.
Seismic Exposure (Manawatu River Bridge)	Collapse of bridge expected under 1:230 year event (transverse) or 1:480 year event (longitudinal) if event occurs in first 27 years. No change from existing. Liquefaction resulting from design event would undermine pile integrity if event occurs in first 27 years. No change from existing. Meets current seismic design standards thereafter.	Options 1 and 2: Meets current seismic design standards. Option 2A: Collapse of bridge expected under 1:230 year event (transverse) or 1:480 year event (longitudinal) if event occurs in first 27 years. Liquefaction resulting from design event would undermine pile integrity if event occurs in first 27 years. No change from existing. Meets current seismic design standards thereafter.
Steel Fatigue	Residual risk of steel fatigue in first 27 years. No change from existing.	Options 1 and 2: Risk to route security eliminated. Option 2A: Residual risk of steel fatigue in first 27 years (refer Section 18.5.2 a))

Table 18.2.1: Achievement of Project Objectives		
Objective	**Do Min**	**Options 1, 2 and 2A**
Gas Explosion	Residual (very low) risk to route security in first 27 years. No change from existing. Gas transmission pipeline almost certain to be relocated under river thereafter, eliminating risk to route security.	Options 1 and 2: Gas transmission pipeline to be relocated under river, eliminating risk to route security. Option 2A: Residual (very low) risk to route security in first 27 years. No change from existing. Gas transmission pipeline almost certain to be relocated under river thereafter, eliminating risk to route security.

The following conclusions can be drawn from the assessment against project objectives:

a) The Do Minimum does not meet the project objectives to the same extent as Options 1, 2 and 2A, and in many respects does not represent much change from the existing situation;

b) Option 2A does not meet the project objectives to the same extent as Options 1 and 2, in that the Manawatu River Bridge does not have TL5 edge protection and remains exposed to seismic and fatigue risks until its replacement in 2042;

c) Options 1 and 2 both meet the project objectives of improving efficiency and resilience;

d) Options 1 and 2 both meet the project objective of improving safety, but not to the fullest extent possible. Option 1 does not provide separate shared path facilities and Option 2 retains the at-grade crossings for the properties owned by Barnett and Koputara Farm Ltd and does not improve the paper road intersection.

18.3 Multi-Criteria Analysis

18.3.1 Initial Analysis

An initial Multi-Criteria Analysis (MCA) is included in Appendix T. The template for, and content of, the MCA were agreed with senior Transport Agency personnel at a workshop held on 7 October 2014.

The following conclusions can be drawn from the initial MCA:

a) Option 2A is assessed as preferred, having fewer and lesser negative effects than Options 1 or 2;

b) There appears to be little to differentiate between Options 1 and 2;

c) The Do Minimum is assessed as least preferred, having significantly fewer and lesser positive effects than the options.

18.3.2 Revised Analysis

The content of the MCA has subsequently been updated as part of the SAR to reflect the current development of the options. The revised MCA is included in Appendix T.

The following conclusions can be drawn from the revised MCA:

a) There appears to be little to differentiate between Options 1, 2 and 2A;

b) The Do Minimum is assessed as being least preferred, having significantly fewer and lesser positive effects than the options.

18.3.3 Limitations

Whilst the MCA is a good indicator, its limitations mean that it must only be considered as a single input to the decision-making process. These limitations include:

a) The categories are not explicitly weighted, but the different number of criteria under each category could create the perception that some categories are more important than others;

b) The criteria are not explicitly weighted, which may result in a lack of emphasis on key criteria. In addition, the visual effect created by the colour rating system could create the perception that all criteria are equally weighted;

c) The rating system is coarse, which may result in failure to adequately differentiate between options;

d) Each criterion is rated at a summary level over the entire study area, which may disguise significant positive or negative effects in parts of the study area.

18.4 Additional Criteria

The following criteria were not included in the MCA, but still have some bearing on identification of the preferred option.

18.4.1 Consistency with Adjacent Project

The Detailed Business Case (DBC) for Implementation of the Waitarere Beach Road Curves Realignment, located 3.3km to the south of the study area, recommends a cross-section comprised of 3.0m wide shoulders with wire rope edge barriers, 3.5m wide traffic lanes and 4.0m wide median with wire rope median barrier. The only difference between this cross-section and the two cross-sections investigated in this SAR is the median treatment. Cross-section H1/B1 has a 1.5m wide median with wire rope median barrier, and cross-section H2/B2 has no median or median wire rope barrier.

The 4.0m wide median recommended in the DBC for Waitarere Beach Road Curves Realignment is the minimum standard specified in the RoNS Design Standards and Guidelines.

A 1.5m median has been agreed with the Transport Agency during the investigations for this SAR, to optimise bridge costs.

18.4.2 Road Safety Audit

The road safety audit report of the options investigated by this SAR is included as Appendix U.

The road safety audit report did not identify any Serious or Significant issues that would differentiate between options.

18.4.3 Future Proofing

A high level of uncertainty exists as to if, or when, any future project would attract funding.

However, it is noted that:

a) None of the options would either facilitate or preclude future four laning of SH1. Whilst Options 2 and 2A could facilitate future four laning if the existing state highway designation is retained, it is unlikely that the Transport Agency would be able to demonstrate that retention of the existing designation was reasonably necessary in respect of section 171(1)(c) of the RMA;

b) Options 2 and 2A would retain greater flexibility for a future eastern bypass of Foxton;

c) Option 1 would not preclude a future eastern bypass of Foxton, but it would result in a suboptimal horizontal alignment if the bypass was constructed.

18.5 Assessment

18.5.1 Do Minimum

The Do Minimum was identified as the least preferred outcome by the assessment against project objectives and the MCA.

The less desirable aspects of the Do Minimum include:

a) HPMVs will not be able to use the SH1 route until the Manawatu River Bridge is replaced in 2042, as the definition of the Do Minimum precludes strengthening of the existing Manawatu River Bridge;

b) An inconsistent cross-section will exist along the project length until the Manawatu River Bridge is replaced in 2042, as the definition of the Do Minimum precludes widening of the existing Manawatu River Bridge to address safety issues associated with the narrow shoulders;

c) The risks to route security presented by concrete deterioration and seismic events are assessed as being low probability/high consequence. If these risks are realised, this nationally strategic section of SH1 would be closed for an unacceptably long period while it is reconstructed. This would almost certainly result in extended national media coverage and significant loss of reputation for the Transport Agency;

d) The Do Minimum also relies on the accurate assessment of the remaining service life of the existing Whirokino Trestle. Whilst the Transport Agency is currently monitoring the condition of the structure on an annual basis, it is possible that progressive and possibly accelerating concrete deterioration and/or seismic exposure could result in catastrophic failure of the structure before the assessed 10 year remaining service life of the structure expires, with the potential for fatalities and/or serious injuries.

On the basis of the above considerations, the Do Minimum is not preferred.

18.5.2 Option 2A

Option 2A is the lowest cost and most economically efficient option.

Option 2A was assessed as not meeting the project objectives of improving safety, efficiency and resilience to the same extent as Options 1 and 2.

The MCA did not distinguish between Options 1, 2, and 2A. Option 2A has the least impact on property and environmental and cultural values.

However, the following factors are not obvious from the MCA, which compares the options to the existing situation rather than to each other:

a) While widening and strengthening will significantly improve the function of the existing Manawatu River Bridge, it will not extend the remaining service life of the structure. Retention of what will remain a 72 year old bridge carries the following risks:

   i) The residual fatigue life of the bridge is uncertain and will be shortened by the passage of 50MAX vehicles. Fatigue issues could emerge at any point, requiring bridge replacement. The consequences of this risk impacting shortly after widening and strengthening of the existing bridge are loss of reputation for the Transport Agency, impacts on SH1 traffic (e.g. speed and/or load restrictions) and undermining of the economic efficiency of Option 2A;

   ii) The bridge is susceptible to liquefaction under medium seismic events, which would not be addressed by the widening and strengthening completed under Option 2A. The consequences of this risk impacting are possible catastrophic collapse of the existing structure, resulting in the Transport Agency failing to meet its statutory obligations under the Civil Defence Emergency Management Act 2002, possible fatalities and serious injuries to road users travelling on the structure at the time of the seismic event, significant impacts on SH1 traffic at least until a Bailey bridge could be erected (6 months minimum) and undermining of the economic efficiency of Option 2A.

b) Extremely strong community support exists for "doing it once and doing it right". Of the 64 written responses received through the public information day, 63 supported replacement of both bridges;

c) The economic efficiency of the options is very similar. BCRs range from 1.0 to 1.1 for Cross-section H1/B1, and from 1.2 to 1.3 for Cross-section H2/B2;

d) While the MCA attempts to differentiate between the options, the effects of the options are very similar. In particular, all options impact on the Manawatu River to more or less the same extent;

e) Option 2A will introduce a reverse curve between the new Moutoa Floodway Bridge and the existing Manawatu River Bridge for the medium term, which while compliant with current standards for rural state highways is less than desirable.

   The Scheme Estimates included in Appendix O do not take into account the consequences of the above risks, as they lie beyond the scope of the Risk Register included in Appendix Q (i.e. NZTA Minimum Standard Z/44 – *Risk Management* specifies that the scope of Risk Registers for capital improvement projects extends to completion of construction).

The cost of replacing the Manawatu River Bridge following one of the above risks impacting (i.e. progressing to Option 2 following initial construction of Option 2A) is estimated to be at least $22M.

On the basis of the above considerations, Option 2A is not preferred.

18.5.3 Option 2

Option 2 was assessed as meeting the project objectives of improving safety, efficiency and resilience. It achieves this at less cost than Option 1 ($5.6M and $4.8M less for Cross-sections H1/B1 and H2/B2 respectively) and is one of the two most economically efficient options.

The MCA did not distinguish between Options 1, 2 and 2A. Option 2 could be expected to progress through the statutory approval process faster and result in less onerous conditions than Option 1 because it has less impact on utilisation of adjacent land than Option 1 and is therefore assessed as being less likely to be opposed by landowners. It also has lesser landscape and visual amenity effects than Option 1 due to the greater distance between the dwellings on Matakarapa Road (Easton) and the new intersection.

Although Option 2 is the least preferred option on archaeological grounds, due to the potential impacts on the 1899 bridge piles and possible remnants from the river ferry, none of the route options have impacts on archaeological values so high as to preclude their construction. As such, Option 2 is not considered to represent a significant risk in terms of archaeological effects and the associated statutory processes.

Option 2 also eliminates any reputational risk to the Transport Agency in respect of assertions of inefficient investment in the Foxton South Curves project, and better facilitates a future eastern bypass of Foxton.

On the basis of the above considerations, Option 2 is preferred.

18.5.4 Option 1

Option 1 is the highest cost and least economically efficient option. It was assessed as meeting the project objectives of improving safety, efficiency and resilience.

The MCA did not distinguish between Options 1, 2 and 2A. Option 1 has a significant impact on utilisation of adjacent land. As a result Option 1 could be expected to meet strong opposition from at least two landowners (Koputara Farm Ltd and Easton) through the statutory approval process.

Option 1 has greater landscape and visual amenity effects on two dwellings on the property owned by Easton than Option 2. Consultation undertaken with landowners as part of this SAR suggests that it will be possible to mitigate these effects to the satisfaction of landowners.

The only quantifiable benefits over Option 2 are:

a) Improved horizontal geometrics, although Option 2 fully complies with current standards for rural state highways;

b) Improved safety, through elimination of existing at-grade crossings that provide connectivity for farm equipment at the properties owned by Barnett and Koputara Farm Ltd;

c) Improved safety at the intersection with the paper road providing access to properties owned Burling, Himatangi Station Ltd and Koputara Farm Ltd (RP954/10.57).

On the basis of the above considerations, Option 1 is not preferred.

18.5.5 Cross-section

Cross-section H1/B1 is consistent with the Safer Journeys approach to road design. Cross-section H2/B2 is not. Cross-section H1/B1 is also more consistent, although not entirely consistent, with the proposed Waitarere Beach Road Curves Realignment and the remainder of the Wellington Northern Corridor RoNS.

The effects of left in/left out access at the Matakarapa Road/Whirokino Road intersection under Cross-section H1/B1 are considered to be acceptable given the low volume of traffic using these local roads and the safety benefits generated for other road users.

Neither cross-section places any restrictions on traffic movements at existing vehicle entrances.

On the basis of the above considerations, Cross-section H1/B1 is preferred over Cross-section H2/B2. The Transport Agency could defer a decision on the preferred cross-section until value engineering is undertaken during detailed design stage. For example, potential exists to provide a wide median with audio tactile profile pavement marking instead of a wire rope median barrier.

19. Recommendations

It is recommended that the Transport Agency confirm Option 2 with cross-section H1/B1 (i.e. 1.5m median with wire rope median barrier) as the preferred option.

Appendix A
Scheme Drawings
(separately bound)

Appendix B
Survey Report

Appendix C
Preliminary Geotechnical Appraisal Report

Appendix D
Geotechnical Report

Appendix E
Drainage and Stormwater Management Report

Appendix F
Bridge Hydraulics Report

Appendix G
Archaeological Assessment

Appendix H
Ecological Opportunities and Constraints Report

Appendix I
Route Option Assessment
– Traffic Noise and Vibration

Appendix J
Preliminary Assessment of Landscape and Visual Amenity Effects

Appendix K
Cultural Impact Assessments

Appendix L
Consultation Report

Appendix M
Statement of Identified Maori Interest

Appendix N
Environmental and Social Responsibility Screens

Appendix O
Cost Estimates

Appendix P
Summary Risk Analysis Report

Appendix Q
Risk Register

Appendix R
Economic Evaluation Report

Appendix S
Peer Review Reports

Appendix T
Multi-Criteria Analysis

Appendix U
Road Safety Audit Report